

APN Final Activity Report

APN Supported Project: Land Use/Management Change and Trace Gas Emissions in East Asia (APN 2001-16)

Project Leaders: Arvin R. Mosier; Research Chemist; USDA/ARS, P.O.Box E, Fort Collins, CO 80522, USA; amosier@lamar.colostate.edu; and Cai Zucong; Soil Scientist and Head of Division of Soil Chemistry and Environmental Protection, Institute of Soil Science, Chinese Academy of Sciences, P.O. Box 821 Nanjing, China, zccai@ns.issas.ac.cn

APN/START Funding: : Year 1 (2000-2001): \$82,700; Year 2 (2001-2002): \$56,400;

Participants from the following countries were funded: China, Germany, Indonesia, Japan, Philippines, Thailand, USA

Project Summary

The main objectives of the project were to: (a) develop an East Asian trace gas flux data base; (b) continue development of temperate east Asia and southeast Asia land cover/use data bases; (c) integrate agricultural land management into land use data bases; (d) link these data bases; and (e) evaluate methodologies, using data bases, to project regional trace gas emissions and (f) to consider mitigation strategies.

As noted in the 2000 Project Report, the main goal for the first year of the project was to perform the initial data base development both for trace gases and land use/management. These objectives were outlined in an initial project workshop in Nanjing, China in June, 2000. This effort also initiated the first steps to integrate southeast Asia and temperate east Asia land use data bases. The addition of land management information is an important new development for the land use data bases. Currently, land use data bases do not differentiate between crop production systems. Specific accomplishments during the first phase of the project were discussed during a second project workshop in Bangkok, Thailand in January, 2001:

1. The first phase of development of the trace gas data base (graduate student Mr. Guoding Kang was employed to develop the database).
2. Considerable progress has been made on inputting land management into the temperate east Asia land use data bases (Mr. Zhengxing Wang was employed to work on the landuse/management database).
3. The Thailand land use data base is now operational and available for use (Mr. Teerapun Keeprasertsup is now partly funded to assist in web page and Thai land use/management data base work).
4. A workshop on the input and analysis of Thailand project trace gas and land use information from the APN Project data bases into the DNDC model was completed. Participants used the specific Thai site data to simulate the impacts of agricultural practice and water management on methane emissions from rice ecosystems. This exercise also helped to recognize data base needs and gaps that needed to be filled.

The main goal for the second year was to use the information developed during the first year of the project to conduct integrative analyses using the DNDC model for a number of locations within East Asia. A third project workshop was held at the International Rice Research Institute in Los Baños, The Philippines January 7-11, 2002, mainly to discuss these analyses. A number of difficulties had to be overcome to accomplish the tasks outlined in 2001 as the land use/management data base teams in Beijing and Bangkok determined that the soils data bases, and others, for specific countries were not documented in the same format or with same definitions. As a result, combining land use data sets proved to be much more difficult than expected when the project was initiated. This project brought together scientists who collect trace gas data from the field, remote sensing specialists, and biogeochemical modelers, who previously had not worked together. They found that formatting and availability of information needed to link the biogeochemical models with trace gas data base and land use/management change information cannot be completely implemented at the present time. The full effort will take a considerable investment in time and resources which are far beyond the scope of APN funding. During the 3rd workshop a DNDC model workshop was conducted and 15 research papers were presented on projects that were conducted with data from the trace gas data base and the DNDC model. Success and problems were demonstrated and the combined effort will be documented in the five manuscripts to be prepared for Global Biogeochemical Cycles.

Introduction/Background

Land use and land management data sets exist for temperate East Asia and for South East Asia but currently do not include adequate land management information and are not interactively linked. We proposed the development of a trace gas data base (from existing studies) to which we would link to these land use and land management data bases and improve the land management parts of the data bases. From these data bases an analysis and synthesis of the impact of land management and land use changes on trace gas emissions (methane and nitrous oxide) from terrestrial ecosystems in East Asia are proposed. These analyses would facilitate policy development for land management and atmospheric constituents in the region. The main objectives of the project were to: (a) develop an East Asian trace gas flux data base; (b) continue development of temperate east Asia and southeast Asia land cover/use data bases; (c) integrate agricultural land management into land use data bases; (d) link these data bases; and (e) evaluate methodologies, using data bases, to project regional trace gas emissions and (f) to consider mitigation strategies.

Outline of activities conducted

The first organizational workshop for the project was held in Nanjing, China, June 19-21, 2000. Funding for the workshop was provided by the APN Program and was hosted by the Institute of Soil Science, Chinese Academy of Science in Nanjing. Eighteen persons participated, 8 from outside China. Our objectives for the first workshop were for participants to get acquainted and to start forming working relationships, to identify trace gas data sets, and to identify common links for setting up the trace gas data base. The processes of linking temperate East Asia and Southeast Asia land use data bases and identifying mechanisms of scaling from field to provincial to national and regional projections were begun. Overall project goals were confirmed and persons listed in the first workshop report were identified as contributors of specific project information.

The initial goal of developing the trace gas data base has been completed. Linking this to the land use data bases is continuing to progress with plans set for initial analysis. In addition, the main integrative tool to link trace gas and land use/management data bases is the DNDC (DenitrificationDecomposition model developed by Changsheng Li) model, Jariya Boonjawat volunteered to set up a Project web page through her START office in Bangkok.

