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Foreword

Today, we are living in a rather different world than our ancestors. This wonderful planet Earth is dramatically changing and nothing has remained the same as 10 -20 years ago. Should we search for behind-the-stage reasons and people to blame, the Economic Development is found to play a crucial role. Moreover, this Economic Development heavily depends on natural resources and nowadays their scarcity is a cruel reality. Their exploitation followed the 'as-needed basis' principle, with no respect towards the Environment. And the consequences are too visible today.

Humankind has constantly meddled with the Environment and most of the time it resulted into wastage and loss of the nature's balance. What next? The future generations are doomed to live in a more and more hostile Environment. The question is: are we fully aware of the responsibility we bear concerning the future of this wonderful Planet Earth?

The human society keeps moving forward and the Economic Development helps humankind build a better and comfortable life. The truth is that only the fortunate ones are taken into account. But, what is the price to pay? While looking at the people in the undeveloped countries, a sure thing is that Economic Development brings about many disparities. Is it possible that we agree to the fact that some people are scrambling to take care of their daily needs?

In 1998, John Brett Elkington defined the triple bottom line of the 21st Century : People- Planet- Profit[1] *starting from the same universal concern : to preserve and to protect what he have, to respect and to create a better place under the sun for all the people of the Planet and to be able to balance all this with the main economic goal- making a good profit.*

The Journal of Economic Development, Environment and People *aims to be a forum to deal with 'hot' topics related to the People, Planet and Profit triangle, thus providing the scholars and professionals with the opportunity to voice their worries, to launch debates and to point out at solutions with the explicit purpose to put together a 'better world' for us and for the next generations.*

Prof. Manuela Epure, PhD
Editor en-chief

[1] John Brett Elkington – *Cannibals with Forks: The Triple Bottom Line of 21st Century*,

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Climate Changes- Challenge, But Also an Obligation for the Education

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Abstract

Is there a law on environment? Why hasn't this term been precisely defined yet? why is there no harmonized meaning neither in the general, nor in the language of law? Without any doubt, our environment is composed at least from earth, water and air. It is surrounded by living organisms comprising the flora and fauna. Therefore, the definition rises from the human demands and it is in this sense that we ask a few questions. Do men create the environment of national parks? Does cities and villages with their streets and buildings represent environment? What is the case with the very distant environments? Should the term environment be restricted only to planet earth?

The pollution and the soil and atmosphere degradation is dangerous for two reasons; the great speed in the case of disasters and the volume of pollution have global consequences.

The field of international law on environment comprises of three main topics are: air pollution, reduction of the ozone layer and climate changes.

While the politicians and economists are debating, the scientists are unanimous in how to stop the climate changes, because the warming of the planet must be stopped.

The main goal of the authors of this paper is how to create educational institutions that will generate experts in order to prevent: the planet earth to remain without the climate zones till 2100; to become a planet of hot poles; the plants and animals, and even humans to became endangered and extinct, enlarging of the tropical and subtropical zones by high temperatures; the developed countries of becoming the biggest polluters and the increase of CO2 emission in the air; China and India, as new development poles, to ask for permit to pollute the earth in the same amount as the USA and Europe without a drawback for the percent of poverty.

The authors seek for answers to these questions in the insufficient cooperation between the society and the higher education institutions. How can education make the entry in the economy, in the praxis, easier; can the severe reality of the praxis, of the economy of degradations and the earth pollution enrich the research knowledge? The economic, legal, ecological, as well as engineering and scientific workers cannot allow themselves to disregard the application of their work, according to their tasks in the industry and society. In addition, the other way around, the companies must integrate the new research findings in their work programs. Only those that increase their know-how remain constantly powerful in making decisions and implementing specific concepts.

The modern professor in the higher education must be familiar with the praxis, as user of the economy impulses.

The consciousness toward this mutual usefulness creates a need for securing constant growth, which in turn reveals the needs of today and gives the future generations a possibility to realize their goals and it should be a foundation for the Alliance of Central and Eastern European Universities, which will enable future staff that with their knowledge will create an economy that will not pollute and degrade the planet earth.

Keywords: climate changes, climate zones, developed countries, environment, global consequences, higher education, institutions, pollution.

JEL Classification: I15, I25, Q53, Q54.

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1. Introduction

Bargaining with the planet earth and not facing the changes and the sustainability of the economic development are unfortunately constantly present and a lection yet not learned from the catastrophes in Ukraine, Japan, Russia, USA and other countries, which we persistently ignore at our own risk, at the risk of the humanity. When it comes to the planet earth, there is serious risk that is almost certain, the global warming and the climate changes. However, if there were other planets where we could move, but at what price, in the case of almost certain outcome predicted by the science that could confirm that kind of risk is worth taking. Are there such in the scientific world and could we think in that direction. Expanses for reducing the emissions are small in comparison to the possible risks that the world is facing. Are there inter-organizational relations in the organizational ecosystems, where are the competitors, are there changes in the management, is there an inter-organizational change in all this. How big is the dependency of assets, how is the resource strategy enforced, what is the strategy of power. Are there networks for collaboration, why collaboration, is there a chance to become partners instead of opponents? Is there ecology of population; are there organizational forms, processes of environmental changes, survival strategies? Is institutionalism necessary, are there institutional opinions, is there an institutional design and are there institutional systems?

2. Climate changes, global warming

The climate in the world has changed very little until the appearance of the industrial revolution. The temperature was stabile in the XIX century; it increased a little in the XX century, whit a small decrease in the 1950-1970s and then it starts rising again. Over the last 100 years the increase has been around 0.6° C[1]. But what is the reason for panic? Not the increase itself, but the reasons for the increase in the temperature.

When the solar energy comes to the Earth, most of it returns back to the space. But, the carbon dioxide and 30 other greenhouse gases, such as methane, enable the creation of shell around the Earth, which “traps” part of the solar energy and with that it heats the Earth. Furthermore, because of the combustion of natural fuels, the level of carbon dioxide in the atmosphere has raised from 280 parts of the million in the time of industrialization, to 380 parts of the million today. With the current rate of increase of the level of carbon dioxide in the atmosphere until the end of this century it will reach 800 parts of the million[1]. If the concentration of carbon dioxide reaches very high levels, the result would be a total change in the temperatures of air- global warming- change of the natural laws of climate.

[1] The Economist, THE HEAT IS ON, A Survey on Climate Change, September 2006, pg. 3

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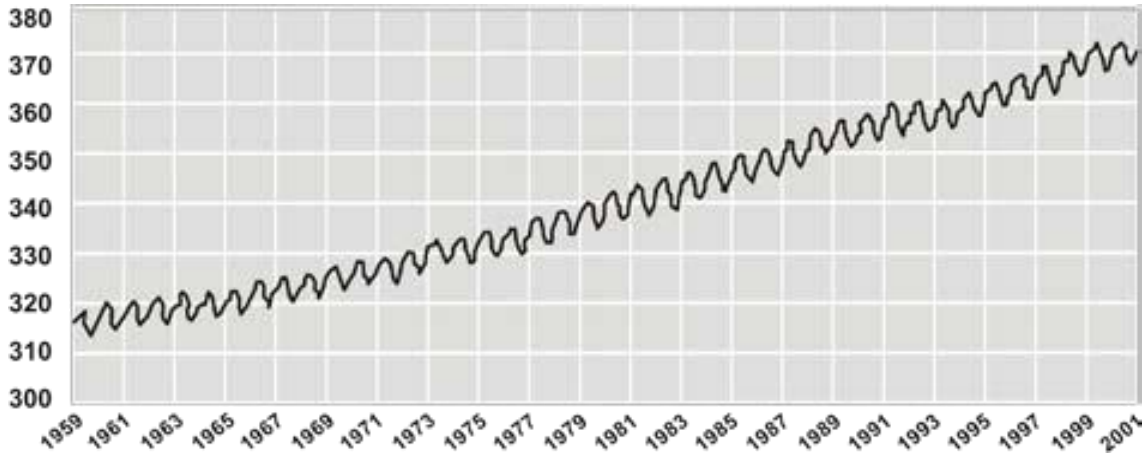

Fig. 1: The presence of carbon dioxide in the air, part of million (*Source: Caring for Climate, A guide to the Climate Change Convention and the Kyoto Protocol. UNFCCC, Bonn, 2005, pg. 2)*

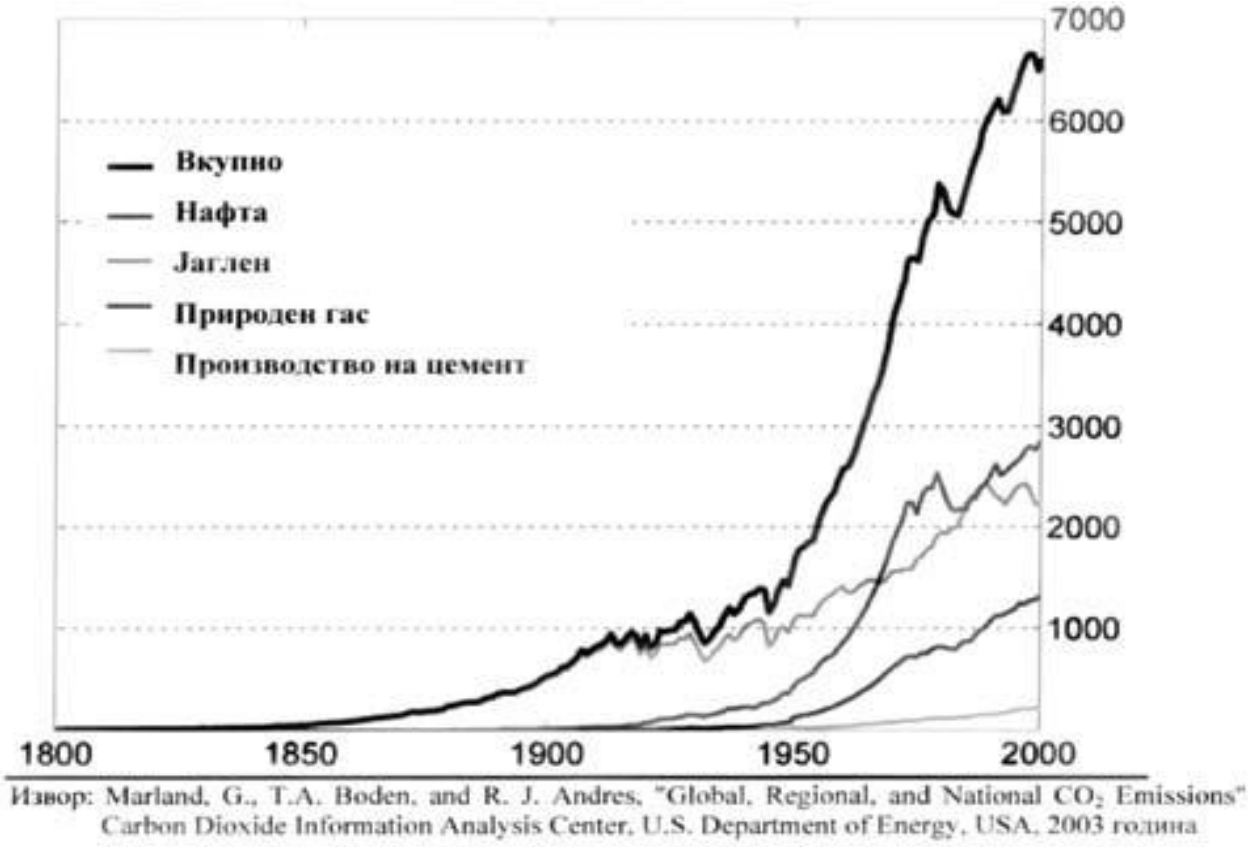

Fig. 2: Global emission of carbon dioxide per year in tones

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Table 1: Examples of climate changes and their influences

Expected changes	Expected influences
Higher maxim. temperatures, more warm days and heat waves through the whole planet	+Cases of death and serious illnesses in the case of adults and homeless
	+Risk of drought
	+The need for electric cooling
Prognoses:	
Most likely higher min. temperatures, more warm days and heat waves through the whole planet	+Confidence in the offer of electricity
	-Mortality connected with cold
	- Risk of craps damage
Prognoses:	
Most likely increased number of summer days in continental areas of the middle geodetic latitude and supporting risk of drought.	- Demand for heat energy
	+Damage on the construction fundaments because of accumulation of soil
	+ Risk of wildfire
Prognoses:	
Probably Increased intensity of the tropical cyclone winds	- Quality and the amount of water sources
	+Risks for the human lives, risks of epidemics of cyclone winds infective diseases
	+Erosion of the coastline
Prognosis:	
Probably, in some regions increased variability of the summer monsoon rains in Asia	+ Damage on the coastal ecosystems
	+The range of floods and droughts in Asia

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Prognosis:	
Probably, in some regions increased variability of the summer monsoon rains in Asia	+ Damage on the coastal ecosystems
	+The range of floods and droughts in Asia
Prognosis:	
Probably heavier rains	+ Floods, landslides, and damages from avalanches
Prognosis:	
Most likely, for many regions increased intensity in of storms in areas of middle geodetic latitude	+ Erosion of soil
	+Risks for the human lives and health
	+ Lost of property and infrastructure
Prognosis : Probably	+Damage on the coastal ecosystems

Symbols: + Increasing, -Decreasing, Source: Caring for Climate, A guide to the Climate Change Convention and the Kyoto Protocol, UNFCCC, Bonn, 2005, pg. 1

The scientists are warning about the environmental catastrophe on Earth, the world pays very little attention to these problems and the interactions between them and the social and economic systems, which could pose the biggest problems and surprises in the future. The economist, on the other hand, find it very difficult to predict how much carbon dioxide will be e emitted in the world (which, on the other hand, depends on whether the governments shall pay any attention to the warnings from the scientists), how fast will the temperatures grow as a result of the increased concentrations of the carbon dioxide, what effect will the climate changes have on the economies (which depends on how fast and good will people adapt to them) etc.

Still, the effects of climate changes will not be considered bad everywhere. A few degrees higher temperature will not harm Northern Europe. Russia could benefit from a little warming: big parts of the state which are now unpopulated, can become comfortable enough for living. Around 25% of the undiscovered oil and gas reserves in the world, for which it is thought that they are in the Arctic, many of them in Russia will be easier to exploit. However, the whole world will lose, because Africa and India will decrease the rate of the global GDP. Africa and India, contrary to the rest of the world, are mostly dependent on agriculture, and this is more vulnerable by the climate changes, then the investment banking or production of cars.

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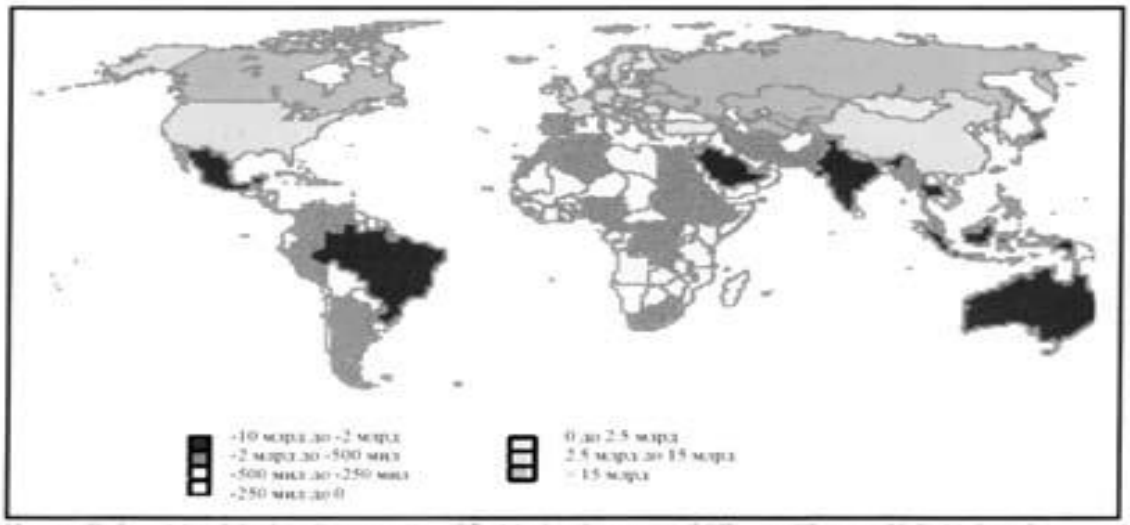
Слика 1: Влијанието на климатските промени врз земјите во светот изразено во проценти БДП (предвидување за 2010 година)

Извор: Robert Mendelsohn, "Dynamic Forecasts of the Sectoral Impacts of Climate Change", Yale University, 2004 година

Fig. 3: Dynamic Forecast of the Sectoral Impacts of Climate Change, Yale University, 2004

Слика 2: : Влијанието на климатските промени врз земјите во светот изразено во САД долари (предвидување за покачување на температурите за 2°Ц во 2060 година)



Извор: Robert Mendelsohn, Country-Specific Market Impacts of Climate Change, Yale University, стр. 16

Fig. 4: Country Specific Market Impacts of Climate Change, Yale University

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3. The frame convention of the United Nations for climate changes and the Kyoto Protocol

The frame convention of the United Nations for climate changes since 1992 is just one of the agreements signed in recent times, and through which the countries in the world are joined in order to face this problem. This convention divides the countries in the world in three different groups with different responsibilities:

1. Industrialized countries, which in 1992 were members of the OECD plus the countries in transition from Central and Eastern Europe, including the Russian Federation and the Baltic states. Their responsibility is to adopt the measures and policies for climate changes, with the purpose of reducing their greenhouse gas emissions to the level of 1990 until 2002;

2. Member states of OECD, without the countries in transition (states from the former Soviet Union and Central and Eastern Europe). These countries should provide financial means that would help the developing countries to engage in activities according to the Convention and to help them in adjusting to the unpleasant impacts of the climate change; and

3. Developing countries, especially vulnerable to unpleasant impacts in the climate changes and which need the help in handling the climate changes[2]. The Kyoto Protocol of 1997 supplements and strengthens the Convention by providing a frame for corrective and preventive measures for measures for fighting the unpleasant effects of the climate change. The protocol is focused on gases:

- Obligations, including the legally binding goals for the emissions;
- Implementation, including the state undertakings and the three mechanisms for implementation:
• Exchange of emission between governments,
• Mechanisms for clean development,
• Joint implementation,
• Minimizing the influence in the developing countries, including the utilization of the Fund for Adapting; Accounting and reporting; Fulfillment, including the Committee for assessment fulfillment and management of problems[3].

The Kyoto Protocol also predicts possibilities for “trading” with greenhouse gas emissions. Trading with emissions of greenhouse gases is similar to most of the markets, where sellers and buyers meet. The buyers (countries from the first group, who find it hard to reduce the emissions) give offers for buying reductions or reduction options. The sellers (the countries from the first group, for which is easier to reduce the emissions) give an offer for selling of the reductions or reduction options. The buyers of emission reductions actually invest in the existing or proposed projects and business, for which expected to result in emission reduction.

[2] Caring for Climate, A guide to the Climate Change Convention and the Kyoto Protocol, UNFCCC, Bonn, 2005, pg. 9
[3] Caring for Climate, A guide to the Climate Change Convention and the Kyoto Protocol. UNFCCC. Bonn. 2005 година, стр. 24

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This document[4] was signed by 141 countries in the world, but is still not ratified, nor respected by the biggest "polluters", among which: USA, Australia, Canada etc. USA as a military and economically most powerful country, that is the biggest advocate for globalization, hasn't signed the Protocol, but is emitting around 1/3 of the greenhouse gases in the world.

4. Recommendations for the reduction of greenhouse gases emission

In the future it will be necessary a mechanism to be created that would stop countries such as USA or any other state, which refuses to implement the emission reductions and inflicts damage on others. The Maldives in 50 years will become Atlantis of the XXI century by disappearing under the ocean, the same will happen to one third of Bangladesh etc.

At the beginning the President Bush denied the existence of global warming. Some American politicians thought that the reduction of emissions will compromise the American standard of living, but the American emissions, a dollar per GDP, are twice as high as those of Japan. USA can allow itself to save more energy; it can even increase its energetic security. That will be good for their environment, as well as for the economy. Still, this would probably not be good for the oil companies, which have had a great prosperity with their administration[5].

Likely, the frame for international trade was established which can be used to force the countries that are causing damages to other countries to behave better. The nonpayment of the costs of the damage on the environment is a subsidy, the same as the nonpayment of the workers' loans. In most developed countries in the world today the companies pay for the costs of global environment pollution in the form of taxes on coal, oil and gas. Still, the American companies are subsidized, i.e. they don't pay the total costs for production.

There is a simple cure: other countries should forbid the import of American goods produced with energy intensive technologies or at least to introduce high taxes for them, in order to reduce the subsidy they receive for them. Actually, the USA also acknowledges this principle. They prohibited the import of crabs from Thailand that were hunted with meshes for turtles that contribute to the unnecessary death of these endangered species. If the prohibition of the import of crabs in order to save the turtles is justified, then we should certainly justify the limitation of import of goods produced with technologies, which unnecessary pollute our atmosphere, in order to protect the priceless global atmosphere from which we all depend. Japan, EU and the rest of the signatories of the Kyoto Protocol should act immediately for the inadequate subsidies, for which the Busch administration and the oil companies would be worried. But, we must emphasize the obvious: the American companies have an unfair advantage, because of their cheap energy and while they receive the benefit, the world is paying the price of global warming.

[4] www.ieta.org. International Emissions Trading Association, 2006 година

[5] Joseph E. Stiglitz, A New Agenda for Global Warming, Economists' Voice, The Berkeley Electronic Press, 2006, pg. 1

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The introduction of taxes on energy will bring the balance and at the same time will motivate USA to behave better[6].

In some way the USA should salute the initiative, because they complained for a long time that the Kyoto Protocol does not have obligatory mechanism. They claimed that if they signed the Protocol, they will be obliged to the responsibilities, but the other countries (that have no knowledge, nor the technology for the reduction of emissions) will not respect it, which will put the USA in an unfair position. By establishing a strong mechanism for sanctions, all will be certain that finally in the world there is a flat "field for play".

