Working Paper and Preprint 94/02

REPORT OF A JOINT ISRIC-IRRI QUESTIONNAIRE ON SITE CHARACTERISTICS OF IRRIGATED RICE LANDS OF RELEVANCE TO METHANE PRODUCTION AND EMISSION

N.H. Batjes

February 1994

ISRIC

INTERNATIONAL SOIL REFERENCE AND INFORMATION CENTRE

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World Inventory of Soil Emission Potentials. Proceedings of an International Workshop organized in the framework of the Netherlands National Research Programme on Global Air Pollution and Climate Change (24-27 August 1992). WISE Report No. 2, ISRIC, Wageningen, iv + 122 p. [ISBN 90-6672-049-2].

A Review of Soil Factors and Processes that Control Fluxes of Heat, Moisture and Greenhouse Gases. Technical Paper 23/WISE Report 3, ISRIC, Wageningen, viii + 201 p. [ISBN 90-6672-048-4].

World Inventory of Soil Emission Potentials: Guidelines for soil profile selection and protocol for completing the WISE data entry sheets. Working Paper and Preprint 93/02, International Soil Reference and Information Centre, Wageningen, ii + 32 p.

World Inventory of Soil Emission Potentials: Profile Database User's Manual (Version 1.0 for IBM-PC Compatible Microcomputers). Working Paper and Preprint 93/04, International Soil Reference and Information Centre, Wageningen, ii + 28 p.

World Inventory of Soil Emission Potentials: Development of a global soil database of process controlling factors. Working Paper and Preprint 94/01, Wageningen, the Netherlands, 18 pp.

...

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INTERNATIONAL SOIL REFERENCE AND INFORMATION CENTRE

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1. Introduction

The International Soil Reference and Information Centre (ISRIC) is carrying out a project on the Geographic Quantification of Soil Factors and Processes that Control Fluxes of Greenhouse Gases. This project, which is currently referred to as World Inventory of Soil Emission Potentials (WISE), is a sequel to the International Conference on Soils and the Greenhouse Effect (Bouwman, 1990). The WISE project is part of a wider research programme being carried out within the framework of the Netherlands National Research Programme on Global Air Pollution and Climate Change (NOP), and includes cooperation with the International Rice Research Institute (IRRI) in the Philippines and the Land and Water Development Division (AGLS) of the Food and Agriculture Organization (FAO).

The activities of the WISE project have been divided into two phases. The first activity was to assemble the relevant literature in a background study of the chemical, physical and biological factors controlling gaseous exchanges from soil to the atmosphere (Batjes and Bridges, 1992a). The first phase culminated in a workshop, attended by an international panel of scientists working in the field, whose expertise and experience were drawn upon to refine the broad lines of the project outlined in the original research agreement (Batjes and Bridges, 1992b). The second phase of the WISE project, which ends in December 1994, includes two main goals, the successful completion of the first of these will enable the second to be accomplished.

A global soil data base with a grid size of 30' latitude by 30' longitude is being compiled from a digitized and edited version of the 1:5 M Soil Map of the World (FAO, 1991 and 1994), in close collaboration with staff of FAO's Land and Water Development Division (Batjes *et al.*, 1994). Currently, a procedure for linking the area-data and profile-data is being developed and tested, using a prototype database for Africa. Once this is completed, the framework will be in place for assembling and handling the soil data required to make a series of environmental studies. In the context of the current WISE project, an inventory will be made of methane producing soils throughout the world. The next step will require development of a schematic model of the different soil factors that determine potential methane production in irrigated rice soils. This work will be done in collaboration with scientists from the International Rice Research Institute, Nagoya University and the Department of Soil Science and Geology of Wageningen Agricultural University.

An international workshop held in Wageningen in 1991 recommended a questionnaire should be sent to known researchers in the field of gaseous exchange between soils and the atmosphere, especially those involved with methane emissions from paddy fields and natural wetlands. The findings of this survey are summarized in Section 2, with supporting tables in Annex 1. These served to identify priorities for further work in the context of the WISE project (Section 3). A copy of a blank questionnaire is attached as Annex 2, while Annex 3 is a list of the addressees/respondents to the questionnaire.

