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ambi-agua@agro.unitau.br

Universidade de Taubaté
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Urbini, Giordano

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Internationalization, education and technological innovation: three key factors to improve the quality of the environment and public health

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Giordano Urbini

Member of the Editorial Committee of Ambiente & Água Journal

Università degli Studi dell'Insubria, Varese, Italy

Department of Biotechnologies and Life Sciences

e-mail: giordano.urbini@uninsubria.it

ABSTRACT

The environment and the health of mankind are subject to strong pressures from pollutants. The ambition of a better quality of life is often frustrated by the increase in emissions as a result of the increasing consumption of resources and energy to satisfy the growth of the world's population and its expectations for socioeconomic development. At times, problems take on a planetary dimension, the best known example being greenhouse gas emission, with the resulting effects of climate change. Pollution highlights our failure to provide adequate education, which is essential if we are to become fully aware of problems and actively seek sustainable solutions. To this end, it is essential to set up an extended environmental and health education program in all communities that will accompany younger generations from the beginning of their education in order to make them conscious players in protecting the environment and their own health. The size of the problems requires that a joint effort be made at an international level in the political realm and in the scientific-cultural realm in order to share experiences and sensitivity and to seek joint solutions. It is necessary to assign an increasingly important role to scientific and technological innovation which, in the last century, from Marconi to Einstein to Fleming, to the most recent innovations in the fields of genomics and microchips, has allowed humanity to achieve a rate of growth of wellbeing never previously seen in its thousands of years of history. This innovation must rationally be entrusted with our expectations to provide a practical solution to the problems of pollution that threaten our everyday lives and the survival of the planet. This text discusses the types of progress most eagerly awaited in the fields of water supply, wastewater treatment, atmospheric pollution and waste disposal.

Keywords: environmental education, pollution control, water resource.

Internacionalização, educação e inovação tecnológica: três fatores-chave para melhorar a qualidade do meio ambiente e saúde pública

RESUMO

O meio ambiente e a saúde humana estão sob forte pressão de poluentes. A ambição de uma qualidade de vida melhor é muitas vezes frustrada pelo crescimento das emissões, devido

ao aumento do consumo de recursos e energia para atender à crescente população mundial e às expectativas de desenvolvimento socioeconômico. Às vezes os problemas assumem uma dimensão global, da qual o exemplo mais conhecido é constituído pela emissão de gases de efeito estufa e os consequentes efeitos nas alterações climáticas. Poluição tem as suas raízes na falta de educação adequada, como base imprescindível para uma tomada de consciência das questões e participação na busca de soluções sustentáveis. Neste sentido, é essencial começar, em todas as comunidades, um extenso programa de educação ambiental e de saúde que possa acompanhar a geração mais jovem desde as fases iniciais do estudo, para torná-los protagonistas conscientes do meio ambiente e da sua própria saúde. A dimensão do problema exige um esforço conjunto a nível internacional pela política e pela ordem científico-cultural para transferir experiências e sentimentos e também buscar soluções compartilhadas. Um papel sempre mais importante deve ter a inovação científica e tecnológica, que no século passado, a partir de Marconi a Einstein e a Fleming até as últimas inovações nas áreas de genômica e microchips, permitiu à humanidade alcançar uma taxa de crescimento do bem-estar nunca conseguida antes, em milhares de anos de história. Esta inovação está atrelada às nossas expectativas de fornecer uma solução prática para os problemas de poluição que ameaçam a nossa vida diária e a sobrevivência do planeta. No texto, são citados os progressos mais esperados nas áreas de abastecimento de água e tratamento de esgotos, poluição do ar e disposição dos resíduos sólidos.

Palavras-chave: controle da poluição, educação ambiental, recursos hídricos.

1. DISCUSSION

1.1. The strong need for internationalization and environmental education

Today, the word “internationalization” is one of the most used and abused. Articles and books are even written to explain its meaning, also giving it philological and philosophical interpretations. Apart from these literary ruses, the practical meaning of the term should refer to any of man’s activities that have international involvement. Internationalization produces exchange at various levels, and expands knowledge to a broad audience; as such, it is an instrument for personal gratification, for professional fulfillment and, without being rhetorical, of social progress. Over time, the concept of “internationalization” and its actual practice have been extended greatly, favored by very rapid instruments and means of communication. We know of the internationalization of markets and economies, of universities, of the sciences and of culture, of sport, of businesses, banking systems and commerce. It is essential also to include the internationalization of thought and of ideas, where the world’s best minds come together. The main objective is to enhance excellence in individual countries by expanding and intensifying cooperation with the best researchers in other countries, fields and institutions.