Table 2: The costs for the substitution of foreign technologies, with the purpose of reducing the emissions

New technology	Old technology	Cost/el. measure	The cost of the old technology	The cost for substitution Short term	Long term
Nuclear energy	Gas power plant	USA cents/ kWh	3.5-4	6	5
Wind	Gas power plant	USA cents/ kWh	3.5-4	5	6
Solar energy	Electricity network	USA cents/ kWh	10	15	8
Bio-fuels	Petro	USA cents/ kWh	12	15	15

The table shows that the substitution of the old technologies for energy production is expensive and long process, which is the second problem of the Kyoto Protocol: where the developing countries are also involved. Namely, the Protocol is based on reduction of national emissions equal to the 1990 level. The developing countries are asking, why is it allowed for the developed countries to pollute more today, simply because they polluted more in the past? Actually, because the developed countries have so far contributed so much, they should be forced to make greater reductions. It seems that there is no solution for this problem: USA are refusing to join in until the developing countries are not involved; the developing countries see no reason why they shouldn't pollute as much as it is allowed for USA or Europe, nor they have the means to invest in new technologies, with the purpose of reducing the emissions.

The solution is introducing a joint (global) environmental tax on the emissions.
There is a special cost for the emissions, and the joint environmental tax will simply make everyone pay the social cost. The tax, for example, can be set in a way that the level of (global) reductions is the set goal of the Kyoto Protocol. As the technologies are developing, the nature of the global warming threat will become clearer, and the tax rates can vary[7].

[6] Joseph E. Stiglitz, A New Agenda for Global Warming. Economists' Voice. The Berkeley Electronic Press, 2006, pg. 2
[7] Joseph E. Stiglitz. A New Agenda for Global Warming, Economists' Voice, The Berkeley Electronic Press, 2006, pg. 3
15 Agenda for Climate Action, Pew Center on Global Change. 2006

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However, the remaining recommendations for the reduction of emissions of greenhouse gases are: Investing in science and technological researches; Establishing legal limitations for the emission of greenhouse gases; Stimulation of innovations in the main economy sectors (transport, production, agriculture); Increasing of the efficiency of the energy system, exploitation of energy sources, which do not contain large amounts of carbon;

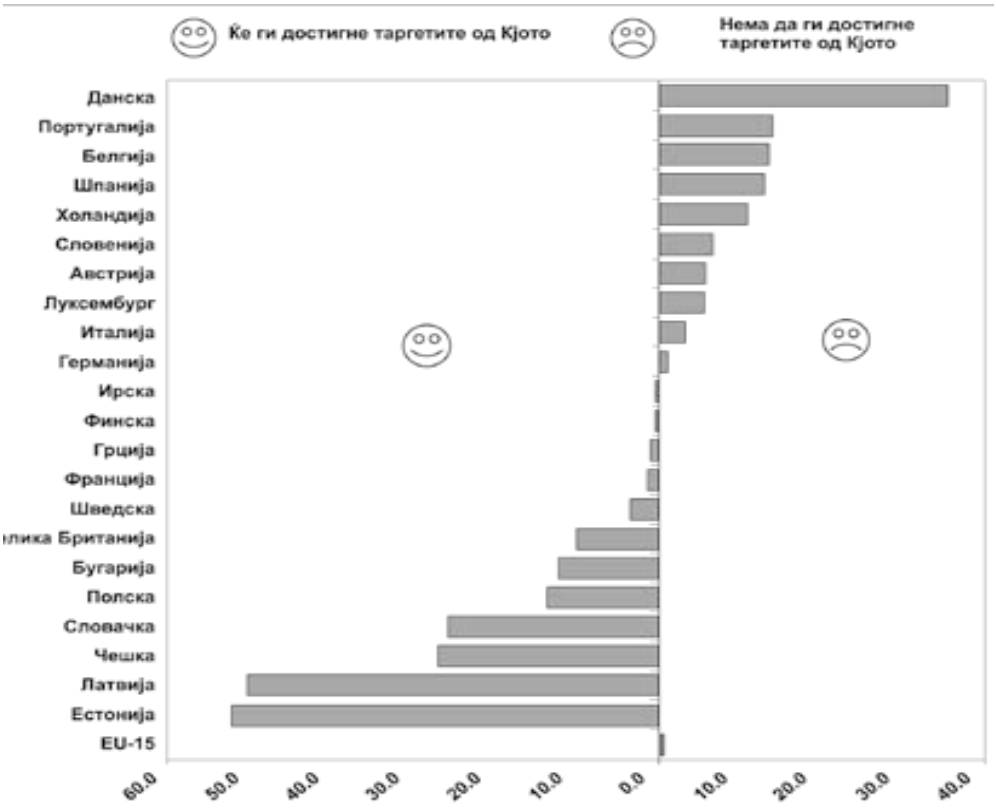

Fig. 5: The difference between planned greenhouse gas emissions and the goals of the Kyoto Protocol for 2010

The world invested a lot in the Kyoto Protocol, and the achieved success is significant. Still, no solution for the current problems is offered, and it is already time to look for alternatives. It is a matter of the wellbeing of the whole planet.

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5. Education in managing climate changes

The education about managing climate changes is same as the education about environment. Each deeper analytical question about the future shows as that only a thorough change in people's behavior toward the environment can give hope to the further progress of human society and the development of civilization[8]. In that context, including the educating about the environment, Feinstein says[9]: "We cannot solve any problem that we ourselves created". By analyzing the words of Feinstein, the creation of strategy for establishing a serious process for education of the environment, entails engagement whose basic goals would be: Educating about the environment that will last for a whole life and will be constantly upgraded; Creating a feeling of responsibility for the condition of the environment, going horizontally and vertically from the local plan and ending with the global plan; Providing to those interested a correct, full and timely information; Stimulating the principle of sustainable development; Promoting open partnership with all relevant actors, exploitation of all available resources; Investigating the most appropriate approach for educating about the environment and in the same time its change into a place of working and living.

Regarding the above stated determinations about the education, we create a feeling, securing and recognizing the problems, securing of every correct information, stimulation, promoting and researching of the most adequate approach, are all based on important programs and activities for the support of the knowledge and the skills about the protection and managing of the environment, such as: Visionary approach; Interdisciplinary approach; Problem approach; Researching approach; Activist approach; Business approach.

Each strategy for environment education entails knowledge, understanding, feelings and specific approach. That means establishing the basis for changes in the environment with personal changes of each citizen. Especially the part about quality education for the young population will influence the creation of new value systems, and thus will stimulate the shaping of attitudes that will lead to positive patterns of behavior and bringing responsible decisions. Consequently the education about environment will be more successful if it starts early in life. Considering the fact that in the realization of sustainable development problems and conflicts occur regularly is correct and then here is the author's problem, in the existence of different views on subjects with mutually interrelated interests, such as state organs, local self- government, entrepreneurs, scientists, foreign governmental organizations, schools, factories, means of public information, local population and the whole public regarding the issue of sustainable development[10].

Regarding this issue we should build a relation on a positive approach, democratic dialog and open partnership, as basic prerequisites for a long-term advancement. Therefore, it is especially important and practical to build and stimulate, and in the same time expand, the mutual approach to quality information, as a unique and possible approach for implementing the sustainable development.

[8] Muller, J. H. Methoden zur Regionalen Analyse und Prognose. Hanover, 1996.

[9] Klepac, Ratomir. Osnove Ekologije. Zagreb: June NA, 1980.

[10] UBA, Umveltbundestant, Environmental Targets in Europe Vancuver-Canda, 1996

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We can easily answer to this challenge if all citizens are capable and stimulated to cooperation in the decision making processes in all processes regarding the managing and economizing the environment. The educational public would know to ask from the state authority a real strategy for sustainable development, as the only acceptable developmental strategy which will stimulate with its financial instruments, favorable loans, appropriate policies, price policy etc[11]. Such a development defines the ethics connected to appropriate responsibility for sustainable development in respecting the moral code of each individual, in the same time enabling the nongovernmental organizations and the open public for participation and co-acting in the making of development decisions, by building an information system for the environment, which would function as a database, all information would be able to the public and will establish a system for assessing the status of the environment, showing data of single interventions in the environment, establishes a system of standards and norms, defines the identification of situation in the environment, regularly implements recording for the situation and statistically processes the data. On the other hand, the educated citizen that comprises that public, such as the employees in the factories and the institutions, can have a quality contribution and participate in the decision making regarding the environment, inside, in their working environment. The vocational education in the field of managing climate change is very important. The area of climate change requires vocational education and qualification of the employees in fulfilling their everyday activities that the working process demands. Therefore, it is necessary that in the Republic of Macedonia a place would be opened and it would create qualified agreement in order to open a Center for education on environment protection and the process of managing climate change. The goal of opening a Center for training is the conducting of high educational process in environment protection, and with it other additional activities in managing climate change, the waste, selecting, recycling, biological decomposition, incineration etc.

The dedication of the Center, which will be aimed at environmental education, will explain and enlighten, practically and sophistically, the development of the structure in environment. With this approach, we will practically start with the development of the environment structures, the climate change and the waste, as an applicable ecologically secondary raw material. This approach straightens the unpractical and substandard process of the junk collectors, traders with steel material, physical workers, and here starts the real development of this branch in the Republic of Macedonia.

The universities in the Republic of Macedonia are educating chemises and engineers in the field of environment. However, so far there was no training of technicians, ecologists, processors of waste, technicians that would manage waste and adequate experts that would be educated for BBC education environment and waste management. An adequate education for teaching, in the profile of professors is also necessary. Training of special vocational directions, such as managing waste material, water supply, protection of waters, air and soil, opens a broad space for action and gives space for hope that the training of specific vocations for the protection of the environment, demands establishing of an appropriate legal regulation, which is hesitantly introduced in the new legislative project. The gaining of knowledge in this area will open a broad space for establishing and furthering of the employees as the smallest measure of expertise in the managing of the environment.

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It is difficult to speak of appropriate expertise in the field that we are elaborating and to appropriately appoint services with appropriate expert workers, such as workers in a dumping plant or transporters of waste material, which were used to the activity without investing in the educational process. Today, the increased need for environment protection will legally demand trained and specialized workers, including academics in the field of waste. We think that the request for expertise in the work structure of every communal worker will be formed in the next period.

In the same time, the demand for establishing new techniques for handling with waste will grow with each year. The new technologies will demand specially trained workers, such as engineers, technicians, chemises, ecologists and other experts. The way of managing the new machines, such as compactors, bulldozers, transporting machines will demand electronic improvements, computer navigation, which is a another problem requiring appropriate education, such as machines constructed in the sixties or the seventies of the last century, which are used the most in the Republic of Macedonia, were plainly constructed with a tank for handling waste, a pump, valve, all manual. However, today's equipment in the communal work mostly works with new technologies and computer aided systems. This kind of development is conditioned by a safety strategy and philosophy for managing the environment. The new constructions, the new computer navigation in the communal work in respect of processing and managing waste emphasize the issue about new service personnel with higher expertise. Form the above stated crucial works one thing comes certain, the necessity of education in the field of managing environment.

Is handling with the amount of waste, the endangering of the environment, the unserious approach toward the issue of water, air and soil pollution an open issue because of the expert approach of the employees in this sector or the inadequate strategy for managing with the new models of living is such as a result of the unspecialized staff when it comes to this problematic where the specialized staff should show competence in solving all cases. Exactly these circumstances, together with the demand for new staff in managing the environment, make the issue of educating specialized staff even wider and full with new challenges. The employers in the public sector are expected not just to show appropriate political responsibility, but also knowledge in managing the environment. We would like to point out, for example, that even laboratory analysis published as the real picture must be read by environment experts, but also it must properly interpreted. With this type of demands we receive expert staff, which depending on the education will take the lead in the Republic of Macedonia, and which puts an accent or emphasizes the knowledge of the educational center for environment protection.

We can only assume what would the future of these environment experts look like, but it is certain that the intended future will become reality in the Republic of Macedonia. We hope for a turn in a positive direction in the field of environment, however so far only the negative activities in the field of environment protection are the ones giving an incentive, under pressure, for solving of the many problems regarding the inappropriate expert personnel in the field of environment protection. This is development that is not wished by the author, and which in the same time cannot be allowed.

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A realistic development in the communal field, additionally to the development of new technologies, buying new innovative technologies, also demands a more realistic process of educating professionals that will be capable of recognizing and applying the knowledge in techniques and global protection of the environment and in the implementation of the influences in their expert field. The producing of educated staff in the field of environment and workers' qualification for communal works represents a logical consequence of the intended development in this area in the Republic of Macedonia. With the establishing of this Center for education in environment protection we create a possibility for realistic presentation of the transparent and understandable strategies in process of managing the environment by expert staff. This gives a significant contribution to the companies and public enterprises, a possibility for mutual understanding of the environment protection, which will be achieved through quick and influential activities.

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Energy potential of Republic of Serbia as an Investment Opportunity

UDK 338.48

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Abstract

Serbia has a big potential to accomplish the goal of making the environment green and comfortable for living. It started with reforms in comprehensive Energy Sector and set up a new Energy Policy in accordance with the EU practice and standards. With new national policy, Serbia became aware of middle-term and long-term strategies for developing of adequate Power Sectors. There were investments into the Network and there are plans for building new and expanding existing transforming stations, building new interconnecting line and making some other investments. Having in mind the cooperation with EU, Service for Electrical Energy Market Development has already prepared wide range of available services related to market and deregulation of network, from requirements for connecting to transmission line to securing balance mechanism, and that makes possible for international Electrical Power market to exist. Since the production system is unable to respond to the demand in certain moments of time and Serbia has to import Electrical Energy that makes Renewable Energy Sources very attractive for use in Power system. Deficit of electrical power must be covered either by import or by more intensive investments in new production capacities, making Serbian energy sector economically interesting.

Keywords: Energy potential, Investment, Renewable energy, Serbia

JEL Classification: Q40, Q48, H54.

1. Introduction

Serbia is a country located in south-eastern Europe, but it is also a country aware of its turbulent history where a lot has been lost. Now, efforts are being given for catching up with all European standards in order to become a part of the European Union.

Besides good will, Serbia has a big potential to accomplish the goal of making the environment green and comfortable for living. We are aware of limited sources of coil, bad influence of Thermo-power Plants and unavoidable passive pollution caused by Hydropower Plants. Since our Power System is based on these two types of power production and with appreciation to the latest studies and trends of European Union in energy sector, we had adopted and accepted standards which were declared by *EU Energy Agency* as well as goals that EU towards to. Practically, we have started with reforms in comprehensive Energy Sector and set up a new Energy Policy in accordance with the EU practice and standards.

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In the year 2005 Government of Serbia made the first move by reorganizing of Public Enterprise "Electrical power industry of Serbia" into two: "Electrical power industry of Serbia" (EPS) - with reduced authority over power generation (with whole accompanying sector), electric power distribution and management, and electric power trade, and into "Power Networks of Serbia" (EMS) - with authority over electrical power transmission, trade of transmitted electrical power and transmission system control. Also, speaking of Renewable Energy and Energy Efficiency most important EU directives that have been adopted are 2001/77/EC and 2009/28/EC. Serbia became a member and founder of International Renewable Energy Agency (IRENA) and the first intergovernmental organization, focused on Renewable Energy Sources.

With new national policy, Serbia became aware of middle-term and long-term strategies for developing of adequate Power Sectors, including private domestic and foreign investments safety in new or existing Power units.

2. Power system of Serbia

Serbian power system is relatively well branched system with good connections to nearby countries. It is well networked in European interconnectivity system UCTE and constantly taking part in international trade of electrical energy.

2.1. Power plants

Power Plants in Serbia are Thermo-powered and Hydro-powered. Also, there is a small number of Thermo Power Plants – Boiling Plants, powered by natural gas and fossil fuels with possibility of Electrical Power production out of heating season. Total installed power of Power Plants is 8.359 MW including capacities in Serbian Autonomous Province of Kosovo and Metohija, that is 7120 MW just within territory of Serbia. Our major production is based on Thermo-power Plants with 5.171 MW (just Serbia 3936 MW) of installed power and mostly lignite coil as primary energent. Peaks of daily and season consumption are being covered by Hydro-power Plants, which have 2.831 MW of installed power. And, there are Thermo Power Plants – Boiling Plants with negligible installed power of 353 MW. All Power Plants are owned by EPS. It is important to highlight that Reversible Hydro-power Plant Bajina Bašta has 614 MW of installed power and important capabilities to stuff Daily Consumption Diagram of Electrical Energy by producing power and keeping Thermo-power Plants running during low consumption by pumping the water into the dam and so acting as a load to the system.

Altogether eight Thermo-power plants (TPs) with 25 blocks are divided into two organizations TP "Nikola Tesla" and TP "Kostolac". TPs of each organization are based mostly on lignite coil as primary energent, where lignite makes 92% of national reserves. Both organizations have their own surface mining where the coil is being dug out of.

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Currently average age of equipment in mines is about 20 years and requires investments. Some of them were already made with goal to revitalize mines successively. These actions directly amplified capacities of coil production as well as of electrical power indirectly.

During the year of 2008 25.019 GWh were produced in TPs, where, to accomplish this production, amount of almost 38 million tons of lignite were burned. This dimension of production is closing up to the maximal limit of Thermo-power capacities, where last TP was built back in 1991.

It means that weighted unit of TP has worked 173.615 h (almost 20 years) on average. In the past period activities related to infrastructure were aimed more to revitalization of already built capacities and less to building new facilities. Revitalization is directed to improvement of generators and especially to the following equipment such are turbines, equipment for measuring and regulation, etc, with the focus on renewing and improving systems for environment protection. This is to reach gain in power production, improve energy efficiency and reach higher standard of living. In some facilities this led to higher production of power after reparation then when the facilities were originally built. Also, there is plan for building two new Thermo-Power Plants of 1.400 MW of installed power. Recently pre-contract has been signed up with China National Machinery & equipment Import & Export Corporation to build the first 700 MW. Other 700 MW are in building process and up to now about 40% has been built where the rest of building is planned to be realized through investment from strategic partners. Also, revitalization of Thermo Power Plant – Boiling Plant in Novi Sad is planned as well. It should be done by common investment of EPS and strategy partners, too. EPS owns 9 Hydro-power Plants (HPs) with 50 hydro-aggregates which is 34% of Electrical potential of Serbia. There are three categories of them: The run-of-the river, Storage and one Reversible Hydro-power Plant.

11.093 GWh was produced in HPs in the year 2008. They are important part of Serbian Power System since they regulate all demands in consumption, which are very various, keeping the system delivering quality Electrical Energy. Technically usable Serbian Hydro Power potential is about 17.000 GWh per year of which up to now about 10.000 GWh is activated. Nearly 5.000 GWh is available in plants with over 10 MW of installed power, while rest of 2.000 GWh is available in plants under 10 MW. Most of unused hydro potential is located on the river of Drina in west Serbia, on the border with Serbian Republic.

On the other hand, the average age of one Hydro-power Plant at the end of 2007 was 33.3 years, making them very old. That is why revitalization of HPs is very important topic for EPS. Revitalization of Reversible Hydro-power Plant Bajina Bašta is planned to be done by 2012 and is joint investment of Kf W Bank and EPS. Its capacity will be about 10% stronger afterwards. Also, HP Đerdap is in process of revitalization but none of important work has been done yet.

There are two HPs with all necessary documentation waiting to be built: Brodarevo with 51 MW of installed power and 190 GWh of energy production per year and Ribarići with 46.7 MW and 76 GWh, respectively. The only missing thing to realize these projects is investment.

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2.2. Transmission network

Lower Government investments during 1990s and devastation of transmission system objects in NATO bombing had been added to their deterioration. Considering Transmission Network, Serbia has 9.850 km of transmission lines with 400 kV, 220 kV and 110 kV voltages and installed power of nearly 18.000 MVA. The Transmission Network is of average age. Lines of 220 kV were built in 1968 (building started in 1960) while building of lines of 400 kV started in 1970. Public Enterprise "Power Networks of Serbia" (PNS), in charge of the transmission network, is trying to keep up with top-technology, so latest systems and equipment as SCADA system of monitoring and control are already in use. Also, there is an aim to fully improve remote system of transmission tracking and accounting measured data.

For that reason there were investments into the Network. EBRD approved loan of 60 million euro for year 2008 for purpose of building new and expansion of existing transforming stations 400/110 kV, as well as building new 400 kV and reconstruction of existing 110 kV lines. Also, EIB approved loan of 60 million euro for reconstruction of existing biggest vital transforming stations and loan of 31 million euro for improving new telecommunication system. It should not be forgotten that considerable amounts of donations were made by EAP (21 million euro) and by Government of Switzerland (15.3 million euro) for building new interconnecting transmission line, rehabilitation of Serbian National Dispatching Center and projecting controlling system for electrical energy market.

Currently, there are plans for building new and expanding existing transforming stations, building new interconnecting line, etc. Just in period from 2006 to 2015 the sum of 350 million euro has been planned for improving system performances and getting the leading role in south-eastern Europe as well as for projects for environmental protection. Because of all these reasons the biggest investment in transmission network in Europe nowadays and in close future are in Serbia.

PNS is organized as two services: Electrical Energy Market Development and Commercial Scheduling. Having in mind the cooperation with EU, Service for Electrical Energy Market Development has already prepared wide range of available services related to market and deregulation of network, from requirements for connecting to transmission line to securing balance mechanism. That makes possible for international Electrical Power market to exist.

2.3. Consumption of electrical energy

In the last report given by EPS (for year 2008) stands that 36.579 GWh of energy was produced while consumption was 33.697 GWh in gross or 32.186 GWh in net. The percentage of loss in distributive system was 3,63% while the loss in transmission system was 2,79%.

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The dominant category of energy consumption in Serbia consists of households. They participate in consumption with 53.07% (for 2008). Over last twenty years Serbian economy has been slowly decreasing its capacities of industrial production, mostly because of current sanctions.
Therefore, industry in Serbia is not taking major place in consumption as it should be in a developed country. But, in prior time foreign investors have been coming and that trend continues. On the other hand privatization of commune companies is coming to an end; therefore it is quite realistic to expect rapid increase in consumption in near future.

Due to the facts about the consumption of electrical power in Serbia, EPS is expecting an increase in electrical energy consumption in industrial sector by amount of 2.7% per year until the year 2015 and its relative stability. In very same period of time average rise of overall electrical energy consumption is predicted to be about 0.9% with about 0.5% increase of demanded power peak, per year. All predictions were made with evaluation of macro-economical parameters of economical development of Republic of Serbia until year 2015, considering planed effects for rationalization of electrical power consumption, according to the State Energy Efficiency Plan. With these predictions final consumption in 2015 should be about 35.480 GWh compared to 32.473 GWh in year 2008. Because of this and because of stochastic schedule of hydro system, which makes planning and exploiting of it hardly predictable, every year TPs, as primary power source, are setting new records in production. But it's getting close to the maximum of theirs possible production. On the other hand, due to unsteady consumption and its peaks, production system is unable to respond to the demand in certain moments of time and then Serbia has to import Electrical Energy. This makes Renewable Energy Sources very attractive for use in Power system because it can provide additional energy in consumption peaks. For example, in summer period during very hot days consumption can reach relative maximum due to air-conditioning systems. Unfortunately, Hydro-power Plants usually cannot provide enough energy because of low water level. On the other hand, in that particular time solar panels reach their yearly production zenith making them very convenient for covering consumption peaks. For that purpose, wind energy is not negligible too.