2. Results of questionnaire

The WISE workshop agreed that ISRIC and IRRI should make best use of past and current field measurements of methane production and emission from rice paddies, and natural wetlands, for model development and verification. One aim of the questionnaire would be to obtain data for deriving expert-systems on methane production/emission, permitting geographic extrapolation using a Geographical Information System linked to the WISE soil database and other auxiliary databases (Fig. 1). Information gathered by the questionnaire might be used also to guide the formulation of further experiments on methane emissions.

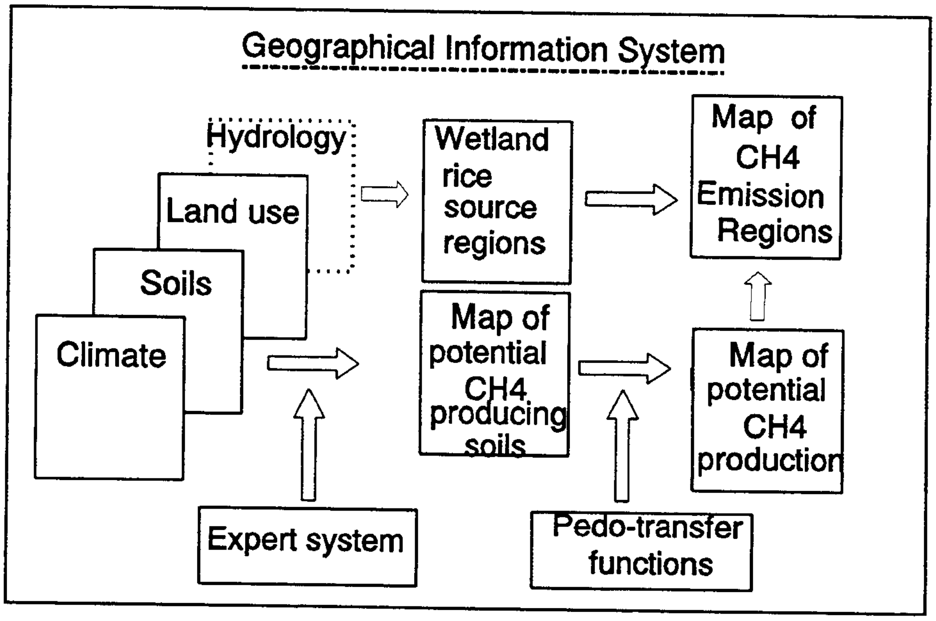

Fig. 1. Schematic representation of projected use of WISE and auxiliary databases in identifying potential methane producing soils and, ultimately, in refining calculations of methane emissions from wetland rice soils (Batjes *et al.*, 1994).

Following circulation of a draft questionnaire for comments, copies of the final ISRIC-IRRI questionnaire were mailed to 21 scientists in March 1993. The proposed deadline for responding to the questionnaire was September 1, 1993. At the time of compilation of this report 9 research groups had replied to the questionnaire, corresponding with a response rate of 43%.

For practical reasons, the answers to the questionnaire have been regrouped according to main themes in self-explanatory tables in Annex 1. The first table shows which trace gases are studied by the various groups, the measurement techniques used, adopted quality controls, and time scales and periods of measurements. The second table gives information on measurement site, the wetland ecosystems under investigation, on the recent past cropping history, and on soil types. Descriptions of the pre-planting activities and type of field preparations in use in the various experiments are also summarized in the second table. Answers to all questionnaires have been filed for further reference at ISRIC.

The last table in Annex 1 inventories the various temporal and spatial scales for which CH_4-models are being developed, including empirical, deterministic and stochastic models. In general, the respondents rated the importance of soil factors in determining potential CH_4-production as being moderate to high. Similarly, soil factors are considered to be of moderate to high importance for the kinetics of CH_4-formation processes, and net CH_4 emissions from wetland rice soils. Further research is needed on the importance of CH_4 production and CH_4 oxidation when calculating net CH_4 emission, and on how their ratio is affected by changes in environmental and agricultural conditions (Kimura, 1992; Wang Mingxing *et al.*, 1993; Denier van der Gon and Neue, 1994).