A second project workshop was held in Bangkok, Thailand, January 19-22, 2001. During this workshop we evaluated the trace gas and land use data bases that have been compiled. These data bases are now held on CD and are available for project use (were submitted with project report in February 2001). During the workshop we identified gaps in the data bases and mechanisms by which to fill the gaps. The trace gas data base contains more than 80 data sets from 36 locations in China, Indonesia, Japan, Philippines and Thailand. About 60% of the sets contain only methane flux data and the remainder contain both nitrous oxide and methane data. The majority of the data sets are from agricultural systems, typically rice based agriculture constitutes a significant agricultural practice in east Asia. A day during the workshop was devoted to conduct a DNDC model validation for a test case using Thailand data that was contributed to the databases. Following the project workshop APN/START project participants had the opportunity to participate in a two day IGAC symposium (International Global Atmospheric Chemistry activity of the International Geosphere Biosphere Program). This symposium provided Project scientists the opportunity to interact with members of the IGAC scientific council who are among the leading atmospheric scientists internationally. Project participants presented six oral and 5 poster papers at the symposium which was attended by 12 IGAC science council members and about 50 other persons. Project papers were presented by Xunhua Zheng, Reiner Wassmann, Haruo Tsuruta, Orawan Siritpiriya, Tolentino Moya and Rhoda Lantin, Arvin Mosier, Changsheng Li, and Chuang Liu. Details for project activities between June 2000 and January 2001 were provided in the 2000 Project report (copy attached as appendix 1).

In July, 2001 a poster session was held during the International Geosphere Biosphere Program Science Conference in Amsterdam the Netherlands, that highlighted our APN project. six posters were presented by persons involved with the project. An overall project poster entitled : "Land Use/Management Change and Trace Gas Emissions in East Asia: Asian-Pacific Network for Global Change Research/START: Project Ref: APN2000-01 & APN2001-16" anchored the session.

The third Project workshop was held At the International Rice Research Institute (IRRI) in Los Baños, The Philippines, January 7-12, 2002. The workshop was attended by 19 project scientists and 8 participants from IRRI, Philippine Rice Research Institute and Philippines Agricultural University, Los Baños (UPLB). The day of January 7, Dr. Changsheng Li conducted a workshop on the use of the DNDC model to integrate trace gas emissions across regional scales, using China as an example. The workshop was attended by 24 persons from the project, IRRI and local scientists (Attendance list in Appendix 2). The following three days project progress reports were presented and discussions were held to facilitate finalizing the project products. Five manuscripts were outlined to be included in a special section of the journal, Global Biogeochemical Cycles. On 11 January staff from IRRI presented research goals from IRRI and interacted with project scientists in a lengthy discussion session during the day. The full workshop proceedings are attached as Appendix 2.

Outcomes/Products

The main goal for the second year was to use the information developed during the first year of the project was to conduct integrative analyses using the DNDC model for a number of locations within East Asia. A number of difficulties had to be overcome to accomplish these tasks as the land use/management data base teams in Beijing and Bangkok determined that the soils data bases, and others, for specific countries were not documented in the same format or with same definitions. As a result, combining land use data sets proved to be much more difficult than expected when the project was initiated. This project brought together scientists who collect trace gas data from the field, remote sensing specialists, and biogeochemical modelers, who previously had not worked together. They found that formatting and availability of information needed to link the biogeochemical models with trace gas data base and land use/management change information cannot be completely implemented at the present time. The full effort will take a considerable investment in time and resources which are far beyond the scope of APN funding. During the 3rd workshop 15 research papers were presented on projects that were conducted with data from the trace gas data base and the DNDC model. Success and problems were demonstrated and the combined effort will be documented in the five manuscripts to be prepared for Global Biogeochemical Cycles (GBC). The manuscripts outlined encompass the concepts discussed in the second workshop. The papers to be prepared for submission to GBC are as follows:

1. Analysis of net GHG Emission and agricultural land management in East Asia (Li, Cai, Wassmann, Mosier, Liu, Tsuruta, Wang, Orawan, Setyanto, Lantin, Moya)
2. East Asia Land Use Data Integration in Support of Biogeochemical Analysis (Boonjawat, Liu, Li, Lantin, Wang).
3. Land classification system for trace gas emissions in East Asia (Liu, Boonjawat, Tsuruta, Moya, Setyanto, Wang, Delgrosso).
4. Model inter-comparison of Net GWP in Upland East Asian Soils (Del Grosso, Li, Mosier, Wassmann, Wang).
5. Field validation of the DNDC Model for trace gas emissions in East Asian Cropping Systems (Cai, Sawamoto, Li, Moya, Kang, Huang, Setyanto, Wassmann)

Training and Capacity Building

The project also promoted training and capacity building through the partial funding of Ph.D. programs of Mr. Guoding Kang in Nanjing and Mr. Wang Zhengxing in Beijing. Ms Nattaya Tanyarak, a graduate student at Chulalongkorn University, Bangkok, Thailand was also partially funded by the project. Post doctoral fellow, Dr Takuji Sawamoto, Department of Environmental Planning, National Institute for Agro-Environmental Sciences, Tsukuba, Japan, and Ph.D. student, Mr. Steve Del Grosso, Colorado State University, Fort Collins, CO, USA, also participated in the third workshop.

