Impact of Canada-China Environmental Research

Jing M. Chen\textsuperscript{1}, Joseph Whitney\textsuperscript{1}, and Julia Pan\textsuperscript{2}

\textsuperscript{1}Department of Geography and Program in Planning
\textsuperscript{2}Ontario Institute for Studies in Education
University of Toronto, Ontario, Canada

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Canada’s overall investment in Canada-China environmental research from 1983-2013

Review of 5 projects led by University of Toronto

Legacy of these projects
Canada’s Overall Investment in Environmental Research in China from 1983-2013

- China Council for International Cooperation on Environment and Development (CCICED) ($20 Millions in 3 phases);
- Canada Climate Change Development Fund (~$10 Million on 6 projects in China);
- Biodiversity Protection and Community Development in Inner Mongolia Autonomous Region;
- Canada-China Cooperation in Cleaner Production;
- Canada-China Jiangsu SME Applied Management and Environment;
- Canada-China Cooperation on the Management of Environmental Sustainability;
- At least three other programs that have an environment component.
# Canada-China Environmental Projects
Led by University of Toronto

<table>
<thead>
<tr>
<th>Project Title</th>
<th>Funding Agency/Duration</th>
<th>Principal Investigators</th>
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<tbody>
<tr>
<td>Soil Erosion and Land Management in the Granitic Regions of Guangdong Province</td>
<td>IDRC/ 1987-1990 $495,000</td>
<td>Shiu-hung Luk Qingyin Yao</td>
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<tr>
<td>GIS-based Erosion Management Outreach Program for China: Consolidation and Training (SEMGIS 2)</td>
<td>CIDA/ 1996-2001 $700,000</td>
<td>Rodney White Qiangguo Cai</td>
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<tr>
<td>Sustainable Water Management in the Beijing-Tianjin Region (subproject in the 3X4 project)</td>
<td>CIDA/AUCC $1,458,000</td>
<td>Michael Leaf Rodney White Shu Tao Shiqiu Zhang</td>
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<tr>
<td>Combating Global Change: Enhancing China’s Capacity in Forest Carbon Sequestration</td>
<td>CIDA/2002-2006 $2,300,000</td>
<td>Jing M. Chen Jiyuan Liu</td>
</tr>
</tbody>
</table>
Geographic Locations of These Projects

- Changbaishan
- Heihe
- Liping
- Xinguo
- Baoying
- Wangjiagou
- Beijing
- Tianjin
- Deqing

- PI: Shiu-hung Luk, U Toronto and Qingyun Yao, Guangdong Institute of Geography
- Study region: Deqing County, Guangdong Province

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**Major Outcome:**
- Data for quantitative assessment of soil erosion by rainfall;
- Effectiveness of ferns (*Dicranopterus linearis* and *Blechnum orientale*) in erosion control;
- Upstream and downstream relationship: policy implication.

**Legacy:** Encouraged the development of rational soil erosion control policies and practices.

- PI: Joseph Whitney, U Toronto, and Yongzong Chen, INSGR
- Study region: Wangjiagou, Lishi, Shanxi Province

- PI: Joseph Whitney, U Toronto, and Yongzong Chen, INSGR
- Study region: Wangjiagou, Lishi, Shanxi Province

Plate 4-2: Rainfall simulation experiments Wangiangou (Photo: S.H. Luk).

- PI: Joseph Whitney, U Toronto, and Yongzong Chen, INSGR
- Study region: Wangjiagou, Lishi, Shanxi Province

Major Outcome:
- Introduction of GIS technology for soil erosion control;
- ERODE and YIELD models are validated using data collected from rainfall simulation experiments using an innovative sprinkler system;
- Finding that terraces may trigger tunnelling and induce catastrophic erosion.

Legacy: The idea of using computers for land management was well received and used by local government and farmers, and laid foundation for SEMGIS II.
Project 3: GIS-Based Erosion Management Outreach Program (SEMGIS II) for China (1996-2001)

- PI: Rodney White, U Toronto, and Qiangguo Cai, IGSNRR, CAS
- Study region: Wangjiagou, Lishi, Shanxi Province
Project 3: GIS-Based Erosion Management Outreach Program (SEMGIS II) for China (1996-2001)

- PI: Rodney White U Toronto, and Qiangguo Cai, IGSNRR, CAS
- Study region: Wangjiagou, Lishi, Shanxi Province

**Major Outcome:**
- Implementation of Window-based GIS to run on ordinary PCs;
- An AGROFORESTRY submodel of YIELD was developed;
- Household surveys on farmer’s perceptions of the impacts of land use scenarios on their livelihood.

