Spring 2011

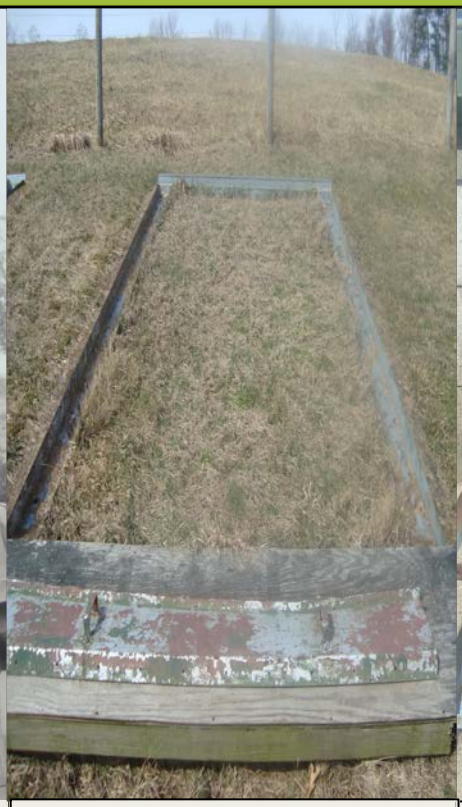
THE OHIO STATE UNIVERSITY OARDC

CENTER CarbOn sequeStration

Student Field Trip to Coshocton

Photos courtesy of: A. Gelaw

How Coshocton lysimeter was constructed



Lysimeter plot

Coshocton wheel & proportion sampler

A. Gelaw, M. Varghese and O. Vilmnundardottir studying soil physics

Inside:

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Research Scientist Moves On

Dr. Klaus Lorenz, valued OSU Research Scientist (2005-2011) returns to his home country Germany for a prestigious appointment with the Advanced Sustainability Studies (IASS)

Dr. Klaus Lorenz was pioneering researcher at C-MASC in studying soil organic carbon storage in entire soil profiles under agricultural, forest and urban land uses. He started as a post doctoral fellow in 2005. In 2007 He was promoted to Research Scientist. Dr. Lorenz established chemical and physical fractionation methods to separate soil organic carbon fractions differing in degree of stabilization. Klaus Lorenz' research highlighted the importance of organic carbon fractions in sub-soil horizons stabilized in association with the mineral phase for mitigation atmospheric increases in carbon dioxide. Translocating organic carbon to deeper soil layers is a potential strategy to adapt the large soil organic carbon pool to climate change.

Dr. Lorenz is now Research Fellow at the Institute for Advanced Sustainability Studies (IASS) in Potsdam, Germany - a recently established think tank funded by the leading science and research organizations in Germany.

According to the IASS CHARTER, the institute will PROMOTE SCIENCE AND RESEARCH INTO GLOBAL SUSTAINABILTY PARTICULARLY IN THE AREAS OF CLIMATE CHANGE, THE EARTH SYSTEM AND SUSTAINABLE DEVELOPMENT. As SOILS ARE CRITICAL TO SUSTAINABLE DEVELOPMENT AND THEREFORE must BE A FOCAL PART OF SCIENCE AND RESEARCH AT IASS.

A major task for Dr. Lorenz is to establish the research focus soil science at IASS aside co-organizing workshops on recarbonization of the biosphere, ecosystem services and a global platform on soil protection.

Please see the images on the following page of the new facilities in Potsdam.

IASS Workshops

IASS Potsdam, Germany
Recarbonization of the Biosphere 20-22 March 2011

The Institute for Advanced Sustainability Studies (IASS) was founded in February 2009 in Potsdam, Germany, on the initiative of the German Federal Ministry of Education and Research (BMBF) in coordination with the Alliance of German Scientific Organizations. One of the objectives of IASS is to organize strategic dialogue and unlock critical potential in its focal areas of research into climate change, Earth system dynamics and the sustainable development of the human habitat.

Klaus Töpfer (Executive Director IASS) and Rattan Lal (Member IASS Scientific Advisory Council) together with The Organizing Committee are convening a workshop entitled 'Recarbonization of the Biosphere' to be held on the 20-22 March 2011 at IASS Potsdam. This workshop will involve 15-20 scientists to discuss the current understanding of the role of ecosystems in the carbon cycle, and future perturbations of carbon cycling in the biosphere and its interaction with the Earth-Human System. Articles presented at the workshop will be published as a book by Springer Verlag.

Left to Right: K. Lorenz,R. Lal, P. Crutzen (Nobel Laureate), and T. Tilmann

Left to Right: K. Topfer, P. Crutzen, and R. Lal,

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IASS Workshops

Continued....

