

OFFICE OF DIRECTOR GENERAL
ICRAF
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ACTION.....
F.Y.I.....
FILE.....

KENYA AGRICULTURAL RESEARCH INSTITUTE
HEADQUARTERS:
P.O. BOX 57811 TEL; 4183301-20
TELEX:25287 KARI HQ. KE FAX: 4183344
NAIROBI

When replying please quote:

Our Ref/KARI/HQTS/13/05-06

Date: 28th May, 2008

ICRAF,
P.O. Box 30677,
NAIROBI.

Dear Sir,

**RE: CONTRACT NO. KARI/HQTS/13/05-06 PROVISION OF
CONSULTANCY SERVICES FOR THE BACKSTOPPING OF
WKIEMP BY ICRAF - PHASE II**

Forwarded herewith is one original copy of the above contract for your retention and necessary executory action.

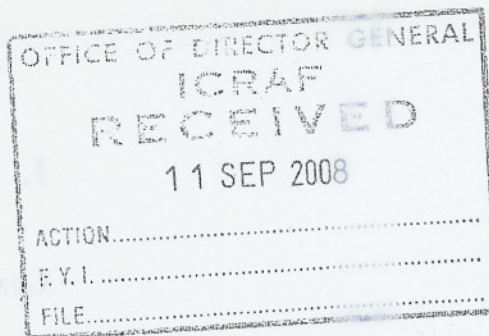
You are required to contact Dr. Jane Wamuongo and/or Dr. Ayaga in this regard who are KARI's representatives in this contract.

Yours faithfully,

F. M. Ruiru
Chief Supplies Officer
For: DIRECTOR, KARI

c.c. Dr. Jane Wamuongo, - For information and further necessary action.
KARI HQTS.

Dr. Ayaga - 1 copy enclosed for information and necessary action.
Project Coordinator,
WKIEMP,
KISUMU.



CONTRACT FOR CONSULTANTS' SERVICES

LUMP-SUM REMUNERATION

CONSULTANCY CONTRACT FOR THE BACKSTOPPING OF WKIEMP BY ICRAF – PHASE II

between

Kenya Agricultural Research Institute

and

World Agroforestry Centre (ICRAF)

Dated: **JANUARY, 2008**

I. Form of Contract

LUMP-SUM REMUNERATION

This CONTRACT (hereinafter called the "Contract") is made the 16 day of the month of ...MAY..... between, on the one hand, *Kenya Agricultural Research Institute* (hereinafter called the "Client") and, on the other hand, *World Agroforestry Centre (ICRAF)* (herein called the "Consultants").

WHEREAS

- (a) the Client has requested the Consultants to provide certain consulting services as defined in the General Conditions of Contract attached to this Contract (hereinafter called the "Services");
- (b) the Consultants, having represented to the Client that they have the required professional skills, and personnel and technical resources, have agreed to provide the Services on the terms and conditions set forth in this Contract;
- (c) the Client has received a credit from the International Development Association (hereinafter called the "Association") towards the cost of the Services and intends to apply a portion of the proceeds of this credit to eligible payments under this Contract, it being understood (i) that payments by the Association will be made only at the request of the Client and upon approval by the Association, (ii) that such payments will be subject, in all respects, to the terms and conditions of the agreement providing for the credit, and (iii) that no party other than the Client shall derive any rights from the agreement providing for the credit or have any claim to the credit proceeds;

NOW THEREFORE the parties hereto hereby agree as follows:

1. The following documents attached hereto shall be deemed to form an integral part of this Contract:

- (a) The General Conditions of Contract;
- (b) The Special Conditions of Contract;
- (c) The following Appendices:

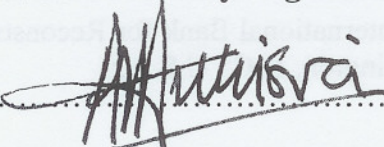
Appendix A: Description of the Services
Appendix B: Reporting Requirements
Appendix C: Key Personnel and Subconsultants
Appendix D: Breakdown of Contract Price in Foreign Currency
Appendix E: Breakdown of Contract Price in Local Currency
Appendix F: Services and Facilities Provided by the Client

2. The mutual rights and obligations of the Client and the Consultants shall be as set forth in the Contract, in particular:

- (a) The Consultants shall carry out the Services in accordance with the provisions of the Contract; and
- (b) the Client shall make payments to the Consultants in accordance with the provisions of the Contract.

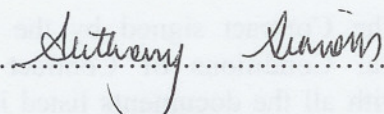
IN WITNESS WHEREOF, the Parties hereto have caused this Contract to be signed in their respective names as of the day and year first above written.

For and on behalf of **Kenya Agricultural Research Institute (KARI)**

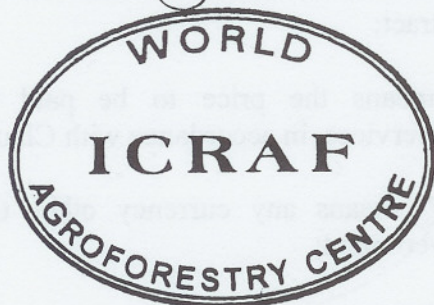
Signed: ....., Director, KARI

Date: 16.05.08

For and on behalf of **World Agroforestry Centre (ICRAF)**

Signed: ....., Director General

Date: 16.05.08



II. General Conditions of Contract

1. GENERAL PROVISIONS

1.1 Definitions

Unless the context otherwise requires, the following terms whenever used in this Contract have the following meanings:

- (a) "Applicable Law" means the laws and any other instruments having the force of law in the Government's country (or in such other country as may be specified in the Special Conditions of Contract (SC)), as they may be issued and in force from time to time;
- (b) "Bank" means the International Bank for Reconstruction and Development, Washington, D.C., U.S.A.;
- or**
- (b) "Association" means the International Development Association, Washington, D.C., U.S.A.;
- (c) "Contract" means the Contract signed by the Parties, to which these General Conditions of Contract (GC) are attached, together with all the documents listed in Clause 1 of such signed Contract;
- (d) "Contract Price" means the price to be paid for the performance of the Services, in accordance with Clause 6;
- (e) "Foreign Currency" means any currency other than the currency of the Government;
- (f) "GC" means these General Conditions of Contract;
- (g) "Government" means the Government of the Client's country;
- (h) "Local Currency" means the currency of the Government;
- (i) "Member," in case the Consultants consist of a joint venture of more than one entity, means any of these entities; "Members" means all these entities, and "Member in Charge" means the entity specified in the SC to act on their behalf in exercising all the Consultants' rights and obligations towards the Client under this Contract;
- (j) "Party" means the Client or the Consultants, as the case may be, and "Parties" means both of them;
- (k) "Personnel" means persons hired by the Consultants or by

any Subconsultant as employees and assigned to the performance of the Services or any part thereof;

- (l) "SC" means the Special Conditions of Contract by which the GC may be amended or supplemented;
- (m) "Services" means the work to be performed by the Consultants pursuant to this Contract, as described in Appendix A; and
- (n) "Subconsultant" means any entity to which the Consultants subcontract any part of the Services in accordance with the provisions of Clauses 3.5 and 4.