**Legacy:** GIS-base soil erosion management was first adopted by Shanxi Ministry of Water Resources and used for many small watersheds across Shanxi Province. It was also endorsed by the Chinese Ministry of Water Resources for adoption across the country.
Project 4: Sustainable Water Management in the Beijing-Tianjin Region (1997-2004)

Our first comprehensive research workshop, Nankai University, 1999
Project 4: Sustainable Water Management in the Beijing-Tianjin Region (1997 - 2004)

Prof. Lino Grima (University of Toronto) reads through material presented by municipal planners
Project 4: Sustainable Water Management in the Beijing-Tianjin Region (1997 - 2004)

**Major Outcome:**
- Quantified water deficit of the region if existing water use trends continue and no action is taken;
- Assessed impacts of various water use management strategies on reducing the water deficit.

**Legacy:** A set of water management position papers were submitted to high-level offices. These papers might have influenced water use policy by the local governments, although the extent of the influence is assessed mostly based on anecdotal information rather than formal documents.

- PI: Jing Chen, U of Toronto, Jiyuan Liu, IGSNRR, CAS
- Study sites: Heihe, Gansu; Changbaishan, Jilin; Liping, Guangxi; Xingguo, Jiangxi; Baoyin, Jingsu

**Participating Institutions:**
- Inst. of Geog. Sci. & Natural Resources Research, CAS (Jiyuan Liu)
- Beijing Normal U. (Qijiang Zhu)
- Nanjing Inst. Soil Sci., CAS (Xuezheng Xue)
- Nanjing U. (Qingjiu Tian)
- Nanjing Agric. U. (Jianjun Pan)
- University of Toronto (Joe Whitney, Sean Thomas, Virginia Maclaren)
- Canada Centre for Remote Sensing (Josef Cihlar)
- Environment Canada (Yongyuan Yin)

**Project Managers**
- Julia Pan (U of T)
- Gaohuan Liu (IGSNRR)

- PI: Jing Chen, U of Toronto, Jiyuan Liu, IGSNRR, CAS
- Study sites: Heihe, Gansu; Changbaishan, Jilin; Liping, Guangxi; Xingguo, Jiangxi; Baoyin, Jingsu
Brown coniferous forest soils
(针叶林黄壤)
Korean pine, spruce and fir

Shi Xuezheng, etc. Nanjing Institute of Soil Science
Ground Truthing and Remote Sensing at Changbaishan

Leaf area index

\[ RSR = 14.57 - 14.57 \times \exp(-0.13 \times LAI) \]

\[ R^2 = 0.57179 \]

Net primary productivity

\[ y = -4.4765 + 1.04236 \times x \]

\[ R^2 = 0.7355 \]

Sun Rui, Zhu Qijiang, etc. Beijing Normal University
soil sample incubated:

25°C, 90 days

Study on SOC decomposition

PAN Jianjun, YANG Lixia, Nanjing Agricultural University

人工培养箱土壤碳分库试验
Validation of Soil Organic Matter Modeled by InTEC at Changbaishan

\[ y = 1.1435x - 0.3585 \]

\[ R^2 = 0.758 \]
The landscape of Guizhou Karst areas

黎平县

Lipings 贵州喀斯特地貌
Study Site: Guizhou Province, Liping County
40–year-old Chinese fir forest

40岁杉树
Natural Masson Pine Forest 马尾松
Grain-for-Green Program 退耕还林

Plots in Liping County 黎平县
NPP DYNAMIC CHANGE OF LIPING COUNTY, GUIZHOU PROVINCE (ETM, 2001)
Comparison between the field measurement and Prediction of NPP

BEPS NPP 验证

August, 2004 Liping County, China

$r^2=0.71$

NPP (t/hm²·a)

Plot NO.