A lot is expected of internationalization: progress in living conditions, greater fairness in the use and distribution of resources, better protection of the environment and of public health, peace and widespread well-being. The large organizations that govern world politics are being called upon to give substance to these hopes, by promoting joint efforts on the big themes concerning the life of man and of the planet. The greatest challenges this century faces inevitably relate to climate change, the planet’s nutrition, the safety and sustainability of energy supplies, the fight against poverty and infectious diseases, as well as the construction of basic health and sanitation infrastructure. It is worth remembering that for a large part of the world’s population, the scarcity of water and the absence of such infrastructure constitute a grave danger to health and are a limiting factor in socioeconomic development. The UN data is shocking: approximately 40% of the world’s population suffers these shortages, and the trend is upward, to 65% by 2025 (UN-Human Rights et al., 2010). In this situation, no

fewer than 1,500,000 children die every year in the world because of contaminated water or the scarcity of water (UN Water, 2013).

Water is a limited resource; but at the same time, it is vital for all of man's activities, so much so that any scarcity will stunt a society's development. Thus, the development trend taking place in many of the world's countries requires ever greater consumption of water, exploiting the natural water resources. However, there are many situations in which this resource is shared by more than one nation, and unilateral exploitation leads to dangerous tensions and competition. The UN has indicated that this danger concerns no fewer than 180 areas of the planet.

A great number of impediments to improving the environment and the sustainable exploitation of resources stem from extremely poor knowledge on the part of a very large proportion of the world's population. We need to be aware that, only with extended and effective environmental education of new generations, starting as early as primary school, will it be possible to promote and sustain the proper actions, both locally and globally. Unfortunately, we must acknowledge that this path must still be constructed entirely, because the young generations are currently very detached from the nature surrounding them, of which they themselves are a vital and integral part. The objective we must set is to educate young students to respect nature as a universal value and to assess its benefits for the life of man itself. The education process should make students genuine "environmental stewards", bringing them back into direct contact with animal and vegetable life, allowing them to rediscover the importance of things that are only apparently small, like the planting of a sapling which they can see grow over time, giving them the important understanding of the extraordinary value of life. Schools need encouragement and time to dedicate to environmental education; they also need funds with which to train teachers adequately. The students thus educated will be able to turn their knowledge into positive environmental actions in the community.

1.2. Science and technology in defense of the environment and of the health of man

In the last few years, mankind's need to live in a less polluted environment has driven science and industry to introduce a multitude of innovations: from recycling materials, to biodegradable plastics, to using eco-friendly propellants for domestic and health sprays; to replacing the phosphorus in detergents, to using biodegradable dyes in industry, to exploiting the waste biomass to produce biofuels, animal feed and energy, and many others.

In the field of wastewater treatment, it is known that the processes most applied are biological ones that are about 100 years old (Tchobanoglous et al., 2003). However, the original plant configuration remained all but unaltered until the 1980s-1990s, when an impressive development of more refined, efficient and innovative ideas and technologies began. I am referring to biological, submerged bed systems, to UASB (Upflow Anaerobic Sludge Blanket) reactors, to SBBR (Sequencing Batch Biological Reactor) systems, to MBBR (Mobile Bed Biological Reactor) systems, and, above all, to the recent introduction of MBR (Membrane Biological Reactor) systems, which can be more compact, and can give better purification yields (Farabegoli et al., 2003, Raboni et al., 2013a; 2013b, Torretta et al., 2013a; Raboni et al., 2014a; 2014b). Many new plants are designed with these innovative technologies and, in particular, with biofiltration processes and advanced MBR processes (Torretta et al., 2013a). In the near future, it is expected that these processes will be implemented with technologies aimed at removing the emerging micro-pollutants (particularly active ingredients of medicines and abused drugs), the accumulation of which in the aquatic ecosystems is a worrisome danger for them and for public health.

In the field of water, the great, future challenge for mankind will be to distribute fresh water to satisfy the demands of the whole of the world's population. This will be a very

difficult task, because it will only be possible by desalinating water from the oceans, a process that is already done today, but at a cost that makes it only accessible to the richest nations. While waiting for this, mankind should immediately focus on reusing water. Indeed, the growing consumption for civil, industrial and, above all, agricultural purposes (Figure 1) has brought many areas of the world to conditions of genuine water stress (water drawn at a rate of 20% above actual availability). These areas even include a number of countries in the European Union, such as Cyprus, Spain, Bulgaria, Belgium, Malta and Italy.