Besides the microbial community, the factors having the greatest effect on methane emissions probably are: seasonality of water regime and/or water management; climatic conditions such as temperature, solar radiation, and rainfall; application of mineral and/or organic amendments; nature of field preparation/planting practices; plant 'transport' functions; and soil properties (see also Kimura, 1992; Neue and Roger, 1993; Khalil, 1993). At present there are insufficient data to incorporate all the above factors in databases for global CH_4-budget studies (see Matthews, 1993). For instance, there still is no global information on the application of organic matter to rice paddies, while the importance of organic matter quality and quantity on methane emission is well known (Minami, 1993). Similarly, the nature of regional pre-planting activities (e.g. puddling, direct-seeding/transplanting), drainage and water percolation, which through their effect on soil redox potentials and crop growth (and gas transport properties) have a significant effect on methane emission, remain difficult to quantifying a global model. Nonetheless, global estimates of CH_4 emission can be improved substantially by incorporating the current knowledge on water levels and temperature (Khalil, 1993; Minami, 1993). Bachelet and Neue (1993) proposed an expert-classification of rice soils to group rice growing regions according to their methane production potentials, for which additional experimental, scientific-backing is now being sought. An important contribution of the WISE project to this work will be in providing quantitative data on the geographic and attribute data of the world soils, using currently available knowledge.

3. Conclusions

Many research groups are investigating the factors and processes controlling production, oxidation, transport and emission of methane in irrigated rice land and natural wetlands. Main objectives of this work are to develop models of CH_4 fluxes at various temporal and spatial scales, and to propose mitigation options for reducing CH_4 emission from rice paddies. These options must take into account possible adverse effects on yield and N_2O emissions.

An important aim of the questionnaire was to obtain additional data for deriving expert-systems on methane production potentials, so as to permit a refined geographic extrapolation using a Geographical Information System linked to WISE and auxiliary databases. Responses to the questionnaire contained less information useful for developing an initial modelling approach than had been anticipated by the WISE workshop. Many of the field experiments by the questionnaire respondents are still ongoing. Quantification of effects of the perceived controlling factors of methane production, oxidation, transport (e.g. via vascular plants or leaching) and emission in a mechanistic model remains uncertain, in spite off the marked recent progress in this area of research (JEA-EPA, 1990; Braatz and Hogan, 1990). Modelling of CH_4 fluxes at different spatial and temporal scales remains an important topic for cooperative research (Smith and Minami, 1993).

A collaborative activity with colleagues from the Soil Science and Geology Department of the Wageningen Agricultural University has been initiated in the framework of another NOP-sponsored project on the Influence of Soil Parameters on the Production and Emission of Methane in/by Wetland Rice Soils. First, this will include an analysis of available incubation experiments on potential methane production of paddy soils. This work should provide the basic data necessary for developing pedo-transfer functions that relate soil characteristics (held in the WISE database) with potential methane production rates of the main methane producing FAO-Unesco soil units (e.g. Fluvisols, Gleysols and gleyic subunits, and Histosols) in a quantified way. Contacts with specialist research institutes, established in the framework of the joint ISRIC-IRRI Methane Questionnaire activity, should prove useful to identify research-groups that could contribute topsoil samples for eventual, follow up experiments. IRRI, for instance, cooperates in the inter-regional Research Programme on Methane Emissions from Rice Fields in China, Indonesia, Thailand and the Philippines, a UNDP-funded project which started in 1993.

At the time of writing, the WISE project is nearing completion and already requests for the soil database are being received. Some immediate applications are being investigated but many of the opportunities provided by the existence of such a database remain to be exploited in the future by ISRIC and the international modelling fraternity.

Acknowledgements

The idea for preparing a joint ISRIC-IRRI methane questionnaire evolved during the WISE workshop, in August 1991. Messrs. E.M. Bridges, H.A.C. Denier van der Gon, M. Kimura, H.U. Neue, L.R. Oldeman and R. Wassman are thanked for their constructive comments on a preliminary version of the questionnaire. All respondents are gratefully thanked for their cooperation and contributions. The The WISE project is sponsored by the Netherlands National Research Programme on Global Air Pollution and Climate Change (Project No. 851039).