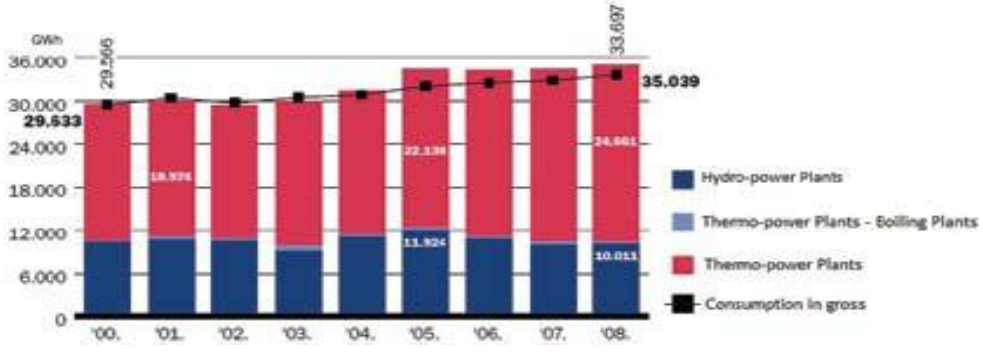

Fig.1: Structure of production and consumption in gross

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On the diagram below we can see the increase in Electrical Energy consumption in Serbia up to year 2015, by mentioned prediction:

It is also worth mentioning that Serbia has adopted policy about Rationalization in Electrical Energy Consumption. It should balance requirements over consumption and possibilities of EPS production. Basic austerity measures are:

- Increasing price of electrical energy and balancing prices of primary energents
- Substitution of electrical energy use for heating by other energents
- Decreasing losses of electrical energy in distributing sector
- Decreasing self-consumption in Power-plants and other system objects
- Stimulating the use of energy efficient devices and materials

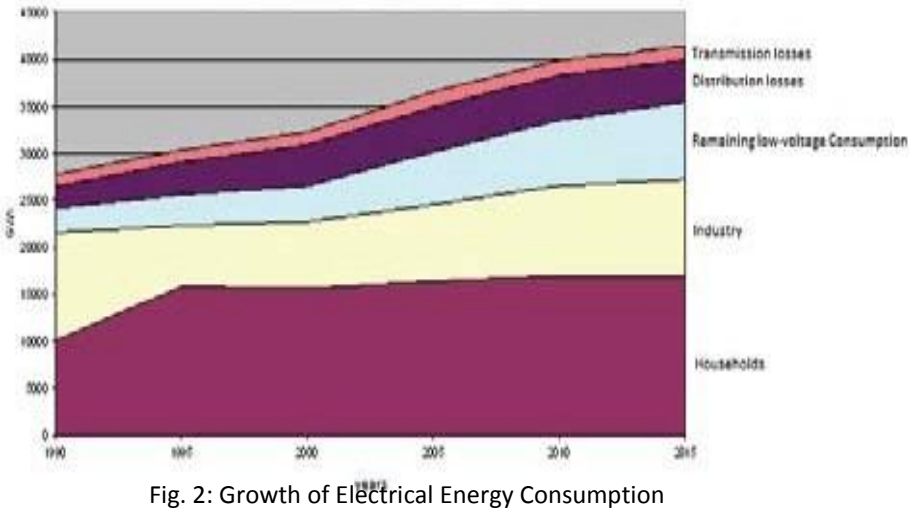

Fig. 2: Growth of Electrical Energy Consumption

All these austerity measures are aimed to increase social conscience over electrical energy consumption and to make place for alternative sources of energy to come.

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3. Conclusion

Government is aware of consequences that conventional electrical power production brings. On the other hand, undeniable rise of consumption and certain development of industry are present and soon coming and that will demand more and more power produce. To respond to this, Government is trying to insure power resources. Therefore, EPS has founded joint company with Energy Company of Serb Republic, in order to build several Hydro-power Plants on the river of Drina. Also, building of new Thermo-power Plant is quite realistic and is about to happen. But, making these steps draws the questions of human health and green environment.

Luckily or unluckily for Serbian citizens only one Thermo-power Plant and a few Hydro-power Plants are possible to be build. Building of these will cover consumption demands over next thirty years but it still does not solve Serbian requirements for energy in the long therm. This makes it possible for breakthrough in Electrical Power generated out of Renewable Energy Sources to happen. By minor action of increasing social consciousness and already accepted declarations it would be real too. Thanks to our highly competent experts in the corresponding areas of interests it should be presented and accepted by society in reasonable period of time.

Also, generally transmission system is in good shape with enormous potential regarding advantageous position of Serbia in region. Besides bare potentials, EMS worked on procedures for making power international trade possible and easy to do. That makes power trade for power producers even more attractive and beneficial because, besides Serbian market, it brings foreign markets in the market game.

In corresponding conditions of planned revitalizations and modernizations in all parts of the system and even mines whose reserves are slowly coming to an end, predictions about tendency of continual consumption increase are present. This deficit of electrical power must be covered either by import or by more intensive investments in new production capacities, making Serbian energy sector economically interesting.

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The Right to a Healthy Climate as a Function of the Right to Life

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Abstract

Objective: *To define the concept of healthy climate and in this regard to determine the relationship between the right to healthy environment and right to life, as top human right, from a legal and ethical aspects.*
Results: *Analysis of international legislation on environment, climate and human rights, and laws on nature protection, environment and other environmental laws of the Republic of Macedonia and other countries of Southeast Europe, based on the facts of climate change, shows that these changes affect the quality of life and therefore the exercise of the right to a healthy life.*
Conclusion: *The right to life is top human right. All other human rights are subordinate to it. It is healthy climate in which the weather as a meteorological phenomenon is mostly compatible with the physiological states of human organisms, most of the average healthy people, and allows normal physiological functions. Normal physiological functions of the organism have a direct impact on human health. Human health is directly in function of life. It makes life healthy and happy. Only healthy and happy life is a real human life. All the troubles in life can be overcome if the person is healthy. It is a notorious fact. Thus, the right to a healthy climate is in function of the right to life.*

Keywords: climate, change, human, right, environment, life, health, legislation, law.

JEL Classification: I180, Q540, K100, K320, K330.

The right to a healthy climate as a function of the right to life!

1. Introduction

The climate can be defined as the meteorological, geographical and biological concept. As a meteorological term climate is the average balance of meteorological elements and phenomena in a certain longer period of time over a point or part of the earth's surface. As a geographical term, climate is a set of atmospheric conditions over a certain part of the earth's surface during certain longer period of the time. Biological climate is a complex climatologically conditions which with other factors of some areas affects to the existence, development, reproduction and migration of living organisms[1].

[1] See difinitions on climate: Vojna enciklopedija, tom, 4, Redakcija vojne enciklopedije, Beograd, 1972, p. 365 and Enciklopediski leksikon, Geografija, Interpress, Beograd, 1969. p.269.

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Elements that determine the climate of some area are air, temperature, humidity, air pressure, cloudiness, precipitation and wind. The existence of these elements or only some of them at one time or over a shorter or longer period of time: from several minutes to several hours or days it seems like weather as a meteorological phenomenon.

The climate is expressed through weather. It is basic and only its contents. Thus, if the weather in a certain area of the earth's surface mostly cold, the climate in the area is classified as cold, if warm, it is hot, if the weather is rainy and humid, the climate is moist or opposite: if the weather is dry, without precipitation or with little precipitation, that the climate is dry.

Besides the climatic elements for climate are important climatic factors, it is modeled, of course, through the weather. The climatic factors include solar radiation, latitude, distribution of land and sea, relief, altitude, soil composition and character and general circulation of the atmosphere.

Within the general concept of climate as meteorological or phisico-geografical phenomena and, we differ macroclimate, mezoklimate and microclimate.

Macroclimate is climate discussed in the continental or planetary scale. The climate in the regional or local scale such as the Pannonian Plain, Dinaric Alps, Shar Massif, Pelagonian Ravine and similar is called mezoclimate, and it in the surface air – up to 2 meters high, or in a small space: the hill, field, forest, town square, etc, is called the micro-climate.

Climate is not stable. It changes. Its changes can be radical or periodical. Radical changes in climate occur over geological periods of soil development of planet Earth. Thus, the Paleocene and Eocene climate was very warm. We conclude it from fossils which show that the north end has grown cypress, poplar and other plants that we see today in moderate latitudes. At moderate latitudes has grown tropical and subtropical vegetation. During the kwarter there were several ice epochs which are separated by warmer periods. After periods of ice has been completely re-increase of air temperature in the Earth's atmosphere.

Periodic changes in climate are occurring in shorter time periods and they are not as sharp as a radical change. They last for decades or even less. Examinations their periodicity has shown that dry periods with higher temperatures alternating with wet periods with lower temperatures.

The climate changes was coming and coming mostly because of the influence of natural factors. Besides them, there are climate changes caused by humans. Economic activities of the man releases into the atmosphere huge amounts of gas and dust. A man destroys huge amounts of forests in the earth's soil, barrages river valleys, changes river courses, drain wetlands, irrigate large areas of desert and semi desert soil making it cultivable and fertile, built huge cities and industrial complexes. All these activities affect the climate in certain regions of the world and beyond.

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Climate changes are legally defined by the United Nations Framework Convention on Climate Change. This Convention, in article 1 defines climate change as change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods. Climate influences the whole life on planet earth - the people, animals and plant life.

The influence of climate on people's direct or indirect. Direct effect consists in the operation of the complex of meteorological elements and phenomena primarily temperature, wind, rainfall and sunshine to the soil and health, working ability, habits and way of life.

The bright regions are more frequent heat waves, sunstroke and sunburn caused by sunlight radiated. Cold climate leads to frostbite and freezing. Warm climate in the tropical and subtropical regions favors the emergence of malaria, yellow fever, plague and intestinal infections (cholera, dysentery and other). Cold and wet climate creates a fertile ground for the emergence and development of influenza, tuberculosis, pneumonia, diphtheria, scarlet fever and the like.

The indirect effect of climate on humans is carried out through the flora and fauna as a source of his food. Flora and fauna, in addition to food, provide the living ambience of the man in the environment in which he lives. The climate creating the flora and fauna of the environment affects human life. If the ambience is better and more pleasant, the quality of human life is better. Given that all in the Earth's biosphere is born, created, live and grow in a particular environment which in turn depends on climate, climate affects everyone, directly and indirectly, therefore all rights of the man, as a living being.

Besides the influence on man as an individual, climate affects the community. In history and in modern times (the African Sahel) are observed the migration of various social communities from adverse impact of climate on living conditions that make the conditions unbearable. In areas with favorable climate, working capacity of the people is greater and therefore social development is larger and faster. Conversely, in areas where the climate is very hot or cold is spending more energy on countering human unfavorable living conditions. It leads to the loss of pace and intensity of social development.

From the point of impact on human health climate can be healthy and unhealthy.

Healthy climate is that which does not affect adversely on human health. Thus a healthy climate allows for normal development of physiological and psychological functions of man. In contrast it is an unhealthy climate that adversely affects the function of the human organism.

2. Relationships between the right to healthy climate and right to life.

Impacting on human health, the climate influences on human life.

In order to determine the relations between the right to healthy climate and right to life, one must proceed from the notion of healthy climate. The very climate without living organisms is objective natural phenomenon. It is neither healthy nor unhealthy.

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Impact on living environment, especially on living organisms in nature, and above all, on people, it is healthy or opposite, unhealthy. If it positive effect on human health, it is healthy. If, however, adversely affect it is unhealthy.

Health is the natural state of man as a creation of nature. Every human being aspires to be healthy because health is a function of life. Only healthy being can be held in life. Every living being strives to maintain as long as possible in life. In order to maintain tends to be healthy.

Health however, as the natural state of man's personality is substantive element of the right to life, understood in its fullest sense.

The man is a masterpiece of nature. It was created by the evolution of nature. Like all living beings on earth, a man as an individual is born, lives and dies. The period from birth to death is period of his life. He takes a short or longer until the disease or a fatal injury did not stop. Life is a favorite man's gift of nature and everyone wants to live out happy, in tranquility, free from harassment and hardship. As a gift of nature, human life is inalienable and no one can revoke it, except nature, after the natural course of its duration. Inviolability of human life includes, firstly his right to life. The human individual is the owner of his own life and nobody can decide on its duration and manner of its passing, except its owner. The right to life is not just recognition of the individuality of physical, biological and psychological human beings. The right to life is much more than that. It's right to exist, to existence worthy of man. Hence the sanctity of the right to life includes physical and psychological integrity of the human person as a biological creation of nature. From there, the right to life is the source of the requirement for a range of social, political, cultural and other rights and freedoms to which the man released, anthropological and social conditioning and becomes humanized, own and free human being[2].

Impacting on the environment as a natural setting of human life, climate influence on human health and therefore on his life. This is best evidenced by the words of Hippocrates. According to him, nature has a tendency to maintain a continuous state of stability, and therefore continuously adapt and readapt its elements to maintain a balance. While the man is in such balance he is healthy. Different effects can lead to disorder of the balance and then disease occurs[3]. Climatic effects usually lead to imbalance between natural elements and human health as a natural state of man's personality.

The right to health is one of the existential rights of man as the formation of the nature. It most directly related to health as a natural state of man. Health however, as such, the substantive element of the right to life conceived in its fullest meaning, namely: a physical and mental health.

Hence, the theory of natural law, the right to health is the natural right of man, because it is the element of the essence of human being as creation of nature.

Health as the supreme value of human life is materially legal base for stipulation the right to health in international, as well as in national normative acts.

[2] Ѓорѓевиќ Ј.: Уставно право, Завод за стопанство и општествени дејности, Скопје, 1979, p. 544

[3] Cucic V. i dr. Socijalna medicina, Savremena administracija, Beograd, 2000, p.19.

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Human life takes place in the environment. International documents of Human Rights and national normative regulations, regulating the right to life, regulate the right to a healthy environment. The right to a healthy environment is a function of the right to health and through him, indirectly, the function of the right to life.

The climate creates the environment with flora and fauna, soil, water and air. The environment with these elements affects the climate. Thus, climate and environment are in a dialectical unit. The quality of this dialectical unit affects the quality of life. Therefore, a healthy climate influence on the environment, making it healthy. Healthy environment affects human health, making it with good quality. Quality of life in a healthy environment also positively affects health. Dialectical unity between a healthy climate, healthy environment, human health and human life as top human values is obvious. So, if one has the right to a healthy environment in which he lives, he has the right to a healthy climate. Realization this right he realize a healthy life, or the right to health as the natural state of his personality that is a direct function of life, and therefore the right to life.

2.1. The right to healthy climate in the international human rights documents

The international normative acts on human rights: Universal Declaration of Human Rights, International Covenant on Economic, Social and Cultural Rights, the International Covenant on Civil and Political Rights, the European Social Charter, the Convention on the Protection of Human Rights and Fundamental Freedoms (European Convention on Human Rights) in any of the provisions do not provide for the right to a healthy environment as a human right. These documents provide for the right to life and right to health[4]. Their provisions on these rights represent the quality normative-legal basis for establishing a national regulatory framework to protect the lives and health of citizens based on legal and philosophical foundations of the theory of natural law.

Life and health, as we have just seen, depend on the natural environment in which man lives. Climate has a huge impact on the environment that a human environment. Therefore, the provisions on the right to life which must be worthy of man and the provisions on the right to health as the highest standard of physical and mental health of man could serve as international legal basis for further overregulation of human rights at the international level that would largely regulate environmental law and within it, the right to a healthy climate.

This option is obviously used for passing the Resolution of the Human Rights Council of the United Nations about climate changes since March 2008. The adoption of this resolution is imposed obviously by need to intensify efforts of the world countries and other international entities to find solutions for problems associated with climate changes that threaten man's environment on a global or world's level.

[4] See article 3, and 25 of the Universal Declaration of Human Rights, article 12 of the International Covenant on Economic, Social and Cultural Rights, article 6 of the International Covenant on Civil and Political Rights, article 11, of the European Social Charter and article 2 of the Convention on the Protection of Human Rights and Fundamental Freedoms (European Convention on Human Rights).

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This resolution preceded other international documents on climate and environmental changes such as: United Nations Framework Convention on Climate Change, Bali Action Plan from the 2007th Rio Declaration on Environment and Development, Johannesburg Declaration on Sustainable Development, Declaration of the United Nations Conference on the Human Environment (Stockholm Declaration from 1972) and other documents.

Among those documents, certainly the most important is the United Nations Framework Convention on Climate Change. According the provisions of this Convention, States have to cooperate and coordinate their activities for protection of the environment and for prevention of further pollution. This problem affect the whole humankind and cannot be efficiently solved unless state work together to combat climate change.

At the level of the European Union issued the following documents: Eco-Management and Audit Scheme EMAS, adopted in 1995 mode by the Council of the European Union, Environmental Impact Assessment) since 1997 ordering the mandatory environmental impact assessment of public and private projects on the environment; Council Directive Concerning Integrated Pollution, Prevention and Control, since 1999, The Sixth Community Environment Action Program adopted in 2002 as a continuation of the action plan that applied from 1992 to 2002.

None of these documents in any of the provisions stipulate the right to a healthy climate, but measures should be taken on the level of the international community to prevent climate changes and their negative impact on the environment. It is their lack of course because it is a healthy climate which is in direct function on human health, and health in function to the human life as the highest value of man.

Given that the highest value of human life, the right to life is a top human right. All other rights are in the function of exercising the right to life. Thus, the right to a healthy environment is a function of exercising this right. With this in mind, we cannot accept the fact that in the international normative regulations on human rights has no provisions for a healthy climate as a prerequisite of healthy living in the human environment. Therefore, there is a need for incorporating such provisions in the form of amendments to the existing international normative acts on climate change and the environment or to make a special international normative instrument for a healthy climate.

2.2. The right to healthy climate in the national normative regulations

The protection of the environment and the obligation to provide healthy climate is responsibility of states- that have to adopt national legislation, to establish national institutions for improvement and implementation of regulations and agenda, to ratify the international instruments for the protection of the environment, and to harmonize their national legislation. States have to work together in order to protect the climate system and maintain it for the future generation.

Constitutions and laws of almost all countries of the world base their provisions on freedoms and rights of citizens to the provisions of international documents on Human Rights. Therefore, jurisprudence and logic that are based on these documents has been accepted in national constitutional systems and legislatures of the states. This is the reason that in them there are not provisions for a healthy climate, but the provisions of a healthy environment, healthy living, health as the most standard of physical and mental health of man, etc.

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Thus, the Basic Law for the Federal Republic of Germany (Constitution), in article 20-a, stipulate the responsibility of the German state toward future generations. According that, the state shall protect the natural bases of life by legislation and, in accordance with law and justice, by executive and judicial action, all within the framework of the constitutional order.

The Constitution of the Republic of France does not contain provisions for protection the human environment. Therefore, National Assembly of the Republic adopted in 2004 a special Constitutional Charter on the Environment, which contains more provisions to protect it.

The constitutions of the Balkan countries contain very short and concise provisions on the right to a healthy environment. In none of them does not mention the right to a healthy climate. There is no doubt that constitution makers went from the logic that this right is element of the right to a healthy environment, and therefore it is not necessary to stipulate it separately.

According the article 74 of the Constitution of the Republic of Serbia everyone has the right to a healthy environment and the timely and full information about her condition. The Republic of Serbia and autonomous provinces are responsible for environmental protection. Everyone is obliged to preserve and improve the environment.

The Constitutions of the Republic of Serbian and Republic of Montenegro are very short in stipulating the right to healthy environment. Man has the right to a healthy environment. Everyone, according to law shall, within its capabilities, protect and advances the environment, Constitution of the Republic of Serbian sad (article 35). Constitution of the Republic of Montenegro almost in the same way regulates this right. According to its article 19, everyone has the right to a healthy environment and the timely and full information about her condition. Everyone is obliged to preserve and enhance the environment.

The Constitution of the Republic of Bulgaria, in article 55 guarantees to the Bulgarian citizens the right on healthy and favorable environment in accordance with established standards and norms. They must protect the environment, which sounds very imperatively.

The Constitution of the Republic of Croatia under Article 69 is approaching the idea of a special stipulation the right to a healthy environment by stipulating the right to a healthy life, right to healthy environment and obliges each legal entity in the state, within their powers and competences to dedicate special attention to the protection of human health, natural and human environment.

The Constitution of the Republic of Macedonia[5], not stipulate the right to a healthy life, but only the right to a healthy environment, which is slightly more than the constitutions of other Balkan states. According to the article 43 of the Constitution, everyone has the right to a healthy living environment. Everyone is obliged to promote and protect living environment. Republic provides the conditions for exercising the right of citizens to a healthy living environment.

Republic of Macedonia in its efforts to create a legal system that will be compatible with the legal systems of the European Union and based on the directives and other documents of the Union to regulate social relations in various spheres of social life, it seems that she went very forward in the normative regulation of the right to a healthy environment and within that the right to a healthy climate.

[5] Службен весник на Република Македонија, n. 52/1991

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To conduct in the life the cited constitutional provisions related to a healthy environment and for implementation of the above-mentioned documents of the European Union on the environment, the Republic has passed several laws that directly and indirectly protect the environment and climate, and therefore the rights of citizens to a healthy environment and to a healthy climate. Among them, the most important are: The Law on Environment Protection[6], The Law on Nature Protection[7], and the Law on Quality Ambientaly Air[8].

Among these laws certainly the most important is the Law on Nature Protection. This law, among numerous provisions dedicated to the numerous legal Institutes in the field of nature protection, contains provisions on the National Plan for Appeasement the Climate Changes. This plan is adopted for a period of six years. It is adopted by the Government of Macedonia. The plan is prepared by the Ministry of Environment and Spatial Planning in accordance with other ministries in whose jurisdiction there are activities related to climate changes such as: Ministry of Agriculture, Forestry and Water Management, Ministry of Economy, Ministry of Transportations and Communications, Ministry of Health and other bodies of the state administration. The plan, among other things, contains a national inventory of greenhouse gases, analysis and projections of greenhouse gases, and cartographic displays information about the activities of monitoring, research and systematic monitoring of climate change, action plan and measures to mitigate climate change, economic analysis of proposed measures to prevent causes and to mitigate climate change, information on the implementation of commitments undertaken by international treaties related to climate change and other measures and activities which are appointed by the Minister of Environment and Spatial Planning.

