



UNITED NATIONS
UNIVERSITY

UNU-FLORES

Institute for Integrated Management
of Material Fluxes and of Resources

*Advancing a nexus approach to the sustainable
management of environmental resources*



OPENING CEREMONY PROCEEDINGS UNU-FLORES

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About UNU-FLORES

United Nations University (UNU)

The UN University is the academic arm of the United Nations. It bridges the academic world and the United Nations system. Its goal is to develop sustainable solutions for pressing global problems of human survival, development and welfare. Through a problem-oriented and interdisciplinary approach it aims at teaching, applied research and education on a global scale. The UN University was founded in 1973 as an autonomous organ of the United Nations General Assembly. The UN University encompasses 15 research and training institutes and programmes located in 13 countries around the world. The University system is led by UNU Centre, which comprises a headquarters unit in Tokyo and administrative services outposts in Bonn, Kuala Lumpur, New York and Paris.

UNU Institute for Integrated Management of Material Fluxes and of Resources (UNU-FLORES)

The United Nations Institute for Integrated Management of Material Fluxes and of Resources (UNU-FLORES) was established in 2012. Its mission is to contribute to the development of integrated management strategies for the sustainable use of the environmental resources water, soil and waste in particular in developing and emerging countries. It will thus engage in research, postgraduate teaching and capacity development in a broad sense in scientific, educational, managerial, technological and institutional terms. The institute will develop innovative concepts for target- and region-specific knowledge transfer as well as appropriate methodologies and approaches for postgraduate and professional education.

Background

The ongoing and expected future change of the global and regional climate, current land-use changes and substantial alterations of the demographic structure in and between urban and rural societies challenge the paradigms of sustainable development and integrated resources management. Changes in the frequency and intensity of floods and droughts, pollution, soil degradation and erosion as well as problems associated with insufficient waste management are among the pressing problems, in particular in many developing countries. Thus, sustainable use of the resources soil, water, and recyclable organic matter and fertilizers in wastes is of growing importance for mitigating of and adapting to the future changes of climate, land-use and demography. The complex relations between demands, resource availability and quality, financial and physical constraints can only be considered by knowledge-based policies and professional practice. High priority is to be given to capacity development in order to generate and transfer knowledge using innovative methods.

The core scientific areas of research and teaching have been extensively discussed and shaped during two International Scoping Workshops held in Dresden and Maputo in 2010 and 2011. High-ranking stakeholders of UNU, Dresden University of Technology (Technische Universität Dresden, TUD) as well as international experts and stakeholders from potential African partner universities and organizations contributed to define the core areas of research and teaching. For establishment of the institute a Memorandum of Understanding

(MoU) was signed between the Federal Ministry for Education and Research of Germany (BMBF), the Free State of Saxony, TUD and UNU in November 2010. Based on the signed MoU, the Federal Ministry of Education and Research (BMBF), the Free State of Saxony and UNU signed the required Funding Agreement in November 2011 to make UNU-FLORES operational.

Purposes and Activities

As mentioned in the Statute of UNU-FLORES approved by the Council of UNU, the primary purpose of UNU-FLORES shall be to contribute, through research, teaching, advanced training, capacity development and dissemination of knowledge, to the resolution of pressing challenges in the area of sustainable use and integrated management of the environmental resources water, soil and waste that are of concern to the United Nations and its Member States, particularly the developing and transitional countries. The main scientific areas for activities of the institute are:

- Systems and flux analysis;
- Soil and land use management;
- Management and treatment of waste;
- Water inventory and fluxes;
- Resources quality and quantity;
- Global change assessment (climate, demographic, land use, socio- economy).

UNU-FLORES aims at a truly integrative and global perspective on resources management, considering interrelated resources (such as water and soil) in a comprehensive manner. This will be followed also with respect to impacts of global change on resources management and its nexus to green economy. Thus, a core scientific task will be to replace traditional input-output models by a linked cycle management approach.

The institute will be closely collaborating with its partner university, TUD, both in research and teaching. Close cooperation is also sought with other universities and UNU institutes working in related areas. A unique feature of the teaching programmes will be the emphasis on the global dimension of the covered issues, international exchange programmes for students and involved teachers as well as internships in UN agencies.

Twinning Strategy

According to the 'twinning' strategy of UNU, additional campuses of its existing and future institutions, such as UNU-FLORES, shall be established. Twin institutes should be located in developing and transitional countries. For UNU-FLORES Mozambique is currently being evaluated as a potential location of a twin institute. The twinning concept foresees a close interaction of the twin campuses both in research (joint projects) and teaching activities (exchange programmes for students and lecturers). The twin institute of UNU-FLORES, by establishing and strengthening strong partnerships within the region, is envisioned to act as a hub for integrated management of material fluxes and of the resources water, soil and waste for the region.



Part I Scientific Lecture (16⁰⁰ - 16⁴⁵, 10 December 2012)

The Nexus of Soil, Water and Waste (by Prof. Rattan Lal¹)



Rattan Lal is a Distinguished University Professor of Soil Science and Director of the Carbon Mgt. & Sequestration Center at the Ohio State University, Columbus, OH. He held positions at the Rockefeller Foundation, New Delhi, India, the University of Sydney, Australia, the IITA, Ibadan, Nigeria and the University of Iceland, Reykjavik. He is also a scientific advisor to IASS, Potsdam, Germany. He served in various international organizations such as the International Committee on Tropical Deforestation and Land Management, Nigeria (Chair), the World Association of Soil and Water Conservation (President), International Soil Tillage Research Organization (President), and the Soil Science Society of America (President). He was lead author of the UN Millennium Ecosystem Assessment and Lead Author in IPCC reports.

Mr. Rector, Colleagues, Friends, Ladies and Gentlemen,

First of all it is a great honor to be here; thank you for inviting me. It is a privilege to be a participant and a speaker at the opening ceremony of this institution. I really appreciate this. The topic that I am going to talk about is: The nexus of soil, water and waste. The importance of this topic, which I would like to emphasize, can perhaps be better stated by view of the planet Earth and the comments made about the planet by Carl Sagan. He said:

"Look again at that blue pearl in the space. That's here. That's home. That's us. On it is everyone you love, everyone you know, everyone you ever heard of, every human being who ever was, lived out their lives. The aggregates of our joy and suffering, thousands of confident religions, ideologies, and economic doctrines, every hunter and forager, every hero and coward, every creator and destroyer of civilization, every king and peasant. Every young couple in love, every mother and father, hopeful child, inventor and explorer, every teacher of morals, every aspiring politician, every "super leader", every saint and sinner in the history of our species lived there- on a mote of dust suspended in a sunbeam".

¹ Director, Carbon Management and Sequestration Center. The Ohio State University. Columbus, OH 43210 USA. Presentation given at the Opening Ceremony of United Nations University - Institute for Integrated Management of Material Fluxes and of Resources (UNU-FLORES) held in the city of Dresden, Germany, on December 10, 2012.

This unique and serene planet was disturbed drastically. The climate changed dramatically about 15.000 years ago. The temperature that was fluctuating and was never stable increased by 5°C and with that not only the temperature increased, but it also stabilized. We call that period from ~15.000 years ago till now The long summer (Fagan, 2004). It was during the early stages of the long summer, about 12.000 to 10.000 years ago, that the settled agriculture began in different parts of the World. With the beginning of Agriculture the human population grew in number and living in communities because agriculture improved both the diet quantity and quality. Subsequently in 1750 the discovery of fossil fuel, the coal, started the so called Anthropocene (Paul Crutzen, 2000), or the era since the industrial revolution.

However, as early as the neolithic revolution, agriculture emerged in different parts of the World.

- In the Near East, the Middle East, nine to fourteen thousands years before present, several crops: emmer, barley, pea, lentil etc. were cultivated;
- In northern China, the rice was cultivated circa nine thousand years ago;
- In Papua New Guinea, about six to nine thousand years ago, sugarcane and root crops were cultivated;
- In Central Mexico, Aztecs and Mayans, about seven to eight thousands years before present, domesticated maize, squash, gourds, beans and cocoa;
- In Indus Valley, wheat, barely, jujuba were cultivated 7.5 to 11 thousand years ago;
- In West Africa, four to five thousand years before present, yam and cassava were cultivated;
- In eastern North America, the Cherokees were cultivating four to five thousand years ago [long before 1492] several crops including cranberries, chenopod, marsh, elder, sugar maple, tobacco and squash;
- And of course, in the western North America, the Pueblo Dwellers were cultivating amaranth and pine nuts about 6 thousand years ago;
- And in South America, the Incas were cultivating cocoa, potatoes and beans about 7 thousand years ago.

The origin of agriculture, in different parts of the World, was made possible by the truly defining moment in human history when the ice sheets melted and climate warmed. Things changed for the humans and the planet. There are two factors which are responsible for the origin of agriculture: (1) the increase in the global temperature, and (2) the increase in the atmospheric concentration of carbon dioxide from 180 ppm to 280 ppm. As a result of this combination, the biomass production of C-3 plants: wheat, barley, potato, sugarbeet increased drastically, and that of C-4 plants such as corn increased moderately. These increases were possible because also the legumes were able to fix atmospheric nitrogen through biological nitrogen fixation, which changed the fertility of the soil.

Consequently, there was a population boom. In 1800 we were only one billion people, compared with seven billion in 2011. The population is projected to be about ten billion people by 2100. The impact of this population may be expressed as per equation below (Ehrlich and Holdren, 1971):

$$I = P \times A \times T \text{ where } P = \text{Population, } A = \text{Affluence of the population and } T = \text{Technology}$$

The impact of this drastic increase in population changed the planet Earth that Carl Sagan described dramatically. Alterations of soil, water and the waste generated by humans impacted the natural resources. The soil, transferring run-off and percolation into the blue water and the latter by soil into the green water that plant use for their growth; The soil also contributing the transformation of waste from crop, animal and trees into humus and plant nutrients, and vice versa. Similar to the link between soil and waste, that between water and waste is equally important. Human use of water creates grey and black waters which can through purification be used as source of water and plant nutrients. Application of sludge on soil is an important source of nutrients and organic matter. The contaminated water, grey and black, must be converted into blue and green by denaturing and filtration through soil. The goal is reuse and recycling of the waste following appropriate purification treatment.

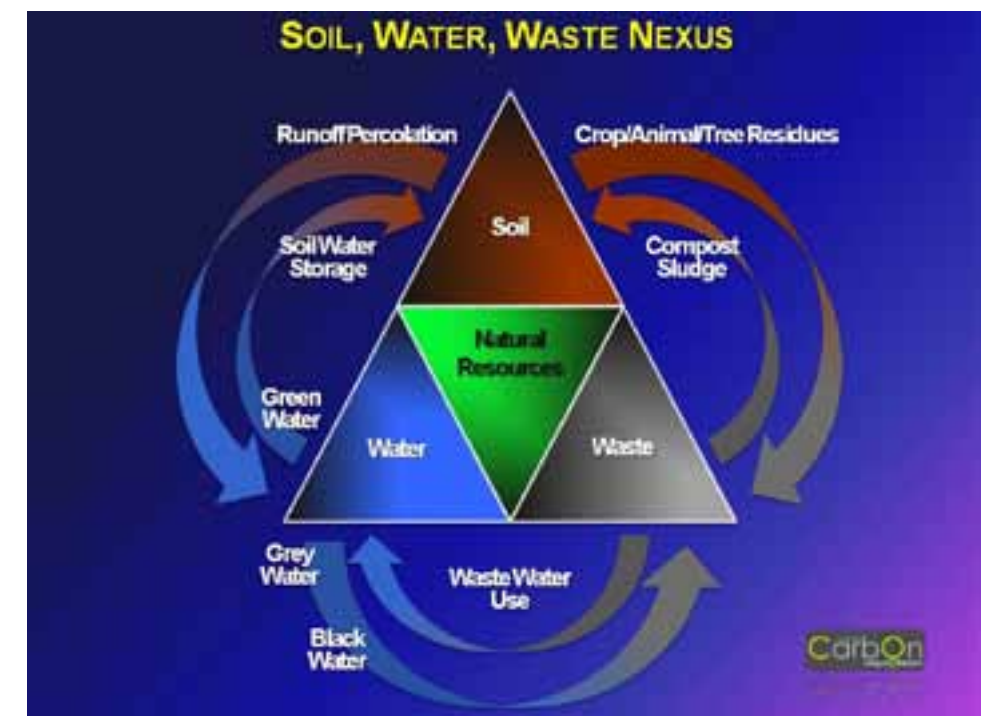


Figure Soil, Water and Waste Nexus

This nexus, the central theme of the UNU-FLORES, is very crucial to the existence of human, the wellbeing of all species and of course to that of the planet Earth.