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Annex 1 Summary tables of answers to questionnaire

Table 1. Trace gases studied and techniques for their measurement

Group	Trace gases and techniques for their measurement	Controls of quality	Time scales of measurement	Period of measurements	No. of replicates
1	CH_4	-	Proposes to use weekly intervals	Proposed 2 seasons of deepwater rice	3 x
2	CH_4 using closed chamber method; GC with FID	5.45 ppm CH_4 mixed with purified N_2	CH_4 measured 1 time between 11:00 and 16:00 at 7 days interval. Emission rates is estimated from change in concentration between 40, 20 and 0 min after covering chamber	1 yr	3 x
3	CH_4 and CO_2; soil incubation in static boxes and soil pore water membrane exchange	standardized gases and fast sampler analysis	all from hourly, daily, monthly, seasonal and annual	1989 to present	4 x and 2 x
4	CH_4, CO_2, N_2O, hydrocarbons, OCS and CO; static and dynamic chambers coupled to GC/FID, GC/HgO, GC/MS, GC/ECD instruments. In future proposed: FTIR and Eddy correlation	standards rigorously maintained and cross-calibrated; field experiments with controls. For each specific experiment there are specific reliability measures and experiments	Campaign to assess what should be systematically measured. Rice paddy CH_4 and other gases measured on weekly basis. Atmospheric measurements on hourly to weekly basis	Tuzo, P.R. of China for 5 yr; Beijing location for 1 yr	3 x replicates and replication of plots from 2 to 4 per field, plus replic. of fields from 2 to 6 fields
5	CH_4-production via in-situ soil core samples and laboratory experiments; CH_4-emissions via automatic and continuous measuring system with box technique	not specified	CH_4-production once a week; CH_4-emission every 2 hours during entire growing season	various experiments starting from 1990	1990-1991: 4 x 1992-1994: 2 x
6	CH_4, CO_2, N_2O; CH_4 in field determined with cont. automatic system (Schutz et al, 1989); lab. and greenhouse studies undertaken to determine production, ebullition, plant mediated transport, soil entrapment and influence of temperature and enrichment with CO_2.	standard operation controls, documentation and control charts	hourly, daily and seasonally	July 1991 - October 1991, and each rice growing season until 1995; each year 1 in dry and 1 in wet season	4 x

7	CO_2, N_2O and NO; GC flame ionization detection (CH_4), GC electron capture detector + IR (N_2O), chemiluminescence (NO); all covered chamber techniques in greenhouse	standard gases run periodically	seasonally and shorter	3 yr for CH_4 and N_2O; 1 yr for NO	3 x
8	CH_4, CO_2, N_2O, reduced S-gases; GC + diffusion chambers	certified standard gases	seasonally	2-3 yr for CH_4 and N_2O; beginning with measurements of reduced S-gases	3 x
9	CH_4 in chambers with fan	yes, see Yagi and Minami (1990)	weekly	1992-1993	2 x or 3 x

Abbreviations:

ECD: Electron capture detector
GC: Gas chromatography
FID: Flame ionization detector
FTIR: Long-path Fourier-transform infrared spectroscopy
IR: Infrared spectrometry
MS: Mass spectrometry

Table 2. Information on measurement site, wetland ecosystems and soil types

Group	Location	Wetland ecosystem	recent past cropping history and agricultural practices	Summary of main field operations	Soil type
1	15°N & 101°15'E; 3 m; Brachinburi Rice Research Station, Basung, Thailand	deepwater rice (HTA 60)	deepwater rice in flood prone rainfed rice ecosystem	A2, B1, F2, P1, S1, H2	Rungsit, acid sulphate clay
2	35°10'N & 136°50'E; 100 m; Aichi prefecture, Japan	irrigated rice (various Japonica, Indica, and Japonica + indica cultivars)	under irrigated rice for many years	B1, H1, I1, A1, F3, O1, S2	Dystric Cambisol
3	29°57'N & 94°30'W; 5 m; Texas, USA	irrigated rice	3 yr cycle: rice/fallow/fallow	A1, B2, I1, H1, S3, F5	Typic Pelludert
4	Tuzu, near Changzu, and Schuan, P.R. of China	irrigated rice (local plus hybrid varieties)	rice planted in spring, harvested in fall	S4, A1	Info being collected
5	28°55'N & 110°30'E; 48 m; Hunan Province, P.R. of China	irrigated rice	planted in rice for at least 10 yr, previous cropping history not recorded	A1, O2, F6	Endoaquept
6	14°11'N & 121°15'E; 21 m; Laguna, Philippines	originally as coconut grove. Under irrigated rice since 1960.	common cultural practice of flooding 3 wk before transplanting	A1, A2, F7, H1, I1, O2, Z1	not specified in questionnaire
7	34°46'N & 87°39'W; 116 m; Alabama, USA	simulated irrigated rice (pot experiments in greenhouse)	a) CH_4: straw addition; floodwater 3 weeks; transplanting; b) N_2O, NO: measured during dry period following rice crop	A3	not specified in questionnaire
8	≈ 29°N & 90° W, Mississippi delta, USA	natural vegetation: Spartina patens (brackish), Spartina alterniflora (salt), and Panicum hemitomon (fresh); NPP ≈ 1000 g m^{-2} yr^{-1}	not applicable	A4	not specified in questionnaire