In addition to the adoption of national laws on environment and climate change, the Republic of Macedonia adopted a series of laws on ratification of international legal acts. So in 1997 the Republic has ratified the Convention on Climate Change adopted at the International Summit held in Rio de Janeiro in 1992, in the course of 2004, Macedonia has ratified the Protocol to this Convention in Kyoto.

Later, in 2010, the Republic of Macedonia has ratified a number of international documents adopted in the framework of United Nations Economic Commission for Europe (UNECE), as follows: Protocol for Long-term Financing Programs for Cooperation, Monitoring and Evaluation of Wide-ranging Transfer of air Pollutants in Europe to the UNECE Convention of 1979 for Long-range Transboundary Air Pollution; Protocol to Control Emissions of Volatile Compounds and their Cross-border Transmission since 1991, Protocol for Further Reductions in Sulfur Emissions since 1994; Protocol to Control Emissions of Nitrogen Oxides and their Transboundary Transfer and other documents.

[6] Службен весник на Република Македонија, n. 53/2005, 81/2005, 24/2007, 159/2008, 83/2009, 48/10, 124/10 и 51/11.

[7] Службен весник на Република Македонија, n. 67/2004, 14/2006, 84/2007, 35/10 и 47/11.

[8] Службен весник на Република Македонија„ n 67/2004, 92/2907, 35/10 и 47/11.

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Among other things, in March of 2010, Parliament of the Republic of Macedonia has passed a resolution on the impacts of climate change in the Republic of Macedonia[9].
This resolution is a general act of political-normative nature by which the Republic of Macedonia has clearly shown its determination to stand shoulder to shoulder with other countries of Europe and the world in the fight of the resistance against the climatic changes and their consequences.

There is no doubt that the Republic of Macedonia has achieved significant results in the normative regulation measures for resistance to climate changes and to prevent their consequences. From the point of our study subjects, Macedonian normative regulations may be objected that it has little bit of provisions on measures to prevent the consequences of climate changes to the health and lives of people aimed at realizing the right to a healthy climate within the framework of a healthy environment.

The same criticism can be made to the normative regulations of other Balkan countries and beyond. Life as the greatest human value must be the focus of the holders of all social activities, and of the authors of the normative acts. All rights whose exercise is a function of life, including the right to a healthy environment should take priority in the normative regulation of environmental protection and the living environment.

3. Conclusion

Climate change is a work of nature or the work of people. A man can not oppose to climate changes caused by nature. They are the result of the eternal movement of nature and everlasting changes that result from that movement.

A man can do much to prevent climate changes that are the result of his activities in nature. Human activities were and remained extremely selfish. He had been taking and taking from nature what he had been could and could. He returns to her more and very little or nothing. Nature does not tolerate selfishness and punishes it. Selfishness of people to nature is selfish for humanity, because the man is the work of nature and its integral part as a biological and social being with all the creations of his work: from the huge, wrapped of smog cities, industrial plants which emitted into the atmosphere huge amounts of greenhouse gases, power plant from which come complete clouds of smoke, dangerous nuclear power plants and vast artificial lakes, to tiny rural shacks and shepherds' tents.

In pursuit of profit, many members of the human race and their associations have forgotten the man and humanity. Money is not the biggest man's value. From it are more valuable health and life. It is true that money can buy all or nearly all that the man has created. But, money cannot buy gifts of nature: the life, the health, healthy environment and healthy climate. The money is buying mean among the people, not between them and nature. Nature does not recognize the most valuable money, or most valuable gold or diamond. It recognizes only respect for its laws. One of its laws is "All by measure" that spooked the famous Epicurus, so everything in moderation and without exaggeration, especially when it comes to nature.

[9] Службен весник на РМ, бр. 31/.2010 година

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It punishes all excess, all greed, and excess and greed especially for her. Of the excess and greed to the people suffer individuals, and of the excess and greed to nature suffer the whole human race.

It is high time to put an end the excessive exploitation of natural resources. It will get in the way only by organized approach for the whole world community. This approach involves primarily the formation of transnational institutions with wide powers. Their decisions must be binding for all countries of the world. All countries in the world would have to carry out normative acts which they would adopt. The control of their execution by the national government also would be carried out by transnational control institutions. In such an organization of fighting for salvation of humanity from the excessive and irrational use of natural resources the national states would be converted to a kind of agencies of transnational institutions, responsible for the enforcement of their decisions and for the implementation in practice their normative acts.

In the normative regulation of relations of man to nature, the emphasis should be given to the right to life as the supreme human right and, after that, to other human rights that are in function of its implementation, among which, of course, first of all come the right to healthy living environment and within it, the right to healthy climate.

The right to life is a fundamental natural right of the man. It is supporting human right, because without life the man cannot exist. The right to life man gets with birth. It is his inherent right according the Article 6 of the International Covenant on Civil and Political Rights. The right to life is the ultimate human right, because in order to enjoy other rights, the man must be alive. At the time of birth it becomes a legal entity and the holder of the rights and obligations. In this moment hi becomes the bearer of the right to life. All other man's rights are a function of his right to life, some directly and some indirectly. The right to a healthy environment is the most direct in its function. The right to a healthy climate is an element of the right to a healthy environment.

It is healthy climate in which the weather as a meteorological phenomenon is mostly compatible with the physiological states of human organisms, most of the average healthy people, and allows normal physiological functions. Normal physiological functions of the organism have a direct impact on human health. Human health is directly in function of life. It makes life healthy and happy. Only healthy and happy life is a real human life. All the troubles in life can be overcome if the person is healthy. It is a notorious fact. Thus, the right to a healthy climate is in function of the right to life.

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Irrigation, a Component of the Sustainable Agriculture in North Western Romania in the Context of the Climate Change

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Abstract

The paper is based on the researches carried out during 1976-2010 in the long term trial placed on the prelvosoil from Agricultural Research and Development Station Oradea. The main field crops of the area (wheat, maize, sunflower, soybean, bean, potato, sugarbeet, alfalfa) were studied. Based on the soil moisture determination ten to ten days, the soil water reserve was maintained between easily available water content and field capacity on the watering depth. Pedological and strong pedological drought (the decrease of the soil water reserve on watering depth bellow easily available water content, bellow wilting point respectively) were registered every year. The use of the irrigation determined the improve of the water/temperature + light (Domuta climate index) report, the increase of the daily and total water consumption, yield gains very significant statistically, the improve of the yields stability and yields quality, the increase of the water use efficiency. The use of the good soil management didn't worsen the soil structure and the chemical and biological parameters of the soil were improved. The researches sustain the irrigation opportunity for sustainable agriculture in the North-Western Romania.

Keywords: irrigation, yield level, soil water content, pedological drought

JEL Classification: Q15, Q54, Q25.

1. Introduction

The appearance of the sustainable agriculture concept is belong to the United National Conference for Human Environment from Stockholm in 1972 and "Broundland Report" of ONU Conference on Environment and Development from Rio de Janeiro. These were the crucial moments in definition of the development sustainable concept, especially sustainable agriculture. The researchers who published about this problem were Tinbergen (1956), Odum (1971), Clarck and Mun (1986), Hall (1995) and all (Domuța C., 2009b).

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There was in Romania in 1999 a reference moment regarding this problem, Hera.Cr, organized the symposium ”The performant sustainable agriculture”, scientifically manifestation of Plant Crop Section belonged to ASAS “Gheorghe Ionescu Şişeşti”. Many and interesting papers were presented in the symposium; those written by Puia and Soran, Toncea, Săulescu, Iliescu, Sin, Picu Hera 1999). Budoi and Penescu (1996), Guş and all (1998) in the treatises of Soil Management had an important contribution in knowledge of this concept, too. All these papers sustain the crop rotation like central pivot and presume a variation structure of crops. In this system, the organic fertilization it’s very important, the chemical fertilization can be used with moderate rates, the soil tillage must be right executed, the plants protection is realized by integrated management; all this things assured the conservation of the soil, water and biodiversity reserve and obtaining an ecological and profitable yields.

If it’s used correctly, the irrigation is a component of sustainable agriculture (Doorembos and Kassam, 1986, Doorembos and Pruitt, 1992, Domuța C., 2005, 2009).

2. Material and method

The researches were obtained in Oradea in the north part of Crişurilor Plain during 1976-2010, in a long term trial on preluvosoil.

On the ploughed depth, the preluvosoil has a hydraulic conductivity with big value, median on 20-60 cm depth and very small below 60 cm depth. On 0-20 cm depth the soil is small settled (BD = 1,41 g/cm3) and very settled on the irrigation depth of the crops studied and on the depth (0-150 cm) for soil water balance. Field capacity (Fc) is median on the all soil profile and wilting point (Wp) has a median value till 80 cm depth and big value below this depth. Easily available water content (Wea) was established by formula (Botzan 1966, Grumeza and all, 1989):

$$Wea = Wp + 2/3 (Fc - Wp);$$

Soil reaction is low acid, the humus content (1,8%) is small and the total nitrogen content (0,127-0,156 ppm) is small- median; the mobile potassium content is small – median, too. The annual fertilization with the doses specifical for irrigated crops increased the phosphorus content from 22.0 ppm to 150,8 ppm.

The water source for irrigation is water ground (15 cm depth). The irrigation water has a low natrium content (12.9 %), the salinization potential is low (CSR = -1.7) and SAR index (0.52) is low too.

The irrigation equipment of the research field permitted to measure exactly and to distribute uniformly the irrigation water.

Soil moisture determined ten to ten days maintaining the soil water reserves on irrigation depth (0-50 cm for wheat and bean; 0-75 cm for maize, soybean, sunflower, potato, sugarbeet, alfalfa 1st year, maize for silo; 0-100 cm for alfalfa 2nd year) between easily available water content and field capacity.

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Domuța Climate Index was calculated after following formula:

$$ICD = \frac{100\ W + 12{,}9\ A}{\sum t\ +\ Sb}$$

Were:
W = water (irrigation, rainfalls, water ground)
A = air humidity, %
Σt = the sum of monthly average temperature, °C;
Sb = sun brilliance, hours

The climate characterization after ICD value is: < 3 excess droughty; 3.1-5.0 very droughty; 5.1-7.0 droughty; 7.1-9 median droughty; 9.1-12 median wet; 12.1-15 wet I; 15.1-18 wet II; 18.1-25 – wet III; > 25 excess wet.

The crops technologies wished to be the optimum one, for this part of the country. Crop rotation used were: alfalfa 1st year – alfalfa 2nd year- maize – bean – wheat – soybean – sugarbeet – sunflower – potato. The fertilization system had a rate of 40 t/hamanure for sugarbeet and potato and annual medium rate on crop rotation of N 140 kg/ha a.s., P 110 kg/ha a.s. and K 90 kg/ha a.s. were used. (Brejea R., 2010)

The structure of soil was determined with Cseratzki method and water consumption with soil water balance method; balance depth was 0 –150 cm.(Domuța C., 1995, 2003, 2009a)

The water use efficiency was calculated like report between the yield and water consumption (Borza I., 2007)

3. Results and discussions

3.1. The influence of irrigation on soil

A right leading of irrigation regime (through maintaining the soil water reserve between easily available water content and field capacity on irrigation depth), the application of melioration crop rotation and a organo-mineral system of fertilization for irrigated crops determined the realization of structured degree of 35.98%, with 3% bigger than structured degree determined in unirrigated wheat- maize rotation. In unirrigated melioration crop rotation the structured degree (47,52%) was bigger than the wheat – maize crop rotation with 34% (table 1).

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Table 1: The influence of the melioration crop rotation and irrigation on macrostructure stability of the preluvosoil, Oradea 1976-2010

Nr. crt	Crop rotation	Ø 5 mm		Ø 2 mm		Ø 1 mm		Ø 0.25 mm		Σ	
		Agreg %	Dif. %	Agreg %	Dif. %	Agreg %	Dif. %	Agreg %	Dif. %	Agreg %	Dif. %
1	Wheat-maize unirrigated	1.93	100	1.76	100	2.45	100	29.12	100	35.26	100
2	Melioration unirrigated	3.93	204	0.96	55	1.96	80	40.67	139	47.52	134
3	Melioration irrigated	0.56	29	0.63	36	1.12	48	33.42	114	35.98	103

3.2. The pedological drought

The periods with soil water reserve on watering depth below easily available water content on irrigation depth was considered the pedological drought. (Domuța C, 1995).

The pedological drought was present in each of 35 years reseached, the maximum frequency at wheat crop was established in June in wheat and in August in maize, sugarbeet and alfalfa. In potato the maximum frequency (92%) was registered in July (table 2).

In other years, soil water reserve on irrigation depth decreased below wilting point.

Table 2: Monthly situations of periods with soil water reserve below easily available water content on irrigation depth in main crops, in unirrigated conditions from Oradea, 1976-2010

Nr. crt	Crop	Specif.	Month					
			IV	V	VI	VII	VIII	IX
1	Wheat	1	12	21	24	10	-	-
		2	82	96	100	70	-	-
2	Maize	1	2	8	13	23	29	25
		2	21	46	79	88	100	92
3	Sugarbeet	1	6	10	21	26	28	24
		2	39	48	87	87	100	96
4	Potato	1	6	8	17	24	21	-
		2	35	54	83	92	83	-
5	Alfalfa 1st year	1	5	12	19	27	29	27
		2	35	65	96	96	100	100

1= Number of days with soil water reserve below easily available water content
2 = Frequency of days with soil water reserve below easily available water content

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3.3. The irrigation influence on microclimate

The irrigation determined the improvement of microclimate conditions. The value of report water/temperature + light (Domuța Climate Index, ICD) calculated for irrigated maize crop was bigger with 135% in August, 115% in July, 49% in June and 32% in May. In irrigated maize, the microclimate was characterized "median wet" vs "median droughty" in May, "wet II" vs "median wet" in June, "wet III" vs "median droughty" in July, "wet I" vs "droughty" in August (table 3).

Table 3: The modifications of the water/temperature + light report (Domuța Climate Index/ICD) under the influence of the irrigation in maize crop, Oradea 1976-2010

Variant	V		VI		VII		VIII	
	ICD	%	ICD	%	CD	%	ICD	%
Unirrigated	8.9	100	10.7	100	8.6	100	6.3	100
Irrigated	11.8	132	15.91	149	18.5	215	14.8	235
Variation interval of differences	0-383		0-302		0-795		28-3126	

3.4. The irrigation influence on water consumption

The irrigation determined the increase of the values of daily water consumption. In this case the total water consumption had values bigger than total water consumption of unirrigated crops, the differences was registered between 36.6% (wheat) and 108.4% (maize for silo double crop).

The most important part from total water consumption was covered with rainfalls registered in the period of the vegetation crops. For the assurance of optimum water consumption of these crops (maintaining the water reserve below easily available water content and field capacity) the irrigation was necessary every year; the participation averages in the covering sources have values between 33.7% (wheat) and 58.7% (maize for silo double crop); the maximum values of the variation interval were registered between 61.0% (maize) and 103.2% (maize for silo double crop), (table 4).

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Table 4: The water consumption Σ (e + t) and the covering sources, Oradea 1976-2010

Crop	Σ(e+t),m3/ha			Covering sources of Σ(e+t) optimum, m3/ha				
						Σm		
	Unirrigated	Irrigated	Difference Irrigated-Unirrigated %	Ri-Rf	Rv	m3/ha	%	Variation interval %
1.Wheat	3138	4289	36.6	535	2307	1447	33.7	0-61.8
2.Maize	4253	6223	46.3	509	3237	2477	39.8	13.5-61.0
3.Sunflower	3947	5900	49.5	933	2798	2169	36.8	6.2-63.0
4.Soybean	3828	5826	52.2	563	3049	2214	38.0	9.4-61.5
5.Bean	3211	4184	30.3	324	2472	1388	33.2	7.0-71.4
6.Sugarbeet	4618	6992	51.4	840	3459	2694	38.5	8.3-67.9
7.Potato	3803	5292	39.2	516	2953	1823	34.4	7.1-61.1
8.Alfalfa 1st year	4681	6698	43.0	525	3578	2595	38.7	9.1-64.7
9.Alfalfa 2nd year	5074	7791	53.5	945	3796	3050	39.1	14.3-61.2
10.Maize for silo 2nd crop	1378	2872	108.4	-145	1333	1685	58.7	10.5-103.2

Ri-Initial reserve; Rf-Final reserve, Rv-Rainfalls from vegetation period; Σm- Irrigation rate

3.5. The irrigation influence on yields level

The average of the yields obtained during 1976-2010 in irrigation conditions were bigger than in unirrigated conditions, the relative differences registered had the values between 39% (wheat) and 127% (maize for silo double crop).

The amplitude of the variation interval for yield differences between two variants was 104% at sunflower, 116% at wheat crop, 176 % alfalfa crop 2nd year, 218% sugarbeet crop, 291% at alfalfa 1st year, 353 % soybean, 358 % at potato, 800 % at bean, 806% maize for corn and 25745% at maize for silo double crop (table5).

3.6. The influence of irrigation on yield stability

The quantification of the yield stability was made using the “standard deviation” indicator. In all crops, the irrigation determined the increase of yield stability, the differences between standard deviations for irrigated and unirrigated conditions was 8.7% (sunflower) and 50.4% (maize for silo double crop) (table 6).

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Table 5: The level of yields in main crop, in irrigated and unirrigated conditions, Oradea 1976-2010

Crop	Variant	Yield level			
		Average		Variation interval	
		kg/ha	%	kg/ha	%
1.Wheat	Unirrigated	4547	100	2736-7100	100
	Irrigated	6343	139	3993-8300	105-221
2.Maize	Unirrigated	6608	100	1510-12600	100
	Irrigated	11993	181	17880-16480	107-912
3.Soybean	Unirrigated	1836	100	300-3400	100
	Irrigated	3087	168	1380-4080	107-460
4.Bean	Unirrigated	1439	100	180-2720	100
	Irrigated	2170	151	1321-3770	105-905
5. Sun flower	Unirrigated	2289	100	1350-3140	100
	Irrigated	3394	148	1757-4580	106-210
6.Sugar beet	Unirrigated	39895	100	18960-80900	100
	Irrigated	64453	162	44850-87800	109-327
7.Potato	Unirrigated	24137	100	11500-43700	100
	Irrigated	38284	159	20670-66050	106-464
8. Alfalfa 1st year	Unirrigated	45472	100	18500-89800	100
	Irrigated	69905	154	30500-120850	113-404
9. Alfalfa 2nd year	Unirrigated	60953	100	29500-118590	100
	Irrigated	96822	159	57000-145420	119-295
10. Maize for silo 2nd crop	Unirrigated	13890	100	0-31000	100
	Irrigated	31470	227	10160-44640	115-25860

Table 6: Standard deviation in unirrigated and irrigated crops, Oradea 1976-2010

Variant	Crops for grain									
	Wheat		Maize		Sunflower		Soybean		Bean	
	Kg/ha	%	Kg/ha	%	Kg/ha	%	Kg/ha	%	Kg/ha	%
Unirrigated	922	100	3271	100	580	100	814	100	820	100
Irrigated	642	69.6	1879	57.4	530	91.3	547	67.2	680	82.9
Crops for stalk and roots										
Variant	Sugarbeet		Potato		Alfalfa 1st year		Alfalfa 2nd year		Maize for silo 2nd crop	
	Kg/ha	%	Kg/ha	%	Kg/ha	%	Kg/ha	%	Kg/ha	%
Unirrigated	9240	100	9440	100	37950	100	30160	100	9310	100
Irrigated	6920	79.9	5480	58.1	33630	88.6	25720	85.3	4620	49.6

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3.7. The influence of irrigation on quality of yield

In irrigated maize, the quantity of total nitrogen in grain was bigger than unirrigated maize with 19.7%. Taking in consideration the yield differences between irrigated and unirrigated maize, results much more protein (135.4%) in irrigated conditions,(table 7).

The participation of the big potato in the yield of the irrigated variant was of 84.4% with 11.6% more than unirrigated variant (table 8).

Table 7: The influence of irrigation on protein content in maize corn, Oradea 1987-2010

Variant	Total nitrogen content in maize grain		The protein content in grains
	%	%	Kg/ha
Unirrigated	1.42	100	556.94
Irrigated	1.70	119.7	1311.52

The improve of the yield quality was registered in soybean and sugarbeet, too (Domuța Cr., 2010).

Table 8: The influence of the irrigation on the big tuberous participation from potato crop, Oradea, 1976-2010

Variant	The big tuberous participation		Variation interval of big tuberous participation
	Values %	%	Kg/ha
Unirrigated	75.6	100	71.6-82.5
Irrigated	84.4	111.6	80.1-92.4

3.8. The influence of irrigation on water use efficiency

Excepting the sunflower crop, in all the crops, the irrigation determined the improve of water use efficiency, for 1m3 water consumpted was obtained a bigger quantity of the main yield than unirrigated conditions, the relative differences had medium values between 2% (wheat) and 25% (maize for silo double crop), (table 9).

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Table 9: Irrigation influence on water use efficiency, Oradea 1976 – 2010

Variant	Crops for grain									
	Wheat		Maize		Sunflower		Soybean		Bean	
	Kg/m3	%	Kg/m3	%	Kg/m3	%	Kg/m3	%	Kg/m3	%
Unirrigated	1.45	100	1.55	100	0.58	100	0.48	100	0.45	100
Irrigated	1.48	102	1.93	125	0.58	100	0.53	110	0.52	115
Crops for stalk and roots										
Variant	Sugarbeet		Potato		Alfalfa 1 st year		Alfalfa 2nd year		Maize for silo double crop	
	Kg/m3	%	Kg/m3	%	Kg/m3	%	Kg/m3	%	Kg/m3	%
Unirrigated	8.64	100	6.35	100	9.71	100	11.94	100	10.08	100
Irrigated	9.22	106.7	7.23	114	10.44	108	12.42	104	10.95	109

3.9. Correlations from soil –water- plant- atmosphere system

Over the years was quantified the correlations from soil – water – plant-atmosphere system for all researched crops (Domuța, 1995, 2009, Domuța Cr., 2010). In this paper were presented the correlations at one of important crop in this area which is maize.

Between number of days with water reserve below easily available water content and yield, respectively water use efficiency and between number of days with water reserve on irrigation depth below wilting point and yield determined an inverse links, statistically very significant. Between numbers of days with water reserve below easily available water content and yield gain obtained using the irrigation was quantified a direct link, statistically very significant.