Changing Climate

Now, after about fifteen thousand years, the climate is changing once again. Examples of the climate change include the unique drought that happened in the United States in 2012. This drought decreased production of corn by about 30 to 60%. The impact on food has not yet been felt, but I think it may be felt by the low income group in the near future. Every 1°C increase in temperature may lead to a decline of 10 to 17% in grain yields around the World, and the reduction of crop yield in Sub Saharan Africa may be as much as 8 to 20%.

Agriculture and food production systems are vulnerable to the changing climate. One of the things that may affect agriculture, agronomic productivity, and in the end well-being of human beings and of the other species is an increase in frequency and intensity of drought, as one type of the extreme events which may happen more often in a changing climate. There are several types of droughts (Monzy et al., 2012):

- Meteorological drought: a long term deficiency of precipitation;
- Hydrological drought: decline of water in rivers, reservoirs, aquifers, etc.;
- Pedological drought: reduction in soil water storage;
- Agronomical drought: low availability of water at critical stages of crop growth;
- Ecological drought: low water availability because of land use change and conversion; and
- Sociological drought: demand of a community exceeding the supply.

The anthropogenic demand and the increasing affluence of growing population can increase the pedological, agronomical, ecological and sociological drought, even if the meteorological and hydrological droughts do not happen. The change in climate on the other hand, will influence the top two categories, the meteorological and hydrological. The drought that we experienced in the Midwest of the United States in 2012 was of course the pedological and agronomic.

In terms of climate change, the question is when did the current climate change begin? Most people associate the current climate change to 1750 - remember the Anthropocene that I mentioned in the first slide - the on-set of the so called Industrial Revolution. That may be a debatable theory. Some researchers believe that the trend in increase of atmospheric carbon dioxide concentration began 8.000 years ago and that of the methane, 5.000 years ago, corresponding with the dawn of settled agriculture with attendant deforestation, soil cultivation, spread of rice paddies and raising of cattle. The increase of methane is associated with the spreading of rice paddies and cattle and the increase of CO₂ of course with deforestation and agriculture.

If that is correct, then the so called Carbon Civilization, beginning with the Industrial revolution and continuing perhaps for another century or so, may have started long time ago. The pre-historic land use has thus far contributed about 320 Pg (Gigatons) of carbon into the atmosphere (Ruddiman, 2003; 2005). From 1750 to 2010, another 136 Pg were

released into the atmosphere and from 2010 to 2030 it is projected that we may have additional 30 Pg coming from land use change and soil cultivation.

In comparison with emissions from land use, fossil fuel combustion from 1750 to 2010 contributed about 200 Pg, and another 200 Pg is projected between 2010 and 2030 (Holdren, 2008). Thus, from now on, obviously the fossil fuel combustion will be the major determinant of the atmospheric chemistry. But in the past, prior to circa 1750, that was not the case, because the principal source of atmospheric CO₂ was the land use conversion, biomass burning, soil cultivation and its implications. However, combined these emissions have and will affect the ecosystem, the soil, water and waste, the nexus that we are concerned about, and it is that nexus and its impact, that is going to drive the production of food, feed, fiber, fuel and shelter for the human well-being and that of the other species.

Let's start with the carbon civilization since the 1750 for the moment. By 1860 the coal production was 132 Mt per year. In 2010 it was 3731 Mt per year, an almost 30 fold increase. The oil consumption at present is 87.4 m bbl/day (IEA, 2012). That comes to about 0.6 gallons/day/person (for each among seven billion of us in 2011). In USA the per capita oil consumption is five times that of the world average, or 3 gallons/day/person. Thus, the present civilization is really addicted to oil. In addition, the global gas use is 8.1 billion m³/day.

And compare the use of oil with that of drinking water need, which is 0.6 gallon per day. (The average beer consumption in Ohio is merely 0.1 gallon/day).

Soil degradation

Another characteristic of the anthropocene is the degraded land area. On a global scale, Bai et al. (2008) estimated that 3.5 billion hectares, which is about 24% of the total territory, may be degraded to some degree. The global soil degradation (land and soil are different; and soil is a part of land) due to water erosion is 1.09 billion hectare (Oldeman, 1994), wind erosion accounts for 0.55 billion hectare (Oldeman, 1994) and salinization for 0.85 billion hectares (FAO, 2005). The risks of secondary salinization are increasing tremendously with changing climate.

What is the cause of the serious problem, what is driving the soil degradation? One of the reasons is survival and desperation, especially if these are resource-poor people. Other reasons include the purposely overuse of resources and subsidies, human greed and corruption, the desire to produce and consume in a "world without limit" and expectations: competition, territory and power. Ignorance and misunderstanding about functioning of soil ecosystems causes unsustainable soil use and management based on the lack of knowledge. There are many examples of such cause-effect relationship.

However, soil erosion may not be always or necessarily due to desperation. Extreme Erosion may not only happen in Africa or Asia, but also in the heart of the U.S. Corn Belt. Land misuse and soil mismanagement can cause extreme erosion especially by extreme

climate events. Accelerated erosion can also be a source of greenhouse gases. Based on my own data on a global scale, if 6 Pg of carbon is being displaced by water erosion, 1.1Pg out of that can be emitted into the atmosphere as carbon dioxide and about 0.6 Pg is transported into the ocean and other aquatic ecosystems and depressional sites (Lal, 2003). Therefore, soil erosion not only impacts productivity of the land, and results in a loss of water resources, but also of the so-called anoxia of the ecosystems, along with emissions of greenhouse gases into the atmosphere. This issue needs multi-disciplinary research on watershed basis to study the fate of carbon transported by the erosional processes.

In developing countries, such as in West Africa, erosion can be caused by human desperation because resource-poor farmers and people require everything they can harvest from the land. The risk for erosion in Africa is projected to increase by 36% between 1980 and the end of the century. Globally though the risk of soil erosion may increase by 14%.

As the population increases, we not only encroach upon the prime agricultural land to construct buildings, roads, malls, shopping centers, airports and so forth; top soil is also used often for brick making. In India, the Indo-Gangetic Plains, China and other regions, one meter of top soil is used for brick making. As the population increases, it may require as much as 40.000 hectares to provide accommodation and infrastructure to one million people. The annual increase of population at the moment is about 75 million people, which means 75 million times 40.000 ha/million or three million hectares of prime land going out of production every year because of urbanization (Lal, 2011). Yet, this estimate does not include the land scalped of its topsoil for brick making that I just discussed. By 2015, there will be 236 cities in the world that will have a population of more than 10 million people. And these 10 million people require 6.000 tons of food per day. Imagine the amount of nutrients, especially phosphorus, being transported from the rural areas into the cities (some of which may also have a population of 20 or 30 million). And those plant nutrients being brought into the cities as food are not getting back to the land where they came from and are needed to replace what has been removed.

The demand for food is going to increase: Feeding 7 billion in 2010 takes cropland the size of South America. Feeding 9.2 billion in 2050 would take the land area of South America plus that of Brazil, the additional area needed, unfortunately, we don't have. In addition, there is also the problem of land grabs that is just a symptom of the shortage of land in densely populated countries. Some estimates indicate that 57 million hectares (mostly in Africa, but also in other parts of the world, in South America and Central America) are already affected by the so called land grab. If estimates are correct, this is an issue that might eventually create lot of social and political problems which perhaps need to be addressed right now through improvement in productivity of the existing land. The land grab must also be distinguished from direct investments.

What kind of yields are required to meet the food production? We had a global average cereal yield in 2005 of 3.3 Mg (metric ton) per hectare. By 2025, the average cereal yield must be increased to 3.6 Mg/ha because of the increase in population. By 2050, the aver-

age yield must be 4.3 Mg/ha. Total cereal production has to go up from 2.2 billion Mg in 2005 to 2.8 billion Mg (2025) and about 3.3 billion Mg (2050). These numbers only hold, however, if the food habits do not change. But since the income of the population, e.g. in China, India and other developing countries are going to increase, unfortunately the food preferences towards animal-based diet are also going to change. Consequently, considering the animal-based diet preferences, the yield of cereal must increase from 3.3Mg/ha in 2005 to 4.4 Mg/ha (instead of 3.6) in 2025 and to 6 Mg/ha in 2050 (Wild, 2003). That is a major major challenge.

Water use and management

Water is obviously a very important factor, remember that only 2.5% of the global entire water is fresh water. The remainder 97.5%, of course, is saline water. We may distinguish several types of water (Falkenmark and Rockstrom, 2004):

- Blue water: the oceans, the rivers, lakes and so forth;
- Green water: the water that plants absorb and use in photosynthesis;
- Grey and black water: which is the sludge and the water used by human consumption;
- and Virtual water: water that we do not have but we use by importing and exporting especially the food products.

We have to understand that blue and black water have to be converted to green, and hopefully we can manage the virtual water more properly.

Global water use is going up as summarized in below table. The total consumption increased from 430 billion m³ per year in 1990 to 6.000 billion m³ per year in 2000. So total demand went up by a factor of 14, agricultural demand by a factor of 10, industrial by 63 times, and urban by 22 times.

Units in 10⁹ m³/year

Year	Total	Agricultural	Industrial	Urban
1990	430	350	30	20
2000	6.000	3.400	1.900	440
Increase	14	10	63.3	22

Table Global Water Use (Kondratyev et al., 2003)

And the increasing use by industrial and urban sectors is reducing the availability of water for agriculture, which is a serious issue.

Among the 10 top countries which import and export the virtual water (Thenkabail et al., 2010), the exporters are Australia, Canada, USA, Argentina, Brazil, Ivory Coast,

Thailand, India, Ghana and Ukraine. The countries that import most of the virtual water are Japan, Italy, UK, Germany, South Korea, Mexico, Hong Kong, Iran, Spain and Saudi Arabia. In view of the growing scarcity of water globally, we have to consider whether trading of the virtual water is the best option or not.

Then we have the waste water. Many countries which have limited water resources also create a lot of wastewater, e.g. in North Africa and Middle East. Most water-deficit countries are also prone to creating more wastewater. Consequently, something has to give. Our thinking, societal values and philosophy has to change. And this is a policy issue, a political issue. Where politicians promote free access to pump water, as for example in Punjab and other states in India and elsewhere, such a wasteful use will result in overuse or non-sustainable use. No one protects or safeguards an undervalued resource. A rapid depletion of groundwater by as much as 1 meter per year is caused by undervaluing of the precious water resource. Policy implications are obviously very important in water use.

Nutrients

Looking at the global fertilizers use, the Haber-Bosch process of synthesizing fertilizers has certainly increased the use of nitrogen fertilizers, from < 10 million Mg in 1950 to 11 - 12 million Mg in 1960, and increasing to 81 million Mg of nitrogen in 2000. The global N use is expected to be 135 million Mg in 2020 and 236 million Mg of N fertilizers by 2050. Concerning phosphorus, its use has increased from 10 million Mg in 1960, to 33 in 2000, 48 in 2020 and 84 million Mg in 2050 (IFDC, 2004).