The DNDC modeling workshops conducted by Dr. Changsheng Li were attended by approximately 30 scientists from Thailand and the Philippines as well as APN project scientists.

Interactions with other Organizations

Project participants interacted directly with the IGAC scientific steering committee during a symposium following the Project workshop in Bangkok, January 2001. Project participants also conducted a poster section of the IGBP all science conference in Amsterdam, July, 2001. During the project workshop in The Philippines Mr. Leandro Buendia, program officer for the Intergovernmental Panel on Climate Change, Hayama, Japan, presented a lecture about the IPCC National Greenhouse Gas Inventory mechanisms. He highlighted the role of the agricultural sector and land management (approximately 80% of global N₂O emissions and 40% of CH₄ emissions are attributed to the agricultural sector and another important fraction of CO₂ and CH₄ linked to land use change). He expounded upon the continual need for such projects as this APN program in the development of models which further describe land use and agricultural greenhouse gas emissions and facilitate interaction of mitigation technologies with improved crop production.

Future directions/follow-up work

The final products for this phase of the project will be the manuscripts submitted for publication in a special section of Global Biogeochemical Cycles. An attempt to locate funding will be made to conduct two workshops to promote capacity building for biogeochemical modelling and remote sensing data base development. Further attempts may also be pursued to acquire funds to continue full development of the goals set out in the initial project. Proposals will be prepared within the coming 6-8 months in attempt to support program and training activities.

Project Website Details

Project reports can be found at <http://www.start.or.th/ea/lutg/>

3rd Project Workshop

Details of the third project workshop can be found in Appendix 2. Power point presentations made during the workshop can be viewed on a CD provided to the APN office.

Appendix 1

Land Use/Management Change and Trace Gas Emissions in East Asia APN/START 2000/2002: Project Ref: APN2000-01 Year End Report

Project Leaders: Arvin R. Mosier; USDA/ARS, P.O. Box E Fort Collins, CO 80522, USA, amosier@lamar.colostate.edu; and Cai Zucong; Institute of Soil Science, Chinese Academy of Sciences, P.O. Box 821 Nanjing, China, zccai@ns.issas.ac.cn

APN Funding: Two year proposal: Year 1: \$82,700; Year 2: \$56,400; Project was begun June, 2000.

Participating Countries: China, Japan, The Philippines, Thailand, USA

Participants were funded from the following countries:

Workshop participation was funded for persons from China, Japan, The Philippines, Thailand and USA. Project activity funding was used in China and Thailand.

Introduction/Background:

Land use and land management data sets exist for temperate East Asia and for South East Asia but are currently not interactively linked. We proposed the development of a trace gas data base (from existing studies) to which we would link to these land use and land management data bases. From these data bases an analysis and synthesis of the impact of land management and land use changes on trace gas emissions (methane and nitrous oxide) from terrestrial ecosystems in East Asia are proposed. These analyses would facilitate policy development for land management and atmospheric constituents in the region. The main objectives of the project are to: (a) develop an East Asian trace gas flux data base; (b) continue development of temperate east Asia and southeast Asia land cover/use data bases; (c) integrate agricultural land management into land use data bases; (d) link these data bases; and (e) evaluate methodologies, using use data bases, to project regional trace gas emissions and (f) to consider mitigation strategies.

Outline of activities conducted:

The first organizational workshop for the project was held in Nanjing, China, June 19-21, 2000. Funding for the workshop was provided by the APN Program and was hosted by the Institute of Soil Science, Chinese Academy of Science in Nanjing. Eighteen persons participated, 8 from outside China. Four Chinese scientists who are conducting trace gas work in China were invited to participate and joint the APN project: Dr. Huang Yao (Nanjing), Dr. Zheng Xunhua (Beijing), Dr. Huang Guohong (Shenyang) and Dr. Xing Guangxing (Nanjing). Dr. Rhoda Lantin from the Philippines represented the UNDP methane project and Dr. Sakorn Phongpan (Bangkok, Thailand) substituted for Pornpimol Chaiwanakupt (Bangkok, Thailand).

Our objectives for the first workshop were for participants to get acquainted and to start forming working relationships, to identify trace gas data sets, and to identify common links for setting up the trace gas data base. The processes of linking temperate East Asia and Southeast Asia land use data bases and identifying mechanisms of scaling from field to provincial to

national and regional projections were begun. Overall project goals were confirmed and persons listed in the first workshop report were identified as contributors of specific project information.

The initial goal of developing the trace gas data base has been completed. Linking this to the land use data bases is continuing to progress with plans set for initial analysis. In addition, the main integrative tool to link trace gas and land use/management data bases is the DNDC (DenitrificationDecomposition model developed by Changsheng Li) model, a workshop was held to conduct an initial DNDC model validation for a test case using Thailand data that was contributed to the databases. Jariya Boonjawat volunteered to set up a Project web page through her START office in Bangkok. The time frame for and contributors to the initial project activities are listed in the first Workshop Report.

At the second workshop (second Workshop Report will be submitted in February, 2001) we evaluated the trace gas and land use data bases that have been compiled. These data bases are now held on CD and are available for project use. During the workshop we identified gaps in the data bases and mechanisms by which to fill the gaps. The trace gas data base contains more than 80 data sets from 36 locations in China, Indonesia, Japan, Philippines and Thailand. About 60% of the sets contain only methane flux data and the remainders contain both nitrous oxide and methane data. The majority of the data sets are from agricultural systems. Typically rice based agriculture constitutes a significant agricultural practice in east Asia. Goals for the second year of the project are outlined below.