A direct links, statistically very significant were quantified between microclimate conditions and yield, respectively between water consumption and yield. These correlations sustained the need of irrigation in maize from this area. (table 10).

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Table 10: Correlation in the soil – water – plant – atmosphere system in maize, Oradea 1976-2010

Nr. crt.	Correlation	Regression function	Correlation coefficient
Correlation between soil moisture stress and yield			
1	Nr.of days with WR<WP x yield	y = 601,33 x0,9047x	R = 0,88 ooo
2	Nr. of days with WR<Wea x yield	y = 158,88 e-0,0148x	R = 0,66 ooo
3	Nr. of days with WR<Wea x WUE	y = 3,5236 e-0,0144x	R = 0,62 oo
4	Nr. of days with WR<Wea x spor yield.	y = 0,0935 x-0,0127	R = 0,78 xxx
Correlation between microclimate and yield			
5	ICD x yield	y=-0,2931x2+13,57x-21,108	R = 0,88xxx

WR = water reserve on 0-75 cm depth; WP = wilting point; WEA = easily available water content; WUE = water use efficiency; kg/m3; ICD = Domuța Climate Index.

4. Conclusions

The paper is based on the researches carried out during 1976-2010 in Oradea, in a long term trial at ten different crops.

The presence of irrigation in the components of the sustainable agriculture is sustained by following arguments:

- The evolution of the soil structure. In the conditions when was used alfalfa as ameliorative crop rotation, and the fertilization system included manure, the structured degree (35.98%) was maintaining to the level of the structure degree from crop rotation unirrigated wheat- maize (35.26%);
- The decrease of soil water reserve on watering depth below easily available water content every year and in other years even below wilting point level;
- The droughty microclimate of unirrigated crops and the positive influence of the irrigation on water/ temperature + light report (Domuta climate index);
- The improve of the crops water consumption; the differences in comparison with unirrigated crops were between 36.6% (wheat) and 108,4% (maize for silo double crop). The optimum water consumption can be assured using the irrigation only. This participation in the covering sources was between 33.2% (sunflower) and 58.7% (maize for silo double crop).
- The highest level of yields; median differences, were between 39% (wheat) and 127% (maize for silo double crop). The maximum values of the variation interval are between 110% (sunflower) and 25760 (maize for silo double crop). The quality of yield is better than unirrigated conditions;
- A better stability of the yield, standard deviation values were smaller than unirrigated conditions with relative values between 8,7% (sunflower) and 50,4% (maize for silo double crop);

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• The increasing of water use efficiency with values between 2% (wheat) and 25% (maize);
• The correlations from soil-water-plant-atmosphere system:
• The inverse correlations between number of days with pedological drought and yield, respectively water use efficiency;
• The direct correlations between number of days with pedological drought and yield gain obtained using the irrigation;
• The direct correlations between water/temperature + light report (Domuța Climate Index) and yield, respectively between water consumption and yield.

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The Role of Mid-Ranged Universities in Knowledge Transfer in Central and Eastern Europe - Sustainable University Strategies in the Era of Post-Mass Education

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Abstract.
The paper focuses on social-organizational innovation mediated by the academic sector. It is strengthening the role of the social and organizational foundations in the economic development and in the development of human resources in which the different forms of knowledge have a key role. In this paper we try to adapt the models of universities' regional engagement in the case of a peripheral border region in Central and Eastern Europe, the South Transdanubia Region in Hungary.

JEL Classification: I23, I28, I25, I21.

1. Introduction

In many regions, universities are viewed as the core of the knowledge base, acting as key elements of innovation systems, supporting science and innovation-based regional growth (Huggins & Kitagawa 2009). The so-called regional engagement of universities has been developed through an evolutionary process during the last 50 years. Traditionally, universities primarily focused on teaching and, to some extent, research, while university education was elite education. In many European countries, due to the gradual expansion of the higher education sector, the appearance of mass education and lifelong learning, and the declining share of grants provided by the state in the 1970s and 1980s, competition between the universities have become stronger, and they have been forced to perform their research activities on a profit-oriented basis. Universities have had to seek alternative sources of funding from business, industry, civil society and non-national state actors (Harloe & Perry, 2004). Also, the public funding became increasingly competitive funding and research activities often require public-private partnership. This is called the "entrepreneurial turn", or the servicing mission of universities (Tjedvoll, 1997; Inman & Schuetze, 2010) or the "Mode 2 university" (Harloe & Perry, 2004). In this context, "Mode 1" refers to the traditional way of knowledge generation which is anchored in disciplines and is more homogenous and hierarchical.

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This is also referred to as the ivory tower model of universities. In contrast, "Mode 2" refers to the application oriented, transdisciplinary and reflexive way of knowledge generation (generative role of universities) in the context of the entrepreneurial university (Clark, 1998; Chatterton & Goddard, 2000). "Mode 2" is also characterized by heterogeneity and organizational diversity, social accountability and quality control.

Later, in addition to teaching and research universities started to adapt a third mission or developmental role, which can be described as "community service" mainly by the US literature, and "regional engagement" in Europe (Holland, 2001), "regional innovation organization" or "academic entrepreneurialism" (OECD, 1999).

The university engagement literature, while accepting that universities may well undertake knowledge generative activities, proposes that they adopt a broader, developmental focus on adapting their core functions of teaching and research, as well as community service, to address regional needs (OECD 1999; Chatterton & Goddard 2000). In regard to human capital formation, the
university engagement literature focuses on the importance of regionally-focused teaching (Chatterton & Goddard, 2000), which is manifested in a stronger focus on regional student recruitment and graduate retention; the development of programmes that address skills required by regional industries, particularly, small and medium-sized enterprises; and the localization of learning processes, for example, through workplace-based learning and regional projects.

This third (developmental) mission is a somewhat indefinite concept which refers to the economic development role motivated by the social responsibility of the institutions. According to Harloe and Perry (2004), the third role of universities in relation to sub-national (EU regions) economies and societies has been widely justified in terms of the development of the knowledge economy and the significance of the regions in economic development. This "regionalization of the economy" strengthens the links between the universities and the clusters of firms and regionally-based supply chains of small and medium sized firms (Gunasekara, 2004). Knowledge and innovation have become increasingly important sources of economic development, and there is a pressure from government, businesses and communities for universities to align their core functions with regional needs (Chatterton & Goddard, 2000).

Huggins and Kitagawa (2009) argue that although universities emphasize their international orientation, they are embedded in their region and add to the area's economic and social strength through e.g. preserving local jobs, diversifying the local economy and attracting inward investors. Among many others, these authors state that economic development and the welfare of regions can be enhanced through universities' various engagement with the local economy, including research, infrastructure development, education, effective industry-university partnerships, technological innovation and community development.

In this paper we try to adapt the models of universities' regional engagement in the case of a peripheral border region in Central and Eastern Europe, the South Transdanubia Region in Hungary. Although the study applies the concept of mid-range university to Central and Eastern Europe, the term of mid-ranged universities was borrowed from the study by Wright et al. (2009), which is focused on mid-range universities and their links with industry in British, Belgian, German and Swedish regions. In the UK for example, midrange universities are defined as all universities excepting top universities and new (post-1992) universities.

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For example, the sample of Wright et al. (2008) included universities teaching between 8 thousand and 33 thousand students and employing between 700 and 2500 full-time researchers. However, in the UK and other European countries there are many first-ranked universities located in non-metropolitan regions, which is not the case in Central and Eastern Europe. As the consequence of a spatial concentration of top universities in Central and Eastern European countries almost exclusively in metropolitan areas, mid-range universities are most often located in non- metropolitan regions (Gal and Ptaček, 2011).

In our article we examine that to what extent regional, mid-range universities may enhance economic development in a lagging area and to what extent European models of the universities' third role may be relevant in this particular region. Our hypothesis is that universities' developmental role is much weaker in peripheral regions where mostly mid-range universities are present, and the traditional models designed for first-ranked universities located in prosperous economic environment are not directly applicable due to e.g. the different sectoral structure of the economy and the different nature of the knowledge supply and demand.

Our paper is structured as follows. In the next section, we briefly summarize the results of the literature concerning the economic impact of the universities and the methods of the quantitative measurement. Then, we present the relevant theoretical considerations of developmental role of universities including the traditional theories, the triple helix model and its variants and the regional engagement literature. The following section focuses on the specificities of the mid-range, peripheral universities which have similar characteristics to those of the South Transdanubia. After it, case studies are presented from the region which may reveal the position of the universities in the system of regional and cross-border development. Finally, some concluding considerations are included in the last section.

2. Regional engagement and the developmental role of universities

The literature on the engaged university (OECD 1999; Holland 2001;
Chatterton & Goddard 2000) also focuses on the third role of universities in regional development, but it differs from the triple helix model in its emphasis on the responses of universities that adopted a stronger regional focus in their teaching and research missions. The evolution of the engaged universities ran parallel with the regionalization of the economy, or "the rise of the regions" which means that the salience of the regional scale is increasing and the regulatory capacity of the nation-state declines (Arbo & Benneworth, 2007). Essentially, universities' regional engagement means meeting the various needs of the modern client population, such as flexible structures for lifelong learning created by changing skill demands, more locally based education as public maintenance support for students declines, greater links between research and teaching, and more engagement with the end users of research (Chatterton & Goddard, 2000). Also, regional institutions including universities have gained more and more importance in the governance of the regional economy; therefore, universities as important parts of the regional networks have become more embedded in their regional environment.

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The engaged university approach encompasses a range of mechanisms by which universities engage with their regions. The literature on the responsive university places less emphasis on academic entrepreneurialism, compared with the triple helix model, and more on community service. Here, community service means that the university is a community-based institution serving the needs of the society in a local area or region (Chatterton & Goddard, 2000). Unlike in the US, European higher education institutions are highly dependent on state support. However, from the point of view of their regions, they function as autonomous institutions and have control over the nature of teaching and research, since they are under national regulations and raise the majority of their funding from national sources. Therefore, regional engagement is not inherent to these institutions. There is an external pressure from government, businesses and communities for universities to align their core functions with regional needs. Universities also need to diversify sources of funding due to the rising relative costs of education, the intensifying competition for students and research contracts in conjunction with fiscal and demographic pressures, in order to m*a*intain their academic standing and in some cases, to even survive. Taking a specific approach, OECD (1999) as well as Srinivas and Viljamaa (2008) analyzed the process and motives of becoming an engaged university in the context of institutional change and institutional interactions.

University engagement can incorporate several activities. Together with the shift of the higher education sector from elite education to mass education and the prevalence of life-long learning, there is a requirement from universities to educate graduates in compliance with the needs of the regional labour market. This means that universities provide an interface between graduates and the labour market in their region. According to Chatterton and Goddard (2000), engaged universities provide flexible structures for lifelong learning created by changing skill demands; and more locally based education as public maintenance support for students' declines.

In the field of research, universities' engagement means greater links between research and teaching; and more engagement with the end users of research, e.g. in the form of regional research networks and joint research with participants from the academia and the industry (Chatterton & Goddard, 2000). Since university research is conducted mainly in international academic networks, universities are able to channel the international knowledge to regional users. A considerable part of the literature, e.g. Varga (2009) build on the notion that knowledge generation becomes localized and agglomeration effects are crucial for the spillover effects to work. Evidence proves (see e.g. Drucker & Goldstein, 2007) the importance of proximity in supporting university-industry joint research efforts and other collaborations.

Universities engage with their regions not only in the fields of education and research but also in regional institutions and governance systems. This is the consequence of the previously mentioned phenomenon that the regionalization of the state activity is increasing in Europe, and administrative and political decisions are increasingly made at the regional level (Chatterton &
Goddard 2000). For this reason, institutional capacities have to be built and extended at the sub-national level and sub-national policy networks have to be created. As important regional actors, universities are part of these governance networks (see Arbo & Benneworth, 2007). Individuals in the academic sphere take an active role in the civil society:

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Academic staff, either in formal or informal capacities, can act as regional animators through representation on outside bodies ranging from school governing boards and local authorities to local cultural organizations and development agencies. Higher education institutions also act as intermediaries in the regional economy by providing, for example, commentary and analysis for the media. As such, they make an indirect contribution to the social and cultural basis of effective democratic governance, and ultimately, economic success through the activities of autonomous academics" (Chatterton and Goddard, 2000 p. 481).

In addition, the community service of the universities often takes the form of developing the social and cultural infrastructure of the region in accordance with the specific needs of university students and academics.

Arbo and Benneworth (2007) review the numerous aspects through which higher education institutions are embedded in their regions. These are primarily noneconomic aspects including regional policy, national and regional innovation systems, human capital development and governance systems. They concentrate on the numerous interfaces through which the university and its region may be linked.

The impact of local universities is not restricted to the technical sphere, but may spread into wider social and economic effects on their region. Commitment to social and organizational innovation is gaining more-and more importance as main barriers emerge from the social sides even if universities and regions try to introduce adopted technologies. Social and organizational innovation means in wider context the generation and implementation of new ideas and creativity in order to overcome the social barriers of innovation and it requires ongoing social interactions (Mumord, D.M.–Moertl, P. 2003).

Innovators face many social and managerial barriers which inhibit innovations. Among the others the inadequate funding, risk avoidance, incorrect measures and forecasts, lack of partnerships and deficiencies in collaboration are the most important social and managerial constraints. Social innovations facilitate the formation of new institutions, networks and building up social capital through collective learning processes (Kitagawa, 2004). A good example derived even from the Silicon Valley proves this new trend as since 2008 the Standford University spent more on social and organizational innovation than on technology oriented R&D!

2.1. Mid-range universities in peripheral regions

Many of the empirical studies on universities' regional developmental role and economic impact derive their findings from investigating large, world-class research universities located in highly developed economic environment. Nevertheless, Wright et al. (2008) argue that those findings are not necessarily relevant for all the universities, especially for mid-range universities.

The main features of the mid-range, regional universities are that they are located in secondary cities where the regional demand for innovation is moderate, the density of contacts are much lower and possible spillover effects emerge more sparsely; they may not possess a base of world-class research; academics work in a smaller local scientific community in which they interact with the industry; and the creation of spin-off companies is different in its nature (Wright et al., 2008).

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According to Gal and Ptaček (2011), the model of university engagement can be adopted by those mid-range universities in the less developed East European regions which do not have the critical mass to engage in world-class scientific research, but instead *these universities* can focus on other than high-technology innovation. For the less developed, reindustrializing Central and Eastern European regions with substantial human capital resources, benefiting from the relocation of European industry but not yet fully developed knowledge creation and transfer capacities, this special situation forces mid-range universities to take on new roles in contrast with other countries/regions where university-state-industry-citizen relations have perhaps had longer time frames to evolve. This new role means a stronger regional engagement in medium-tech innovations and in social and organizational innovation.

In their paper, Huggins and Johnston (2009) compare the economic impact of universities of different types, and they found that there are significant differences in the wealth generated by universities according to regional location and the type of institution. According to their results, universities in more competitive regions are generally more productive than those located in less competitive regions, and more traditional universities are generally more productive than newer ones in the UK. Furthermore, the overall economic and innovation performance of regions in the UK is generally inversely related to their dependence on the universities located within their boundaries. This means that weaker regions tend to be more dependent on their universities for income and innovation, but often these universities underperform in comparison with similar institutions in more competitive regions. Although knowledge commercialization activity might be a source of productivity advantage for universities, markets for knowledge in less competitive regions appear to be weak on the demand side. Huggins and Johnston (2009) emphasize that the regional environment may also influence the actions of institutions, since a relatively strong knowledge-generating university in a relatively weak region may have a greater propensity to engage with firms in other regions. In weak regions the private economy's strength may be insufficient and small and medium-sized enterprises may be unable to exploit the benefits of the engagement with the universities. In the long term this may result in a leakage of knowledge from the home region, which further deepens the disparities in regional competitiveness.

Benneworth and Hospers (2007) focus on how peripheral regions which are functionally distant from core economic activities can reposition themselves in the knowledge economy. They argue that such regions are internally fragmented, which reduces their capacity to attract and embed external investment to reduce this distance, and upgrade their status among other regions within a technical division of labour. In regions with sub-optimal innovation systems, it is very hard to lay down the foundations of a sustainable local economic growth. According to Benneworth and Hospers (2007), a governance failure is in the root of this problem, namely the networking deficiencies. They list a range of internal and external barriers that less-favored regions face when building local networks which exploit the knowledge spillovers of external investments. Internal barriers include a lack of local institutional capacity, a lack of critical mass or substantive outcome, the lack of entrepreneurial resources, and a mismatch between the science base and the knowledge users. External barriers to building and integrating local networks are the unfavorable economic specialization (to low-tech industries), externally imposed barriers to local governance integration, antipathy by external firm owners to local innovation, and poor external image discouraging potential investors.

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The situation described in the above paragraphs is quite pessimistic. A more favourable picture can be drawn for peripheral regions if one investigates the universities' role in the local economic development. Benneworth and Hospers (2007) review the literature discribing the ways universities can play an integrative role in the regional innovation system of less favoured regions. For example, universities can help build large-scale excellence in research attracting new external partners; be an additional body/institution in governance networks, thereby increasing network connections; or provide educated and informed citizens for public institutions. Furthermore, universities can provide an inflow of new ideas to old industries; act as a big globally focused actor making demands for new kinds of planning arrangements; actively shape development of programs through their consultancy that address and represent the cornerstones of regional innovation systems. Universities may strengthen the regional focus of the local actors through their long-term planning horizons, stability-oriented way of thinking and their interests which span beyond the host locality. As a consequence, universities' regional engagement is a key factor in the innovation-based economic development of the peripheral regions.

2.2. University engagement in Central and Eastern Europe

Limits of economic impact of universities in Central and Eastern Europe – the regional case from South Transdanubia, Hungary

There is a substantial spatial concentration of top universities almost exclusively in metropolitan areas in the Central and Eastern European countries. Mid-range universities are most often located in non-metropolitan regions or to put it another way, most of the universities outside the capital cities can be classified as mid-range, where the R&D potential and the "density of contacts" are much lower and possible spillover effects emerge more sparsely. For this very reason, mid-range universities represent the keystones of regional innovation systems and are often crucial
parts of regional innovation strategies (Gal & Ptaček, 2011). During the transition in the 1990s universities were mostly facing the pressure of the state to increase their educational role. The system of universities' financing in this decade did not motivate them to search for new contacts and collaboration with industry and it was much easier to survive through the rising numbers of students.

The gradual "marketization" of the higher education sector started after 2000 as a result of several factors. In general, it was the recognition of knowledge as a source of economic growth. In the process of the marketization, universities started to use standard tools borrowed from Western
Europe, but the result cannot be the same because of different history and position of universities in the regional or national innovation systems. EU accession and the possibility to use EU development funds (such as cohesion funds) for building knowledge infrastructure induced an active approach from the side of universities. The establishment of the supporting innovation infrastructure (scientific parks, scientific incubators) was further developed at the universities thanks to the role of intermediaries (mostly technology transfer offices or R&D services) which focused, on the one hand, on building of ties with industry and, on the other hand, on gaining EU funds for infrastructure building. In that period, the trend of incoming foreign direct investments shifted from the low-paid routine labour towards investments requiring a skilled and university educated labour force. In this sense multinational companies have a pioneering role in the knowledge spillover from universities to industry (Ptaček, 2009).

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The regional impact of these processes is leading to the ongoing polarization of the R&D potential between metropolitan and non-metropolitan areas; that is, R&D resources and research capacities are more and more unequally distributed among the regions (Ptaček, 2009; Gal 2005). This resulted in that mid-range universities remain the keystones of regional innovation infrastructure outside of the metropolitan regions, furthermore, their role even increases. Sectoral research institutes set up in the socialist era and sponsored by the industry and relevant ministries were mostly closed down after the regime shift, and so their role was taken over by local universities.

In sum, the role of mid-range universities in CEE countries is weaker than in more developed countries of the EU and the process of adaptation to new social and economic conditions started substantially later than in Western Europe. At the same time mid-range universities located mostly outside of the metropolitan areas have to face similar problems and disadvantages as in their western counterparts such as less intensive university-industry contacts, weak local R&D networks etc. (see Table 1 and Gal & Ptaček, 2011).

It is often argued that universities are able to generate economic effects based on knowledge spillovers and innovation transfers to businesses (Etzkowitz et al. 2000). The differences between the advanced regions of metropolitan agglomerations and the most backward regions are emphasized in the relationship between universities and their regions (Acs et al. 2000). This means that in most of the non-metropolitan Central and Eastern European regions, where the regional innovation systems and the university-industry linkages are still weak, the role of universities in local development has to be revised and, consequently, the economic impact of universities cannot be unambiguously extended to transition economies. For example, a Hungarian study concluded that the knowledge-producing ability of the academic sector did not increase the knowledge-exploitation ability of the local business sector and, moreover, both universities and the less developed local economy may be responsible for several hindering factors of intraregional knowledge transfer between universities and industries (Gal & Csonka, 2007). Similarly, Bajmoczy and Lukovics (2009) showed that university researches for local economic development may be an outstanding instrument in case of advanced regions but not necessarily for the less developed regions where the lack of appropriate industrial base is one of the main constraints. They measured the contribution of Hungarian universities to regional economic and innovation performance between 1998 and 2004. The results showed that the presence of universities does not affect the growth rate of per capita gross value added and gross tax base per tax payer. Therefore, general economic effects of universities and related R&D investments are hardly visible in transition economies such as many Central and Eastern European regions.

Our case study area, South Transdanubia, is a less developed reindustrializing region with lower knowledge absorption capacity and with an underdeveloped research and technology development sector relative to the national average (Figure 1). Basic conditions for change in the technology sphere are rather unfavorable. Its regional GERD was 23 M euros in 2007, which is only 2.5 per cent of Hungary's total. The region has one of the poorest R&D capacities in Hungary (in 2007 with only 4.1 per cent of the Hungarian R&D employees). The region has large public RTD infrastructure mainly based on the two universities1 absorbing more than four fifths of regional GERD, therefore the HEI2 sector plays dominant role in R&D performance (Table 1).. Unlike the public RTD sector, the visibility and the performance of the business sector is very low, even in comparison with the national average. The RTD creation of the business sector in Southern Transdanubia is limited (3.4 M € BERD in 2004). Universities are the major employers of RTD personnel.

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The orientation of the knowledge creation activity of the region is based to a great extent on the profile of its universities, which have the strongest potential in life science (biotech) research and they also have a good reputation with measurable RTD outputs in laser physics, environmental and animal cytology research.3 However, the strongest barrier in South Transdanubia is the clear mismatch between the knowledge-production specialization of the universities and the economic structure of the region.