Haber-Bosch process obviously is very important for Nitrogen, but Phosphorus, where will that come from? There is a growing concern about peak phosphorus. By 2035, the phosphorus will peak out, like peak oil; we know that that problem exists. There are five countries in the world which contain most of the phosphorus reserves: Morocco, China, South Africa, USA and Jordan contain 90% of P reserves. This issue is also related to the concern that most of the nutrients are coming to megacities, where in reality we have more than 50% of the population living already and urban population is projected to be 70% of the total by 2050, which is a major liability as a cause of environmental pollution and eutrophication of water. Phosphorus is going to be one factor which we really need to consider. And high P losses in runoff and erosion from agro-ecosystems are causing considerable problems to water quality, such as anoxia in the coastal ecosystems.

In that context, is there also a peak soil, like peak phosphorus? Are there endangered soils? Of course there are. I can name quite a few of them. This question of overuse of soil and other resources is really an important issue.

Feeding the world

The question that I think the United Nations, and of course the United Nations University and the institutions like we are inaugurating today (UNU-FLORES) need to address is how can we feed the 10 billion people in view of the shortages of soil, water, energy, the

carbon civilization? That is a very important question. Some options to feeding the 10 billion people are:

- First and foremost, reduce post-harvest losses: 10 to 40% in developing countries.
- Minimize the food waste, from farm- to- fork- to landfill: 20 to 40% in developed countries. In United States, 40% of food already in the grocery store is wasted from homes;
- Reduce the diversion of food to biofuels. One third of corn even in 2012, with 30 to 60% reduction in yield in the US may go to ethanol production;
- Prefer plant-based diet. On unit area basis a lot more people can be fed on plant-based than animal-based diet (Global Soil Week, 2012). It takes 6 to 8 kg of grains per kg of grain-fed meat, especially lamb, pork or beef. Some other meat (chicken, fish) might be less grain-intensive; and
- Per capita grain consumption in India, is only 170 kg per year and that of US is 4 times more and it is primarily because of the more meat – based diet in USA versus that in India, that is the main factor.

We must promote an efficient use of food that we produce.

"More than one-fourth of all the water we use worldwide is taken to grow over one billion tons of food that no one eats, it is wasted." (World Water Week 2012)

Therefore, the second option of course we have is to adopt a climate-resilient sustainable intensification of agriculture. Let's start with wasted food for a moment. For example in India, 16.6 million Mg of wheat produced in 2010 and stored in the open, is prone to wastage. One rain can waste the entire stock stored in the open. So, that is wasted morsels.

Management principles

In terms of sustainable soil management, there are three basic principles (Hammer, 2010):

- Replace what is removed;
- Respond wisely to what is changed; and
- Predict what will happen from anthropogenic and natural perturbations. If you can predict, then obviously you can anticipate what to do about what may happen.

One other thing which is very important, two geographical regions that I discussed (sub Saharan Africa and Asia), are two major regions which are deficit in food production. These are also the regions with a serious "yield gap", or the difference in the national average yield and the research experiment or the attainable yield.

In India, for example, especially in the Indo- Gangetic plains, the present yield of wheat is about 3 Mg/ha. It can be 7.5 Mg/ha. The proven technology exists to achieve the high yield. Similarly, the present yield of rice is 5 Mg/ha, and the technology exists to achieve 8.8 Mg/ha. In sub-Saharan Africa, maize yield averages ~ 1 Mg/ha (there are some regions

with much higher national average yield such as Ghana, Malawi, Zambia) compared with the attainable yield of up to 4.5 Mg/ha or more. In some of my experiments in Nigeria conducted about 30 - 40 years ago (in 1970s and 1980s), yields of 4 and 5 Mg/ha/season were normal under recommended management. So, existing knowledge can be applied properly to bridge that yield gap.

We should not misuse the limited resources. There is no such thing as waste. Nature does not have a waste. The death leads to life and this cycle of life and death are the two sides of the same coin. These crop residues, which I had shown in a picture before, are being taken out from the agricultural land for multiple uses, and they contain a lot of nutrients. In addition, the residues left in the field are source of energy and habitat for the organisms.

Calculated from Bundy (2012)

Nutrient	Grains	Stover	TOTAL
N	36	15	52
P	8	2	10
K	9	37	46
TOTAL	58.4	71.8	130.2

Table Nutrients removed per Mg of Corn Grains and Stover (Kg/ha)

The amount of nutrients harvested (kg of nutrients/Mg of crop residues) in grains and stover of corn are estimated at 36 and 15 for N, 8 and 2 for P, and 9 and 37 for K, and 58 and 72 total, respectively. These nutrients removed have to be replaced, to minimize depletion and avoid the wide spread problem of negative nutrient budget on croplands of sub-Saharan Africa and South Asia.

But it is not only the nutrients alone. In a set of experiments, conducted at IITA (in Nigeria) in the 1970s, soil scientists studied the impacts of residue removal on soil properties and crop yields while all other management (e.g. variety, fertilizer, tillage method, time of sowing etc.) were kept the same. The difference in soil properties was immense, especially in bulk density, crusting and soil structure. Therefore, the earthworm population, the microbial activity, the soil quality, soil bulk density, porosity, infiltration rate were superior in soil receiving the crop residue mulch. Soil biota, the organisms that I just mentioned, are the bioengine of the Earth and that residue is the food for those organisms. If we deprive those organisms from the food, they cannot survive. My slogan has been **"grains for people, and the residues for the soil"**. This equity must be maintained to achieve sustainable use of soil resources.

Those who also believe that the biofuels can be created from crop residues without any adverse impacts on soil quality must think again. There is no such thing as a free biofuel

from crop residues. That residue is needed for survival of the organisms which are so essential to soil quality. In 1970s, the world faced the oil crisis as you know. At that time the famous soil scientist at UC Davis, Dr Hans Jenny stated in a note in Science: "I am arguing against indiscriminant conversion of biomass and organic wastes to fuels. The humus capital, which is substantial, deserves being maintained because good soils are a national asset". So, crop residues are not free. Their indiscriminant removal from agro-ecosystems certainly has a large price tag in terms of the adverse impacts on soil quality.

Another important product is the animal waste, which in southern Asia and many parts of Africa of course is used as a household cooking fuel. You can imagine the impact on health of the children sitting around the fire, or children not yet born, by the inhalation of the noxious gases which are released from incomplete combustion in a traditional stove under unventilated kitchen. It has been stated that during late 1990s and early 2000s, more plant nutrients were burnt in dung as households fuel than chemical fertilizers used in India. I had the opportunity to talk to a member of the Planning Commission in India, and I mentioned to him that one crucial strategy to restore degraded soils and improve the environment would be to provide clean cooking fuel to the housewives in the rural communities and elsewhere. Throughout South Asia and sub-Saharan Africa, the so called atmospheric brown cloud (ABC), which I am not going to talk about at this occasion, is affecting the Monsoons through alterations of the energy budget. You can imagine the color of the first snow fall into the Himalayas because of the atmospheric brown cloud.

If the crop residues, the dung, the cover crop and other biomass such as city sludge can be put back on the land, it would have strong positive impacts on soil organic carbon pool and soil quality. In depleted soils, there occurs a notable increase in soil quality by improving the carbon concentration in soil. The available agronomic data show that increasing soil organic carbon stock in the root zone by 1 Mg/ha (even with the existing management of fertilizers, varieties and so on) can increase the productivity of maize, soybeans, wheat, rice, sorghum, millet and beans. The data in on increase in crop yields are from Africa and Asia, (Lal, 2006; 2010a; b):

Crop	Yield increase (Kg/Ha/Mg C)
Maize	100-300
Soybeans	20-50
Wheat	20-70
Rice	10-50
Sorghum	80-140
Millet	30-70
Beans	30-60

We can increase the production in the developing countries by 30 to 50 million Mg per year, which can substantially bridge the gap between the demand and supply at local level.

Adapting to climate change

Soil quality and adaptation to climate change are really crucial issues. What does adaptation mean? It involves any activity that reduces the negative impacts of climate change through anticipatory or reactive strategies and – that is very important – takes advantage of new and beneficial opportunities that may be presented by climate change.

I hear most of the time negative things about climate change. You remember that about 15,000 years ago, the settled agriculture was made possible by the climate change or the so called “Long Summer”. I do not think that Mother Nature would create anything that has only negative impacts. While the magnitude of anthropogenic climate change must be minimized, any positive impacts or opportunities in agriculture or forestry must also be explored. It is up to us to identify what positive things may happen, and then take advantage of those.

Thus, innovative technologies must be identified to take advantage of any new opportunities which may emerge? How will agriculture look like in 50 years from now? I am not in a position to recommend GMOs, I am neither a plant breeder nor geneticist, but I do believe that genetically modified plants/animals probably will be increasingly used, despite some of the disadvantages. This theme needs additional and an objective research. The plough-based agriculture, the so called conservation agriculture farming will also play an important role in the future. We may have nano-enhanced materials for use in fertilizers for example, so that the use efficiency can be increased. We may have plants which emit molecular-based signals, plants tell us “I am thirsty”, “I am hungry”, “Give me this nutrient”, “I am being attacked by this grass hoppers” or “I am being attacked by a certain virus”. So they emit plant-based signals which can be detected by remote sensors and we can target treatment of those specific stresses, whether they are biotic or abiotic stresses. This is the kind of technology that has to come in the future, including of course the growing need for urban and peri-urban agriculture. And more important, the key resources (such as water and plant nutrients) must be delivered directly to the plant roots in a form and exactly at the time the plants need these resources at specific phenological and growth stages. Such innovations, also called “sustainable intensification” are important, so that the waste is avoided and key resources are used efficiently and sustainably.

In terms of climate change, a field of corn, managed with normal farming practices (such as crop residues and animal waste return under conservation agriculture) can produce 400 times the annual increase in atmospheric carbon pool contained in the air column above that field of corn. The total net biomass or biome productivity is three petagram (Pg) of C per year that is just about the same amount as the increase in atmospheric CO₂ during the 1990s. Herein lies the strategy of off-setting anthropogenic emissions through natural processes of greening the Earth. I am going to share with you here the data from Dr. Jim Hanson of NASA. He estimated that between now and 2100, 50 ppm of CO₂ can be withdrawn from the atmosphere by forestry and soil. Indeed, carbon sequestration in

the terrestrial biosphere is the most cost-effective strategy of stabilizing the atmospheric chemistry. My estimates of the reduction in CO₂ sequestration are probably double that of Jim Hanson, and I think that this can be achieved through sustainable intensification of natural resources (soil, water, vegetation, waste etc.).

Laws of Natural Resources Management

We have a book coming out very soon, Dr. B.A. Stewart and myself are the editors. The book, as a series Advances in Soil Science published by Taylor and Francis is entitled “Laws of Sustainable Soil Management”. It is based on ten tenets of soil management (Lal, 2007):

Law #1 describes “Causes of soil degradation”. It is very important to realize that the “biophysical process of soil degradation is driven by economic, social and political forces”. We know in Africa and Asia how to minimize soil degradation. It is the governance or the political will to implement the management that is often lacking. The vulnerability to degradation depends on how rather than what is grown.

Law #2 states that “when people are poverty stricken, desperate and starving, they pass on their sufferings to the land”. Poverty and degradation go together. The stewardship does not have any meaning when someone is starving.

Law #3 states that “it is not possible to take more out of the soil than what it is put in it, without degrading its quality. Only by replacing what is taken can a soil be kept fertile, productive and responsive to inputs”.

Law #4 is called the “Marginality Principle”. It states that “marginal soils, cultivated with marginal inputs, produce marginal yield and support marginal living”. Take the case of Sub-Saharan Africa or South Asia: the soils are poor, they are cultivated poorly and they perpetuate poverty, misery and hunger. That vicious cycle can be broken. Recycling is good as long as there is something to recycle. I am not going through all the 10 laws on which this book is based, but I think these are the basic principles of soil management.