Recarbonization of the Biosphere 20-22 March 2011

RECOMMENDATIONS FOR POLICY MAKERS

The workshop entitled "Recarbonization of the Biosphere" was sponsored by the Institute of Advanced Sustainability Studies, and held in Potsdam, Germany from 20-23 March 2011. It was attended by about 30 participants from Germany, USA, Australia, Italy, France, China representing soil science, forestry, climatology, sociology, and political sciences along with policy makers and media representatives. Specific recommendations for the policy makers emerging from the deliberations include the following:

Land-Based Carbon Sinks: Priority ecosystems with large C stocks which must be protected and sustainably managed are: permafrost, wetlands, peatlands, tropical rainforests, tropical savannas, urban lands, degraded or desertified lands, and agricultural lands.

C Sink Capacity Management: The C sink capacity of land-based sinks are continuous, and require long-term management and protection strategy because it grows with a progressive improvement in ecosystem health.

Ecosystem Services and Co-Benefits of Land-Based C Sinks: Protecting and enhancing land-based sinks generate numerous ecosystem services. Important among these are:

- Food security,
- Quality and quantity of renewable fresh water resources,
- Adaptation and mitigation to climate change, and
- Biodiversity

A Global Instrument of Soil Protection: The key roles in advancing food security and providing numerous co-benefits and ecosystems services of vital significance to humanity necessitate identification, nurturing and support of an organization with primary focus on sustainable management and protection of world soils.

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Upcoming IASS Workshops

May 29-31 Towards a Global Instrument on Soil Protection (GISP) and Management

Key stakeholders (10-12) on soil protection mainly from the European and International soil science community (ECSSS, ESCS, EU JRC Soil, IUSS, ISRIC, FAO, IAEA, WB, UNEP, UNCCD etc.) will be invited to deliberate "modus operandi" for creating the GISP. The meeting will generate the 'Potsdam Declaration' towards creation of GISP.

November 6-9 Carbon Sequestration and Ecosystem Services

Renowned scientists are invited to discuss how the restoration of the ecosystem C (and especially soil C) pools may enhance ecosystem services with specific reference to agronomic production and food security, use efficiency of inputs, water quality, biodiversity etc. The focus is on enhancing ecosystem services. The results obtained will contribute to an improved understanding of short- and long-term impacts of current land use and adaptability to abrupt climate change, disposal of wastes, chemical fertilization, genetically modified organisms, conflicting interests with regard to food and energy production and enhanced soil sealing (urbanization) rates. The human dimensions issues (i.e., food security, access to land and water) and payments for enhancing ecosystem services will be deliberated.

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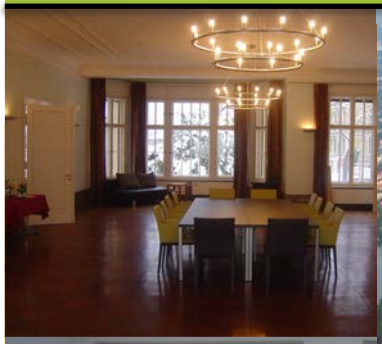
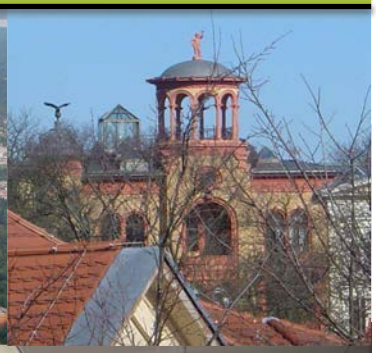
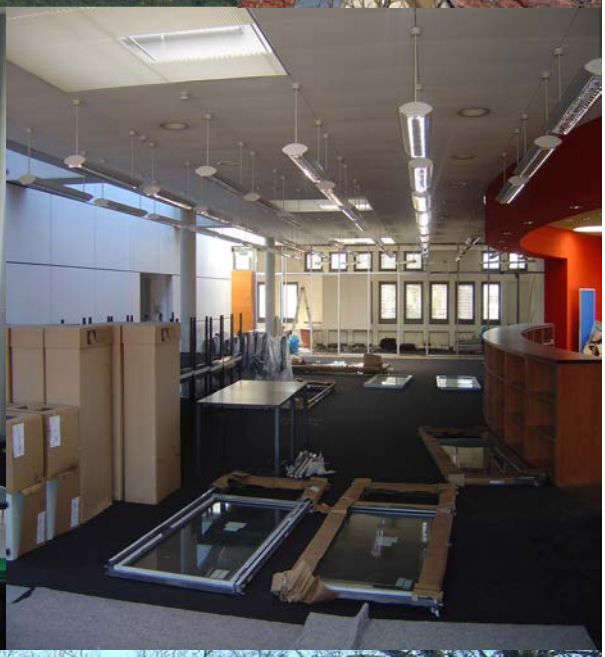
IASS Potsdam, Germany







Visiting Scholars

Dr. Meharban Singh Kahlon, April 2010-May 2011

Title of Training Program: Soil water dynamics, hydrological components and carbon pool studies under different tillage and mulch practices in view of climate change scenario.