The main findings of this section are based on an empirical survey which listed 92 time-series indicators covering 20 different EU regions, including South Transdanubia commissioned by ERAWATCH S.A. in Brussels (Gal & Csonka, 2007). This research was focused on the constraints of knowledge transfers in the case of mid-range universities in the less developed transition regions with traditional, non-research universities. The survey on South Transdanubia identified the main reasons for the poorer performance in RTD transfers. On the one hand, there is a mismatch between the economic and research specializations, which is combined with the low share of the business sector in RTD investment, the high share of the traditional lower tech sectors, the small size of local SMEs and the consequent lack of resources to invest into RTD and absorb its results. On the other hand, there is a lack of demand for research results from larger (mainly foreign-owned) companies and, to some extent, the necessary knowledge supply in the region for certain sectors and in certain disciplines is also lacking (Gal & Csonka 2007).4 It should be also accepted that these regions are specialized in activities that are not highly research intensive, therefore increased R&D expenditures cannot be easily exploited by local businesses or utilized by HEIs. In these situations, setting up a new research base that is not linked to the needs of the regional economy could be like building „*cathedrals in the desert*" as they are unlikely to be able to develop knowledge transfer and spillovers with local economic actors, particularly for high-tech industries (Dory, 2008; Gal, 2010).

2.3. Engaged Universities – The Hungarian Cases

Universities can act as regional actors, developing stronger partnerships between universities and the regional development agencies, emphasizing the key role of higher education in regional development. The policy approaches and activities in CEE regions almost exclusively concentrated only on the first two missions of the universities and the notion of regional engagement did not constitute the part of the university strategies up until very recently. Two compelling endogenous and exogenous factors have contributed to the recognition of the importance of stronger regional engagement of the universities recently. Firstly, the accumulated knowledge and the experiences of staff at the higher education institutions provide expertise in various fields, and this can be a very effective way of accelerating progress of collaboration through the exploitation of economic and social interactions transmitted by spin-offs and other university based consultants within the newly formed regional networks. Secondly, exogenous pressures are extorted by new market demand and policy goals which envisage a real regional and social prosperity that integrates knowledge, social and human development.

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This exogenous factor facilitates connectivity among different institutions including universities and other stakeholders and will provide not only better funding opportunities but also a collective learning platform for social interactions (Leydesdorff & Etzkovitz, 2001).

In the following sub-sections we present two case studies the authors participated in, from South Transdanubia, which show the new types of developmental roles and community engagement that local universities can take in a peripheral, border region in order to revitalize the economy of a lagging, de-industrialized area. The first one presents an example of a urban development project based on campus (property) development in conjunction with the European Capital of Culture 2010 project, and a city development strategy of the health and environmental sectors; the second one provides insights into the building of a common cross-border knowledge region in the framework of universities' partnership . It is characteristic of both case studies that the strategies are strongly reliant on the contribution of the local academic sector.

University engagement in the South Transdanubia Region: The European Capital of Culture 2010 Project and the so-called „growth pole" development programmes.

In the case study presented in this section we focus on the biggest city of the South Transdanubia Region and its university. The city of Pecs has adopted two strategies with strong collaboration of the University of Pecs to mobilize endogenous resources and enhance its competitiveness University of Pecs is the oldest university in Hungary that was established in 1367). Higher education has been a strong driver of economic restructuring; in fact, it was probably the university which saved the city of Pecs from the depression experienced by other Central and Eastern European industrial regions after the change of the political regime – even if it could not fully prevent the disadvantageous processes (Lux, 2010). In the 1990s and the 2000s, Pecs, the city with 2000 years of history dated back to the Roman and medieval times, has lost most of its economic potential which was built on coal and uranium mining and several industrial plants. Due to its peripheral situation and the adverse effects of the war in the former Yugoslavia, the foreign direct investments are insufficient in the region and there is a lack of local economic strength. In an economic environment characterized by a decreasing industrial sector, the city's cultural, educational and market services give a chance for the economy to rise again. Cultural issues first appeared markedly in local development policy in the 1995 city development strategy, which envisaged a growth path built on knowledge-based economy, services and innovation, where innovative tourism and "cultural industry" get priority (Lux, 2010). After the integration of several local universities and a number of smaller higher education facilities in 2000, the University of Pecs, being the oldest university of Hungary (est. 1367), has become one of the largest employers in the city and even the region. Although R&D outputs in engineering and natural sciences and the university-industry links are limited, the presence of students and employees has had a multiplier effect on the economy of Pecs, mainly in the field of rented flats, consumer products and services and culture. Of course, the university has contributed to the urban ambience and real estate site development of Pecs, as well (Lux, 2010).

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One of the strategies is a comprehensive initiative which aims to reconfigure the economy of the city to utilize the heritage and cultural basis in the framework of a singular large project of the European Capital of Culture 2010 to generate growth. The European Capital of Culture 2010 project tries to capitalize on the idea of culture-led urban regeneration and helped Pecs to reinvent itself through culture. The University of Pecs has played a major role in organizing the European Cultural Capital project, which became the largest ever exercise of community service of the local university, being heavily involved not only in the cultural events but also in the development of the new cultural, community and educational functions of the city's newly built cultural quarter (Lux, 2010). The project is the Zsolnay Cultural Quarter: built on the site of the eponymous ceramics factory, which was originally established as a mixture between production facility, artist's colony and living environment for the owner and his family, it intends to endow a disused area with new cultural, community and educational functions serving as the new training site for the university's Faculty of Music and Visual Arts. Benneworth et al. (2010) describes the universities' urban development role and the major factors conditioning the success of co-operation for both the city and the university in detail.

The strong university engagement in the city's development was also reflected by the development pole programme5 called "Pecs – Pole of Quality of Life" which has three pillars: health industry, environmental industry and cultural industry. The main features of this programme are introduced by – among others – Lux (2010) as follows:

1. Similar to the European Capital of Culture 2010 project, the "growth pole" programme has strongly involved the contribution of the University of Pecs during the planning period as well as in the governance and the implementation, especially within the ealth industry pillar and the Environmental industry pillar. (Figure 2)

2. "Health industry" covers health services relying on the university's Faculty of Medicine and its clinics, which have achieved outstanding results in treating movement-related disorders. Several industrial functions are connected to these services including the manufacturing of medical and prosthetic equipment; and other services in the field of human recreation.

3. The "Cultural industry" pillar of the programme is expected to benefit from the European Capital of Culture 2010 programme, and this returns to the idea of promoting the urban culture of Pecs as a complex, innovative product.

4. The "Environmental industry" pillar is both narrower and wider than the "quality of life" concept: it might be helpful in fostering a cleaner, more attractive environment, but the actual elements of the development project have a prioritized focus on alternative energy sources.

University engagement through the Hungarian–Croatian cross-border programmes: lessons from the "South Pannonia" region.

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Another initiative under the umbrella of universities' engagement is the Hungarian-Croatian cross-border project titled "*Regional Universities as Generators of a Transnational Knowledge Region: UNIREG IMPULSE*" started in the "South Pannonia" region with the aim of developing a knowledge region based on the universities' active regional engagement – their third mission – mediating organizational and social innovation by strengthening networked relation between universities and regional actors (Figure 3). The project initiates networking relations on three different fields: rural development; strategic and regional planning; environment and sustainable local energy systems. There is a vast scope for enhancing the universities regional, economic development and knowledge disseminating role in the region. Besides mainly bilateral educational and research relations between the region's universities there is a need for building the channels of the local knowledge flows towards their lagging, underprivileged hinterlands in those fields also where not primarily high-tech oriented R&D activities are demanded. Instead, the specific regional development impacts of the universities and their social and organizational innovations, as well as he knowledge generation and transfer through the contacts with local actors contribute most to the local development[6].

The central problem of the regional development in the cross-border area is that these regions are not only peripheral but also below the average in terms of the economic development in both countries. The neighboring border regions have a common interest in sustaining open borders in order to reveal and exploit the potential advantages of the cooperation in the fields of the education and economic and social activities which should be customized to the region's geographical specificities.

Effectively it was after the millennium that the local governments along the two sides of the border area have started to make contacts with each other thereby linking almost the entire border region and have undertaken activities which influence the progress in their environment. The various interregional, organizational, sectoral etc. applications and their implementation resulted in mutual idea formation and ambitions, as well as the creation of institutions in both sides of the border that are able to engage in mutual tasks on the basis of value-creating co-operations.

The general aim of the project was to motivate a more active regional engagement of the universities – in terms of their third mission – and to create a South Pannonian knowledge region which is based on the knowledge networks transmitting organizational and social innovation through the strengthening of the network relations between the universities and the regional actors. The regional academic sector possesses those intellectual capacities through which the cross-border region's inherent specificities, problems and mutual development perspectives can be envisaged. The project activities included the establishment of a knowledge transfer office as the organizational framework for the implementation of the third role of the local universities, the development of the co-operative knowledge networks and the creation of a knowledge map to serve as a basis for stronger cross-border co-operations between the universities.

In this case structural changes and cross-border social dialogues should all be regarded as priorities. Due to the region's economic, geographic and environmental specificities, the new cross-border knowledge region which extends the innovative capacities of the area should be built on the foundations of regional development instruments and rural economic development opportunities.

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Our approach assumes that the expansion of the universities' functions can be interpreted as a social and organizational innovation, while as a result of the project activities; a new co-operation interface emerges between the knowledge sector and the industry which is in accordance with the aims of the project. Dissemination, knowledge maps, joint knowledge transfer office, webpage development and workshops, publications and reports addressing the specific problems of the region help achieve the overall goals of the project while they provide frameworks for analyzing, planning and implementing new communication and co-operation forms in the field of social and organizational innovation.

In summary, the main implications of the case studies are as follows:

1 Higher education has been a strong driver of economic restructuring, and urban development/regeneration of slum districts within the city and contributes to the urban ambience and real estate site development of cities. University of Pecs has not only played a key role in supporting urban development and regeneration through campus development (Regional Library and Information Centre, Cultural Quarter etc.) but it also contributed to the quality of urban governance and to place branding (external image creation) of the city. These new development sites take part in the development of new cultural, community and educational functions of the city generated by the university.

2 The presented Unireg Impulse project called for an active cross-border engagement of the regional universities in order to create a transnational knowledge region through organizational and social innovation and strengthening networked relations between the universities and regional actors. The project was useful, one hand, for the regional universities, since it included elements for defining the universities' growth strategy (third role, social visibility, strategic involvement).and with the active involvement of the relevant regional stakeholders they increased their partnership as a potential for future collaborations. On the other hand the project was useful for regional and local government bodies because it provided a synthesis of Hungarian experiences on EU accession and expert guidelines for the transition on regional level based on the expressed needs. It can be concluded that universities have to be relevant players in the development and evaluation of regional policy that fosters 'new combinations' of partnership-based, innovation-centered approaches, which maximize the development of human capacities such as skills and mobility, and the formation of social capital through networking, collective learning and building up trust.

3. Conclusions

This paper has applied the regional and community engagement literature to mid-range universities of Central and Eastern Europe and explored the peculiarities and specificities of these mid-range universities facing a number of extra constraints in the less developed CEE regions. After summing up the ways in which universities may contribute to the economic development of their regions and presenting the measurement methodologies and the theoretical considerations, the paper focused on the problem of adapting the literature on peripheral regions with mid-range universities. From the presented theories, the literature on the universities' regional engagement is the most relevant in the context of our article. There are several facilitating and hindering factors concerning the process of becoming a regionally engaged university, and our main lesson is that the whole regional innovation system should be developed in an integrated manner in order to reach this goal.

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The mentioned constraints impede peripheral, mid-range universities to build linkages to the local economy and develop internationally recognized areas of research excellence, with the associated critical mass, and exploit the advantages of global knowledge networks. The research found that not only the position of universities in the collaboration with business sector but their role in the innovation system is quite different, which is mainly due to the different development path of innovation systems and development trajectories in post-communist countries described in the paper. Because of historical path-dependence, mid-range universities, unlike top-universities, are very often located in non-metropolitan regions in CEE countries where the RTD potential and "density of contacts" are much lower and possible spillovers emerge more sparsely than in capital city regions.

We argued that in these regions, setting up new university based research directions that are not linked to the needs of the regional economy are unlikely to be able to develop knowledge transfer and spillovers with local economic actors. In peripheral situation the lack of research capacity in science and engineering RTD can be also a serious obstacle to the modernization of the industrial structure. Universities are looking for contacts out of the regions and their contribution to the regional innovation infrastructure cannot fulfill the possible expectations. Rather, these universities need to take careful strategic decisions to build up those areas and the related intermediaries where they have the scope to make an international impact but also to differentiate investment in those areas where they can make a regional contribution.

Economic policy practices suggest that the support of university researches for stimulating local economic development may be an outstanding instrument in case of advanced regions but not necessarily for the less developed CEE regions where the lack of appropriate industrial base is one of the main constraints. It can be also argued that business-led networks connecting different actors have much higher importance in economically advanced regions while in the less advanced ones universities and public agencies play more significant role in network building and in catalyzing activities of the key actors. If universities are embedded in a region it has a clear impact upon the intensity and nature of the relationships and, hence, their ability to effect tacit and codified knowledge transfers. Regionally-focused teaching and research are manifest in a stronger focus on regional student recruitment and graduate retention (in order to combat brain drains in R&D), the innovation oriented regional development programs addressing skills required by regional industries and the localization of learning processes.

The paper also argues that mid-range universities in the reindustrializing CEE regions have to take on new roles, which means a stronger regional engagement also in medium-tech innovations and in social and organizational innovations. Universities have to be practically relevant in the development and evaluation of regional policy that fosters 'new combinations' of partnership-based, innovation-centered approaches, which maximize the development of human capacities such as skills and mobility, and the formation of social capital through networking, collective learning and building up trust. In the less developed CEE regions there is a need for much more comprehensive and complex economic policies initiating not only the support of the university sector but also the starting of developing high-tech industries, small-scale enterprises and constructing regional advantage with the stronger developmental role and community involvement of universities. This contributes towards the third mission of universities through meeting learning needs of the region. This might be achieved by exchanging knowledge between higher education and the business community or through outreach to local communities to combat social exclusion and to improve cultural understanding.

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Table 1: Main indicators of mid-range universities in Western Europe and their CEE counterparts

	University of Pécs (Hu)	UP Olomouc (Cz)	Notthingham University	University of arlsruhe	University of Ghent	University of Antwerp
N students	28,000	22,000	33,000	15,686	21,160	8,029
NFTE researchers	1051	1158		2500	1401	846
N FTE technology transfer	6	7	4	1	3	4
HERD Mill. Eur	14	19.4	150	83	122	45
N spin-offs	11	7	27	unknown	12	2
Total RSBO	n.a		n.a.		23	4
Regional GDP (Bn Eur)	6.7	11.2	103.8	316.9	157.3	157.3
GRP per capita (Eur)	6,900	9,600	24,145	29,694	26,194	26,194

Note: by the authors and Wright et al. 2008

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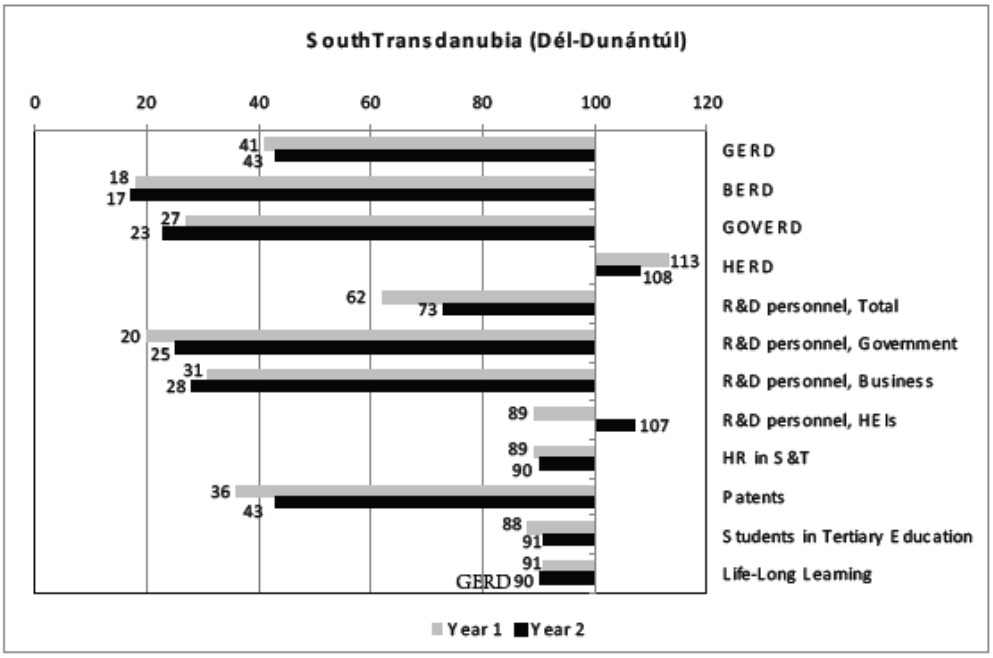

Fig. 1: Key indicators on Southern Transdanubia's knowledge base development in comparison to the nationalaverage, in percentage*

Source: calculated by the Author based on EUROSTAT and KSH (Hungarian Statistical Office) data
**BERD= Business expenditure on Research and Development,*
GERD= Gross expenditure on Research and Development
HERD= Higher Education expenditure on Research and Development
GOVERD= Government expenditure on Research and Development
Note: The following years were used for BERD, GERD, HERD GOVERD1999, 2003;
R&D personnel 1999, 2004; HR 1997,2004; Patents 199s, 2003 and
Lifelong learning 1999, 2004

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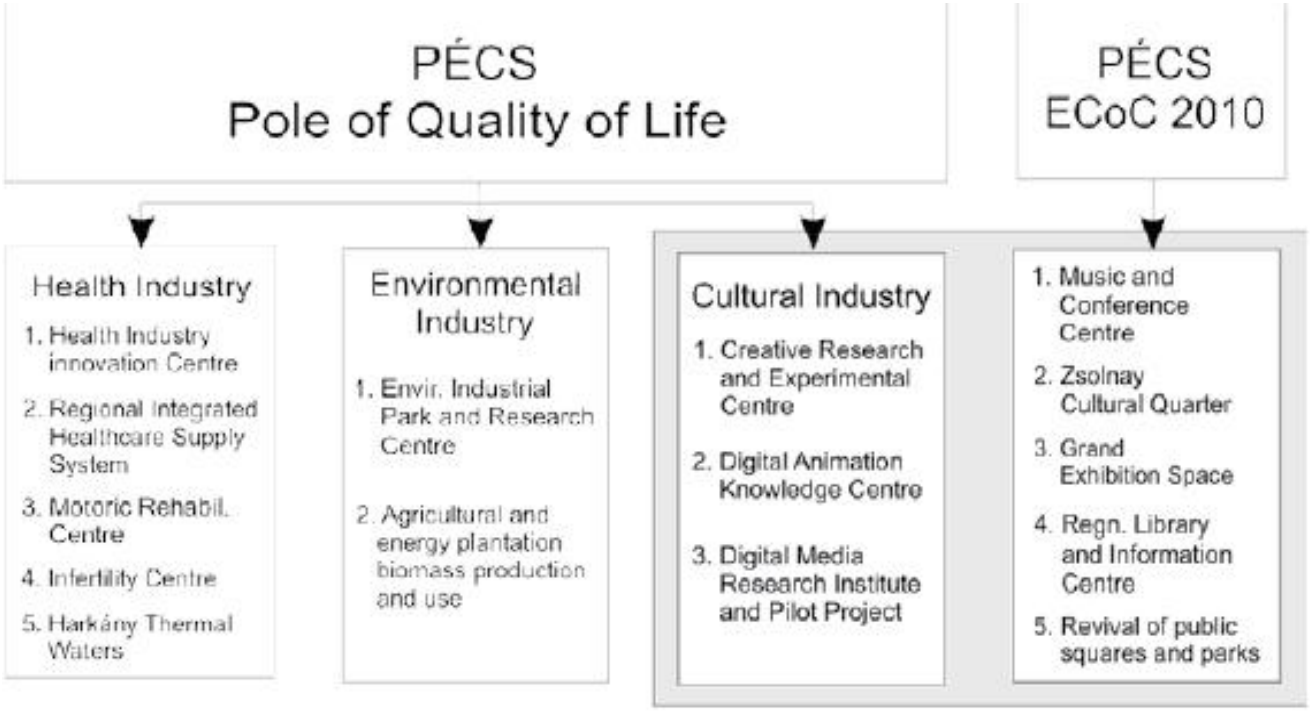

Fig. 2: The system of cluster initiatives and projects in Pecs Note: Lux (2010) p. 115

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Fig.3. Cross-border areas of Figure Hungary and Croatia covered by the UNIREG IMPULSE project
Source: http://www.hu-hr-ipa.com/

Footnotes

1 University of Pecs (est. 1367) and University of Kaposvar (est. 2000).

2 Higher Education Institute

3 The relative strength of biotech research base is demonstrated by its large share of total input-output indicators and also by the increase of RTD spending in this field (64.8m in 2004). In addition, the 11 university spin-offs in the biotech sector are tightly connected to the Medical School (MS) which has 48 employees and produces a turnover of €3 million (2004).

4 A few large enterprises in high tech electronics have been engaged in high-tech activities, but their influence on the local RTD sector is considered to be marginal, as they usually rely on the in-house RTD activities of their parent companies importing the technology from outside the region.

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5 The development pole based type of development appeared in France and its main characteristic is that the central motivator of the development process is the university. The overall aim of the pole programme is to promote the formation of internationally competitive clusters; specialization on high value-added, innovative activities; strong cooperation primarily between businesses and additionally between universities and local governments; to strengthen the regions through the increasing competitiveness and better business environment of the pole cities. The expected results (for the period between 2007 and 2013) include that the businesses – through clustering and the cooperation with the academic and university sector – reach the critical size which is necessary for being competitive in Europe and pole cities emerge as centres which are able to strengthen and sustain competitiveness for both themselves and their surrounding regions on an international scale.

6 In the project the social-organizational innovation mediated by the academic sector was serving for strengthening the social and organizational foundations of the local economic development and focused on the development of human resources in which the different forms of knowledge have a key role. The adult education and professional training courses organized by the universities, the exchange of practical knowledge bound to certain sectoral policies, development priorities, the elaboration of development strategies and practical development programmes (in rural development and in environmental sector) customized to the demands of local society and the universities' narrow and broad environment are important components in the increased regional engagement of universities.