In the context of the new institute (UNU-FLORES), I would also like to share with you 10 basic laws of natural resources management, which I call the Laws of Nothingness (Lal, 2013). They are based on the Latin phrase: *Ex nihilo nihil fit* which means “Nothing comes from Nothing”. In terms of soil, water and waste these laws can be stated as follows:

- 1 Nothing is appropriated. There are always trade offs (give and take);
- 2 Nothing is permanent. Everything is in a dynamic equilibrium (as was stated in the nexus concept stated earlier), and in a transient state;
- 3 Nothing is absolute: All processes, properties and values are relative to a baseline. We must know what the baseline is;
- 4 Nothing is a panacea: There is no silver bullet, there is a multitude/menu of options;

- 5 Nothing is universal: Soil/site/region specificity is an important consideration which must never be overlooked;
- 6 Nothing tangible is free: under valuing a commodity – I discussed with you the example of over use of irrigation water- leads to “Tragedy of the Commons”;
- 7 Nothing is empty in nature: All space in rocks is occupied. Pores in solid rock contain water or air and injecting into these pores the fracking solutions can cause problems. Keep that in mind;
- 8 Nothing is given or for granted: It is the judicious use and management which produce goods and services;
- 9 Nothing is waste: There is no such thing as waste. Everything in nature has a use. Try to find out how to use that waste or better the by-product;
- 10 And finally, nothing is nothing: there is no such thing as nothing.

I think these are the basic things we have to understand, to implement the judicious management of limited resources. In terms of the sustainable management, we need a combination of science and policy. We have natural resources and they must be Restored, Improved, Sustained and Enhanced (R.I.S.E.), through Science, Policy, Practices, but also Religion and Culture. I want to share with you something about Religion and Culture (Lal, 2010), because you hear about science more often:

Judaism: The word “homo” (man) is derived from the Latin word “humus” or the decomposed organic matter in soil, which is the essence of all terrestrial life. The Hebrew phrase “Tikkun Olam” means “repairing restoring the world”.

Hinduism: Human body is made of soil, water, energy, sky/space, and air” That is in the Prasna Upanishad.

Sikhism: Air is the Guru, water is the Father, and soil is the Great Mother of all. That is in the Gurbani.

Buddhism: “One should not break even the branch of a tree that has given one shelter”

Christianity: The word “Adam” (man) is derived from the Hebrew word “adama” meaning “earth” or “soil”, so the man is made of soil.

Greek: The daughter of Earth goddess “Gaea” named Themis (goddess of Law), and her descendent Demeter was the goddess of agriculture and fertility.

Romans: The Earth goddess (Tellus) was related to the goddess of fertility and harvest, what they called Ceres.

Islam: The Quran states that “He created the man of clay like the potters” (Suhrah Al-Rhman, verse 14) and “We made from water every living thing” (Qur’an 25:54). “Do not overuse water even if you are on a running river”.

In continuation of these cultural believes, another concept I want to share with you is that from Khalil Gibran. Some of you may know him (a US citizen of Lebanese descent). He stated “Trees are poems that earth writes upon the sky. We fell them down and then turned them into paper, so that we may record our emptiness.” That is a great message.

In the end, I want to share with you Gandhi’s seven sins of Humanity which he listed in his autobiography “My Experiments with Truth”. These are:

- 1 Wealth without work;
- 2 Pleasure without conscience;
- 3 Knowledge without character;
- 4 Commerce without morality;
- 5 Politics without principle;
- 6 Religion without sacrifice; and
- 7 Science without humanity. Anything in Science we do must have a humanity angle, it must address societal problems.

I have been sharing with several colleagues what I call Trillema of Natural Resources Degradation (UNCCD, 2011). The data I am going to share are computed as rates per minute on global scale. What happens around the World every minute?

- Population increases by about 150 people;
- There are 250 births and 100 deaths;
- CO₂ increases by 6150 tons;
- Tropical deforestation: 25 hectares;
- Urban encroachment: 5.5 hectares;
- Soil degradation: 10 hectares;
- Deaths from hunger every minute: 16 people, including 12 children. These come down to several jumbo jets, like 70, crashing day after day, seven days a week, 365 days a year and yet it is not an issue for the news or a newsworthy item for TV primetime reports; and
- We have municipal solid waste, every minute in the United States, 540 tons.

The political stability and civil strife are affected by the trilemma such as this and other issues. And I have often wondered if Gandhi were to see the statistics, what he would have added to the seven sins that he listed. I think he would have added the following (Lal, 2007):

- Technology without wisdom;
- Education without relevance; and
- Humanity without conscience.

Thank you so much.

Additional details and references can be obtained from the author.



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Part II Opening Speeches (17⁰⁰ - 18¹⁵, 10 December 2012)

Prof. Konrad Osterwalder

Rector of UNU and Under-secretary-General of UN
(17⁰⁰ - 17¹⁵, 10 December 2012)



Prof. Dr. **Konrad Osterwalder** joined UNU in 2007 as its fifth Rector (2007-13). He earned a doctorate in theoretical physics at the Swiss Federal Institute of Technology (ETH) in Zurich. After a year with the Courant Institute of Mathematical Sciences, New York University, he moved to Harvard University and was promoted to Associate Professor for Mathematical Physics in 1976. In 1977, he was appointed a full Professor for Mathematical Physics at ETH. He was Rector of ETH from 1995 to 2007. In 2006 and 2007 he also served as ETH President pro tempore.

Ladies and gentlemen, colleagues – after the lecture we have just had, actually, I feel almost if it is a sin to try to say something on top of it. I would like to go home to think about all the many things that were said, to think critically about them, and maybe to improve some of the ideas. But, OK, we have to wait before we can do that.

For the moment, I would like to greet some of you, knowing that I will leave out many names and those who are not being greeted explicitly by me, I ask you to tell yourself that I am very happy about your presence.

I would like to give a warm welcome to Her Excellency Prof. Sabine von Schorlemer, Saxon State Minister for Higher Education, Research and the Arts.

I would like to welcome Dr. Maximilian Metzger, Deputy Director-General for the International Cooperation in Education and Research of the Federal Ministry of Education and Research, BMBF.

His Excellency Dr. Martin Frick, Ambassador for International Organizations in Germany.

Mr. Thomas Stratenwerth, Head of Division: General, Fundamental, International, and European Aspects of Water Management, Federal Ministry of the Environment, Nature, Conservation, and Nuclear Safety. The shorthand for this is BMU.

His Excellency Prof. Louis Augusto Pelembe, Minister of Science and Technology of Mozambique - an important partner of the new institute UNU-FLORES.

His Excellency Mr. Amadeu Paulo Samuel Da Conceição, Ambassador of Mozambique to Germany.

His Excellency Professor Ana Maria da Graça Mondjane, Vice-Rector for Academic Affairs from the University of Eduardo Mondlane in Mozambique.

The honourable Mrs. Angelica Kappel, Mayor of the City of Bonn.

Prof. Hans Müller-Steinhagen, Rector Magnificus of the Technical University of Dresden.

Professor Gerhard Roedel, Vice-Rector for Research at the Technical University of Dresden.

Professor Hanz-Gerd Maas, Dean of the Faculty of Environmental Sciences at the TUD.

Professor Hanz Wiesmeth, President of the Dresden International University.

Professor Mahmoud Abu-Zeid, President of the Arab Water Council in Cairo in Egypt.

Professor Rattan Lal, Director of the Carbon Management Sequestration Center at Ohio State University – and you have just heard his wonderful talk.

Excellencies, distinguished guests, colleagues, ladies and gentlemen. Before I come to one or two remarks that go in the same direction as our lecture, I would like to formulate a warm, warm thank you to the founding director of this institute, Reza Ardakanian.

Without his engagement, without his fantastic ideas, without his art of convincing collaborators to do a creative and fascinating job, we would not be here and enjoy this afternoon. Reza, thank you very much – but there is a danger. I warn you. We will measure you in your future work on what you did today!

Let me take up one thought of the seminar we just heard. It is difficult to change the world relying on old people, because they believe they know how things have to be done, and usually it's the wrong way. But you cannot change them.

You can try to change the direction of thinking of the young people. And this is why education is so crucial and so important. And specifying on the education of engineers – we are here at the Technical University – the old scheme was to try to combine research and teaching, teaching with research experience, so as to further the spirit of innovation. Innovation is the catch-word – that is what our industry needs. That is what our civilization needs to produce more, to produce faster, to produce more efficiently.

Well, Compared to this basic attitude, which I think is still the attitude of the majority of our people, ten years before this University was founded, a book appeared that has been a best-seller ever since. In 1962, Rachel Carson published her book "Silent Spring," which probably most of you know. A book that describes the damage that is being done by using fertilizer and insecticides and similar chemicals without limits.

In 1952, twenty-one years before the establishment of UNU, the Americans exploded the first hydrogen bomb in the atmosphere. And twenty years later, in 1972, the Club of Rome published its first version of "Limits to Growth." A book of which every individual statement is probably wrong, but the book that had an enormous influence on the thinking of many people - and it still has I think - and it's the first edition, in spite of the fact that every ten years there was a new edition coming forward. So, what should we do about the education of the young people? Well I think in the future innovation is not just innovation. We have to be aware of the big problems of mankind - of the big problems of survival of our planet, and of ourselves and once we have an idea of this – and the seminar showed that there are such ideas – we have to try to motivate the students to come to their innovations in the right field. In a field that does not increase the production, that does not make cars faster, or the stakes bigger, or I don't know what – but innovations that really help solving the problems, that help moving our society in the direction of a sustainable development.

Sustainable development – I think the word did not appear in the lecture. But it is an important concept as far as I'm concerned. Because if you think of all your friends and your neighbours, and people in other countries you don't know – who believes in that? Nobody believes in it. Why should I care about the fate of somebody who is 10,000 miles away from me? Why should I care about somebody who lives 50 years after my disappearance? This is the basic attitude of people, and this is what we have to change. And this is ultimately a moral question. We cannot prove it scientifically that I have to care about people who live in 50 years.

Now, talking about 'moral' is very difficult, I know it. Because moral notions differ from one culture to another. So how could a moral principle help solving these problems? Well, I think we know that even if there are many moral codices of the world, in the different civilizations, there is a greatest common denominator of all these moral schemes and to some of these common denominators, we got used to. For example, there is the Hippocratic Oath. Nobody questions the Hippocratic Oath. Or there is the declaration of human rights, which again, seems to be a common value in all moral schemes.

And what we have to define now is an oath for sustainability, which I claim can also be identified as something that is common to all the moral schemes in all the civilizations of the world.

This is how I think we should proceed. I wish all of you good luck when you think about this proposal, and maybe take the oath for sustainable development in the future.

Thank you.

Prof. Sabine von Schorlemer

Saxon State Minister for Higher Education, Research and the Arts
(17¹⁵ - 17³⁰, 10 December 2012)



Prof. Dr. jur. habil. Dr. rer. pol. habil. **Sabine Baroness von Schorlemer** was appointed in 2009 as the Saxon State Minister for Higher Education, Research and the Arts. Prof. von Schorlemer taught at the universities of Geneva, Lausanne and Basel, and held the chair in International Law, EU Law and International Relations between 2000 and 2009, and was International Program Coordinator at the TU Dresden. In spring 2009, she was able to attract the world's first UNESCO professorship in international relations to the TU Dresden.