9	a) 35°10'N & 136°58'E, 51 m; Aichi Prefecture; b) 37°28'N & 138°55'E, 8 m, Nagaoka, Niigata Prefecture; c) 34°39'N & 133°55'E, 3 m, Okagama Prefecture d) 37°30'N & 140°28'E, Kouriyama Prefecture, Japan	irrigated rice (various cultivars)	alluvial	S2, O1, F4	Eutric Gleysols and Eutric Fluvisols

* Full details can be derived from the original questionnaires.

Abbreviations:

A1: land preparation, manual; A2: Land preparation, mechanized; A3: pot studies; A4: not applicable, natural vegetation;
B1: Pre-planting treatment, fallow; B2: dry tilling, with flush to level;
F1: NPK-fertilizers and marl, basal and top dressing; F2: burning of rice straw, then with or without chemical fertilizers; F3: NPK-fertilizers, incorporated before transplanting; F4: NPK-fertilizers, basal and supplemental; F5: N-fertilizer, by airplane; F6: urea, KCl and compound minerals; F7: fertilizers and amendments, basally applied during final harrowing, top-dressing broadcast and/or sprayed
H1: herbicides; H2: weeding by hand;
I1: insecticides/pesticides
O1: organic amendments (rice straw); O2: green-leaf manure, rice straw or sludge, incorporated
P1: rock phosphate;
Q1: fungicides
S1: direct seeding; S2: transplanting; S3: dry planting before flooding; S4: seedling bed
Z1: plots not disturbed at any time during growth

Table 3. Work on procedures for modelling methane production and emissions

Group	Models		Importance of soil factors in determining			Main soil factors needed to model[1]:			Published data on models
	Work on	Type	Pot. CH_4 production	Kinetics of CH_4-processes	CH_4 emissions	CH_4 production	CH_4 emission	main controls	
1	No	proposed: ecosystem, day	Mod.	Mod.	Mod.	soil microbiology	soil properties and soil microbial activity	agricultural practices; soil properties; environmental conditions	Not yet
2	Yes	field	-	-	-	easily decomposable org. C; free-Fe; SO_4^{2-}; soil texture; rice plant	soil texture; rice plant	agricultural; practices (e.g. mid-season drainage, rice straw additions; rice varieties)	Yes
3	Yes, mechanistic	site, field and ecosystem level; from hourly to seasonal	High	Mod.	High	Org. C%; % clay/sand	% clay/sand; Org. C %	Org. C source; soil properties; water management; rice cultivar; climate (temperature and solar radiation)	Not yet
4	Yes	a range of temporal and spatial scales	Low/Mod.	Mod.	Low	pH/Eh	oxidation and climatic factors; fertilizer use and planting practices	agricultural practices and climate	In prep.
5	Yes	Model for CH_4-emission using C-inputs, N-input and temp. to predict CH_4-emission for rice paddies in P.R. of China	Mod.	Mod.	Mod.	not specified	Org. C %; C-input; plant cultivar	not specified	Not yet

[1] At the considered temporal and spatial scales of model development.