1.2 Law Governing the Contract This Contract, its meaning and interpretation, and the relation between the Parties shall be governed by the Applicable Law.

1.3 Language This Contract has been executed in the language specified in the SC, which shall be the binding and controlling language for all matters relating to the meaning or interpretation of this Contract.

1.4 Notices Any notice, request, or consent made pursuant to this Contract shall be in writing and shall be deemed to have been made when delivered in person to an authorized representative of the Party to whom the communication is addressed, or when sent by registered mail, telex, telegram, or facsimile to such Party at the address specified in the SC.

1.5 Location The Services shall be performed at such locations as are specified in Appendix A and, where the location of a particular task is not so specified, at such locations, whether in the Government's country or elsewhere, as the Client may approve.

1.6 Authorized Representatives Any action required or permitted to be taken, and any document required or permitted to be executed, under this Contract by the Client or the Consultants may be taken or executed by the officials specified in the SC.

1.7 Taxes and Duties Unless otherwise specified in the SC, the Consultants, Subconsultants, and their Personnel shall pay such taxes, duties, fees, and other impositions as may be levied under the Applicable Law, the amount of which is deemed to have been included in the Contract Price.

2. COMMENCEMENT, COMPLETION, MODIFICATION, AND TERMINATION OF CONTRACT

2.1 Effectiveness of Contract This Contract shall come into effect on the date the Contract is signed by both parties or such other later date as may be stated in the SC.

2.2 Commencement of Services The Consultants shall begin carrying out the Services thirty (30) days after the date the Contract becomes effective, or at such other date as may be specified in the SC.

2.3 Expiration of Contract Unless terminated earlier pursuant to Clause 2.6, this Contract shall terminate at the end of such time period after the Effective Date as is specified in the SC.

2.4 Modification Modification of the terms and conditions of this Contract, including any modification of the scope of the Services or of the Contract Price, may only be made by written agreement between the Parties and shall not be effective until the consent of the Bank or of the Association, as the case may be, has been obtained.

2.5 Force Majeure

2.5.1 Definition For the purposes of this Contract, "Force Majeure" means an event which is beyond the reasonable control of a Party and which makes a Party's performance of its obligations under the Contract impossible or so impractical as to be considered impossible under the circumstances.

2.5.2 No Breach of Contract The failure of a Party to fulfill any of its obligations under the contract shall not be considered to be a breach of, or default under, this Contract insofar as such inability arises from an event of Force Majeure, provided that the Party affected by such an event (a) has taken all reasonable precautions, due care and reasonable alternative measures in order to carry out the terms and conditions of this Contract, and (b) has informed the other Party as soon as possible about the occurrence of such an event.

2.5.3 Extension of Time Any period within which a Party shall, pursuant to this Contract, complete any action or task, shall be extended for a period equal to the time during which such Party was unable to perform such action as a result of Force Majeure.

2.5.4 Payments During the period of their inability to perform the Services as a result of an event of Force Majeure, the Consultants shall be entitled to continue to be paid under the terms of this Contract, as well as to be reimbursed for additional costs reasonably and necessarily incurred by them during such period for the purposes of the Services and in reactivating the Service after the end of such period.

any Subconsultant as employees and assigned to the performance of the Services or any part thereof;

- (l) "SC" means the Special Conditions of Contract by which the GC may be amended or supplemented;
- (m) "Services" means the work to be performed by the Consultants pursuant to this Contract, as described in Appendix A; and
- (n) "Subconsultant" means any entity to which the Consultants subcontract any part of the Services in accordance with the provisions of Clauses 3.5 and 4.

1.2 Law Governing the Contract This Contract, its meaning and interpretation, and the relation between the Parties shall be governed by the Applicable Law.

1.3 Language This Contract has been executed in the language specified in the SC, which shall be the binding and controlling language for all matters relating to the meaning or interpretation of this Contract.

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1.5 Location The Services shall be performed at such locations as are specified in Appendix A and, where the location of a particular task is not so specified, at such locations, whether in the Government's country or elsewhere, as the Client may approve.

1.6 Authorized Representatives Any action required or permitted to be taken, and any document required or permitted to be executed, under this Contract by the Client or the Consultants may be taken or executed by the officials specified in the SC.

1.7 Taxes and Duties Unless otherwise specified in the SC, the Consultants, Subconsultants, and their Personnel shall pay such taxes, duties, fees, and other impositions as may be levied under the Applicable Law, the amount of which is deemed to have been included in the Contract Price.

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2.5.2 No Breach of Contract The failure of a Party to fulfill any of its obligations under the contract shall not be considered to be a breach of, or default under, this Contract insofar as such inability arises from an event of Force Majeure, provided that the Party affected by such an event (a) has taken all reasonable precautions, due care and reasonable alternative measures in order to carry out the terms and conditions of this Contract, and (b) has informed the other Party as soon as possible about the occurrence of such an event.

2.5.3 Extension of Time Any period within which a Party shall, pursuant to this Contract, complete any action or task, shall be extended for a period equal to the time during which such Party was unable to perform such action as a result of Force Majeure.

2.5.4 Payments During the period of their inability to perform the Services as a result of an event of Force Majeure, the Consultants shall be entitled to continue to be paid under the terms of this Contract, as well as to be reimbursed for additional costs reasonably and necessarily incurred by them during such period for the purposes of the Services and in reactivating the Service after the end of such period.

2.6 Termination

2.6.1 By the Client

The Client may terminate this Contract, by not less than thirty (30) days' written notice of termination to the Consultants, to be given after the occurrence of any of the events specified in paragraphs (a) through (d) of this Clause 2.6.1 and sixty (60) days' in the case of the event referred to in (e):

- (a) if the Consultants do not remedy a failure in the performance of their obligations under the Contract, within thirty (30) days after being notified or within any further period as the Client may have subsequently approved in writing;
- (b) if the Consultants become insolvent or bankrupt;
- (c) if, as the result of Force Majeure, the Consultants are unable to perform a material portion of the Services for a period of not less than sixty (60) days; or
- (d) if the consultant, in the judgment of the client has engaged in corrupt or fraudulent practices in competing for or in executing the Contract.

For the purpose of this clause:

"corrupt practice" means the offering, giving, receiving, or soliciting of any thing of value to influence the action of a public official in the selection process or in contract execution.

"fraudulent practice" means a misrepresentation of facts in order to influence a selection process or the execution of a contract to the detriment of the Borrower, and includes collusive practice among consultants (prior to or after submission of proposals) designed to establish prices at artificial non-competitive levels and to deprive the Borrower of the benefits of free and open competition.