**Under-Secretary General,
Dear Professor Osterwalder,
Excellencies,
especially Minister Pelembe from Mozambique,
Magnificence,
Dear Professor Müller-Steinhagen,
Dear UNU Vice Rectors and Directors,
Dear Prof. Ardakanian,
Dear Mr. Metzger,
Presidents, Directors, Deans,
Ladies and Gentlemen,**

It is a great honor to me to welcome you here to the winterly Dresden today on the occasion of inaugurating – together with you – this scientific institute, the United Nations University Institute for Integrated Management of Material Fluxes and of Resources, which is so important to the Free State of Saxony. As of today, the Free State of Saxony is flying the flag of the UN, once again acknowledging its cosmopolitanism spirit. A member of the UN family has now made its home here, and this is indeed a great joy for us. For a long time, we have worked together very intensively between the Free State, the Federal German Level represented by the Ministry of Education and Research, and with the United Nations University, to see this day materializing. Now it has come! Today, Dresden sees the birth of UNU-FLORES, which is the sounding acronym, as you know, and, very soon, we also hope to see the birth of a Twin Institute of UNU-FLORES in Maputo, which we would appreciate, too.

Ladies and Gentlemen,

Let me briefly take you on a virtual long journey of 14,118 kilometers. Please imagine, how huge, seemingly uncountable this distance is. Well, my ministry is exactly 14,118 km away

from your Ministry of Science, Excellency, in Maputo, Mozambique. It takes a flight time of sixteen hours to get from one place to the other. But thanks to Google Maps, it just takes a few touches on our smart phones or tablet computers to get a virtual idea of remote places. And via Skype, for example, despite the huge distance, we can even exchange in real time – and look each other in the eye. That brings 14,118 km away down to an arm's length – that is the distance between the screen of my tablet and me. And this simple example demonstrates that even though we are faced with quite complex tasks on a global level, we are at the same time well on our way to find means and methods to meet those challenges.

In the future, we will only be able to control the global nature and complexity of things together, and we are well aware of that. None of the issues that this world is facing can and should be solved only within its respective regional context. No government or scientific elite alone would be able to master that task. What needs to happen is that we cluster and interconnect the intellectual resources on a global plane. I hope that with UNU-FLORES we will be able to take direct steps towards the goal of finding answers to basic questions of our existence, to the goal of training experts that are able to implement concrete solutions and feasible processes for the real life out there, and that we will be on the right way soon, for example by quickly setting up meaningful master programs and graduate courses.

Since our last workshop in the year 2010, a number of things have been achieved in the scientific community in the Free State of Saxony: Some months ago, the Technische Universität Dresden won an award as a 'University of Excellence' in an ambitious national competition – which was a big step towards playing its role amongst the best universities worldwide. For the Free State of Saxony, this success was significant. It was also a reward for the political priorities we had set by focusing on education and the sciences. Maybe the decisive factor that contributed to this success was the so-called DRESDEN concept, which is a network with independent institutions of research and culture as well as the synergetic cooperation of various departments within the university which is aimed at finding interdisciplinary solutions for complex and multifaceted challenges.

It goes perfectly well together with the Free State's University Development Plan 2020, by which we have set the course of action for research, training, science and technology transfer at our institutes of higher education for the years to come. In the future, we shall also continue to encourage networking between the various regional players in the scientific world. Universities and colleges are to further develop the dialogue between science and society via institutionalized scientific forums, focusing on their central themes which position them uniquely in a global competitive community.

This approach has already yielded its first fruits. For UNU-FLORES, this means that it will also find partners in addition to TU Dresden that will be interested in cooperating with it.

The way has already been prepared for some of those partnerships. To name but a few, there are the Helmholtz Center for Environmental Research (UFZ) in Leipzig, the newly founded Helmholtz Institute for Resource Technology in Freiberg, the Institute of Ecologi-

cal Urban and Regional Development in Dresden and the brand-new German Centre for Integrative Biodiversity Research in Leipzig.

In other words, the academic landscape of Saxony with its pronounced technical profile is well-prepared for meaningful contributions on questions about the future, such as: How do we plan on handling natural resources in the future? How can we move away from the current way of doing things, i.e. from simply “using up” our natural and material resources, our health and energy? How will we handle the responsibility we have when it comes to material resources or people in other parts of the world and, of course, also with regard to future generations?

Ladies and Gentlemen,

Time and time again, this year 2012 has seen critical situations as far as the global climate is concerned.

We, the so-called industrialized nations, have seen that we are subject to natural disasters, too. Definitely, this issue does not just apply to the southern hemisphere. Our Chancellor and our Federal Minister for the Environment have used several occasions this year to make clear statements about Rio +20 and about the energy transition in Germany. Therefore, I believe that I am not only speaking for the Free State of Saxony but also for the Federal government of Germany by stating that it is in our very own interest to better understand the global scientific discussions about the consequences of future climate changes, of uncontrolled land use and of demographics – and also to develop an overall approach to solve these problems together with other nations.

Ladies and Gentlemen, that in politics, we have to go beyond simply defining a problem, analyzing it and issuing dire warnings, and instead ask the question: What do we need to do? What are we able to do? How can we get the emerging nations to not merely imitate their former colonial powers by bringing in their harvest at the expense of nations that are even poorer, but instead embrace aspects of sustainability right from the start?

The answer encompasses economic, ecologic and social aspects and hence, it has a strongly political dimension. Science forms the basis for solving all related concrete questions.

This is where the scientific and political tasks meet. This is where I believe is the most important interface for UNU-FLORES and where I see the core purpose of this UNU Institute. The title, UNU-FLORES, represents the program, ladies and gentlemen. The „flores“- part in UNU-FLORES reminds me of the Latin word for flowers; the work of the institute shall make them bloom.

At the heart of its institutional purpose is the research of an integrated management of water, soil and waste – in cycles that mutually influence one another, and these cycles must be maintained and developed in a stable fashion.

This basic thought was expressed in the forestry ordinances as early as in the 16th century due to an ever greater national shortage of wood, which occurred both in Central Europe and in Japan independently of each other. In his book about forest management, Hannss Carl von Carlowitz, a mining administrator in Saxony, introduced the term “sustainable” in 1713 already.

If we raise the question of sustainable development and combine it with the questions and consequences of technical solutions, their ethical dimension turns out to be an additional point we need to focus on.

Universities and research institutes have to meet this challenge. Scientists – given their excellent knowledge – do have a greater responsibility, and it does not just encompass their direct surroundings, their own research question or projects. We do expect and must even demand from excellent scientists to contribute – to the best of their knowledge – to an adequate solution for global challenges that affect their respective fields of research - be it economics, engineering, natural or social sciences.

Ladies and Gentlemen, this also means that one question has to be asked over and over again within the scientific community, namely: How do my research results contribute to a sustainable development both in the Free State of Saxony as well as in other parts of the world, today and in the future?



Capital	Dresden
Area	18.415,51 km ² (7.110,33 sq mi)
Population	4.134.000 (As of 30 November 2012)
Density	224 inhabitants / km ² (580 / sq mi)
Universities	4
Art College	5
Universities of Applied Sciences	5
Students	> 100.000

Table Sources: 1) https://de.wikipedia.org/wiki/Sachsen#cite_note-2
2) <http://www.studieren.sachsen.de/index.html>

Today, this is something I would really like to highlight, not only since today, on December 10, is the International Human Rights Day. Searching for such global answers and solutions, putting research into an international context, is one of the central tasks of the scientific quest for knowledge if we want to preserve creation and build our future.

Ladies and gentlemen,

We owe the fact that we have been able to further develop the capabilities to do so with UNU-FLORES to all those who – over the past few years – have greatly contributed to the founding of this institute.

Let me express my thanks to them.

The year 2013 is just around the corner. 2013 will see the 300th anniversary of the coining of the term “sustainability” here in Saxony. From the UN perspective, it will also be the International Year of Water Cooperation. I have already touched on some of the correlations between the different spheres, and, summing up, I think we can say:

UNU-FLORES has come at the right time!

Thank you very much for your attention!

Mr. Maximilian Metzger

Deputy Director General for International Co-operation in Education and Research at the German Federal Ministry of Education and Research (BMBF, on behalf of the Federal Minister) (17³⁰ - 17⁴⁵, 10 December 2012)



Mr. Maximilian Metzger was appointed Deputy Director General for International Co-operation in Education and Research at the BMBF in 2010. He is responsible for international co-operation with all countries outside Europe and the UN organizations. After studies in law and philosophy and assignment as a judge at the Administrative Court, he has been serving at the BMBF in various functions. From 2004 to 2008 he was Secretary General at CERN.

**Prof. Osterwalder, Under-Secretary of the United Nations and Rector of the University of United Nations,
State Minister Prof. von Schorlemer,
Minister Pelembe from Mozambique,
Prof. Müller-Steinhagen, Rector of the Technical University Dresden,
Prof. Rhyner, Prof. Ardakanian, and Prof. Lal,
Excellencies, distinguished rectors and professors, ladies and gentlemen:**

You mentioned it already; I have the honour to speak on behalf of my Minister, the Federal Minister of Education and Research in Germany, Prof. Schavan, who is very much enthusiastic about the UNU and about the foundation of this institute FLORES. The more, she regrets not to be able to be here today, and therefore she sends her best wishes, her congratulations, and compliments to all of you and mainly to the stakeholders of UNU and the new institute.

Prof. Schavan always has been a strong supporter of UNU, and in particular, of the foundation of the new institute.

Let me start with some comments on the support of the Federal Ministry of the United Nations University and about the reasons for our commitment.

Since its foundation in 1973, we always have found that the UNU is an important element of international research cooperation and we appreciate very much that four scientific institutions of the UNU are located in Bonn. The more as they stand for high academic quality and are a real advantage for the academic landscape in Germany and in the region of Bonn.

Just to mention that last year UNU was ranked among the first ten government-affiliated global think tanks. For the federal government there is a second reason to strongly support

UNU: they are part of the UN family, which had been settling in Bonn, for which the Federal Government also is very much supportive.

Thus, the Federal Ministry has been providing regular funding to the Institute for Environment and Human Security – UNU-EHS - already since 2003, and we appreciate very much that an evaluation of this institute presented encouraging results, which leads to the logical consequence that we will continue our support.

In the same way, in 2007 the UNU and my ministry agreed a strategic partnership whereby the Federal Ministry also supports the Vice-Rectorate in Europe of the United Nations University in Bonn.

This partnership produced the first Vice-Rectorate of UNU in Europe, which acts as a coordination centre of at least seven institutes of the UNU located in Europe. And since then, the BMBF has supported this Vice-Rectorate as well as the Institute for Environment and Human Security, the latter together with the state of North-Rhine Westphalia.

Now, the most recent addition to the UNU family in Germany, whose opening we are celebrating today, is this new institute with the nice title FLORES. May it flourish.

For us, it is important that FLORES is not limited only to research on the use of water, soil, and waste resources – in particular in developing and emerging countries. The institute shall also develop innovative concepts for target and region specific knowledge transfer, as well as appropriate methodologies and approaches for post-graduate and professional education. This broad approach is the reason why, together with the state of Saxony, we provide funding for the first phase of establishing the new institute – and we are very glad about it.

Let me mention a word on twinning. The twinning concept corresponds very much to some elements of our strategy of internationalization of research and science in Germany. One element is the stronger cooperation with emerging and developing countries on the basis of an equal partnership; in this respect, we are very much in favour of the twinning concept and we do hope that it will turn out as a real success, because we think it's based on partnership, it's based on the same standards and requirements on joint programmes, joint education, and curricula.

In this respect, we think it is a guarantee for the sustainability of cooperation, and it will also provide structures and capacity building in developing countries, above all in Africa.

This corresponds to other initiatives of my ministry, which we have established in Africa and with Africa. For instance, the networks of research in land-use – WASCAL and SASSCAL – meaning regional research networks in Southern and Western Africa. Also, we are establishing networks of research in medicine, translation at medicine, and public health with

Africa. Moreover, we have been establishing strong cooperation links between universities in Germany and in Africa – all over Africa.

We heard so many visions from the previous speakers; I am very grateful for it; I think we need these visions to do our work in our ministries to have the right inspiration and imagination to be convinced that we pursue the right goals.

A word on Dresden: I am particularly pleased that FLORES is based at the Technical University of Dresden, because this university was awarded within the Initiative for Excellence recently, and we consider the cooperation with the Technical University Dresden a precious element for the success of FLORES and its twinning concept.