Outcomes/Products

The main goal for the first year of the project was to perform the initial data base development both for trace gases and land use/management. This effort also initiated the first steps to integrate southeast Asia and temperate east Asia land use data bases. The addition of land management information is an important new development for the land use data bases (see CD of initial data bases for review if needed). APN project participants presented project results during an IGAC (International global atmospheric chemistry activity of IGBP) scientific meeting in Bangkok January 22-23, 2001, following the APN workshop.

Specific products:

- The first phase of development of the trace gas data base (graduate student Mr. Guoding Kang was employed to develop the database) (available for viewing on CD).
- Considerable progress has been made on inputting land management into the temperate east Asia land use data bases (Mr. Zhengxing Wang was employed to work on the landuse/management database) (available for viewing on CD).
- The Thailand land use data base is now operational and available for use (Mr. Teerapun Keprasertsup is now partly funded to assist in web page and Thai land use/management data base work) (available for viewing on CD).
- The strategy for integrating the Thailand and Beijing land use/management data bases was initiated January, 2001 during the Bangkok Workshop.
- A workshop on the input and analysis of Thailand project trace gas and land use information from the APN Project data bases into the DNDC model was completed. This workshop was hosted by Jariya Boonjawat and conducted by Changsheng Li during 17 and 18 January in the Environmental Science Department of Chulalongkorn University. There were 16 participants from Thailand who worked with Dr. Li to input data from the APN data base into DNDC (DNDC model is available for viewing on CD) and worked with the data to understand how the DNDC model functions. They then used the specific

Thai site data to simulate the impacts of agricultural practice and water management on methane emissions from rice ecosystems. This exercise also helped to recognize data base needs and gaps that needed to be filled.

Project Plans for 2001

During the Bangkok workshop the following goals for the coming year were set:

1. We have identified 5 main products in which we will use the data bases for analysis and integration of trace gas fluxes in east Asia:
 - a. Development and use of a detailed land use data base for the Philippines to be used for the country-scale estimation of methane emissions.
 - b. Intercomparison of different upscaling methodologies for estimating methane emissions from rice at the country scale.
 - c. Land use management data integration at different scales in support of biogeochemical analysis.
 - d. An analysis of the relationship between methane and nitrous oxide emissions during wet/dry season cropping sequences in east Asia.
 - e. Managing agricultural soils to mitigate net greenhouse gas emissions in rice-based cropping systems.
2. The projects noted above will require intensive collaborative efforts to complete. The goal to present completed manuscripts that describe the results of the project at a third workshop, tentatively, to be held at the International Rice Research Institute in Los Banos, The Philippines, during the week of January 7, 2002. Using the format set by the U.S. Trace Gas Network, we hope to publish the papers as a set in *Global Biogeochemical Cycles*. In addition, goals for formulation of documents to support policy will be discussed during the coming year. The possibility of linking this APN project to other related efforts, such as the Land use/cover change in Asia and the carbon cycle project that is meeting 29 January, 2001.

Following are brief descriptions of the 5 projects that are planned for 2001:

1. Estimating methane emissions from Philippine rice-based agroecosystems
(Tolentino B. Moya, Rhoda S. Lantin, Changsheng Li, and Reiner Wassman)

Rice-based cropping systems dominate Philippine agriculture. Reportedly, flooded rice cultivation is a key emission source of methane (CH_4) and could be critical to accomplishing the goals stipulated by the United Nations Framework Convention on Climate Change (UNFCCC). Except for a few research sites, CH_4 emission rates from rice cropping systems in the country had, at best, been estimated by the IPCC inventory methodology. With the availability of integrated data base on land use, biophysical and management factors of various crop production environments through the efforts of the Philippine Department of Agriculture and the development of Denitrification-Decomposition (DNDC) model, there evolves an opportunity to estimate CH_4 emission rates in greater details from rice-based cropping systems in the Philippines. The DNDC, a mechanistic model, was developed based on classical laws of physics, chemistry and biology, as well as empirical equations to simulate carbon and nitrogen biogeochemistry. The study aims to characterize CH_4 emissions various rice-based cropping

systems in the Philippines and to provide understanding on the influence of environmental and management factors on the rates of emission.

2. Intercomparison of different upscaling methodologies for estimating methane emissions from rice (Reiner Wassmann, Xhenua Zheng, Tolentino B. Moya, Rhoda S. Lantin, Changsheng Li, Zucong Cai, Haruo Tsuruta, Robin Matthews)

The basic idea for this paper is using

- one dataset comprising land management, soils and meteorology and
- several methodologies of upscaling methane emissions from rice fields
- This approach will be conducted for China, Thailand, Indonesia and the Philippines. The major outcome of the paper should be
- to document the range of uncertainty deriving from the use of upscaling methodologies and
- to identify the causes of deviations.

The dataset to be used for upscaling procedures be adopted from an approach recently published in a special issue of 'Nutrient Cycling in Agroecosystems'. This set collates land management and meteorology data from IRRI documents soil data (in a compatible format with the other data) derived from the FAO soil map.