Sponsoring University: Punjab Agricultural University, Ludhiana, India

Goals:

1) Quantify soil water balance components under different tillage practices
2) Determine changes in soil hydrological components under different tillage practices in corn based cropping systems
3) Assess soil physical quality and carbon pool variations in different aggregate size fractions under long term tillage and mulch interaction studies
4) Acquire knowledge regarding recent developments in field of research, teaching and extension in USA universities.

Achievements in goals:

1. Initial Experimental Setup: Soil water dynamics and hydraulic properties under long-term tillage practices in corn-based cropping system in Southern Ohio:

Place of Experiment : South Center, OH (OARDC); Crop: Corn (*Zea mays L.*)

Experimental details: Field measurements were made on an on-going experiment initiated in 2004 and involving different tillage practices. Two tillage systems selected for the present study were: conventional tillage (CT) and no-till (NT). The CT plots were tilled twice every season before sowing of corn, where as NT plots were never tilled. There were three replications, with the individual plot size of 15×30 m. A buffer zone of 15m was maintained between adjacent plots.

Parameters monitored:

Soil Parameters:

1. Soil moisture dynamics measurements: (up to 90 cm depth): (a) Regular monitoring of gravimetric and volumetric soil moisture content throughout the corn growing season and (b) periodic measurement of soil matric potential, soil moisture storage and drainage throughout the corn growing season
2. Soil hydraulic properties: (a) Water infiltration characteristics: Initial and steady state infiltration, cumulative infiltration, soil water sorptivity and transitivity, and (b) saturated hydraulic conductivity

2. Soil mechanical properties: (a) Bulk density and (b) Penetration resistance

Plant parameters: (a) Relative water content, (b) Leaf desiccation rate, and (c) Root mass distribution

Continued on page….

Visiting Scholars Continued...

Dr. Meharban Singh Kahlon Continued...

Research Highlights:

Soil water dynamics and related aspects:

Soil moisture conservation through suitable tillage techniques has became an important issue in recent years due to global warming which significantly affects amount and distribution patterns of precipitation. The data obtained show that

No-till significantly improves soil moisture storage throughout the growing season as compared to conventional tillage.

Long-term use of conventional tillage increases soil compaction at 20-30 cm depth (as observed from significantly higher penetration resistance and bulk density), which adversely affects other hydraulic properties (i.e., infiltration capacity and saturated hydraulic conductivity). The disruption of soil structure and channels result in lower infiltration characteristics for disturbed soil under conventional tillage. A long-term use of no-till is needed for improving soil hydraulic properties.

Significant temporal variations in soil matrix potential were observed. More retention of soil moisture in no-till particularly during the dry period of the crop season helps in improving crop growth. There were significant correlations between soil moisture dynamics and hydraulic properties, especially with respect to bulk density, infiltration capacity, saturated hydraulic conductivity, porosity, volumetric soil moisture content, and soil matrix potential.

Plant parameters:

Plant's ability to maintain turgidity and growth under drought conditions through proper tillage is essential in scenario of global climate change and limited water situations. Analysis of the results of present study showed that:

No-till maintains significantly higher relative water content even during drought conditions as compared to conventional tillage due to high soil moisture reserves.

Under drought conditions, stomata close much earlier under conventional tillage than in no-till due to higher transpiration losses and leaf temperature.

Tillage also significantly impacts root mass distribution, higher root mass density observed in the surface soil layer under no-till may be due to higher soil moisture and nutrient availability. However, more concentration of roots in the sub-surface layer in conventional tillage may be due to presence of plow pan thereafter. Roots may also proliferate to deeper depth in conventional tillage due to less moisture availability in the surface soil layers.

It is also recommended that long term studies be under taken to confirm these results and their interactions with soil water, soil temperature, environmental factors and agronomic practices namely weed control, nutrition and waters supply and interactions between above ground and belowground parts namely, leaves, shoot and roots.

Visiting Scholars Continued...