What do we expect from FLORES? We expect, of course, excellent science – what else? We expect excellent training. We hope that the new institute will have enough support from third parties and we do indeed expect that there will be some cooperation with the existing initiatives we have established in our ministry – in particular on land use. After all, we hope that these new structures will be sustainable. I recall Prof. Bogardi's speech on sustainability which has had, however, a slightly different flavour. Nevertheless, in a very positive sense, we do hope that you will create persistent structures.

Such a day is also a day of congratulations and of thanks. I would like to close with thanks. Thanks to all who have contributed to this difficult exercise to establish a new institute linked with a university, funded by different sources, and linked to a state on a different continent. Thanks also to the Technical University of Dresden, that took on the task to organize this new institute together with the colleagues from UNU.

Many thanks to the government of Saxony, and in particular to the Science Ministry, for their constructive and very positive cooperation.

Many thanks to all members of the United Nations University, represented today by Prof. Osterwalder, Prof. Rhyner and Prof. Ardakanian.

And also thanks to Prof. Bogardi who was very much a crucial person for this new initiative and for the promotion of FLORES.

Finally, I would like to convey the best wishes to the institute and to Prof. Ardakanian. All success for the benefit of Germany, for the benefit of Mozambique, and also – and in particular – for the benefit of mankind.

Thank you very much.

Prof. Hans Müller-Steinhagen

Rector, Technische Universität Dresden
(17⁴⁵ - 18⁰⁰, 10 December 2012)



Prof. D.Eng. Dr.-Ing. habil **Hans Müller-Steinhagen** is the Rector of Technische Universität Dresden, the largest German university of technology and one of the 11 German Universities of Excellence. Following a distinguished academic career in Canada, New Zealand and England, he became the Director of the Institute of Technical Thermodynamics of the German Aerospace Centre and Director of the Institute for Thermodynamics and Thermal Engineering of the University of Stuttgart from 2000-2010. Prof. Müller-Steinhagen is a Fellow of the Royal Academy of Engineering, Chairman of the Advisory Board of the DESERTEC Industrial Initiative (Dii) and a member of many supervisory and advisory boards.

**Dear Professor Osterwalder,
honorable Minister,
dear Mr. Metzger,
dear Professor Pelembe,
dear Professor Ardakanian,
distinguished Guests,
Ladies and Gentlemen,**

for the city of Dresden and in particular for the Technische Universität Dresden the choice of the location of UNU-FLORES is an honor. For the people who work and live here this is a confirmation of the continuous interdisciplinary work in research and teaching that is done at our university, in particular at the Faculty of Environmental Sciences, within the fields of environmental research and management of natural resources. The area of Water, Energy and Environment belongs to the five research priority areas of the TU Dresden and is especially represented by the Faculty of Environmental Sciences. Research on the sustainable development of the human habitat and the monitoring of the earth as a system on global, regional and local scales are the central aspects of the faculty's work. Water, soil and waste as well as the development of strategies for the sustainable management of resources are in the center of attention.

The principle of sustainability has its origins in the Saxon forestry. There is a long tradition of integrated resource Management in the Free State of Saxony. At our university, this topic again is especially dealt with in the Faculty of Environmental Sciences. There it finds constant development with the help of interdisciplinary and innovative

approaches, just as required by the manifold challenges and the speed of the ongoing changes of the world we live in.

We are happy and proud that we are given the opportunity to contribute our competences and knowledge to the cooperation with UNU-FLORES and by doing so make our own ideas and concepts more visible on an international level.

The Faculty of Environmental Sciences of TU Dresden consists of three departments. The Department of Hydrosociences with its combination of engineering sciences on the one hand and natural sciences on the other hand has already existed since 1968. The interdisciplinary approach brought to life here is a trend-setting strategy that has proven to be very successful.

In addition to that, the Departments of Forest Sciences and Geosciences also contribute to the overall picture of a modern Faculty of Environmental Sciences in that they use innovative research approaches such as environmental system analysis, the production and exploitation of renewable raw materials, soil protection, earth observation, geospatial data analysis and an integrated environmental planning. The high number of national and international research projects conducted within those two departments supports this thesis.

Interdisciplinary platforms such as the Dresden Water Center at TU Dresden, joint appointments together with the Helmholtz Centre for Environmental Research and the Leibniz Institute of Ecological Urban and Regional Development as well as the establishment of research associations as e.g. the International Water Research Alliance Saxony or AgroForNet strengthen the research priority area Water, Energy and Environment and contribute to its international orientation.

For TU Dresden the cooperation with UNU-FLORES along with the development of professional competences is another important step in our internationalization process, but also in the extension of its scientific network. On top of that, this cooperation gives us the unique opportunity for the transfer of knowledge, i.e., establishing, testing and developing different methods and technologies under the specific circumstances of emerging and developing countries.

The Technische Universität Dresden will be a reliable partner in research and teaching and will support the United Nations University in establishing its institute UNU-FLORES. By locating UNU-FLORES in Dresden, the United Nations University will get access to the so-called DRESDEN-concept, a network of TU Dresden and an impressive number of non-university partner institutions.

As a consequence for the TU Dresden, the further development of international study programs as well as the establishment of new graduate schools will be reinforced and fostered together with the United Nations University. Common modules will enrich the teaching in Master programs and the education of PHD candidates. We hope to be able to attract

more international students with the help of these measures. This, on the other hand, will contribute to the visibility of TU Dresden on an international level.

The fact that UNU-FLORES will pay special attention to the topic of capacity development will enable the Institute together with TU Dresden to strengthen its competences in this field and to integrate these competences into the international dialogue. A special connecting factor here is the successful work of the Centre for International Postgraduate Studies of Environmental Management (CIPSEM) that is part of the Faculty of Environmental Sciences. This Center is under the patronage of UNEP-UNESCO and financed by the Federal Ministry for the Environment, Nature Protection and Nuclear Safety. During the 35 years of its existence, more than 1776 postgraduates from more than 135 emerging or developing countries took part in the courses offered by the Center. The Alumni network that has developed since the foundation of the center is a unique, very active worldwide network. I particularly want to mention the transfer of environmental knowledge into political and legislative systems.

Other important advantages of the cooperation between UNU-FLORES and TU Dresden are e.g. the opportunity to share laboratory capacity and to conduct joint appointments. The planned exchange of teaching staff and the realization of common research projects will contribute to a very close collaboration between our institutions.

We are looking forward to getting to know each other and are deeply convinced that both sides will benefit largely from the cooperation between our institutions. Together we will be able to make a significant contribution to improving the management of resources.

Thank you very much.



Wissen schafft Brücken.

Established	1828
Type	Public University
Rector	Prof. Hans Müller-Steinhagen
Faculties	14
Students	36.692 (As of 11 January 2013)
Employees	7.094
Location	Dresden, Germany

Table Source: http://en.wikipedia.org/wiki/TU_Dresden

<http://tu-dresden.de>

Prof. Louis Augusto Pelembe

Minister, Ministry of Science and Technology, Mozambique
(18⁰⁰ - 18¹⁵, 10 December 2012)



Prof. Dr. **Louis Pelembe** was appointed as Minister of Science and Technology of the Republic of Mozambique in 2012. Before his appointment as minister he was Professor and Director of Regional Research Cooperation at University of Eduardo Mondlane (UEM), Maputo. He was a Member and Secretary of Maputo City Assembly (2009-2012). He holds degrees in Food Science (PhD), Food Science and Technology (MSc) from the University of Pretoria (South Africa) and in Chemical Engineering (BSc. Eng. (Hons)) from UEM.

**Honourable Saxon State Minister for Higher Education, Research and the Fine Arts;
Honourable Representative of the Federal Minister for Education and Research;
Honourable Prof. Dr. Konrad Osterwalder, Rector of United Nations University;
Honourable Rector of TU Dresden;
Honourable Prof. Dr. Ana Mondjana, Vice-Rector of Eduardo Mondlane University for academic Affairs and Research;
Dr. Reza Ardakanian, Director of UNU-FLORES; Directors of UNU institutes;
Representatives of government institutions;
Representatives of research institutions;
Representatives of educational institutions;
Distinguished guests; Dear colleagues,
dear friends; Ladies and gentlemen,**

First of all I would like to present my warm greetings to the Honourable Professor Dr. Konrad Osterwalder, Rector of United Nations University (UNU). Thank you Professor for the invitation to attend this remarkable ceremony.

I would like to extend my appreciation to the Government of the Federal Republic of Germany and in particular to the Federal Ministry of Education and Research as well as the Free State of Saxony for the warm reception and hospitality arranged for me and my delegation.

I would to take this opportunity to present my compliments to the Director of UNU-FLORES in Dresden for the accomplishment of the very challenging process that preceded this launching ceremony of the Institute of UNU-FLORES in Dresden.

In this regard, allow us to also convey our profound appreciation to the UNU-FLORES for organizing the **1st and 2nd International Scoping Workshop on the Establishment of the UNU-FLORES and its Twin Institute in Mozambique "Integrated Management of Material Fluxes and of Resources"** alongside UEM.

Honourable Rector, Distinguished guests,

We are glad to be in this ceremony because it is fully aligned with our own science and technology development strategy. In fact, the Government of Mozambique has identified the need for a more intensive and systematic use of science technology and innovation to gear our development. In this regard, in 2006 our Cabinet adopted the Science, Technology and Innovation Strategy (MOSTIS) which states that ST&I *aims at accelerating poverty eradication, creation of wealth and improvement of the social well-being of all Mozambicans*.

According to our Science and Technology and Innovation Strategy, water is one of the strategic areas for the social and economic development of the country as a whole. Equally, MOSTIS identifies knowledge as a key resource to increase productivity and economic growth, therefore urges for the education of Mozambique's citizens

In this regard our Government adopted the Human Resource Development Program for Science and Technology which promotes the creation of research institutions and gives priority for cooperation as key component of our capacity building mechanisms for scientific research, innovation, technology transfer and development.

Distinguished researchers, Ladies and gentlemen,

The issue of Integrated Management of Material Fluxes and Resources is vital; therefore, joint action is critical to address. I am delighted to see that we are all deeply involved in the process of the establishment of the Twin Institute in Maputo. I am also very glad to note that in a moment, we will put a stone mark in our collaboration, through the signing of the Memorandum of Understanding among the UNU, the Ministry of Science and Technology and the Eduardo Mondlane University.

Mozambique is quite proud and enthusiastic for being part of this process. The Ministry of Science and Technology is most delighted to be the representative of Government and avails its full support for the establishment process of the Twin Institute UNU-FLORES Maputo.

Our Government endorses the appointment of the Eduardo Mondlane University as the implementation institution of this initiative. Eduardo Mondlane University has just celebrated its 50th anniversary and is recognized by its pioneering spirit, hardworking and enthusiastic attitude of its staff. We believe with effective participation of Eduardo Mondlane University the Twin Institute UNU-FLORES Maputo will be successful in generating tangible benefits for the institutions and scientists involved but mainly for the citizens in general.

Once again, I want to congratulate the United Nations University for promoting scientific cooperation among various well established research partners and considering scientific research as a top priority and inciting efforts on global and regional levels for practical problem solving.

Thank you for your attention.

Prof. Dr. Reza Ardakanian

Founding Director, UNU-FLORES

(18¹⁵ - 18³⁰, 10 December 2012)



Reza Ardakanian was appointed as founding director of UNU-FLORES in 2012. He holds a PhD in water resources management from McMaster University, Canada and is a faculty member of Sharif University of Technology in Tehran. He served as a former Deputy Minister for Water Affairs in the Ministry of Energy of Iran. He sat on the Board of various international organizations such as UNESCO-IHP, UNESCO-IHE, the International Hydro-power Association and UNU-EHS. He acted as UNU Vice-rector in Europe ad interim during 2009-11. Since 2007 he is serving UN-Water as Founding Director of the UN-Water Decade Programme on Capacity Development (UNW-DPC) hosted by UNU.