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Decision Making Support in Wastewater Management: Comparative Analysis of Techniques and Tools Used in Centralized and Decentralized System Layouts

UDK 628.2

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Abstract

Wastewater management has been seen primarily as a technical and economic issue but it is now recognized that these are some of the elements in an array of other factors that affect sustainability of wastewater systems. Literature studies point out that municipal authorities have a general and long-standing tradition of using indicators in monitoring performance, reviewing progress and reporting the state of the environment as part of the regulatory enacted compliance. However, they have neglected other critical aspects of use of these indicators such as their input into the planning and decision making process. This research advocates for the use of sustainable indicators in a context based planning approach and the utilization of Multi Criteria Decision Aid (MCDA) in a two step approach for comparative analysis and assessment of the sustainability of wastewater systems. The overall objective was to develop a methodology for wastewater systems selection and to produce a practical planning tool to aid in decision making for municipalities. Another objective was to provide recommendations for wastewater and sanitation management improvement in the case study area. The methodology consisted of comprehensive literature review, case study analysis, a review of the Decision Support Systems (DSS) in use and the development of the DSS for Gauteng Province. The full spectrum of viable wastewater or sanitation options was incorporated into the DSS. From the sustainability assessments carried out using Multi criteria decision analysis, one result showed that varying degrees of sustainability are obtainable with each treatment technology involved and decentralized technologies appear more sustainable. Based on the local context and indicators used in this research, the DSS results suggest that land treatment systems, stabilization ponds and ecological treatment methods are more sustainable. One major finding from literature is that no technology is inherently sustainable on its own but is a function of the local context specifics. Since there is so much variation in social and economic needs within the areas; the overall results imply that a differential wastewater management approach should be employed with tailor made solutions resulting for each municipality or certain areas within a municipality.

Keywords: centralized systems, decentralized systems, decision support systems, multi criteria decision analysis, sustainability

JEL Classification: Q25, Q28, Q53, Q58.

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1. Introduction

The decision making process within wastewater planning has not been clear in terms of the choices considered and the reasons for the selection of a particular system solution. Zeng, Jiang,
Huang, Xu, & Li (2006) have pointed out that traditionally, many wastewater systems and technologies have been selected on an ad-hoc basis with more attention being paid to the economic data provided in the feasibility report of the Wastewater Treatment Plant project and the political and economic strength of the recipient communities rather than on the basis of performance requirements and environmental and public health considerations not to mention the efficiency and sustainability considerations that should collectively forming the core criteria for the decision. This resulted in the selection of the alternatives with minimum capital and operation costs being lauded as 'the most economical' means of meeting the applicable water quality and public health requirements without consideration of the long term sustainability. This approach does not meet the triple bottom line requirements for sustainable development and overlooks the importance of the local context, which has to be taken into consideration in assessing the sustainability of specific wastewater solutions since technologies are not inherently sustainable but are rule function of the local context specifics.

The root cause of many of the factors that have contributed to this unfortunate situation can be traced to insufficient attention to planning principles, lack of harmonization of policy guidelines and implementation of quick fix approaches.This inadequate planning is surprising considering that 80-90% of life cycle costs and environmental impacts or costs of the solutions provided are formulated and decided on during this crucial planning stage (Massoud, 2007). Unfortunately, wastewater system planning in developing countries often appears to be a non-strategic supply driven approach and technology bias resulting in the provision of inappropriate and unsustainable solutions. The supply driven approach is characterised by serious flaws where planners and engineers assess needs and decide what type of service to provide without extensive and meaningful consultation with the primary stakeholders (Ilemobade, 2003; Massoud, Tarhini& Nasr, 2007).

Generally there is evidence from practice that one of the primary obstacles to achievement of sustainable wastewater management is actually the lack of a structured and adequate decision making framework and especially so at the level of system level decisions and technology selection. This research advocates for the use of sustainable indicators in a pro-active context based input to planning, utilising Multi Criteria Decision Aid (MCDA) for comparative analysis and assessment of the sustainability of wastewater systems. The overall objective of this research is to make use of Multi Criteria Decision Aid (MCDA) in a Decision Support System (DSS) for the comparative evaluation and selection of wastewater systems technology with respect to technical, environmental and social in one step and then carryout a detailed economic analysis on the finite solution set as a second step. The specific objectives of the research were defined as to improve or restructure the current planning and decision-making and to produce a practical planning tool to aid in decision making for municipalities in South Africa and other developing countries.

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2. Background

It is a known fact now that Sub-Saharan Africa is the world's most rapidly urbanizing region, and most of all this growth has been in slums. UN Millennium Report (2010) states that in the slums, the new city residents' face overcrowding, inadequate housing, and a lack of water and sanitation. Jackson (2002) expands this by pointing out that the mushrooming of informal settlements in most major cities usually precedes installation of basic services provision thus leading to exacerbation of the problem of waste management. Other researchers such as Gumbo &Marjanovic (2003) have confirmed that this approach will continue to put severe strains on the water supply and sanitation services resulting in many African cities having an increasing number of overcrowded, informal settlements or 'shanty towns', characterized by inadequate sheltered housing and poor provision of infrastructure services. According to Tayler, Parkinson & Colin (2003)
the informal sector is now the main provider of urban housing, but informal developers seldom provide their schemes with anything more than the most basic services and this has an impact in meeting the Millennium Development Goals.

Millennium Development Goal # 7 calls for the reduction by 50% of the number of people living without access to reliable and safe water supply by the year 2015 as well as a 50% reduction in the number of people without access to appropriate sanitation services. Estimates indicate that some reasonable progress was made in most of the developing regions between 1990 and 2002 but sanitation coverage still remains very low. Over the period 1990-2002, about 1 billion people globally gained access to improved sanitation (UN Report, 2004).

From a global perspective, the world is on track to meet the water target, however sub-Saharan Africa, despite impressive programs, still lags behind as evident in (Fig 1.1). If the 1990-2002 trends holds, the world will miss the sanitation target by more than half a billion people. With a business as usual investment scenario, the population without adequate facilities would increase to 3.2 billion by 2030.The situation is most serious in sub-Saharan Africa and Southern Asia. Research findings by Gumbo &Marjanovic (2003) reveal that;

- Connection levels for al l services in Africa are lower than in all other world regions
- Approximately 40% of residential accommodation in Africa is non-permanent over 148 million people live in urban slums
- House price-to-income ratios in Africa are the highest in the world at 12.5% which is double that of cities in highly industrialized countries.

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The United Nations Millennium Development Goals Report (2004) showed the global urban and rural population without adequate sanitation was 1.7 billion in 1990 and 2.6 billion in 2002. The projected estimates reveal that even with accelerated investment and improved process and operation efficiency of centralized systems, this number would not reduce before the year 2030 because of population growth (Gumbo &Marjanovic, 2003).Based on literature studies, the likelihood of achieving MDGs therefore increases with decentralization of wastewater management and innovative approaches to water management rather than with centralized wastewater management systems but the most important question is how sustainable are the technologies employed within the decentralized systems? Decision support systems have played an important role in answering the above question.

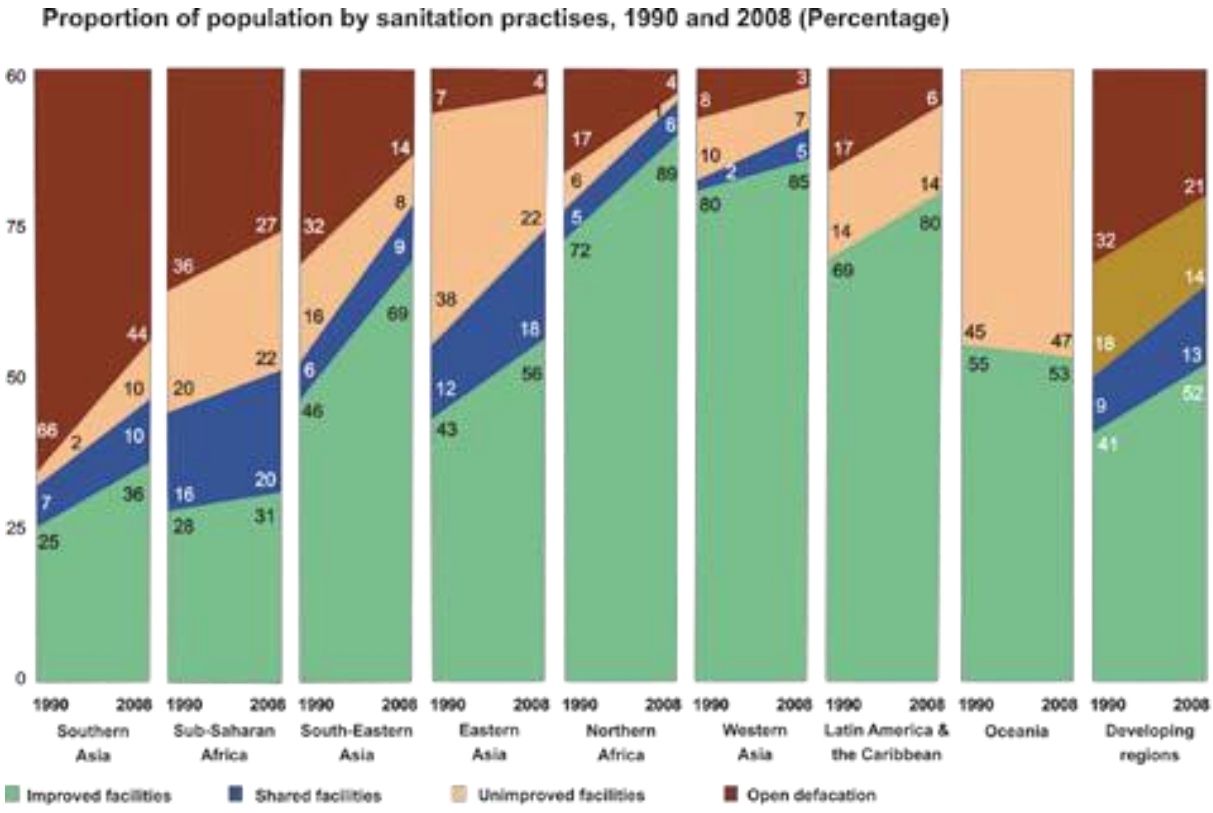

Fig. 1: Proportion of population by sanitation practices, 1990 and 2008 Percentages, (Data Source: United Nations Report, 2010)

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3. Decision Support Systems

In developing countries, water, sanitation, and hygiene practitioners need a way to choose among the numerous available options for securing safe water and sanitation. According to Palaniappanet al., (2008) effectively addressing community needs requires that technologies or approaches be economically, ecologically, and socially appropriate and sustainable. Decision-making supports tools help address this need, guiding practitioners to the most appropriate water and sanitation solutions. Several efforts have been done in the development of decision support programs as valuable tools in finding solutions to many engineering and management problems (Ndiritu and Daniel, 2001; Safaaet al., 2002; Ndiritu, 2003; Ilemobadeet al., 2005; Ilemobade and Stephenson, 2006;; Kahindaet al.,2009; Adewumi, 2010). In the field of wastewater treatment engineering, several contributions have been made to arrive at optimum treatment design by the use of computer programs utilizing decision criteria or indicators. According to Agudelo et al., (2007), many efforts have been done to define multi criteria methodologies as an aid in the selection of urban water systems. Agudelo et al., argue that the methodologies used in each unique case are not comparable since they differ in objectives and boundaries definitions. Ellis and Tang (1990) and Tang and Ellis (1994) also used multi criteria analysis (20 criteria) that cut across technical, economic, environmental and socio-cultural factors to form a decision matrix to rank 46 wastewater treatment processes.

2.2 Multi criteria Decision Aid

Malamis (2008) defines Multi criteria Decision Aid (MCDA) as a branch of a general class of operations research models dealing with decision problems under the presence of a number of decision criteria in a structured and systematic way. According to many authors, Multi-Criteria Decision Making is divided into multiple objective decision making (MODM) and multi-attribute decision making (MADM). Joubert & Stewart (2004) state that multi-Criteria Decision Making (MCDM) is an umbrella term for a wide range of techniques that explicitly include multi criteria in the evaluation of alternatives.

Hidalgo et al. (2007) used multi criteria analysis to develop a decision support system to promote safe urban wastewater reuse. The analysis assigned weights to various indicators like treatment technology, costing factor, land availability, type of soil, type of crops cultivated and their water requirements, meteorological conditions and legislative requirements to score the safe reuse of wastewater effluent. Muga et al., (2007) avoid aggregation of criteria and presents results in a radar plot which is satisfactory for communication and discussion requirements. All these methods have been used as form of support for the decision making process. Agudelo et al, (2007) acknowledge that complicated software to make complex analysis have been developed, however, the reliability of the results depends on the quality of the input data.

Despite the many DSSs developed in the wastewater management, the chance of Decision Support Systems failing to meet the challenge of real-world problems is reported to be high and even the criteria for judging whether a DSS has been successful or not are often a matter of discussion (e.g. Zapatero, 1996; Newman et al., 1999;Giupponi, 2007). There is therefore a widely-recognised need to develop new decision support tools in this field, with greater attention to the context specific needs of the users and which can be tangibly applied to solve practical situations.

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This research presents a practical toolfor decision support system that was developed that is context oriented and enables all sustainable criteria to be evaluated in two steps and across many alternatives (solutions) through the utilisation of Multi Criteria Decision Aid (MCDA)with respect to technical, environmental and social impacts first and later with respect to economics. Earlier studies have used a comprehensive, multi-disciplinary set of indicators but they did not compare conventional/mechanical, package plants, ecological land treatment technologies as proposed in this research. In order to fulfill the objectives of the research and achieve the desired research output, a rather unique methodological approach had to be followed. This approach poses a set of fundamental research questions with reference to a particular real life situation (Case study approach) and tries to answer them by the analysis of the existing situation for particular case (study area) and then uses the findings of this process to identify the problems in current decision making processes in order to develop and propose a new approach to decision making and offer a useful decision making support tool in the form of a user friendly decision support system.

4. Methodology

The first step in the overall methodology was to establish a clear understanding of sustainable wastewater management and the concepts involved. This understanding formed the foundation for step 2 which was the status quo analysis in study area (eight municipalities in Gauteng). The expected findings of step 2 were formulated as the primary drivers of this research. The status quo analysis identified a deficient decision making framework in wastewater management in South Africa and this established the justification for step 3 which was the establishment of a clear understanding of Decision Making in Wastewater Management. Literature review and synthesis were the main approach in completing step 3 of the research. With clear understanding of the problem of Sustainable Wastewater Management and the associated decision making framework it was then possible to engage in steps 4 and 5 and develop decision making methodology and the associated decision support tool to enable better decision making in practice as shown in Fig 2. Finally, in step 6, the conclusions were formulated and recommendations were made.

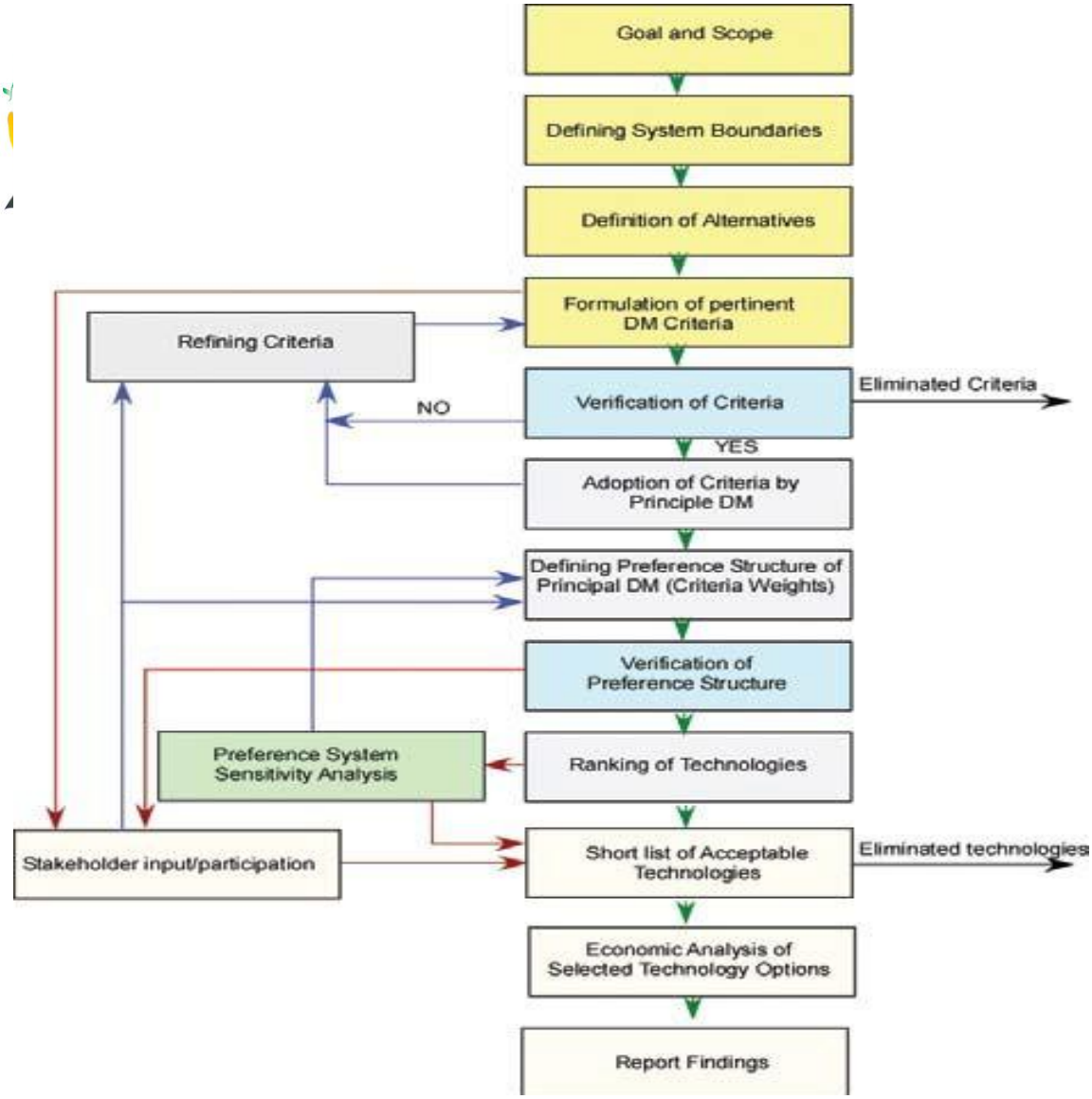

Fig. 2: Technology Option selection Process and Steps

4.1. Goal and Scope Definition

In this stage of the assessment the system boundaries and sustainability criteria are defined. It is convenient to employ a checklist so that key aspects are not overlooked since in the definition of the goal and scope one can rule out sustainable solutions beforehand.

4.2. Defining Alternatives

Alternatives represent the different choices of action available to the decision maker. The alternatives were chosen on the basis of the available knowledge, sound engineering judgement, and practical experience within the South African environment. The technologies were classified on a scale of 1-5 for suitability for use in centralised and decentralised systems. At a workshop and in various meetings all municipal authorities in the 8 municipalities were given an opportunity to list the possible technologies that could be utilised in their respective municipalities.

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4.3. Formulation of Pertinent Criteria

This research considered the use of MCDA in sustainability assessment of wastewater technologies and systems. Indicators developed in this study were reviewed and customized to the South African conditions based on the input from the Water Service Providers (WSPs) and DPLG and as well with reference to published indicators. In light of field testing experiences, it was recommended that Ranking and/or Rating be used as initial screening tools as they provide a quick way to filter out criteria that are not sufficiently significant. A set of 41 criteria was initial set and was consolidated by eliminating overlaps as much as possible. The final set of criteria ended with eleven main criteria. A ranking exercise using a set of questionnaires and criteria were accepted or rejected over the average value score obtained from the ranking. The screening of criteria was done on the basis of the scale shown in Table1.

Table 1:Criteria Classification

Classification of Criteria	Score Range	Decision
Highly Significant	10	Accept
Significant	7-9	Accept
Fairly Significant	5-6	Accept/Reject
Insignificant	<5	Reject

The set of eleven criteria excluding economic criteria is presented in Table 3.2 and is not to be regarded as a final set in any aspect other than representing the final result of this research. In order to be useful this set needs to be continuously revised since the choice of criteria may change as knowledge advances. The rejected criteria for this research are archived in a set which is not considered in further upstream processes for the decision making.

Table 2: Sustainable Criteria

Social	Technical criteria	Environmental
Acceptance	Performance	Resource Utilisation
Awareness	Reliability	Environmental Impact
Job Creation	Adaptability	
Institutional Requirements	Ease of Construction	
Health &Safety Impact		

4.4. General Assessments Methodology

A questionnaire was administered to the decision makers/service. The responses derived from the questionnaire were input into the DSS for analysis. The DSS uses a scale of 1-5 to generate a score from a set of questions/statements. The result obtained by summation of all questions/statements is then aggregated to obtain standardized outcome score on the scale 0 to 10 for the technical, social and environmental criteria. Arithmetic mean is used to aggregate the standardized value obtained in questions/statements involved in DSS questionnaires using the expression below:

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$$a_j = \frac{1}{m}\sum_{i=1}^{m} wx_{ij} \qquad \text{Eqn (5.1)}$$

Where aj= aggregation result for assessment criteria j (j = 1, 2, 3, 4…n)
xij= merit of criteria j with regard to statement i (i = 1, 2, 3, 4…m)
wi= weight of criteria I i(i = 1, 2, 3, 4…m)

The final score on a scale of 0 to 10 is derived from the following positions;
If the Target for an indicator is Maximum score, then
Score= (dave – dlow)/dmax – dlow)*10
If the Target for an indicator is Minimum score, then
Score= |(dave – dlow)/dmax – dlow) -1|*10, where
dave is the average value over the range of scale considered
dlow is the lowest value over the range of scale considered
dmax is the maximum value over the range of scale considered

4.5. Weighted Sum Method

The Weighted Sum Method involves computation through maximising the expected utility function, Hj, as in the following:

$$H_j = \sum_{i=1}^{m} w_i v_{ij} \qquad \text{Eqn (4.2)}$$

where m is the number of criteria of alternative j, vij is the value of jth alternative with respect to the ith criterion, and wi is the weight of importance assigned to criterion i with the constraints of wi≥0 and

$$\sum_{i=1}^{m} w_i = 100 \qquad \text{Eqn (4.3)}$$

The scores derived from use of the above equations are based on theoretical values, which were formulated using a combination of literature studies and assessments by the researcher in collaboration with Gauteng Provincial local government officials as well as Witwatersrand University postgraduate students for the Wastewater Engineering course. The research initially sought to base the scores from the municipal officials in the case study but due to the low responses on the questionnaires it was decided to use the above combinations in order to generate data for analysis and input in the decision support system as a way of testing the methodology. Full validation of the model and the methodology is recommended for the next level of research.