DR. HEBA ELBASIOUNY

Heba Elbasiouny is an assistant lecturer in Al_Azhar University, Egypt. She is a visiting scholar at C-MASC, School of Environment and Natural Resources, Ohio State University since 05/18/2009 until 05/15/2011.

She is studying the spatial variation of carbon and nitrogen pools in Nile Delta, Egypt. It known that the Nile Delta is one of the most fertile deltas in the world, in addition millions of Egyptian people are living and working in this area. This delta is subjecting to the impact of climate change and sea level rise. However, the studies about soil C and N pool is rare, so she focuses her research in this point.

As well as she is conducting the impact of salts on gases emissions and microbial biomass in unsalt-affected soils through incubation study in C-MASC lab. The incubation study is done on two soils from waterman farm (Kokomo and Crospy) to assess the impact of NaCl on microbial biomass and gases emissions and to link between the impact of salts and lack of C and N pools in degraded soils.

She also interested in using remote sensing and GIS techniques to detect the change in vegetation cover in Ohio State through 1984 – 2006 through landsat images.

Future proposals:

Estimating different soil & vegetation carbon pools in the Nile Delta region through field study in addition to new techniques such as remote sensing and GIS.

Estimating potential soil carbon sequestration in Nile delta.

Assessment the soil quality in salt-affected soils in Egypt.

Conducting the effect of restoring degraded ecosystem on enhancing carbon sequestration and mitigate the impacts of climate change.

She wants to express her sincere thanks firstly to Dr. Lal for hosting her in C-MASC and continued support in order to achieve her objectives from this visiting to OSU. As well she introduce all thanks to everybody in the program specially Theresa Colson for the kindness and cooperation.

Visiting Scholars Continued...

DR. LONG LIANG

Post Doc, College of Resources and Environmental Science, China Agricultural University

Education: 2009 D.Sc. Agricultural Sciences
2004 M.A. Education
2001 L.L.B. Law
1996 B.A. in Chinese Literature

Research Interests: Carbon Sequestration, Climate Change and Low-carbon Development

Program of Study at C-MASC: He is a visiting scholar at C-MASC for twelve weeks from January 28, 2011 through April 28, 2011. He will be researching Climate Change and Regional low-carbon develop under the supervision of Professor Rattan Lal. The focus of his research will be on analyzing the situation of agriculture and C sequestration potential in Beijing, including agricultural ecosystem, living stock and poultry farming systems and rural household carbon emission. Furthermore, he will write articles about low-carbon agriculture in modern city such as Beijing and propose proper strategies for rural development in the process of urbanization in China.

DR. XIANGBIN KONG

Associate professor
Department of Land Resource and Management, College of Resource and Environmental Sciences, China Agricultural University .
Education: 2003 Doctor's degree Soil Science

Research Interests: Carbon Sequestration, Soil Quality, Land Use Change and the Effects

Program of Study at C-MASC:
He is a visiting scholar at C-MASC for one year from January 21, 2011 through January 21, 2012. He will be researching Soil Carbon, Climate Change and Soil Quality under the supervision of Professor Rattan Lal. The focus of his research will be on analyzing the effects of long term with different treatment on soil carbon pool and crop yields in HHH (Huang Huaihai) region in China. He will also analysis the effects of land use change ,especially land use intensification on soil organic change and the soil carbon potential in this area. Finally, he will write article about the effects of different long-term fertilizer input treatment and land use change on soil organic carbon pool and on crop yield in HHH plain in China.

Dr. Dennis Garrity, Guest Lecturer, SENR Seminar Seminar Series, 02/2011

Maize growing under a canopy of *Faidherbia* trees in southern Tanzania. Photo: World Agroforestry Centre

EVERGREEN AGRICULTURE

"Evergreen agriculture allows us to glimpse a future of more environmentally sound farming where much of our annual food crop production occurs under a full canopy of trees."

Dr Dennis Garrity, Director General, World Agroforestry Centre

The challenge for agriculture

Throughout the world, agriculture is faced with an immense challenge: how to increase yields to feed a growing population from depleted soils and do so in the face of climate change. Can this be achieved in a way that is sustainable, affordable and does not further threaten biodiversity?

African agriculture must be transformed in the coming decades. At least twice as much food must be produced by 2050 to avoid widespread starvation amongst an expected population in Africa of 1.8 billion. But, food production per capita has been declining, and cereal yields have remained stagnant since the 1960s. Can productivity be doubled, while at the same time adapting to climate change, and also reducing greenhouse gas emissions in ways that will benefit smallholder farmers?