6	Yes, mech-anistic and stochastic	a range of temporal and spatial scales	High	High	High	Org. matter amendments; mois-ture conditions (saturation period); free-Fe, SO_4^{2-} and pH/E_h	crop; texture/structure; methanotrophs	crop residues / Org. matter incorporation; irrigation/ flooding/rainfall; tem-perature; crop	Not yet
7	Yes	field, days	High	High	Mod.	plant growth, org. inputs, O2_tra-nsfer, sol.-Fe, Mn, redox, tem-perature, SO_4^{2-}, residues, perco-lation rates and water depth	soil type; plant growth; soil disturbances	plant growth; soil redox	Yes
8	Yes	a range of temporal and spatial scales	High	High	High	labile C; salinity; SO_4^{2-}	vegetated on non-vege-tated	soil properties	No
9	Yes	global, year	-	-	-	content of readily mineralizable Org. matter; organic matter input	water regime; organic matter input	soil properties; agro-nomic practices; climate; plant functions	Yes

References (quoted in Annex 1):

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ISRIC-IRRI questionnaire on site characteristics of irrigated rice lands and natural wetlands of relevance to methane production and emission

Name of respondent(s): ____________________

Function: ____________________

Address: ____________________

____

____

____

Fax: ____________________
Tel.: ____________________
E-mail ____________________

PLEASE RETURN QUESTIONNAIRE TO:

International Soil Reference and Information Centre
Att. WISE Project (Messrs. N.H. Batjes & E.M. Bridges)
P.O. Box 353
3600 AJ Wageningen
The Netherlands

Fax: int-31-8370-24460

I TRACE GASES STUDIED[2]

Which biotic trace gases are being monitored by your research group?

- Methane: ______________________________
- Carbon dioxide: ______________________________
- Nitrous oxide: ______________________________
- Others: ______________________________

Which techniques are used for measuring production and fluxes of these gases?

____
____
____
____

What controls of quality are being used to check the reliability of measurements (e.g. how are the gas chromatographs used, controls):

____
____
____
____
____

Upon what time-scale are measurements being carried out? (e.g. hourly, daily, weekly, monthly, seasonally or annually):

____
____
____
____

For how long a period have you been measuring gas fluxes from soils at this site?
(e.g. Year 1; Present/Final year)

____
____
____
____

Are the measurements carried-out as single, 2x, 3x or 4x-replicates?

____
____
____
____

2 Please circle or fill in the correct answers as appropriate.

II INFORMATION ON MEASUREMENT SITE

1) Where is the measurement site located?
   Latitude (° ’ "): ______________________
   Longitude (° ’ "): ______________________
   Av. elevation (m): ______________________
   Country, Province: ______________________
   Descr. of location: ______________________
   ____

2) What is the rice ecosystem (a) or natural vegetation (b) at the site being monitored?
   [Fill in the questions under either a) or b) as relevant]

   a) *Rice ecosystem:*

   What is the rice ecosystem (irrigated rice, rainfed rice, deep water rice, tidal rice)?

   ____
   ____
   ____
   ____

   Summarize the recent-past cropping system history of the field?

   ____
   ____
   ____
   ____

   Nature of pre-planting treatment:

   ____
   ____
   ____
   ____

   Type of field preparations?
   - Mechanical:

   ____
   ____
   ____

   - Manual:

   ____
   ____
   ____

Casual practices (e.g pesticide application, weeding)?

- nature:

- type:

- timing:

- others:

Please characterize the experimental conditions for the various treatments and periods of observation, in the following table[3].

[3] In case of multiple experiments per year, please prepare a table for each experimental period.

Year: Time period of experiment:

VARIABLES	Treatment I	Treatment II	Treatment III	Treatment IV
- Rice variety				
date of seeding (DD/MM/YY)				
date of transplanting				
date of tillering				
date of flowering				
date of harvesting				
- Type of floodwater regime[4]				
av. depth of flooding (cm)				
quality of floodwater (EC) (mS cm^{-1})				
a) Organic amendments:	Yes / No	Yes / No	Yes / No	Yes / No
type (e.g. straw, green manure, FYM):				
C/N quotient of org. materials				
amount applied (ton ha^{-1})				
mode of application (e.g. incorp. or superficial)				
b) Chemical fertilizers:	Yes / No	Yes / No	Yes / No	Yes / No
type (e.g. urea, amm. sulfate)				
chemical composition (e.g. % N,P and K)				
amount applied (kg ha^{-1} per crop season)				
mode of application (e.g. incorp. or superficial)				
c) Timing of applications (a or b)				
d) Average yield (specify as: kg ha^{-1} and moist %)	/	/	/	/
grain				
straw				
below-ground				

[4] The most comprehensive way to describe the seasonality of floodwater regime, including period(s) of mid-season drainage and before-harvest drainage if applicable, would be a graph attached to the questionnaire.

b) *Natural wetlands*

Type of wetland:

____

____

____

Vegetation types (dominant and associated plant spp.):

____

____

____

Net Primary Productivity (NPP):

____

____

____

Litter quality (e.g. C/N or lignin/N quotient):

____

____

____

Estimated rate of accretion/degrading (mm/year)?