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4.6. Sensitivity Analysis

The results of the ranking can never be completely objective because of the weighting procedure, but confidence in the results can be increased by carrying out a sensitive analysis. This was done by looking at the effects on ranking caused by changes in the weighting. The criteria most open to subjective interpretation was selected and the weights of the criteria were slightly changed, recalculated and the final scores are summed up and re-ranking the technologies was done. Comparisons between the ranking order for different scoring and weighting scenarios indicated the level of confidence that can be given to the results.

4.7. Justification of the Methodology

The normal and most common multi criteria decision making methods employed in DSS evaluate all the alternatives against all the criteria simultaneously in order to get as sustainability measure of index. This is usually done with limited economic data thus rendering the whole exercise a rough planning exercise which still needs further analysis of the options. In developing countries, economic indicators are often decisive when choosing a technology. Unfortunately, in most cases cost data are hard to find, and many consulting firms or WSPs are not keen to share or publish their data for reasons best to known to themselves.

Since Cost data are hard to get, this research advocates for a two step approach in the normal multi criteria evaluations. The first stage will cover the three main criteria which will be termed stakeholder needs (social, environmental and technical). The shortlist of technologies from the screening exercise is then sent for detailed economic analysis based on the economic criteria. Economic criteria have their own indicators thus become a mini MCDA analysis within the broader MCDA analysis based on the economic criterion adopted. The process of adopting the criteria and the weighing systems is the same as the one employed in the first stage.

The advantages of carrying out the two stage approach in MCDA analysis is that cost data on the technologies and systems is not easily accessed and in the initial stage there will be so many technologies to be evaluated but doing the first stage eliminates some technologies thus the remaining feasible option set has fewer technologies which at that stage the analysis stops and then a detailed economic analysis be carried out involving total annual costs, specific unit costs and Life cycle costs. If the data is not readily available the municipality can carry out the detailed investigation or appoint consultants to come out with accurate figures on the economic costs of the technologies. Once that data is collected the MCDA process starts again on the basis of the economic data only. This will enable detailed investigations to be carried out which requires detailed costing that the municipals officials can commit to find/get before the final decision making and implementation of the findings.

The results from the detailed economic analysis are then sent to the decision makers to enable them to make sound judgment in a structured way and transparent way. The above process can be carried out using excel spreadsheets as a decision support system but this usually requires that users must have a higher understanding of the excel functions. The research aim is to present this methodology that would assist inexperienced or semi skilled personnel to ensure the integration of economic, social and environmental considerations in decision-making at all levels in the wastewater sector and hence, develops a simpler graphical user interface in a DSS that will make it easier for people to use.

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5. Results

5.1. Outline of the Analytical methodology

From the insights gained by the study of decision making processes in wastewater management and in particular the insights gained by doing a case study for the 8 municipalities in Gauteng a clear algorithm for the decision making methodology for wastewater management in Gauteng emerged and is shown in Figure 3.

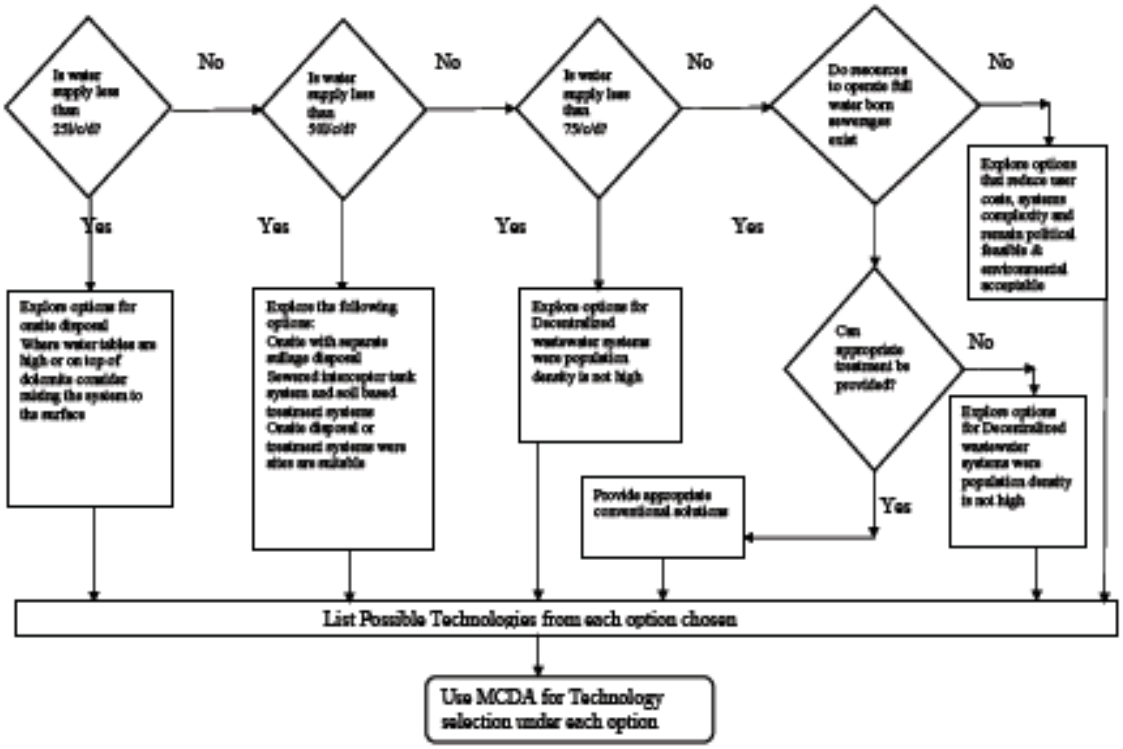

Fig. 3: Algorithm for Technology Selection

The algorithm in Fig 4.1 when used with the technology database in the DSS makes it easier to narrow down the options based on the local context and preferences of the stakeholders in technology selections. As can be seen in Fig 4.1, an array of all possible wastewater treatment technologies can be considered from onsite dry sanitation to offsite full waterborne systems which then based on the local context is taken to the next level of analysis using MCDA.

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5.2. Discussion of Results

The results presented in this section are from the outcomes of the questionnaire survey. It should be noted the results presented herein are not conclusive of the research studies since in the case for Municipal officials the responses out of a possible 35 only 6 responded and the other 15 responses could not be used since there were incompletely filled. Despite repeated efforts to get responses there was no commitment to complete the exercise. This might be understood from a practical case in the study areas where municipal officials are bombarded with questionnaires from different consultants asking the same things in different ways and formats but from the surveys there is nothing tangible that comes from the researches. On the other hand the responses from the postgraduate students for the wastewater engineering course were encouraging. Out of a possible 42 students 37 managed to complete the questionnaires with high enthusiasm.

In order to make the selection much easier this research constructed a technology database in the DSS as shown in figure 4. By double clicking on the technology name, a summary of information of the technology is found which enables a comparative analysis with other technologies in the database. The database also allows for further addition of technology in the prescribe format in which the user is guided through. The database provides a description of the different technology types which will act as information for educating and providing better understanding of the technologies which will eventually lead to the decision makers having confidence in the decisions they make.

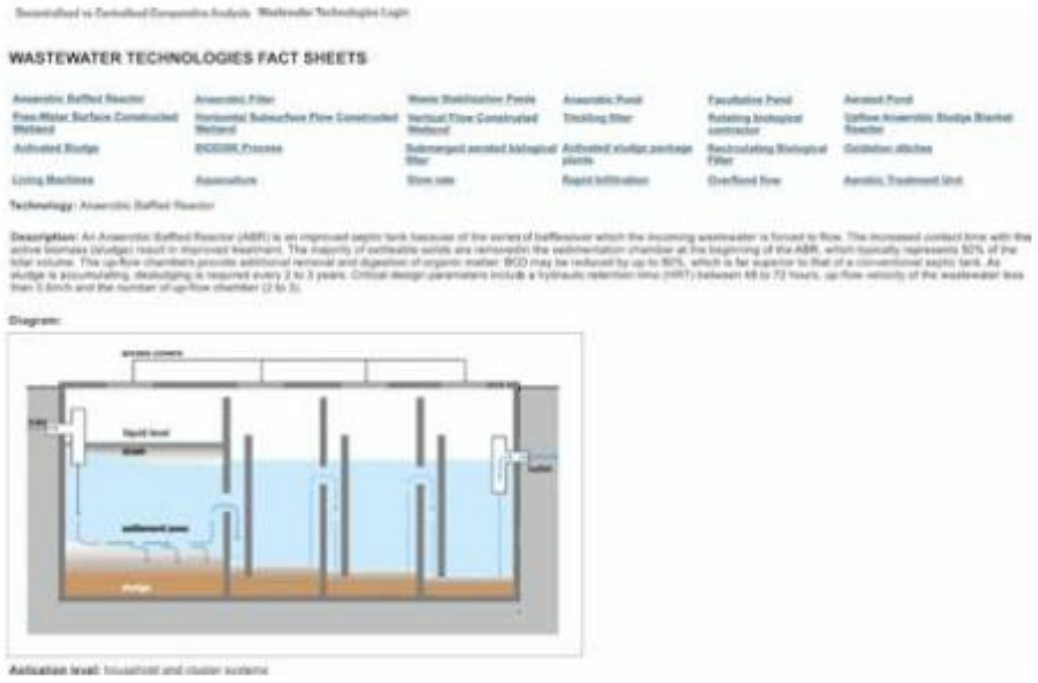

Fig. 4: Dialogue Screen on Technology Factsheets

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5.3. Perceptions to Wastewater Systems

Figure 5 shows that decentralized systems are perceived to perform better than centralized systems. This rational is not surprising since the analysis comes from postgraduate students who are deemed to have more theoretical knowledge of wastewater systems. The results also show a bias since the students had gone through the Wastewater Engineering course which in a way contributed to the bias since the course seeks to challenge conventional thinking in wastewater management. Technical officials' survey reveals the opposite and the explanation is simply that they have not had chance to explore the new knowledge on decentralized systems available and also have a high inertia to change to the critical thinking required.

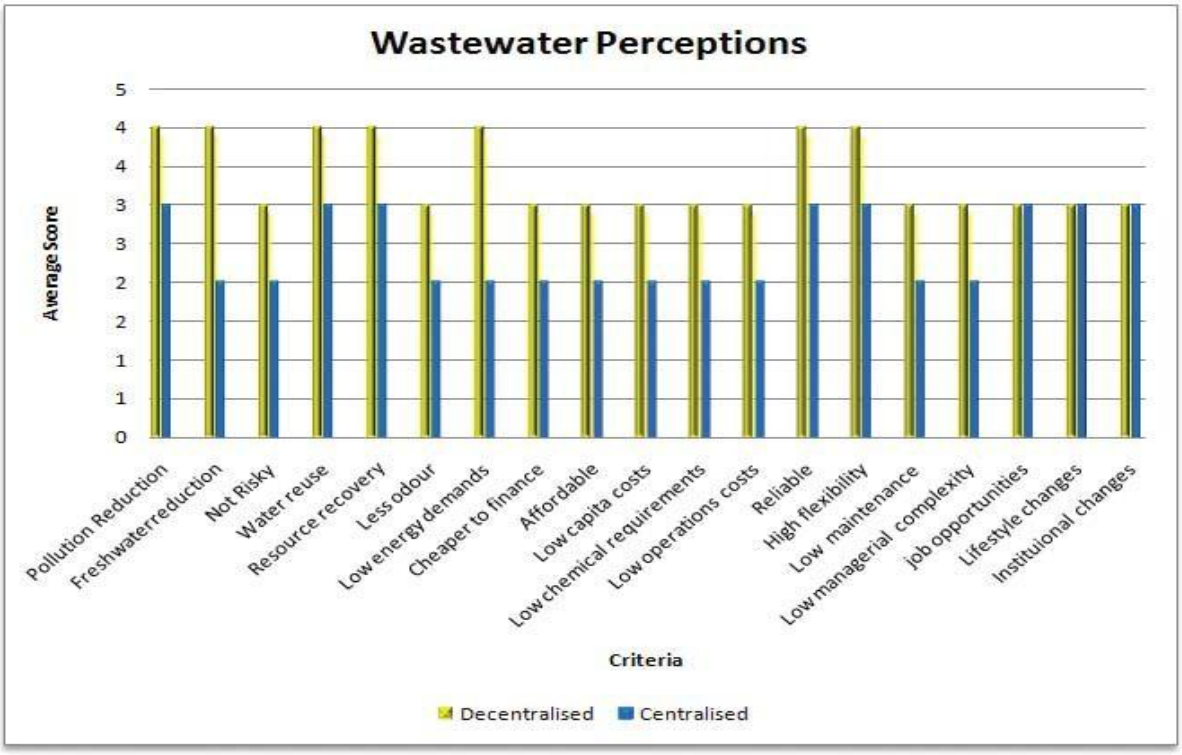

Fig. 5: Perceptions to Wastewater Systems

The list of technologies adopted for the case study is shown in Table 3. Literature studies and a survey among the water practitioners were used to determine the level of suitability of the technologies for either centralization or decentralized systems. The suitability factor was used to measure the degree of centralization or decentralization of the technologies through assessment on a scale measurement as follows; 1- Not suitable, 2- partially suitable; 3-fairly suitable; 4- suitable, 5- High suitable.

Table 3. Technology Suitability for Centralised or Decentralised Systems

Technologies	Suitability For		How Suitable for Centralised Systems					How Suitable for Decentralised Systems				
	Centralised	Decentralised	Highly Suitable	Suitable	Fairly Suitable	Partial Suitable	Not Suitable	Highly Suitable	Suitable	Fairly Suitable	Partial Suitable	Not Suitable
Activated sludge	/	✓	✓						✓			
Trickling filter (biofilters)	/	✓		✓					✓			
Rotating Biological Contactors	/	✓		✓					✓			
Aerated lagoons	/	✓				✓			✓			
Anaerobic lagoons	/	✓				✓			✓			
Facultative ponds	/	✓				✓			✓			
Recirculating biological filter		✓				✓			✓			
Submerged aerated biological filter		✓				✓			✓			
Sequence batch reactor	/	✓				✓			✓			
Oxidation ditches	/	✓				✓			✓			
Bio disc units	/	✓				✓			✓			
Constructed wetlands	/	✓				✓			✓			
Living machines		✓					✓		✓			
Aquaculture		✓					✓		✓			
Slow infiltration		✓					✓		✓			
Rapid Infiltration		✓					✓		✓			
Overland Flow		✓					✓		✓			

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There are many wastewater treatment technologies available for centralized and decentralized systems. Choosing from the large range of set of centralized and decentralized systems can be complex and time consuming, which may cause the municipal authorities to disregards decentralized technologies.

5.4. Results of the first step MCDA Evaluations

The main criteria overall weightings for the case study were as follows technical (30%), social (30%) and environmental (40%). The weightings were derived using the swing method in the second workshop held with the municipal officials. The evaluations using MCDA show that land treatment systems, followed by package plants, ecological and stabilization ponds are more sustainable than the mechanical systems (Figure 4.4). The mechanical systems have high requirements for resources in terms of energy and may require the use of chemicals in some instances. The advantages of the land treatment systems are their low odor potential, as well as high performance in removals of BOD, TSS, N, P and fecal coli forms. Land treatment systems and lagoons both have lower energy requirements although they have high land requirements.

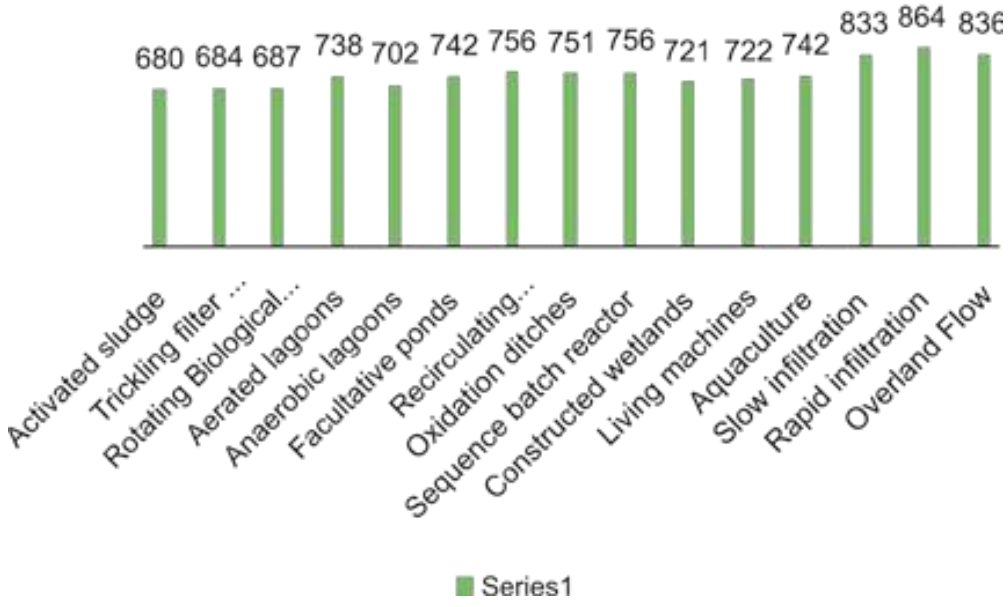

Fig. 6. Ranking of Technologies

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The overall results from the calculation are ranked through a bar chart as shown in Fig 4.4, with the most sustainable technologies having a higher score or length on the chart. The overall score possible with all three main criteria considered simultaneously is 900. Table 4 shows the scale used for analysis and for acceptance for the possible sustainable solutions.

Table 4. Sustainability Index Classification

Classification of Choice	Score Range	Sustainability Ranking
Excellent	800 - 900	Sustainable
Very Good	700 - 800	Sustainable
Good	600 – 700	Partial Sustainable
Fair	400 - 600	Partial Sustainable
Poor	<400	Not sustainable

5.5. Technologies Shortlist

Based on the scale highlighted in Table 4.2, all the technologies having a score above 700 were shortlisted for further assessment after a sensitivity analysis test. Table5 lists the shortlisted technologies.

Table 5. Technology Ranking Shortlist

Rank Number	Technology
1	Rapid Infiltration
2	Overland Flow
3	Slow infiltration
4	Recirculating biological filter (RBF)
5	Sequence batch reactor
6	Oxidation ditches
7	Facultative ponds
8	Aquaculture
9	Aerated lagoons
10	Living machines
11	Constructed wetlands

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5.6. Sensitivity Analysis

The only sensitivity test done was by varying the weight percentages of technical main criteria over the range 20% and it showed that there were no significant changes in the rankings. The environmental criteria proved to be the one more sensitive to weight changes but the rank order in terms of the categories of the technologies remained the same in as much there were rank changes within the categories depended on the increase in weighting for the environment. Sensitivity analysis is of prime importance since it shows how much the results and especially the final ranking of the proposed technologies are influenced by fluctuations in the weight coefficients of the criteria.

5.7. Results of the Economic analysis

The Caribbean data only accounts for the capital and operation and maintenance and it was on this basis that the final ranking was done. The weightings for the economic criteria were 70% capital cost and 30% on operation cost. The results from the evaluation using MCDA is shown in figure 4.5 The results show that land treatment system (Rapid infiltration), ponds and the ecological treatment methods (constructed wetlands and aquaculture) are more sustainable than the package plants. This is because the capital costs for the package plants are higher than those for the land and ponds treatment methods. It should be noted that sustainability measure should not be limited to now but should be over a defined period say at least a minimum of forty years. Since what might not be sustainable now i.e. the high capital costs for the package plants might end up being feasible as the technologies start to be mass produced. It suffices to say that under present conditions the land, ecological and ponds treatment technologies are more sustainable but sustainability also has the connotation of the present generation having a knowhow of the needs of future generations. In view of this, this research advocates for continual review of the criteria and the dynamics involved with the changes in the economics and breakthrough in technologies which might occur in these decentralized technologies.

5.8. Final Ranking of Technologies

The results from the detailed economic analysis are then sent to the decision makers to enable them to make sound judgment in a structured way and transparent way. The results from the methodology employed imply that technologies under decentralized wastewater systems appear to be more sustainable. The above assessments are all employed in the decision making support system developed for this study. It has a simpler graphical user interface which enables the user to navigate through and apply the methodology described here for selection of wastewater technologies

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6. Conclusions

Wastewater management has been seen primarily as a technical and economic issue but it is now recognized that these are some of the elements in an array of other factors that affect sustainability of wastewater systems. Literature studies point out that municipal authorities have a general and long-standing tradition of using indicators in monitoring performance, reviewing progress and reporting the state of the environment as part of the regulatory enacted compliance. However, they have neglected other critical aspects of use of these indicators such as their input into the planning and decision making process. This research advocated for the use of sustainable indicators in a context based planning approach and the utilization of Multi Criteria Decision Aid (MCDA) in a two step approach for comparative analysis and assessment of the sustainability of wastewater systems. The overall objective was to develop a methodology for wastewater systems selection and to produce a practical planning tool to aid in decision making for municipalities. The methodology consisted of comprehensive literature review, case study analysis, a review of the Decision Support Systems (DSS) in use and the development of the DSS for Gauteng Province. The full spectrum of viable wastewater or sanitation options was incorporated into the DSS. From the sustainability assessments carried out using Multi criteria decision analysis, one result showed that varying degrees of sustainability are obtainable with each treatment technology involved and decentralized technologies appear more sustainable. Based on the local context and indicators used in this research, the DSS results suggest that land treatment systems, stabilization ponds and ecological treatment methods are more sustainable. One major finding from literature is that no technology is inherently sustainable on its own but is a function of the local context specifics. Since there is so much variation in social and economic needs within the areas; the overall results imply that a differential wastewater management approach should be employed with tailor made solutions resulting for each municipality or certain areas within a municipality. This research implies a necessity for a paradigm shift in wastewater management which minimizes current and future environmental and human health negative impacts in wastewater management. The use of the DSS incorporating multi criteria decision analysis will aid local authorities in making informed decisions and enhance their planning capabilities. It has been clear in this research that if sustainable indicators are to contribute substantially to the increased sustainability of urban water systems, they must be applied not only in a retrospective way but in a future oriented manner for planning and decision making.

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