Ladies and Gentlemen,

As last presentation for today I would like to provide you an overview of what we have achieved and a roadmap for the future of the institute. Talking about the institutional development of UNU-FLORES, it was an honour for me to be appointed by the rector of UNU in 2010 as focal point to continue on the establishment of the institute. The initiative to establish UNU-FLORES in Dresden gained momentum in October 2010 when the 1st International Scoping Workshop (ISW) was organized in Dresden. In this workshop we were able to define areas of research and postgraduate activities and also the ways of cooperation between UNU, TUD, further research institutes from the region and with existing UNU-institutes around the world. As a result of this, we were able to sign the MoU between BMBF, SMWK, UNU and TUD. We presented all achievements in the form of the statute of UNU-FLORES which was adopted by the council of UNU in December 2010. At the same time BMBF supported the initiative of twinning as mentioned by Mr. Metzger by approving a proposal of feasibility study project for establishing a Twin Institute of UNU-FLORES in Mozambique. We continued working closely with our partners in Mozambique in the Ministry of Science and Technology (MCT) and University Eduardo Mondlane (UEM). They had been participating in the 1st International Scoping Workshop in Dresden together with participants from other African countries' universities and organizations.

In early 2011 we received a letter of interest from the Government of Mozambique in which they expressed their willingness to host the institute and support its establishment. Based on this interest we organized a fact-finding mission to Maputo in May 2011. Together with our rector we had meetings at MCT and also in UEM and we paved the way for organizing the 2nd ISW in Maputo, which took place on 24-25 October 2011. Colleagues from UEM, from TUD, directors of UNU institutes, members of the Council of UNU and international experts

participated in this event. We were able to materialize areas of cooperation and define modules for postgraduate programmes and prepared everything in a way that we were able to finalize the MoU on the establishment of the Twin institute. In the same year, as a follow-up to the MoU for Dresden, we were able to finalize the Funding Agreement for UNU-FLORES in Dresden and based on this we enjoy being financially supported by BMBF and SMWK.

In 2012 as a follow-up to the funding Agreement we worked very closely with SMWK and an affiliated agency, SIB for the premises issue. Thanks to their support and the support of the World Trade Center (WTC) in Dresden, which had been identified as preliminary premises for the start-up phase, we were able to finalize the premises for UNU-FLORES in Dresden. WTC supported us in each and every occasion, including the opening ceremony today. The recruitment of the Founding Director, the today's Official Opening Ceremony, including the signing of the Framework Agreement between UNU and TU Dresden and the MoU for the Twin Institute in Maputo are among our major achievements in 2012.

The opening of the institute should be the appropriate occasion to define its mission. UNU-FLORES will, in line with the general mission of UNU, engage in research, postgraduate education and capacity development in a broad sense. It will contribute to the development of integrated management strategies for the sustainable use of the environmental resources water, soil and waste, focusing in particular on developing and emerging countries. In somewhat more detail the purpose of UNU-FLORES and the scope of its activities have been specified in the statutes of the institute, adopted by the Council of UNU, stating that UNU-FLORES shall engage in research, teaching and capacity development in the areas:

- Systems and flux analysis;
- Cycle and resources management on water, soil and land use and waste;
- Water inventory and fluxes;
- Global change assessment;
- Resources quantity and quality;
- Urban water/urban footprint; and
- Green economy.

We try to concentrate on advancing a nexus approach to the sustainable management of the environmental resources water, soil and waste.

With respect to research, we will initiate research projects in the above-mentioned areas. In line with general UNU policy, research will have an applied focus and be policy-oriented. Projects will be implemented in a collaborative approach together with other UNU-Institutes, with TUD, the planned Twin institute as well as further partners in Germany and outside Germany.

For postgraduate Education we started working on a MSc course on integrated resources management (e.g. joint programme with TUD), a PhD programme (e.g. we think about

involving other UNU institutes and further partners in „multi-nodal“ programme on water) and training programmes on different levels. Common features of all teaching programmes will be that they encompass international exchange programmes for students and teachers as well as internships/research visits at UN agencies. I try to do my best, as director of UNU-FLORES, to also benefit from the experience to work with more than 28 UN Agencies in the framework of UN-Water during the last 5 years. We will emphasize the global dimensions of covered issues. Close cooperation with partners will serve for synergies.

In addition to individual capacity development by providing degrees to students, UNU-FLORES will engage in various activities, e.g. organization of training courses, workshops and seminars and attending international events. We will address the wider public by preparing presentations and publications and also the governance and policy level by providing mappings and analyses as well as policy briefs.

The immediate next steps during the start-up phase of the institute will be characterized by:

- Establishment of International Advisory Committee;
- Finalization of a detailed work plan based on the statute;
- Recruitment of academic staff;
- Activation of the Framework Agreement with TUD (Working groups);
- Establishment of contacts/partnerships;
- Initiating core research programmes;
- Realization of MoU to establish Twin Institute; and
- Developing postgraduate programmes.

In short, UNU-FLORES aims at becoming an internationally recognized focal point promoting a nexus approach to the sustainable management of environmental resources and serving as UN think-tank on resources management.

Thank you for your attention.



Photo: © Hullbr3ach/Wikimedia Commons

Part III Signing of Framework of Cooperation with TU Dresden (18³⁰ - 18³⁵, 10 December 2012)



Photo © Stephan Floss

Building on the signed MoU between BMBF, SMWK, TUD and UNU and referring to the Funding Agreement, a "Framework Agreement" between UNU and TUD was finalized and signed on the occasion of the Opening Ceremony of UNU-FLORES on 10 December 2012. In this agreement the in-kind contribution of the Free State of Saxony mentioned in the Funding Agreement and to be provided via TUD were specified and the areas and ways of cooperation were defined. The agreement provides the framework for joint research projects and joint study programmes to be implemented. A working group on the implementation of the agreement was established.

The working group is currently active in preparing various joint research activities as well as a Proof of Concept for a joint Master of Science course (MSc) in a new study area to be offered as of 2014. The academic officers of UNU-FLORES will serve as guest lecturers in TUD programmes, contribute to seminars and co-supervise students during their thesis work. "Summer schools" will be organized in February/March and July of 2014.



Photo © UNU-FLORES



Photo: © F.H. Mira/flickr.com

Part IV Signing of Memorandum of Understanding with Ministry of Science and Technology University Eduardo Mondlane, Mozambique and United Nations University (18³⁵ - 18⁴⁰, 10 December 2012)



Photo © Stephan Floss

UNU had in 2011 prepared a draft MoU on the establishment of a Twin institute in Mozambique. The draft was based on the MoU of UNU-FLORES, Dresden, considering besides UNU the Ministry of Science and Technology (MCT) and the University Eduardo Mondlane (UEM) as signing parties.

After the appointment of a new Minister of MCT in early October 2012, H.E. Prof. Louis Pelembe, the new Minister, confirmed his support and accepted the invitation to participate in the opening ceremony of UNU-FLORES, Dresden. Until that date, the MoU was finalized to be signed on the occasion of the opening ceremony. A high-ranking delegation comprising stakeholders from MCT and UEM (see stakeholder list in Annex II), headed by Minister H.E. Prof. Louis Pelembe, participated in the opening and in a subsequent workshop to discuss the next steps to be followed for the establishment of the Twin institute in Maputo.

In line with the MoU, a Working Group has been appointed. The working group, established in January 2013, approved a work plan and Terms of Reference and is active in preparing for the establishment of the Twin institute in scientific (e.g. preparing a regional workshop) and organisational terms.



Photo: © Benjamin Zhu

Part V Roadmap of Establishing UNU-FLORES

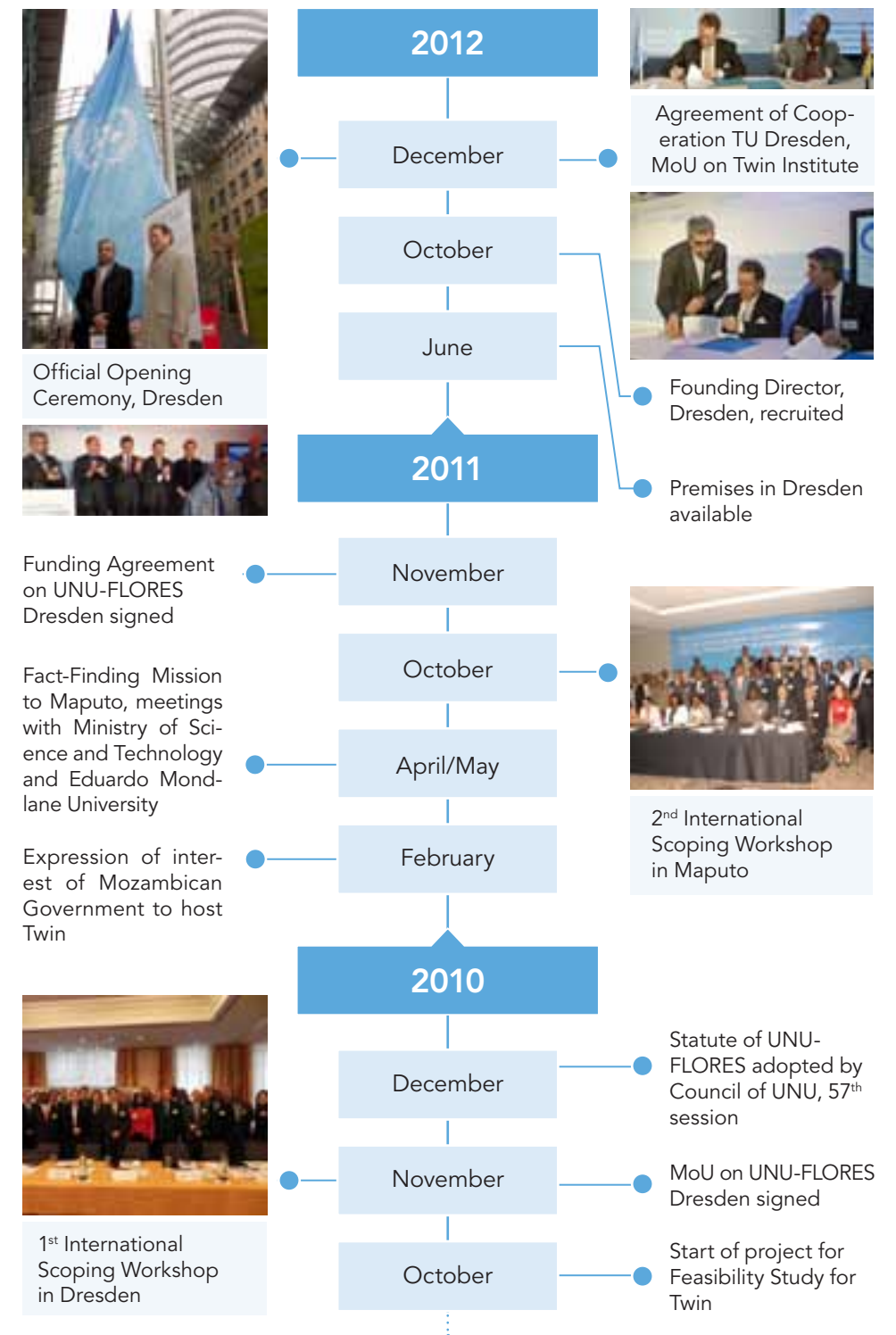
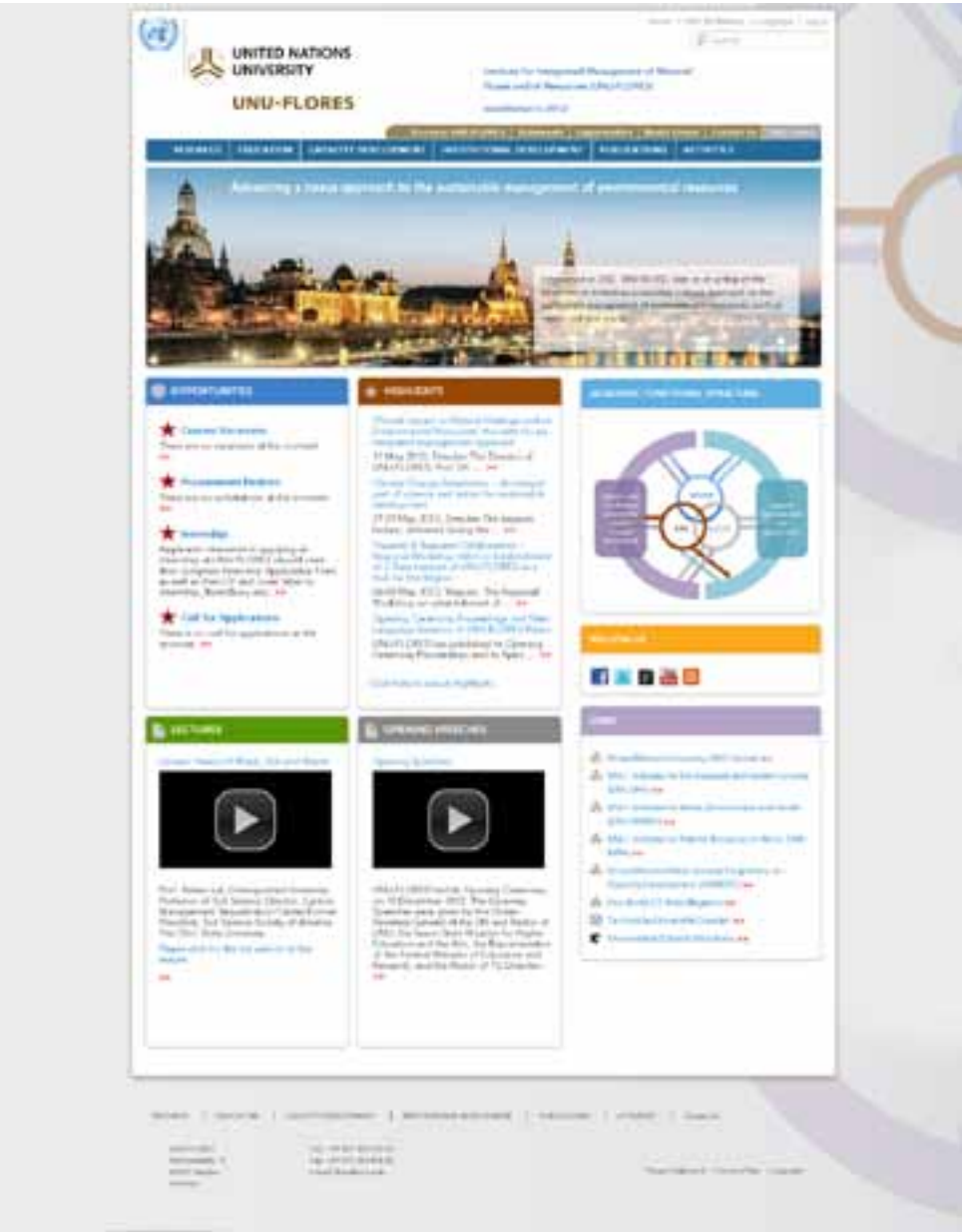