____

____

____

Rate of sedimentation:

____

____

____

Soil drainage condition:

____

____

____

Av. depth of groundwater table below surface (cm): minimum = _____ maximum = _____

Seasonality of water regime[5]: ______________________________

Quality of water (e.g. saline, fresh; EC): ______________________________

____

---

5 The most comprehensive way to describe the annual cycle of the water level would be a graph, attached to the questionnaire.

3) Weather data at measurement site:

Name of nearby (representative) climate station:________________________
Distance in km between measurement site and climate station:________________
Relevance of climate data to trace gas measurement site: Good Moderate Poor

Latitude (° ' "; N or S):____
Longitude (° ' "; E or W):_______________________________________
Average elevation (m):____
Country, Province: ____

Climate classification (Köppen):__________________________________

Summary of selected climatic data:

Variables	J	F	M	A	M	J	J	A	S	O	N	D	Y
av. rainfall (mm)													
av. min. air temp (°C)													
av. max. air temp. (°C)													
pot. evapotransp. (PET; mm)													
actual evaporation (mm)													

* PET calculation method (Thornthwaite, Penman, Frere-Popov, Blaney & Criddle, Papadakis, other= ______)

** Actual evaporation (Class A-pan; Piche, other= _____)

Source from which additional climate data may be obtained:

____
____
____
____

Remarks:

____
____
____
____
____
____

4) Soil characteristics at measurement site:

Have the soils at the experimental sites been described, analyzed and classified (Y or N):

If so, what is the soil classification?

National system:____

FAO-Unesco Legend (1974):_________________________ phase(s):____________

FAO-Unesco Legend (1988):_________________________ phase(s):____________

USDA Soil Taxonomy (version/year):______________________________

a) Greatgroup (e.g. Typic Sulfaquept): ____________________________

b) Family:____

If profile descriptions are available for the soils at the site, or of similar soils in close proximity to the measurement site, please attach copies of:

a) profile descriptions (Available/Attached: Y or N)

b) analytical results (Available/Attached: Y or N)

c) analytical methods: (Available/Attached: Y or N)

Special soil conditions observed which you consider of importance for methane production/emission (e.g. salinity, sulphate contents, free iron contents)

____

____

____

____

____

Are any "dynamic" soil properties being monitored (e.g. redox relationships as a function of time; changes in bulk density under puddling):

____

____

____

*Would your research group - in principle - be interested in having the soils at its experimental site(s) fully described, sampled and analyzed according to the field procedures of FAO and analytical procedures of ISRIC [Relevant analyses include: Organic Carbon content, total N, pH, Electrical conductivity (EC), texture, dominant clay minerals, structure, active-Fe, Cation Exchange Capacity and others]?*____.

[**Note:** In the affirmative, ISRIC may see if these activities can be incorporated into one of its projects, upon the identification of additional funding (e.g. NASREC)]

III PROCEDURES FOR MODELLING METHANE PRODUCTION/EMISSION

Is your research group developing methane production/emission models?

____

____

Type of model (e.g. empirical, mechanistic):

For what scale:	- site:	- field	- ecosystem:	- global:	- other
Temp. resolution:	- hour	- days	- month	- year	-other

At the considered scale, how would you rate the importance of soil conditions in determining:

a) potential methane production
   Low Moderate High

b) Kinetics of processes
   Low Moderate High

c) methane emissions
   Low Moderate High

Which, in your opinion, are the essential soil factors that are needed to model the following at the considered scale?

- methane production:

____

____

____

- methane emission:

____

____

____

Which, in your opinion, are the main controls at the various/scales:
(e.g. agronomic practices, climate, soil properties ...)

____

____

____

____

Is there any published information available on the models/software: Y or N
If so, please specify full references (copies are welcomed):

____

____

____

Additional remarks/comments:

____

____

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