- (e) if the Client, in its sole discretion, decides to terminate this Contract.

2.6.2 By the Consultants

The Consultants may terminate this Contract, by not less than thirty (30) days' written notice to the Client, such notice to be given after the occurrence of any of the events specified in paragraphs (a) and (b) of this Clause 2.6.2:

- (a) if the Client fails to pay any monies due to the Consultants pursuant to this Contract and not subject to dispute pursuant to Clause 7 within forty-five (45) days after receiving written notice from the Consultants that such payment is overdue; or

- (b) if, as the result of Force Majeure, the Consultants are unable to perform a material portion of the Services for a period of not less than sixty (60) days.

2.6.3 Payment upon Termination Upon termination of this Contract pursuant to Clauses 2.6.1 or 2.6.2, the Client shall make the following payments to the Consultants:

- (a) remuneration pursuant to Clause 6 for Services satisfactorily performed prior to the effective date of termination;
- (b) except in the case of termination pursuant to paragraphs (a) and (b) of Clause 2.6.1, reimbursement of any reasonable cost incident to the prompt and orderly termination of the Contract, including the cost of the return travel of the Personnel and their eligible dependents.

3. OBLIGATIONS OF THE CONSULTANTS

3.1 General

The Consultants shall perform the Services and carry out their obligations with all due diligence, efficiency, and economy, in accordance with generally accepted professional techniques and practices, and shall observe sound management practices, and employ appropriate advanced technology and safe methods. The Consultants shall always act, in respect of any matter relating to this Contract or to the Services, as faithful advisers to the Client, and shall at all times support and safeguard the Client's legitimate interests in any dealings with Subconsultants or third parties.

3.2 Conflict of Interests

3.2.1 Consultants Not to Benefit from Commissions, Discounts, etc. The remuneration of the Consultants pursuant to Clause 6 shall constitute the Consultants' sole remuneration in connection with this Contract or the Services, and the Consultants shall not accept for their own benefit any trade commission, discount, or similar payment in connection with activities pursuant to this Contract or to the Services or in the discharge of their obligations under the Contract, and the Consultants shall use their best efforts to ensure that the Personnel, any Subconsultants, and agents of either of them similarly shall not receive any such additional remuneration.

3.2.2 Consultants and The Consultants agree that, during the term of this Contract and after its termination, the Consultants and their affiliates, as well

Affiliates Not to be Otherwise Interested in Project as any Subconsultant and any of its affiliates, shall be disqualified from providing goods, works, or services (other than the Services and any continuation thereof) for any project resulting from or closely related to the Services.

3.2.3 Prohibition of Conflicting Activities Neither the Consultants nor their Subconsultants nor the Personnel shall engage, either directly or indirectly, in any of the following activities:

- (a) during the term of this Contract, any business or professional activities in the Government's country which would conflict with the activities assigned to them under this Contract; or
- (b) after the termination of this Contract, such other activities as may be specified in the SC.

3.3 Confidentiality The Consultants, their Subconsultants, and the Personnel of either of them shall not, either during the term or within two (2) years after the expiration of this Contract, disclose any proprietary or confidential information relating to the Project, the Services, this Contract, or the Client's business or operations without the prior written consent of the Client.

3.4 Insurance to be Taken Out by the Consultants The Consultants (a) shall take out and maintain, and shall cause any Subconsultants to take out and maintain, at their (or the Subconsultants', as the case may be) own cost but on terms and conditions approved by the Client, insurance against the risks, and for the coverage, as shall be specified in the SC; and (b) at the Client's request, shall provide evidence to the Client showing that such insurance has been taken out and maintained and that the current premiums have been paid.

3.5 Consultants' Actions Requiring Client's Prior Approval The Consultants shall obtain the Client's prior approval in writing before taking any of the following actions:

- (a) entering into a subcontract for the performance of any part of the Services,
- (b) appointing such members of the Personnel not listed by name in Appendix C ("Key Personnel and Subconsultants"), and
- (c) any other action that may be specified in the SC.

3.6 Reporting Obligations

The Consultants shall submit to the Client the reports and documents specified in Appendix B in the form, in the numbers, and within the periods set forth in the said Appendix.

3.7 Documents Prepared by the Consultants to Be the Property of the Client

All plans, drawings, specifications, designs, reports, and other documents and software submitted by the Consultants in accordance with Clause 3.6 shall become and remain the property of the Client, and the Consultants shall, not later than upon termination or expiration of this Contract, deliver all such documents and software to the Client, together with a detailed inventory thereof. The Consultants may retain a copy of such documents and software. Restrictions about the future use of these documents, if any, shall be specified in the SC.

4. CONSULTANTS' PERSONNEL

4.1 Description of Personnel

The titles, agreed job descriptions, minimum qualifications, and estimated periods of engagement in the carrying out of the Services of the Consultants' Key Personnel are described in Appendix C. The Key Personnel and Subconsultants listed by title as well as by name in Appendix C are hereby approved by the Client.

4.2 Removal and/or Replacement of Personnel

- (a) Except as the Client may otherwise agree, no changes shall be made in the Key Personnel. If, for any reason beyond the reasonable control of the Consultants, it becomes necessary to replace any of the Key Personnel, the Consultants shall provide as a replacement a person of equivalent or better qualifications.
- (b) If the Client finds that any of the Personnel have (i) committed serious misconduct or have been charged with having committed a criminal action, or (ii) have reasonable cause to be dissatisfied with the performance of any of the Personnel, then the Consultants shall, at the Client's written request specifying the grounds thereof, provide as a replacement a person with qualifications and experience acceptable to the Client.
- (c) The Consultants shall have no claim for additional costs arising out of or incidental to any removal and/or replacement of Personnel.

5. OBLIGATIONS OF THE CLIENT

5.1 Assistance and Exemptions

The Client shall use its best efforts to ensure that the Government shall provide the Consultants such assistance and exemptions as specified in the SC.

**5.2 Change in the
Applicable Law**

If, after the date of this Contract, there is any change in the Applicable Law with respect to taxes and duties which increases or decreases the cost of the services rendered by the Consultants, then the remuneration and reimbursable expenses otherwise payable to the Consultants under this Contract shall be increased or decreased accordingly by agreement between the Parties, and corresponding adjustments shall be made to the amounts referred to in Clauses 6.2 (a) or (b), as the case may be.

**5.3 Services and
Facilities**

The Client shall make available to the Consultants the Services and Facilities listed under Appendix F.

6. PAYMENTS TO THE CONSULTANTS

**6.1 Lump-Sum
Remuneration**

The Consultant's total remuneration shall not exceed the Contract Price and shall be a fixed lump-sum including all staff costs, Subconsultants' costs, printing, communications, travel, accommodation, and the like, and all other costs incurred by the Consultant in carrying out the Services described in Appendix A. Except as provided in Clause 5.2, the Contract Price may only be increased above the amounts stated in Clause 6.2 if the Parties have agreed to additional payments in accordance with Clause 2.4.