The UN estimates that 700 million people currently live in areas where there is a scarcity of water (insufficient for essential needs) and that, by 2025, this number will rise to 1800 million; furthermore, by this date two thirds of the world's population will be living under conditions of water stress (Figure 2).

Today, many countries already resort to reusing treated sewage, primarily for irrigation purposes (e.g. the USA reuse of 7-8%, Australia 8%, Saudi Arabia 16%; Singapore 30%; Israel has the record for recovery, of 70%; in Europe, the two countries that stand out are Italy, with 4-5%, and Spain, with 6-7%). In the future, these percentages will inevitably increase, and the help that technological innovation can give will be essential.

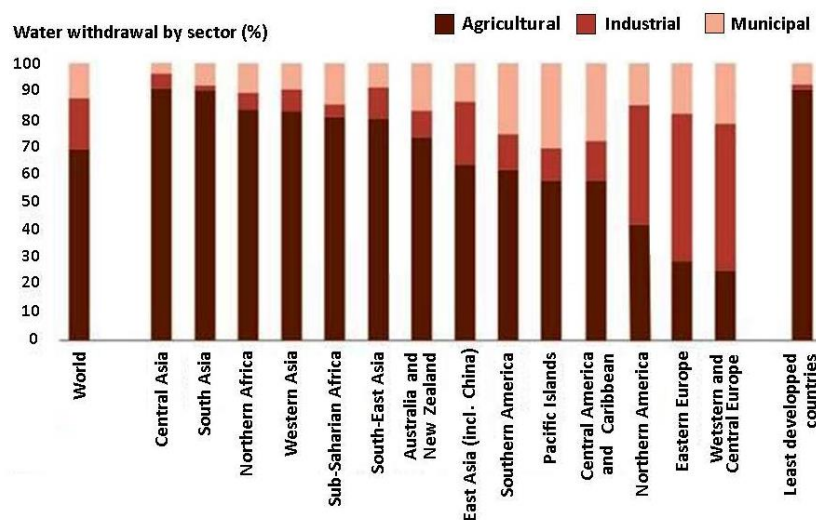


Figure 1. Water withdrawal by sector and by region (UN World Water, 2012).

It is worth remembering that among the forms of reuse that currently exist, there is also reuse as drinking water; the areas affected are obviously those that are climatically very disadvantaged. Of the plants for direct reuse as drinking water, particular mention should go to the service in the city of Windhoek (21,000 m³/d), the capital of Namibia, as it was the first of its kind in the world. Also in the USA, there are cases of obtaining drinking water from civil sewage, albeit indirectly. The most typical example is the plant in Orange County, California (265,000 m³/d), which improves the quality of the effluent from the mechanical-biological plant, with a process based on using membranes (microfiltration and hyperfiltration) and advanced oxidative treatments. The water produced in this way is used to recharge the water table destined for the production of drinking water.

The waste sector has much more complex consequences and, in particular, the disposal choices are often greatly affected by public opposition. At the moment, the most advanced countries base their choices on the so-called “integrated solution” (Rada et al., 2014a; Torretta et al., 2014), which consists of a mixture of organizational and technological systems that include a very intense, initial phase of separated waste collection, with recycling of the materials recovered, and the residual fraction is then sent for incineration to recover energy.

The landfill is only used for disposal of the incineration residues. Within this scheme, where the proportion of waste collected separately can be as high as 50%, incineration has a better degree of acceptance, given also that it is technologically very advanced (Mancini et al., 2013).

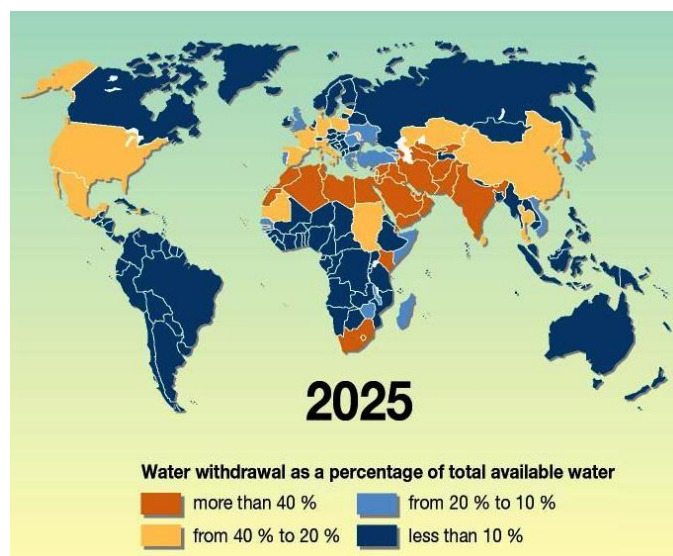


Figure 2. Water withdrawal as a percentage of total available water. Values of 20% above water availability represent water stress conditions; of 40% above water availability, water scarcity (UN World Water, 2012).