The possible upscaling methodologies comprise:

1. DNDC model
2. IPCC coefficients
3. MERES model
4. Differentiated coefficients
5. Sass/Huang model
6. CENTURY model (if available with a methane module in due time)
7. Net Primary Productivity (used as proxy)
8. Organic input (used as proxy)

This list may slightly be modified within the course of writing the paper.

The paper will be structured into following sections:

- Introduction to the purpose
- Description of the data base
- Description of the upscaling procedures and the way how they use the data
- Results/ discussion
- Conclusion

The scheduled time frame is to complete all model runs until April 2001 and to produce a draft manuscript until June 2001. The manuscript will be submitted to a journal jointly with the other APN manuscripts.

3. Land Use Management Data Integration at Different Scales in Support of Biogeochemical Analysis (Chuang Liu, Dennis Ojima, Haruo Tsuruta, Jariya Boonjawat, Changsheng Li, Sombat Yumuang)

Currently various data sets are available describing land use and land cover at the national and global scale. Recent data developments related to interpretation of remote sensing observations have greatly enhanced the description of land cover during the past several decades, however, the land cover classification schemes vary and a harmonization of these schemes is desirable to take advantage of the individual merits of these observations for trace gas emissions.

The development of specific land use management practices related to fertilizer inputs, irrigation management, tillage practices, and organic matter management is important to making trace gas estimates. Much of this information is available from the county level agricultural census data. This information is available only in administrative units and need to be consolidated with the gridded databases for making estimates of trace gas emissions.

The objective of this analysis is a sequential comparison of trace gas estimates based on different land use and land cover data sets. This analysis will provide an insight to the level of information necessary to provide a better estimate of GHG emissions. The initial assumption is that the coarse land cover information provided by the IGBP DISCover data base is too crude to use as is for estimating realistic net exchange of GHG's. Information is needed that can improve the spatial area estimates (Table 1) and in land management information of cropping systems and vegetation types for appropriate analysis of GHG emissions.

Table 1. Comparison of IGBP DISCover and TM-based NLCD (1996) of key land cover types for north east China. The units are 1000 x km².

	Forest	Grassland	Cropland	Wetland	Urban
Source					
DIScover	664	987	1151	1.9	6.4
NLCD (TM)	715	1280	1246	85	4.4

The study would focus on the comparison of land use data inputs for the mid 90's using data available from AVHRR data, TM data, and county level census data. The analysis will be based on data available from China, Japan and Thailand. The development of a land cover translation scheme will be developed which will provide a harmonization scheme between various land cover schemes (e.g., IGBP DISCover, EDC Olson's, DNDC scheme, and Century scheme).

Management information is more available from county or provincial level census information. This data would support data needs of models, such as, DNDC or Century. The management data are statistical representation of cropping management systems, fertilization, irrigation areas, and cropping areas.

The data base integration scheme will be developed using the vector-based census information to the gridded data bases derived from the remote sensing data. The raw information and derived data will be made available as well as the documentation of the efforts to create these derived databases.

Trace gas estimates will be derived from the various levels of land cover and land use data sets. We will use a common data set for soil and climate. The estimates will be generated using methodologies described in the previous study (#2).

4. A comparative analysis of methane and nitrous oxide data from wet/dry season cropping sequences in East Asia. (Haruo Tsuruta, Zucong Cai, Sakorn Phongpan, Arvin Mosier)

Emissions of methane and nitrous oxide vary through an annual rice-based cropping season dependent upon seasonal rainfall, irrigation, and field management. A number of measurements have been made during the past few years to quantify trace gas emissions through the whole year rather than just during the time of flooded rice production. Our goal with this paper is to analyze these data and determine if there are relationships between methane and nitrous oxide emissions that are not readily predicted by water use and to explore possibilities of mitigating net greenhouse gas emissions during annual cropping sequences that undergo wet and dry seasons, such as are typical across east Asia. There are currently four multi-year data sets from different locations in China (Henan, Jiangxi, Jiangsu, Shenyang), one each from Indonesia, the Philippines (Los Banos) and Thailand (Supanburi), and two from Japan (Okayama and Tsukuba) that are incorporated into our APN/START database. The literature will be reviewed for other relevant studies and the data incorporated into the data base. These data will then be used to analyze the seasonal and annual relationships between methane and N₂O emissions. An evaluation of a mechanistic understanding of the relationships will be initiated. These analyses will then be used to develop strategies to limit relative global warming potential due to emissions of these gasses. These mitigation options will, of course, be explored in the light of maintaining or improving crop production.

5. Managing agricultural soils to mitigate net greenhouse gas emissions in rice-based cropping systems in central China (Zucong Cai, Haruo Tsuruta, Changsheng Li, Sakorn Phongpan, Gouxing Kang, Arvin Mosier)

Management within different cropping systems can directly impact net global warming (GWP) of soil carbon (CO₂), CH₄ exchange and N₂O emissions. To test this hypothesis and to assist in the evaluation of mitigation strategies for rice-based cropping systems for areas within China for which soil C, and fluxes of CH₄ and N₂O have been quantified, a DNDC model simulation study will be conducted. A sensitivity analysis across sites to assess mitigation potential for different management scenarios (timing, type, amount of fertilizer additions, organic matter amendments, tillage, crop rotations, water management) will be evaluated for new GWP. Such management variables can impact crop yield, soil carbon storage and the exchange of CH₄ and N₂O. The relative impact on all three gases needs to be considered when assessing GWP because of the much greater GWP for CH₄ and N₂O.