6.2 Contract Price

- (a) The price payable in foreign currency is set forth in the SC.
- (b) The price payable in local currency is set forth in the SC.

**6.3 Payment for
Additional
Services**

For the purpose of determining the remuneration due for additional services as may be agreed under Clause 2.4, a breakdown of the lump-sum price is provided in Appendices D and E.

**6.4 Terms and
Conditions of
Payment**

Payments will be made to the account of the Consultants and according to the payment schedule stated in the SC. Unless otherwise stated in the SC, the first payment shall be made against the provision by the Consultants of a bank guarantee for the same amount, and shall be valid for the period stated in the SC. Any other payment shall be made after the conditions listed in the SC for such payment have been met, and the Consultants have submitted an invoice to the Client specifying the amount due.

**6.5 Interest on
Delayed
Payments**

If the Client has delayed payments beyond fifteen (15) days after the due date stated in the SC, interest shall be paid to the Consultants for each day of delay at the rate stated in the SC.

7. SETTLEMENT OF DISPUTES

7.1 Amicable Settlement

The Parties shall use their best efforts to settle amicably all disputes arising out of or in connection with this Contract or its interpretation.

7.2 Dispute Settlement

Any dispute between the Parties as to matters arising pursuant to this Contract that cannot be settled amicably within thirty (30) days after receipt by one Party of the other Party's request for such amicable settlement may be submitted by either Party for settlement in accordance with the provisions specified in the SC.

III. Special Conditions of Contract

Number of GC Clause	Amendments of, and Supplements to, Clauses in the General Conditions of Contract
[1.1(a)]	The words "in the Government's country" are amended to read Kenya
[1.1(i)]	The Member in Charge is Dr. Jane W. Wamuongo
1.3	The language is English
1.4	The addresses are: <div> Client: Kenya Agricultural Research Institute Attention: Dr. Jane W. Wamuongo Tel: 4183301-20 Facsimile: 4183344 </div> <div> Consultants: World Agroforestry Centre (ICRAF) Attention: Dr. Louis Verchot Address: P.O. Box 30677-00100, NAIROBI. Tel: 7224000 Facsimile: 7224001 </div>
1.6	The Authorized Representatives are: For the Client: Dr. Jane W. Wamuongo & Dr. George Ayaga For the Consultants: Dr. Louis Verchot
[1.7]	The Client warrants that the Consultants and their Personnel (as well as the Subconsultants and their Personnel) shall be exempt from any taxes, duties, fees, levies, and other impositions levied, under the Applicable Law, on the Consultants and the Personnel in respect of: (a) any payments made to the Consultants, Sub-consultants, and the Personnel of either of them (other than nationals of the Government or permanent residents of the Government's country), in connection with the carrying out of the Services; (b) any equipment, materials, and supplies brought into the Government's country by the Consultants or Subconsultants for the purpose of carrying out the Services and which, after having been brought into such territories, will be subsequently withdrawn therefrom by them; (c) any equipment imported for the purpose of carrying out the Services and paid for out of funds provided by the Client and which is treated as property of the Client;

- (d) any property brought into the Government's country by the Consultants, any Subconsultants, and the Personnel of either of them (other than nationals of the Government or permanent residents of the Government's country) for their personal use and which will subsequently be withdrawn therefrom by them upon their respective departure from the Government's country.

[2.1 This contract is a follow-on of a previous contract within the framework of WKIEMP. The date on which this Contract shall come into effect is **the day following the expiry of the previous contract.**

[2.2 The date for the commencement of Services is **the day following the expiry of the previous contract.**

2.3 The period shall be for two years **ending on 30 June 2008.**

[3.2.1 **"Procurement Rules of Funding Agencies**

Furthermore, if the Consultants, as part of the Services, have the responsibility of advising the Client on the procurement of goods, works, or services, the Consultants shall comply with any applicable procurement guidelines of the Bank or of the Association, as the case may be, and other funding agencies and shall at all times exercise such responsibility in the best interest of the Client. Any discounts or commissions obtained by the Consultants in the exercise of such procurement responsibility shall be for the account of the Client."]

3.4 The risks and coverage shall be:

- (i) Third Party motor vehicle **Yes**
- (ii) Third Party liability **Yes**
- (iii) Employer's liability and workers' compensation **Yes**
- (iv) Professional liability **Yes**
- (v) Loss or damage to equipment and property **Yes**

[3.7 • "The Consultants shall not use these documents for purposes unrelated to this Contract without the prior written approval of the Client."

4.2 (a) The Consultant will inform the Client of any changes that shall be made in the Key Personnel in writing •

[5.1 **Obtaining duty and VAT exemptions as specified in clause 1.7 of S.C.C.**

6.2(a) The amount in foreign currency or currencies is **US \$ 460,900.00**

6.2(b) The amount in local currency is **None.**

- Total contract price is **US \$ 460,900.**

6.4 The accounts are:

for foreign currency:

for local currency:

Payments shall be made according to the following schedule:

1. Ten percent (10%) of the Contract Price shall be paid on the commencement date.
2. Twenty percent (20%) of the lump-sum amount shall be paid upon submission (10%) and acceptance (10%) of the inception report which summarizes and analysis of results achieved under contract I and making proposals on activities to be implemented under contract II.
3. Fifty percent (50%) of the lump-sum amount shall be paid during implementation period in equal installments as follows:
 - 3.1 Finalize developing and submitting a master training plan with time frame for training KARI scientists as per TOR 1 10%
 - 3.2 Continue training KARI scientists as per TORS 2&3 20% to be apportioned as follows 20% upon delivery of one training report that combines the outcomes of training courses on GIS and remote sensing, the field exercises for measurements of carbon stocks and training of one KARI scientist on the ongoing measurement of non – CO₂ Greenhouse Gases.
 - 3.3 Finalize studies and documenting institutional capacity issues in Western Kenya to facilitate small holder farmers participate in carbon trade. 10% upon delivery of a report on institutions in Western Kenya requiring training on carbon trade.
 - 3.4 Finalize establishing and continue implementing species screening trials in selected micro catchments in lower blocks of Nyando, Yala & Nzoia as per TOR 5. 10% broken down as follows: 5% upon delivery of Trial Protocol detailing trial objectives, main treatments, design and methodology of implementation and data collection and the other 5% upon submission of a progress report on the trials at the end of the contract as part of the annual report.
 - 3.5 Finalize establishing and documenting the biophysical and socio-economic baseline status of the environment of the priority seven blocks (all blocks in Nyando and Yala and lower block of Nzoia basin) as per TOR 6. 35% upon delivery and acceptance of two baseline reports summarizing conditions for the 7 blocks, i.e. 3 in Nyando basin, 3 in Yala

for foreign currency:

for local currency:

Payments shall be made according to the following schedule:

1. Ten percent (**10%**) of the Contract Price shall be paid on the commencement date.
2. Twenty percent (**20%**) of the lump-sum amount shall be paid upon submission (10%) and acceptance (10%) of the inception report which summarizes and analysis of results achieved under contract I and making proposals on activities to be implemented under contract II.
3. Fifty percent (**50%**) of the lump-sum amount shall be paid during implementation period in equal installments as follows:
 - 3.1 Finalize developing and submitting a master training plan with time frame for training KARI scientists as per TOR 1 **10%**
 - 3.2 Continue training KARI scientists as per TORS 2&3 **20%** to be apportioned as follows 20% upon delivery of one training report that combines the outcomes of training courses on GIS and remote sensing, the field exercises for measurements of carbon stocks and training of one KARI scientist on the ongoing measurement of non – CO₂ Greenhouse Gases.
 - 3.3 Finalize studies and documenting institutional capacity issues in Western Kenya to facilitate small holder farmers participate in carbon trade. **10%** upon delivery of a report on institutions in Western Kenya requiring training on carbon trade.
 - 3.4 Finalize establishing and continue implementing species screening trials in selected micro catchments in lower blocks of Nyando, Yala & Nzoia as per TOR 5. **10%** broken down as follows: **5%** upon delivery of Trial Protocol detailing trial objectives, main treatments, design and methodology of implementation and data collection and the other **5%** upon submission of a progress report on the trials at the end of the contract as part of the annual report.
 - 3.5 Finalize establishing and documenting the biophysical and socio-economic baseline status of the environment of the priority seven blocks (all blocks in Nyando and Yala and lower block of Nzoia basin) as per TOR 6. **35%** upon delivery and acceptance of two baseline reports summarizing conditions for the 7 blocks, i.e. 3 in Nyando basin, 3 in Yala

basin, and 1 in Nzoia basin. One report will be prepared for Nyando Basin blocks and a second for Yala and Nzoia basin blocks. Payment will be made and pegged upon delivery of each draft report at 10% per report and a further 7.5% upon delivery of each final acceptable report .

3.6 Develop a ToR for mapping degraded areas in seven blocks as in 3.5 above **10%**.

3.7 Establish demonstration fields/plots to increase the tree cover on severely degraded sites in selected micro catchments in the lower blocks of Nyando, Yala and Nzoia as per TOR 8. **5%** upon delivery of documentation of progress as captured in the quarterly reports.

4. Finalize and submit three quarterly and one annual report **10%** of the lump sum broken down as follows: 2% for every quarter report submitted and accepted and 4% for the submitted annual report giving an analysis of all activities implemented during the contract period.

5. Ten percent (**10%**) of the lump-sum amount shall be paid upon approval of the final report which will be the improved draft final report.

6.5

Payment shall be made within **30** days of receipt of the invoice and the relevant documents specified in Clause 6.4, and within **60** days in the case of the final payment.

The interest rate is **the Commercial Bank prevailing lending rates**.

7.2

Any dispute, controversy, or claim arising out of or relating to this contract, or the breach, termination, or invalidity thereof, shall be settled by arbitration in accordance with the **Laws of the Republic of Kenya**.

Section IV

Terms of Reference

THE BACKSTOPPING OF WKIEMP BY ICRAF

1 Background

The Kenya Agricultural Research Institute (KARI) and the World Agroforestry Centre (ICRAF) have been collaborating for many years. A Memorandum of Understanding (MoU) between the two institutes was signed in August 1989 and has been in force ever since. It is within the framework of this MoU that KARI has collaborated with ICRAF on the following projects:

1. National Agroforestry Research Programme funded by Sida and implemented at KARI's regional research centre in Embu.
2. Soil fertility recapitalization and replenishment pilot project, funded by various donors, including EU, Rockefeller foundation, the government of the Netherlands, implemented at the KEFRI centre at Maseno and the KARI regional research centres at Kakamega and Kisii.
3. Strategic soil fertility recapitalization research project, funded by the World Bank through KARI's NARP II project, implemented in Western Kenya.
4. The African Highlands Initiative implemented at KARI regional research centres at Embu and Kakamega and the KEFRI centre at Maseno and supported by various donors.
5. Investigations to establish the magnitude of potassium deficiencies in Kenya with a view of developing appropriate soil fertility management recommendations to combat potassium related constraints to crop production. This project was implemented at the National Agricultural Research Laboratories and supported by the EU under the Agriculture/Livestock Research Support Programme Phase II
6. Short term consultancy on the improvement of laboratory services at NARL with practical recommendations and outputs on soil critical nutrient levels to be used in developing crop specific fertilizer recommendations, also implemented with the support from the EU under ARSP II

In addition, KARI has collaborated with ICRAF on an ad hoc basis on various activities such as: (i) Soil Fertility Initiative, which is a sub-Saharan Africa initiative aiming at promoting improved soil fertility management; (ii) training of several KARI scientists using ICRAF facilities and expertise; and (iii) offering joint courses, in which clients i.e. NGO's extension staff and farmers are trained on various technologies. These joint activities have been very successful and have generated a range of technologies, which have been widely adopted by farmers.

Western Kenya Integrated Ecosystem Management Project (WKIEMP) has been initiated with support from the World Bank for implementation. The project, which became effective in July 2005, seeks to improve the productivity and sustainability of land use systems in selected watersheds in the Nzoia, Yala and Nyando river basins through adoption of an integrated ecosystem management approach. In order to achieve this the project will: (i) support on-and off-farm conservation strategies; and (ii) improve the capacity of local communities and institutions to identify, formulate and implement

integrated ecosystem management activities (including both on-and off-farm land use planning) capturing local global environmental benefits. The project based in Kisumu would achieve its objectives through a community driven development process whereby communities would decide on resources for infrastructure investments, technical assistance and implementation of ecosystem management activities.

KARI and ICRAF collaborated in the generation of baseline information that was used in the Project Appraisal Document (PAD) under a Project Development Facility (PDF). KARI requested ICRAF to further continue backstopping the project activities in the 2005/2006 Work plan with the specific objectives of building capacity of KARI scientists, other local institutions, and communities to manage carbon assets including the establishment of a system to monitor and evaluate the biophysical impact of project activities, particularly the impact on net carbon absorption. ICRAF was already undertaking on-farm experiments involving Participatory Action Plans (PAPs) by farmers at several sites within the target river basins. KARI has therefore requested ICRAF to provide additional backstopping of this activity within the framework of WKIEMP.

This contract seeks to continue the collaboration between KARI and ICRAF under WKIEMP with the following objectives.