Photo: © CGIAR

Part VI Launch of UNU-FLORES Website

UNU-FLORES launched its website beginning of February 2013. Till 28 February, the website has obtained 9.258 visitors with 45.075 clicks.
Please visit the website at: flores.unu.edu



Opening Ceremony UNU-FLORES

Date: 10 December 2012

Venue: 14th floor conference room

United Nations University,
UNU-FLORES, Ammonstrasse 74, 01067 Dresden Germany

Time	Programme
15:15	Special Pre-Opening Event: UN Flag-Raising Venue: In front of main entrance, World Trade Centre
15:30	Registration
16:00	Scientific Lecture: "Nexus of Soil, Water and Waste" Prof. Rattan Lal , Ohio State University, USA
16:45	Break
17:00	Opening Addresses <ul style="list-style-type: none"> • Prof. Konrad Osterwalder Under-Secretary-General of United Nations, and Rector of United Nations University • Prof. Sabine von Schorlemer Saxon State Minister for Higher Education, Research and the Arts (SMWK) • Mr. Maximilian Metzger (On behalf of the Federal Minister) Deputy Director General – International Cooperation in Education and Research, Federal Ministry of Education and Research (BMBF) • Prof. Hans Müller-Steinhagen Rector of Technische Universität Dresden • Prof. Louis Augusto Pelembe Minister of Science and Technology, Mozambique • Prof. Reza Ardakanian Founding Director of UNU-FLORES Signing Agreement of Cooperation between UNU and its Partner(s)
18:40	Reception

Speeches will be given in English.

Eröffnungsfeier UNU-FLORES

Date: 10 Dezember 2012

Venue: 14. Etage Konferenzraum

United Nations University,
UNU-FLORES, Ammonstrasse 74, 01067 Dresden Germany

Zeit	Programm
15:15	Sonderprogramm: Hissen der UN Flagge Ort: Vor dem Haupteingang, World Trade Centre
15:30	Anmeldung
16:00	Wissenschaftlicher Vortrag: "Nexus of Soil, Water and Waste" Prof. Rattan Lal , Ohio State University, USA
16:45	Pause
17:00	Eröffnungsansprachen <ul style="list-style-type: none"> • Prof. Konrad Osterwalder Untergeneralsekretär UN, Rektor, United Nations University • Prof. Sabine von Schorlemer Sächsisches Staatsministerium für Wissenschaft und Kunst (SMWK) • Mr. Maximilian Metzger (in Vertretung der Bundesministerin) Ministerialdirigent, Leiter der Unterabteilung 21 Internationale Zusammenarbeit in Bildung und Forschung, Bundesministerium für Bildung und Forschung (BMBF) • Prof. Hans Müller-Steinhagen Rektor, Technische Universität Dresden • Prof. Louis Augusto Pelembe Minister für Wissenschaft und Technologie, Mosambik • Prof. Reza Ardakanian Gründungsdirektor UNU-FLORES Unterzeichnung von Kooperationsabkommen zwischen UNU und Partner(n)
18:40	Empfang

Das Programm wird in Englischer Sprache statt finden.

List of Stakeholders/Participants (as of 10 December 2012)

No.	Name	Function	Organization
From Ministries (Germany)			
1	H.E. Prof. Sabine von Schorlemer	State Minister	Saxon State Ministry for Higher Education, Research and the Arts (SMWK)
2	Dr. Maximilian Metzger (On behalf of the Federal Minister of Education and Research)	Deputy Director General - International Cooperation in Education and Research	Federal Ministry of Education and Research (BMBF)
3	Dr. Martin Frick	Ambassador to the UN	Federal Foreign Office
4	Mr. Thomas Stratenwerth	Head of Division – General, Fundamental, International and European Aspects of Water Management	Federal Ministry for Environment, Nature Conservation and Nuclear Safety (BMU)
5	Dr. Bernadette Denzinger	Policy Officer	Federal Ministry of Education and Research (BMBF)
6	Mr. Kai Ahlborn	Personal Secretary to the State Minister	Saxon State Ministry for Higher Education, Research and the Arts (SMWK)
7	Dr. Angelika Dshemuchadse	Desk Officer	Saxon State Ministry for Higher Education, Research and the Arts (SMWK)
8	Mr. Matthias Lupp	Desk Officer	Saxon State Ministry for Higher Education, Research and the Arts (SMWK)
9	Mr. Matthias Winker	Desk Officer	Saxon State Ministry for Higher Education, Research and the Arts (SMWK)
10	Mr. Karltheodor Huttner	Deputy Spokesperson	Saxon State Ministry for Higher Education, Research and the Arts (SMWK)

No.	Name	Function	Organization
11	Mr. Stefan Wagner	Head, Corporate Branch – Central Office	Saxon State Office for Real Estate and Construction Management (SIB)
12	Ms. Annedore Rudolph	Head of Unit – Dresden Branch	Saxon State Office for Real Estate and Construction Management (SIB)
From Mozambique			
13	H.E. Prof. Luis Augusto Pelembe	Minister	Ministry of Science and Technology (MCT)
14	H.E. Mr. Amadeu Paulo Samuel Da Conceição	Ambassador of Mozambique to Germany	Ministry of Foreign Affairs
15	Prof. Ana Maria Graça Mondjana	Vice Rector for Academic Affairs	University of Eduardo Mondlane (UEM)
16	Prof. Emilio Tostão	Dean of the Faculty of Agronomy and Forestry Engineering	University of Eduardo Mondlane (UEM)
17	Prof. Alberto Júlio Tsamba	Dean of the Faculty of Engineering	University of Eduardo Mondlane (UEM)
18	Ms. Roda Nuvunga Luis	Deputy National Director for Research	Ministry of Science and Technology (MCT)
19	Mr. Luis Muchanga	Cooperation Office	University of Eduardo Mondlane (UEM)
From Cities			
20	Hon. Ms. Angelica Kappel	Mayor	City of Bonn
21	Mr. Stefan Szuggat	Head - Urban Planning Office	City of Dresden
22	Mr. Jürgen Rees	Head - Dresden Branch	POLARES Real Estate Asset Management GmbH

List of Stakeholders/Participants (ctd.)

No.	Name	Function	Organization
From Technische Universität Dresden (TUD)			
23	Prof. Hans Müller-Steinhagen	Rector	Technische Universität Dresden (TUD)
24	Prof. Gerhard Rödel	Vice Rector for Research	Technische Universität Dresden (TUD)
25	Prof. Hans-Gerd Maas	Dean – Faculty of Environmental Sciences	Dresden University of Technology (TUD)
26	Prof. Christian Bernhofer	Vice Dean – Faculty of Environmental Sciences	Dresden University of Technology (TUD)
27	Prof. Karl-Heinz Feger	Vice Dean – Faculty of Environmental Sciences	Dresden University of Technology (TUD)
28	Prof. Peter Krebs	Director – Institute for Urban Water Management	Dresden University of Technology (TUD)
29	Prof. Thomas Berendonk	Director – Institute of Hydrobiology	Dresden University of Technology (TUD)
30	Prof. Hanno Hortsch	Director – Institute for Vocational Education	Dresden University of Technology (TUD)
31	Prof. Bernd Bilitewski	Professor – Waste Management	Dresden University of Technology (TUD)
32	Mr. Jörg Seegert	Chief Executive Officer (CEO) – Dresden Water Centre (DKW)	Dresden University of Technology (TUD)
33	Dr. Rolf Baur	Course Director – Centre for International Postgraduate Studies of Environmental Management (CIPSEM)	Dresden University of Technology (TUD)
34	Dr. Dirk Jungmann	Research Associate – Institute of Hydrobiology	Dresden University of Technology (TUD)

No.	Name	Function	Organization
35	Ms. Antje Urban	Research Associate UNESCO – Chair in International Relations	Dresden University of Technology (TUD)
From Universities and Institutes (Germany)			
36	Prof. Hans Wiesmeth	President	Dresden International University (DIU)
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43	Prof. Rattan Lal	Director, Carbon Management Sequestration Center	Ohio State University, Columbus, Ohio · USA
44	H.E. Dr. Beate Maeder-Metcalf	Vice President and Ambassador	East-West Institute, Brussels · Belgium

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47	Prof. Govindan Parayil	Vice Rector; Director	Institute of Advanced Studies (UNU-IAS), Yokohama · Japan
48	Prof. Jakob Rhyner	Vice Rector in Europe; Director	Institute for Environment and Human Security (UNU-EHS), Bonn · Germany
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