Project plan:

1. Use data from APN data base for two sites in Shichuan and four sites in Jiangsu (for Shichuan there is a 7-year data set that includes soil carbon, CH₄ and N₂O flux) for DNDC model verification and modification if necessary.
2. Once model verifications are complete conduct a sensitivity analysis of DNDC to evaluate the impact of N input, timing, placement and type; organic matter input, water regime, tillage, crop rotations to determine their effect on fluxes of CH₄, N₂O and soil carbon. A 20 year time frame will be used to observe simulated changes in soil carbon. Observations of changes in fluxes and soil C will be made annually and cumulatively over the 20 years. The GWP values for CH₄ and N₂O to be used are the IPCC 20-year time frame values, 62 and 290, respectively.
3. From these analyses mitigation options will be determined for which crop production is either maintained or increased while the net GWP is reduced.

Publications: A manuscript that describes the results of each of the above projects will be prepared for a special section of the journal *Global Biogeochemical Cycles*. We will follow the guidelines set by the U.S. TRAGNET trace gas activity in which a special section of *Global Biogeochemical Cycles* was published in December, 2000 that described synthesis and analysis products from the TRAGNET trace gas data base. This issue will be discussed with Professor Bill Reeburgh who is the editor of *Global Biogeochemical Cycles*. Our goal is to have the five manuscripts ready for submission immediately following the January 2002 workshop that is tentatively scheduled to be hosted by Rhoda Lantin and Toti Moya at the International Rice Research Institute in Los Banos, The Philippines. Dennis Ojima is organizing a poster module for the July, 2001 IGBP Open Science Conference that will feature our APN project activities. At least five different posters are anticipated with contributions from Chuang Liu, Changsheng Li, Reiner Wassmann, and Dennis Ojima.

Participants in the 2nd Project Workshop:

Thai participants in the DNDC modeling workshop conducted by Changsheng Li—January 17 and 18:

Dr. Apisit Eiumnoh	Mr. Somnuek Pongsai
Mr. Sukprachok Ua-kritdathikarn	Dr. Sirintornthep Towprayoon
Ms. Kruamas Smakgarn	Prof. Wongphun Limpaseni
Dr. Laddawan Kunnoot	Mr. Niwat Chareonsilp
Mr. Chitnucha Buddhaboorn	Assoc. Prof. Dr. Orawan Siriratpiriy
Ms. Sangchan Limjirakan	Dr. Anond Snidvongs
Assoc. Prof. Dr. Jariya Boonjawat	Asst. Prof. Sombat Yumuang
Mr. Teerapun Keeprasertsup	Mr. Mongkon Taoun

APN/START Project Workshop Participants:

Jariya Boonjawat, Thailand	Chitnucha Buddhaboorn, Thailand
Zucong Cai, China	Niwat Chareonsilp, Thailand
Gouding Kang, China	Teerapun Keeprasertsup, Thailand
Laddawan Kunngot, Thailand	Rhoda Lantin, Philippines
Sagchan Limjirakan, Thailand	Changsheng Li, USA
Sangchan Limjirakan, Thailand	Chuang Liu, China
Arvin Mosier, USA	Tolentino Moya, Philippines
Dennis Ojima, USA	Sakorn Phongpan, Thailand
Orawan Siriatpiriya, Thailand	Anond Snidvongs, Thailand
Haruo Tsuruta, Japan	Sirintornthep Towprayoon, Thailand
Sukprachok Ua-kritdathikarn, Thailand	Bauying Wang, China
Zhengxing Wang, China	Reiner Wassmann, Philippines (Germany)
Wongpun Limpaseni, Thailand	Xunhua Zheng, China
Sombat Yumuang, Thailand	

IGAC Symposium "Atmospheric Chemistry in the Tropics: From Local to Global, From Air Pollution to Climate Change" (January 22-23).

The International Global Atmospheric Chemistry (IGAC) is a core project of the International Geosphere-Biosphere Program in cooperation with the Commission on Atmospheric Chemistry and Global Pollution of the International Association of Meteorology and Atmospheric Sciences.

APN/START project participants had the opportunity to participate in a two day IGAC symposium. This symposium provided Project scientists the opportunity to interact with members of the IGAC scientific council who are among the leading atmospheric scientists internationally. Project participants presented six oral and 5 poster papers at the symposium which was attended by 12 IGAC science council members and about 50 other persons. Project papers were presented by Xunhua Zheng, Reiner Wassmann, Haruo Tsuruta, Orawan Siritpiriya, Tolentino Moya and Rhoda Lantin, Arvin Mosier, Changsheng Li, and Chuang Liu. The following Project people participated in the symposium:

Jariya Boonjawat, Thailand; Gouding Kang, China; Rhoda Lantin, Philippines; Changsheng Li, USA; Chuang Liu, China; Arvin Mosier, USA; Tolentino Moya, Philippines; Sakorn Phongpan, Thailand; Orawan Siritpiriya, Thailand; Haruo Tsuruta, Japan; Bauying Wang, China; Reiner Wassmann, Philippines (Germany); Xunhua Zheng, China