2. Objectives

The main objectives of this backstopping are to assist KARI to:

- a) Establish interventions that mitigate land degradation
- b) Evaluate and document the potential of different tree species to sequester carbon on degraded land
- c) Evaluate options for river bank protection
- d) Establish interventions that sequester carbon on agricultural systems
- e) Establish PAP intervention plots at several sites
- f) Establish a system for monitoring and evaluating changes in carbon stocks.
- g) Build capacity of KARI staff, other local institutions and communities to actively undertake monitoring and evaluation of changes in carbon stocks.

3. Activities and Time schedule

3.1 Activities

The following specific activities will be implemented in order to meet the above objectives. It is expected that ICRAF will use the budgeted resources to carry out to implement the activities. However, since there is the element of capacity building for KARI, it is expected that KARI/WKIEMP staff will participate wherever necessary in the implementation of the activities to build their capacity.

ToR 1: Develop a master training plan with timeframe for training KARI scientists on methods to measure carbon stocks and non-CO₂ Greenhouse Gases

Expected deliverable: *A training plan encompassing course outline (i.e. classroom/laboratory and field based instructions), expected time for covering the specific modules and in which month or quarter of the financial year. This will help KARI to identify the right caliber of staff to send for this training at specific times.*

ToR 2: Train KARI Scientists on methods of measuring carbon stocks including data collection, laboratory procedures, monitoring and statistical analysis

Expected deliverables: *(Timing of delivery to be detailed in master plan under ToR 1) Training reports to include training objectives, training methods, areas covered and training evaluation by trainees and resource persons.*

ToR 3: (Continuous) Train KARI Scientists on measurements of non CO₂ Greenhouse Gases including data collection, laboratory procedures, monitoring and statistical analysis

Expected deliverables: *(Timing of delivery to be detailed in master plan under ToR 1) Training reports to include training objectives, training methods, areas covered and training evaluation by trainees and resource persons.*

ToR 4: Identify and document institutional capacity in Western Kenya to facilitate smallholder farmers participate in carbon trade

ToR 5: (Continuous) Establish and implement species screening trials in selected micro catchments in the lower blocks of Nyando, Yala and Nzoia

Expected deliverable:

- Trial protocol encompassing trial design i.e. treatments, replications, data to be collected, how, when and method of data analysis.
- Progress reports of on going trials detailing status (results and/or recommendations for various agro ecological zones if any).

ToR 6: Establish and document the biophysical and socio-economic baseline status of the environment in the priority seven blocks (all blocks in Nyando and Yala and lower block of Nzoia basin)

Expected deliverables: *A baseline report in a mutually agreed format to guide the project in deciding appropriate and specific intervention measures to be taken within the micro catchments of the designated priority blocks. The parameters to be collected and analyzed should provide the current status of the indices of indicators given in the appropriate cells of the M&E grid of the Project Appraisal Document that refer to biophysical and socioeconomic conditions of the project areas.*

ToR 7: Identify the severity of degradation as part of the baseline in the lower blocks of Nyando, Yala and Nzoia

Expected deliverables: ToR for mapping severely degraded areas in the seven blocks of Nyando, Yala and Nzoia

ToR 8: (Due end of Quarter 4) Establish demonstration fields/plots to increase tree cover on severely degraded sites in selected micro catchments in the lower blocks of Nyando, Yala and Nzoia

3.2 Time schedule

Annual work plans will be established between the Project Coordination Office (PCO) and ICRAF. The Project Coordinator will be the responsible person for KARI; while the lead scientist in ICRAF will be the responsible person for ICRAF.

The time schedule will become effective with the endorsement of the annual work plan and cost estimate of WKIEMP for 2007/2008 but not before 1 July 2007.

4. Cost Estimate

The cost estimates for the activities outlined above are indicated in Table 1 below. Due to the delay in disbursement of funds allocated for year 1 and year 2 this contract is prepared to cater for all the activities implemented so far and up to 30th June 2008 less the amount for year 1 (2005/6) which is currently under process of payment. (KARI – ICRAF CONTRACT – PHASE I)

Table 1: Cost Estimates

Component	Item	Cost US\$	
1.2: Enhanced capacity for carbon financing (Interventions to mitigate land degradation, potential of trees to sequester carbon, options for river bank protection, interventions to sequester carbon on agricultural land)	Technical Assistance	-	105,000
	Equipment	13,800	-
2.0: Technical Backstopping (Establishment of PAP intervention plots (trees stocking plots)	Field trials	-	43,500
	Technical assistance	-	77,000
3.0 M&E (Improved capacity for monitoring carbon stocks and a net-net accounting of GHC accumulation)	Technical assistance	-	221,600
Total		13,800	447,100

5. Reporting

ICRAF shall provide the following reports to KARI, which amongst others shall serve KARI as the basis for the preparation of consolidated project reports to KARI Management and the World Bank and following closely the recommendations given under clause 3.1 above:

- 1) Two socio-economic and biophysical baseline reports on 7 blocks on target river basins (one for Nyando, and a second for Yala and Nzoia).
- 2) Report on institutions in Western Kenya on carbon trade
- 3) Quarterly reports to give detailed insight on the progress of the sub-projects being executed as proposed in (ii) above. Each quarter report must be received by KARI latest the last day of the quarter to allow timely reporting by KARI to the World Bank
- 4) Annual reports covering a calendar year of the project (latest one month after the end of the calendar year being reported)
- 5) Any other materials e.g., bulletins, manuals, posters being outputs of the sub-projects.
- 6) A comprehensive training report covering progress to date in GIS/Remote sensing, C sequestration and non-CO₂ measurements (Kakamega Forest)

NB: All reports and developed packages have to be submitted to KARI as hard copy (three copies) and as electronic file.

6. Publication of results

- a) Both KARI and ICRAF shall not publish any information related to the project being contracted without informing the other institution well in advance before the material is submitted for publication with a view of giving an opportunity to the other institution to participate.
- b) After publication, each institute shall provide the other institution with at least three copies of such publications and shall subsequently supply as many copies as the other institution may reasonably request.

7. Publicity

In case of communication to and press releases, both KARI and ICRAF shall inform the other institution in writing within a reasonable time to allow participation. In such media releases shall endeavor to portray both institutions as partners in the implementation.

8. Payments

Upon signature of this contract by both parties, payments will be made to ICRAF in accordance with the World Bank accounting procedures and according to the schedule below. After the first payment upon signing of the contract, subsequent payments will be on a quarterly allocation as provide in this work plan, with the next allocation being made the next quarter after accounting for the first disbursement and submission of satisfactory reports.

Summary of Payment Schedule

Outputs/Deliverables	%	Amount, USD
Commencement	10	46,090
Submission of an acceptable inception report	20	92,180
During implementation period in equal installments as detailed in the special conditions of this contract	50	230,450
Submission of acceptable quarterly reports (3) and one annual report	10	46,090
Submission and acceptance of final reports	10	46,090
	100	460,900

This schedule of payment has been revised and will be in accordance with clause 6.4 of Special Conditions of this contract.