Technological innovation is currently making a considerable effort to limit the atmospheric emission of pollutants that have a direct impact on the health of mankind. Urban areas have a high presence of fine particulates, of polycyclic aromatic hydrocarbons (PAHs) and of volatile organic compounds (VOCs), the toxicity, cancerogenicity and mutagenicity characteristics of which are well-known (Copelli et al., 2012; Chiavola et al., 2010; Torretta et al., 2013b; 2013c; Rada et al., 2014b; Raboni et al., 2014c). The sector most under accusation is transport, which is responsible also for significant CO₂ emissions. The European Union is looking at this issue with great interest, and three years ago they adopted an extensive strategy to reduce carbon dioxide emissions in the transport sector by 60% by the year 2050 (European Commission, 2011). From now until 2050, the ambitious targets will require several measures, including the limitation of oil-derived fuels in favor of renewable fuels. In this field, Brazil is the best example in the world, because it had the farsightedness back in the 1970s to implement an extraordinary policy of developing bioethanol and of producing hydroelectric energy, and for a number of years has been working on a program of biodiesel production (Torres et al., 2013). Europe does not have the natural resources for a similar policy, so in the long term interest in using hydrogen might re-emerge, while in the short to medium term a significant development of electric cars is expected. In the current phase, there are many opportunities for using biomethane and biodiesel (Raboni e Urbini, 2014). In fact, all of the European production of biodiesel is already currently used as an additive for mineral diesel. What is really new is biomethane, the use of which in transport is particularly popular in Germany, the Netherlands, Finland, Austria, and especially in Sweden. In this country, several thousands of light-duty vehicles as well as several fleets of vehicles for public transport fueled by biomethane (or biomethane mixed with natural gas) are currently in circulation. In many Swedish towns, the use of biomethane for transport is encouraged with different types of incentives which create an excellent level of acceptance for this kind of biofuel. Sweden's ambition is to have a fossil fuel-free vehicle fleet by 2030.

2. CONCLUSIONS

Over time, the concept of “internationalization” has extended a great deal to a multitude of mankind’s activities. For progress in the quality of the environment and in health, it is essential that we have internationalization, particularly in science and culture; that is, internationalization of thought, of ideas and of research, by bringing together the world’s best minds. The main objective is to enhance excellence in individual countries by expanding and intensifying cooperation with the best researchers in other countries, fields and institutions. Mankind expects much from the development of international relations: progress in living conditions, greater fairness in the use and distribution of resources, better protection of the environment and public health, peace and widespread well-being. The greatest challenges of this century concern climate change, nutrition of the planet, the safety and sustainability of energy supplies, the fight against poverty and infectious diseases, as well as the construction of basic health and sanitation infrastructure. It is worth remembering that, for a large part of the world’s population, the scarcity of water and of this infrastructure constitutes a grave danger to health and represents a limiting factor in socioeconomic development. The UN data is shocking: approximately 40% of the world’s population suffers these shortages, and the trend is upward, to 65% by 2025. In this situation, no fewer than 1,500,000 children die every year because of contaminated water or water scarcity. A worldwide policy for water seems urgent, so that we may define fair access to resources by everyone, and prevent dangerous tensions and competition between nations, which already exist. However, it is necessary quickly also to start an extended education process, beginning in primary schools, to teach young students to respect nature as a universal value, in order to make them genuine “environmental stewards”.

Science and technological innovation will play a decisive role in improving the quality of the environment and of health. The expected progress concerns, as a priority, actions to limit greenhouse gas emissions, which are responsible for the current climate changes, limiting emissions into the urban atmosphere of the contaminants that most affect health (PAHs, VOCs, fine particulates), controlling the release of emerging micro-pollutants (particularly medicines and abuse drugs) into surface waters and, last but not least, actions to fairly satisfy the water needs of the world’s entire population in order to reverse the dangerous trend towards growing situations of water stress and scarcity.

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