Appendix 2

Land Use/Management Change and Trace Gas Emissions in East Asia: APN/START 2000/2002

3rd Workshop International Rice Research Institute Los Baños, The Philippines 07-11 January 2002

Program

06 January 2002, Sunday

Arrival in Manila and transfer to Los Baños

07 January 2002, Monday

DNDC Model Workshop

8:30 Registration

Venue: Seminar Room, Harrar Hall

9:00-17:00 DNDC Training/Workshop

Venue: Burma Room, MSS Hall

CS Li

08 January 2002, Tuesday

Venue: Seminar Room, Harrar Hall

8:00 Registration

Session Chair: Arvin Mosier

8:30 Welcome

WGPadolina

DDG Partnerships

AMosier

8:40 Opening remarks

Project summarization and overview

Land Use/Management Change & Trace Gas

Emissions in East Asia: An APN Project

9:00 Interdata methodology for time series of

Land Use/Management Change Analysis

C Liu

9:20 Predicting net effect of rice agriculture on

global warming

CS Li

9:40 Managing agricultural soils to mitigate net

greenhouse gas emission rice-based cropping

Z Cai

10:10 Picture Taking

10:20 Break

Session Chair: Zucong Cai

- 10:50 Integration of geographical information system, climate and agricultural management data to predict greenhouse gas emissions *JBoonjawat*
- 11:20 The impact of land-use change on greenhouse gas emissions in tropical Asia *HTsuruta*
- 11:50 Antagonisms between CH₄- and N₂O emissions from rice field : mechanisms, experiments and mitigation options *RWassmann*

12:20 Lunch

Session Chair: Haruo Tsuruta

- 2:00 Land use management data integration at different scales in support of biogeochemical biogeochemical analysis *JBoonjawat*
- 2:30 Feasibility of DNDC model to estimate methane emissions from agricultural soils in Jiangsu and Sichuan provinces, China *GKang*
- 3:00 Simulations of CO₂ and N₂O fluxes for native and managed systems in China. *S DelGrosso*
- 3:30 Break

Session Chair: Jariya Boonjawat

- 4:00 Pragmatic cultural practice for maintained rice productivity with the balance of local wisdom and climate change in Central Thailand *OSiriratppiriya*
- 4:30 N₂O emissions from wheat growing season with 18 Chinese soils: an outdoor pot experiment *YHuang*
- 5:00 Estimating methane emissions from Philippine rice-based agroecosystems *TMoya*
- 5:30 Break
- 6:30 Dinner
- 8:00 Project discussions *AMosier/ZCai*
- 9:00 Adjourn

09 January 2002, Wednesday

Venue: Seminar Room, Harrar Hall

Session Chair: Tolentino Moya

- 8:30 The IPCC National GHG Inventories Programme: activities and plans *LBuendia*
- 8:50 The emission of methane and nitrous oxide from wet/dry season cropping sequences in Asia *HTsuruta*
- 9:10 Application of the DNDC model for prediction of N₂O and NO emission from Japanese agricultural soils *TSawamoto*
- 9:30 Philrice R&D activities in mitigating greenhouse gas emissions in intensively managed rice fields *BTadeo*
- 10:00 Break
- 10:30 Discussion of how to proceed with Project Products (journal articles, summary statements, APN newsletter, final reports, etc.) *AMosier/ZCai*
- 12:30 Lunch
- 2:00 Continue project discussions (break up into working groups to work on specific projects, mechanisms for doing this will be decided at this time—work group leaders: Boonjawat, Cai, Liu, Moya, Wassmann)
- 4:00 Break
- 4:30 Reconvene whole group to discuss progress on projects (no more than 10 minutes per working group discussion)
- Moya, Wassmann, Liu, Tsuruta, Cai, Boonjawat, others
- 5:30 Break
- 6:30 Dinner
- 8:30 Plans for publications
Future activities (project summary for policy, IGAC)

10 January 2002, Thursday

8:30 Tour of IRRI Facilities

12:20 Lunch

2:00 Continue project discussions (Future)

Dinner

11 January 2002, Friday

Venue: : Seminar Room, Harrar Hall

8:30 APN Project members who wish to participate will meet with IRRI staff to discuss natural resource management research

12:30 Lunch

2:00 Continue discussions with IRRI staff

12 January 2002, Saturday

Transfer to Manila and departure

Opening presentation made by Dr. William Padolina, Deputy Director General for Partnerships:

In behalf of the Director-General of the International Rice Research Institute, Dr Ronald Cantrell, I would like to extend our warmest welcome to all the participants of this very important workshop on Land use/management change and trace gas emission in east asia. IRRI takes pride in being chosen as the venue of this gathering which incidentally is the first workshop organized for 2002.

IRRI is a research institution which is part of the Consultative Group for International Agricultural Research (CGIAR). There are 16 Centers in the CGIAR covering a variety of crops and concerns. IRRI is mandated to undertake research which will benefit resource-poor rice consumers and farmers. The activities of IRRI are implemented by 50 IRS and around 800 NRS and supported by contributions and donations from around 40 countries. Although IRRI is primarily known as a Plant Breeding Institute, its research activities is ever since it was established has included natural resource management. Thus, we would like to invite all of you to visit with our staff so that you may have a more balanced view of IRRI.