IV. Appendices

APPENDIX A – DESCRIPTION OF THE SERVICES

The backstopping Services are as given in Terms of Reference Clause 3.

APPENDIX B – REPORTING REQUIREMENTS

The reporting requirements are as detailed in Clause 5 of the Terms of Reference.

APPENDIX C – KEY PERSONNEL AND SUBCONSULTANTS

1. Dr. Louis Verchot
2. Dr. Markus Walsh
3. Dr. Keith D. Shepherd
4. Dr. Anja Boye
5. Dr. Laure Dutaur
6. Dr. Robert Zomer

APPENDIX D – BREAKDOWN OF CONTRACT PRICE IN FOREIGN CURRENCY

• Technical Assistance	-	US\$ 403,600.00
• Field Trials	-	US\$ 43,500.00
• Minor Equipment	-	<u>US\$ 13,800.00</u>
		US\$ 460,900.00

APPENDIX E – BREAKDOWN OF CONTRACT PRICE IN LOCAL CURRENCY

N/A

APPENDIX F – SERVICES AND FACILITIES PROVIDED BY THE CLIENT

All data, documents and any other information required and that relates to this assignment.

APPENDIX C - KEY PERSONNEL AND SUBCONSULTANTS

1. Dr. Louis V. ...
2. Dr. ...
3. Dr. ...
4. Dr. ...
5. Dr. ...
6. Dr. ...

APPENDIX D – BREAKDOWN OF CONTRACT PRICE IN FOREIGN CURRENCY

- Technical Assistance
- ...
- ...
- ...

Dr. Louis V. Verchot

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(ICRAF)
P.O. Box 30677, Nairobi Kenya
L.verchot@cgiar.org

Phone: 254-2-524 238
Fax: 245-2-524 001
Cell: 254-733-602 341

Professional Experience

- 2000 – Present: Senior Scientist/Principal Scientist in Climate Change and Land Degradation, International Centre for Research in Agroforestry, Nairobi, Kenya.
- 1997 – 1999: Research Fellow, Ecosystem Ecologist, Institute of Ecosystem Studies, Millbrook, NY.
- 1995 – 1997: Post Doctoral Fellow, Woods Hole Research Center / Instituto de Pesquisa Ambiental de Amozônia, Universidade, Federal do Pará, Belém, Brazil, EMBRAPA.
- 1991 – 1994: Research Assistant for the Woodlot Forestry Research and Development Program at North Carolina State University, Raleigh, NC.
- 1988 – 1991: Forestry Advisor on the Senegal Reforestation Project (USAID 685-0283). Employed by Louis Berger International, Inc. East Orange, N.J.
- 1986 – 1987: Forestry Advisor, member of the technical assistance team for the Village Reforestation Project of Bulkiemdé and Sanguié Provinces, Burkina Faso.
- 1984 – 1986: Forestry Extension Agent, Peace Corps, Burkina Faso.
- 1984: Forestry Aid. U.S. Forest Service Urban Forestry Experiment Station, Syracuse, N.Y.
- 1981: Forestry Technician, U.S. Forest Service, North East Forest Experiment Station field office, East Corinth, Maine.

Honors and Awards

Global Climate Change Distinguished Post Doctoral Fellowship -- U.S. Department of Energy. 1995

Elected Secretary of the International Union of Soil Scientists for Division 4 – Role of Soils in Sustaining Society and the Environment 2002.

Award from Agriculture/Livestock Research Support Programme (EU and Kenya) for collaborative project between KARI and ICRAF for project entitled 'Assessment of emerging soil fertility constraints with particular emphasis on potassium.' 2002.

Grants

- Nitrogen Loss in Piedmont Forested Filter Zones. 1992-1994. NC Water Research Institute, \$47K.
- Effects of N Deposition on Gaseous N Loss from Temperate Forest Ecosystems. 2000-2004. US Environmental Protection Agency, US\$890K.
- Land Degradation and Sustainability Indicators. 2001-2004. Government of Italy, 239K.
- Agrobiodiversity (Latin America, Southeast Asia, Africa). 2001-2003. European Union. 3.1 million.

- N Mineralization in Agroforestry Systems. 2001. IAEA Visiting Scientist Fellowship. \$30K.
- Homeostasis and Degradation in Fragile Tropical Agroecosystems, US National Science Foundation Biocomplexity Program (through Cornell University). \$1.7 million.
- Microbial biodiversity in agroforestry systems. 2001. Rockefeller Foundation. \$66
- Inter-Centre Working Group on Climate Change. 2002. USAID: \$80K. CIDA: \$50K.
- Strengthening the Science-Policy Links in the Area of Climate Change 2002. UNEP. \$26K.
- Pest and Disease Management in East and Southern Africa. SIDA Natur. \$270K.
- Institutional Arrangements and Transactions Costs in Environmental Service Projects. 2003. DANIDA. \$98K.
- Strengthening the Science-Policy Links in the Area of Climate Change 2003. UNEP. \$41K.
- Western Kenya Integrated Ecosystem Management Project Design Grant. 2003. Global Environment Facility. \$250K.
- Homeostasis and Degradation in Fragile Tropical Agroecosystems. 2003-2005. DANIDA. \$193K.
- Microbial Ecology and Soil Health. 2003. Rockefeller Foundation. \$52K.
- Valorisation of within-farm soil fertility gradients to enhance agricultural production and environmental service functions in smallholder farms in East Africa. 2003-2005. Rockefeller Foundation (Through TSBF). \$350K.
- ENvironment and COMMunity based framework for designing aFORestation, reforestation and revegetation projects in the CDM: methodology development and case studies (ENCOFOR) 2004 – 2007. European Union (Through FACE Foundation and KU Leuven). \$2.1 million.
- An Ecosystem Approach to Restoring West African Drylands and Improving Rural Livelihoods through Agroforestry-based Land Management Interventions 2004-2007. \$1.9 million.
- Strengthening the Science-Policy Links in the Area of Climate Change 2003. UNEP. \$80K.
- Western Kenya Integrated Ecosystem Management Project. 2005-2010. Global Environment Facility. \$4.1 million.
- Inter-Centre Working Group on Climate Change. 2006. USAID. \$100K.
- Carbon, Conservation and Livelihoods. 2007. World Wildlife Fund. \$50K.
- Carbon Benefits Project (CBP): Modeling, Measurement, and Monitoring. 2008-2009. Global Environment Facility \$3.0 million (pending final approval).
- Making Carbon Finance Work for Rural Poverty Reduction. 2008-2012. Comart Foundation. 200K.