Fresh, out-of-the-box approaches will be necessary to make this possible.

Evergreen Agriculture is emerging as an affordable and accessible science-based solution to caring better for the land and increasing smallholder food production.

Evergreen Agriculture = A practical transformation

Hundreds of thousands of women and men farmers in Zambia, Malawi, Niger and Burkina Faso are successfully restoring exhausted soils with richer sources of organic nutrients, and dramatically increasing both their crop yields and incomes through the adoption of Evergreen Agriculture.

The integration of appropriate fertilizer trees into agriculture is a promising, but underappreciated, approach. Evergreen Agriculture, where trees are intercropped in annual food crop and livestock systems, sustains a green cover on the land throughout the year. It bolsters nutrient supply through nitrogen fixation and nutrient cycling, increases direct production of food, fodder, fuel, fibre and income from products produced by the trees. Such trees also greatly enhance carbon storage above-ground and below-ground compared to conventional agriculture, thus enhancing opportunities for rewards in the form of agricultural carbon offsets. Trees on farms also enhance resilience to climate variability and climate change.

The evidence

The principles of Evergreen Agriculture have already been widely applied in Africa, where diversity and complexity is a common feature of agricultural systems. The most promising results are coming from the integration of fertilizer trees into cropping systems. These trees improve soil fertility by drawing nitrogen from the air and transferring it to the soil through their roots and leaf litter. Scientists have been evaluating various species of fertilizer trees for many years, including *Sesbania, Gliricidia* and *Tephrosia.* Currently, *Faidherbia albida* is showing particular promise as a possible cornerstone of Evergreen Agriculture in the future.

This indigenous African acacia is already a natural component of farming systems across much of the continent. Unlike most other trees, *Faidherbia* sheds its nitrogen-rich leaves during the early rainy season and remains dormant throughout the crop-growing period. The leaves grow again when the dry season begins. This makes it highly compatible with food crops because it does not compete with them for light, nutrients, or water during the growing season: only its bare branches spread overhead while the food crops grow to maturity (see the photograph on the front of this flyer).

In Zambia, more than 160,000 farmers have extended their conservation farming practices to include the cultivation of food crops within agroforests of *Faidherbia* trees.

Similar results have emerged from Malawi, where maize yields increased up to 280% in the zone under the canopy of *Faidherbia* trees compared with the zone outside the tree canopy. The Malawi Agroforestry Food Security Programme is integrating fertilizer, fodder, fruit, fuelwood and timber tree production with food crops on small farms at a national scale.

In Niger, there are now more than 4.8 million hectares of *Faidherbia*-dominated agroforests enhancing millet and sorghum production, with up to 160 trees on each hectare.

Encouraged by this, new programs to promote farmer-managed natural regeneration with *Faidherbia* and other species have been established in Burkina Faso and other countries across the Sahel.

In each of these cases, there is evidence that the practices have increased household and national food security, and that national governments are deepening their support for the expansion of these Evergreen Agriculture systems.

A call to action: pilots and policies

The success of Evergreen Agriculture has prompted vigorous political action at the continental level. In April 2009, at a meeting organized by the African Union in Addis Ababa, the Ministers of Agriculture, Land and Livestock from across the continent published a declaration committing them to ramping up efforts to increase the number of farmers practicing agroforestry-based conservation agriculture. They also called for increased international support for these efforts. Subsequently, the African Ministers of Environment endorsed this recommendation during their meeting in Nairobi in May, 2009.

A broad alliance is now emerging of governments, research institutions, and international and local development partners committed to expanding Evergreen Agriculture to meet current and future demands across Africa.

Investments are needed for additional pilot projects that further refine and adapt these technologies to a wider range of smallholder farming systems in diverse agricultural environments, especially in the breadbasket regions of other countries. Capacity development is also required, of farmers and the institutions and organizations that support them. So too, policy linkages must simultaneously be advanced so that Evergreen Agriculture can be fully supported. Millions of other farmers can benefit for many years, and for generations to come, from such sustainable and truly African solutions to their food production challenges.

"Successful examples of evergreen agriculture from Africa urgently need further research and scaling up to create a real evergreen revolution." Prof MS Swaminathan, Founder, MS Swaminathan Research Foundation

"There is considerable potential to use trees to improve soil fertility, food production, food security and reduce poverty." Dr Namanga Ngongi, President, Alliance for a Green Revolution in Africa (AGRA)

For more information

World Agroforestry Centre website www.worldagroforestry.org
Visit our Evergreen Agriculture page www.worldagroforestry.org/evergreen_agriculture
Email: icraf@cgiar.org