Last April 2001, David Tilman and his collaborators predict that the next 50 years may be the final episode of rapid global agricultural expansion. The contend that during this period, agriculture has the potential to have massive, irreversible environmental impacts. Tilman and his group suggest that comprehensive land use planning could mitigate some effects of agricultural expansion. Thus, this workshop is very timely and relevant to discuss an international effort to develop new technologies and policies for ecologically sustainable agriculture.

IRRI is happy to participate in this important undertaking which we believe will minimize adverse impacts of agricultural expansion whole providing enough food for all.

Again our warmest welcome to all . We hope that you will enjoy your stay here.

We also wish to congratulate the organizers of this meeting. They have done an excellent job.

Finally allow me to wish you all a Happy New Year!

LIST OF PARTICIPANTS

CHINA

Dr Zucong Cai
Laboratory of Material Cycling in Pedosphere
Institute of Soil Sciences
Chinese Academy of Sciences
71 East Beijing Road
Nanjing 210008
China
Email:

Mr Guoding Kang
Laboratory of Material Cycling in Pedosphere
Institute of Soil Sciences
Chinese Academy of Sciences
71 East Beijing Road
Nanjing 210008
China

Dr Chuang Liu
Commission for Integrated Survey of Natural Resources (CISNAR)
Chinese Academy of Sciences
No. 3 Datun Road, Chaoyang District
P.O. Box 9717, Beijing 100101
China

Mr Zhengxing Wang
Commission for Integrated Survey of Natural Resources (CISNAR)
Chinese Academy of Sciences
No. 3 Datun Road, Chaoyang District
P.O. Box 9717, Beijing 100101
China

Prof Dr Huang Yao
National Laboratory of Atmospheric
Boundary Layer Physics and Atmospheric Chemistry
Institute of Atmospheric Physics
Chinese Academy of Sciences
Beijing 100029, P.R. China
Email:huangy@dq.cern.ac.cn

GERMANY (Representing work conducted on a large Asian methane and rice project at the International Rice Research Institute)

Dr Reiner Wassmann
Fraunhofer-Institut fuer Atmospherische Umweltforschung
Kreuzteckbahnstr 19
D-82467 Garmisch-Partenkirchen
Germany
Email: Wassmann@ifu.fhg.de

INDONESIA

Dr Prihasto Setyanto
c/o IRRI-Bogor Indonesia
Cooperative DEPAGRI-IRRI Program
Jalan Merdeka 147, Bogor 16111
Bogor, Indonesia

JAPAN

Mr Leandro Buendia
Programme Officer
Intergovernmental Panel on Climate Change
1560-39 Kamiyamaguchi
Hayama, Kanagawa, 240-0198
Japan

Dr Takuji Sawamoto
Department of Environmental Planning
National Institute for Agro-Environmental Sciences
3-1-3 Kan-nondai, Tsukuba
Japan 305-8604

Dr Haruo Tsuruta
Department of Environmental Planning
National Institute of Agro-Environmental Sciences
3-1-1 Kan-nondai, Tsukuba 305-8604
Japan
Email:tsuruta@niaes.affrc.go.jp

PHILIPPINES

Dr Tolentino B. Moya
School of Environmental Science and Management
University of the Philippines Los Baños (UPLB), College

Dr Antonio J. Alcantara
School of Environmental Science and Management
University of the Philippines Los Baños (UPLB), College

Dr Bernardo Tadeo
Philippine Rice Research Institute (PhilRice)
Maligaya, Muñoz, Nueva Ecija

THAILAND

Dr Jariya Boonjawat
Southeast Asia START Regional Office Environmental Research Institute
SEA START RC
Chulalongkorn University
Bangkok 10330
Thailand
Email:jariya@start.or.th

Dr. Sakorn Phongpan
Division of Agricultural Chemistry
Department of Agriculture
Thailand

Ms Orawan Siriratpiriya
Environmental Research Institute
Chulalongkorn University
Bangkok 10330
Thailand

Ms Nattaya Tanyarak
Southeast Asia START Regional Office Environmental Research Institute
SEA START RC
Chulalongkorn University
Bangkok 10330
Thailand

U.S.A.

Mr Stephen Del Grosso
Natural Ecology Laboratory
Natural Environmental Science Building (NESB)
Colorado State University
Fort Collins, CO 80523-1499
U.S.A.

Dr Changsheng Li
Complex Systems Research Center
Institute for the Study of Earth, Oceans and Space
Morse Hall
University of New Hampshire
Durham, NH, USA
Phone: 603-862-1771
Fax: 603-862-0188

Dr Arvin Mosier
USDA/ARS P.O. Box E
301 South Howes
Fort Collins, CO 80522
U.S.A.
Email: amosier@lamar.colostate.edu

IRRI

Dr Bas Bouman
Water Scientist
Crop, Soil and Water Sciences Division (CSWSD)

Dr Roland J. Buresh
Soil Scientist
CSWSD

Dr James E. Hill
Head, Crop, Soil and Water Sciences Division (CSWSD)

Dr J. K. Ladha
Soil Microbiologist
CSWSD

Ms Rhoda S. Lantin
Sr Associate Scientist
CSWSD

Dr. John Sheehy
Crop Ecologist/Crop Modeller
CSWSD

Dr. S. P. Kam
GIS Specialist
Geographic Information System (GIS)

Dr T.P. Tuong
Water Management Engineer
CSWSD