Measurement value

Prediction value
Validation of Soil Organic Matter Simulation by InTEC at Liping Country

\[ y = 1.0335x + 0.6017 \]

\[ R^2 = 0.6324 \]

Measured soil organic carbon density (kg/m², 0-20 cm)

Simulated (kg/m²)

PAN Jianjun, SHAO Yuhong, YANG Lixia, et al. Nanjing Agricultural University
Heihe River Basin

Characterized by little precipitation, rapid evaporation, and low runoff ratio

<table>
<thead>
<tr>
<th>Drainage system</th>
<th>Precipitation</th>
<th>Runoff</th>
<th>Runoff ratio</th>
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<tr>
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<td>10^8 m^3</td>
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<td>10^8 m^3</td>
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<td>East drainage system</td>
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<tr>
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<td>19125</td>
<td>33.5</td>
<td>9.61</td>
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</table>

Characterized by little precipitation, rapid evaporation, and low runoff ratio.
semi-desert 半干旱地区

Shrub 灌木

Forest 森林

Grassland 草地
Alpine shrub 高山草甸

Elevation:
3629m

snowing
Elevation: 2600-3000m,
North slope: Dragon Spruce Forest
Elevation: 2883m
Mountainous meadow
山地草甸

Elevation: 3004m

Mountainous Chestnut soils
山地褐壤
Ejina Banner, Inner Mongolia
Populus Euphratica forest: very old 胡杨
Spatial distribution of annual NPP

全中国碳循环模拟

China-wide Carbon Cycle Modeling
Spatial Patterns of NEP in China’s forest ecosystem from 1992 to 2001 (g/m²)

碳源汇空间分布

WANG Shaoqiang, etc., IGSNRR
Future China’s Carbon Dynamics Under Two Climate Scenarios

(a) 5K Warming 850 ppm

(b) 3K Warming 600 ppm

- PI: Jing Chen, U of Toronto, Jiyuan Liu, IGSNRR, CAS
- Study sites: Heihe, Gansu; Changbaishan, Jilin; Liping, Guangxi; Xingguo, Jiangxi; Baoyin, Jingsu

**Major Outcome:**
- Trained participants for use of instruments and models;
- Calibrated Canadian models for China’s ecosystems;
- Mapped the carbon source and sink distribution over all China’s forests and projected its future trends;
- Assessed the “Grain for Green” policy.

**Legacy:** The project made direct scientific contributions to China’s climate policy in response to the Kyoto Accord. A Landuse Decision Support Tools package, consisting of short-term and long-term carbon models, an ecohydrological model, and a multi-criteria integrated assessment model, is provided to the home institution the Chinese State Forestry Administration and is used for China’s carbon sequestration projects.
Instruments and models are getting more widespread with time after the project.

<table>
<thead>
<tr>
<th>Institution</th>
<th>TRAC, DHP</th>
<th>5-Scale</th>
<th>RSA</th>
<th>BEPS</th>
<th>InTEC</th>
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<td>Institute of Opto-electronics</td>
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<td>School of Hydrology, Wuhan University</td>
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TRAC: Optical instrument for measuring LAI
DHP: Digital Hemispherical Photography software
5-Scale: geometrical optical model
RSA: remote sensing algorithms
BEPS: Boreal Ecosystem Productivity Simulator
InTEC: Integrated Terrestrial Ecosystem Carbon Cycle Model
Fond Memory

- Among several international funding sources, Canada’s aid was highly sought after for its genuine help for China’s development with no strings attached, and the Canadian values of improving the life of ordinary people and gender equality are much appreciated.

- Canadian projects were generally very well managed and had clear purposes. Annual advisory board meetings and annual project meetings were well organized and helpful for project execution. The Canadian Embassy in Beijing held annual Chinese New Year parties for the main project participants that allowed them to maintain and expand their scientific ties and social networking. These meetings and parties are fondly remembered!
Canada’s aid to China’s environmental research was delivered at a time of China’s rapid economic development and elevated concerns on environmental problems. The aid given by Canada will have long-lasting impacts for the following reasons:

- Human capital development: trained many Chinese leaders in environmental research;
- Models, algorithms, instruments and data: continuous and more widespread use in China’s environmental and earth science research;
- Canadian values and spirit: remain in the hearts of many Chinese people.
Acknowledgement

We are particularly grateful for the following individuals who provided useful information for this presentation:

- Kent Smith, Former CIDA
- Cai Qiangguo and Liu Gaohuan, IGSNRR
- Li Nuyun and Wang Chunfeng, SFA