Publications

Peer Reviewed Journal Articles

1. Verchot, L.V. 1994. Nitrogen biogeochemical cycling in Piedmont vegetated filter zones. Ph.D. Dissertation. North Carolina State University.
2. Potter, C., E.A. Davidson and L.V. Verchot. 1996. Estimation of global biogeochemical controls and seasonality in soil methane consumption. *Chemosphere*. 32:2219-2246.
3. Verchot, L.V., E.C. Franklin and J.W. Gilliam. 1997. Nitrogen cycling in Piedmont vegetated filter zones. I Surface Soil Processes. *Journal of Environmental Quality*. 26:327-336.
4. Verchot, L.V., E.C. Franklin and J.W. Gilliam. 1997. Nitrogen cycling in Piedmont vegetated filter zones. II Subsurface nitrate attenuation. *Journal of Environmental Quality*. 26:337-347.
5. Verchot, L.V., E.C. Franklin and J.W. Gilliam. 1998. Effects of agricultural runoff dispersion on nitrate reduction in forested filter zone soils. *Soil Science Society of America Journal* 62:1719-1724.

6. Cattânio, J.H., E.A. Davidson, D.C. Nepstad, L.V. Verchot, and I.L. Ackerman. 1999. Intensificação do período seco e fluxo de CO₂ do solo de uma floresta primária no Sudoeste Amazonico. Boletim Técnico da Faculdade de Ciências Agrárias do Pará (Technical Bulletin of the Faculty of Agricultural Sciences of Pará) No. 28.
7. Cattânio, J.H., E.A. Davidson, L.V. Verchot, D.C. Nepstad, and I.L. Ackerman. 1999. Intensificação do período seco e fluxo de óxido nítrico, óxido nítrico e metano do solo de uma floresta primária de terra firme no Sudeste Amazonico. Boletim Técnico da Faculdade de Ciências Agrárias do Pará (Technical Bulletin of the Faculty of Agricultural Sciences of Pará) No. 29.
8. Verchot, L.V., E.A. Davidson, J.H. Cattânio, I.L. Ackerman, H.E. Erickson and M. Keller, 1999. Land-use change and biogeochemical controls of nitrogen oxide emissions from soils in eastern Amazonia. *Global Biogeochemical Cycles*. 13: 31-46.
9. Verchot, L.V. 1999. Cold storage of a tropical soil decreases nitrification potential. *Soil Sci. Soc. Am. J.* 63:1942-1944.
10. Verchot, L.V., E.A. Davidson, J.H. Cattânio and I.L. Ackerman. 2000. Land-use change and biogeochemical controls of methane fluxes in soils of eastern Amazonia. *Ecosystems*. 3:41-56.
11. Davidson, E.A., L.V. Verchot, J.H. Cattânio, I.L. Ackerman and J.E.M. Carvalho. 2000. Effects of soil water content on soil respiration in forests and cattle pastures of eastern Amazonia. *Biogeochemistry*. 48:53-69.
12. Davidson, E.A., M. Keller, H.E. Erickson, L.V. Verchot. E. Veldkamp. 2000. A cross-site test of a conceptual model of nitrous oxide and nitric oxide emissions from soils. *BioScience* 50:667-680.
13. Davidson, E.A. and L.V. Verchot. 2000. Testing the hole-in-the-pipe model of nitric and nitrous oxide emissions from soils using the TRAGNET database. *Global Biogeochemical Cycles*. 14:1035-1042.
14. Verchot, L.V., Z. Holmes, L. Mulon, P.M. Groffman and G.M. Lovett. 2001. Gross versus net rates of N mineralization and nitrification as indicators of functional differences between forest types. *Soil Biology and Biochemistry*. 33: 1889-1901.
15. Verchot, L.V., P.M. Groffman and D.A. Frank. 2002 Landscape versus ungulate control of gross mineralization and gross nitrification in semi-arid grasslands of Yellowstone National Park. *Soil Biology and Biochemistry*. 34:1691-1699.
16. Davidson, E.A., K. Savage, L.V. Verchot., and R.I. Navarro. 2002. Minimizing artifacts and biases in chamber-based measurements of soil respiration. *Agricultural and Forest Meteorology* 113:21-37.
17. Cattânio, J.H., E.A. Davidson, D.C. Nepstad, L.V. Verchot, and I.L. Ackerman. 2002 Unexpected results of a pilot throughfall exclusion experiment on soil emissions of CO₂, CH₄, N₂O, and NO in eastern Amazonia. *Biology and Fertility of Soils* 36:102-108.
18. Venterea, R.T., P.M. Groffman, L.V. Verchot, A.H. Magill, J.D. Aber, and P. Steudler. 2003. Nitrogen oxide gas emissions from temperate forest soils receiving long-term nitrogen inputs. *Global Change Biology*. 9:346-357.
19. Verchot, L.V., P.R. Moutinho, and E.A. Davidson. 2003. Leaf-Cutting Ant (*Atta sexdens*) Alters Nutrient Cycling: Deep Soil Inorganic Nitrogen Stocks, Mineralization, and Nitrification in Eastern Amazonia. *Soil Biology and Biochemistry*. 35:1219-1222.
20. Mosier, A., R. Wassmann, L.V. Verchot, J. King and C. Palm. 2004. Methane and nitrogen oxide fluxes in tropical agricultural soils: Sources, sinks and mechanisms. *Environment, Development and Sustainability* 6:11-49.
21. Palm, C. A., T. Tomich, M. van Noordwijk, S. Vosti, J. Gockowski, J. Alegre, L. Verchot. 2004. Mitigating GHG emissions in the humid tropics: Case studies from the Alternatives to Slash and Burn Program (ASB). *Environment, Development and Sustainability* 6: 145-162.
22. Venterea, R.T., P.M. Groffman, M.S. Castro, L.V. Verchot, I.J. Fernandez, M.B. Adams, and L. Rustad. 2004. Soil emissions of nitric oxide gas in two forest watersheds subjected to persistent N inputs. *Forest Ecology and Management*, 196:335-349.

23. Venterea, R.T., P.M. Groffman, L.V. Verchot, A.H. Magill, and J.D. Aber. 2004. Gross nitrogen process rates in temperate forest soils exhibiting symptoms of nitrogen saturation. *Forest Ecology and Management* 196:129-142.
24. Mutuo, P.K., G. Cadisch, A. Albrecht C.A. Palm, and L. Verchot. 2005. Potential of agroforestry for C sequestration and mitigation of nitrous oxide and methane emissions. *Nutrient Cycling in Agroecosystems*. 71: 43–54, 2005.
25. Bossio, D.A., M.S. Girvan. L.V. Verchot, J. Bullimore, T. Borelli, A. Albrecht, K.M. Scow, A.S. Ball, J.N. Pretty, and M.A. Osborn. 2005. Soil Microbial Community Response to Land Use Change in an Agricultural Landscape in Western Kenya. *Microbial Ecology*, 49:50-62.
26. Verchot, L.V., and T. Borelli. 2005. Application of para-Nitrophenol (pNP) enzyme assays in tropical highland soils of Western Kenya. *Soil Biology and Biochemistry*. 37:625-633..
27. Verchot, L.V., L. Hutabarat, K. Hairiah and M. van Noordwijk. 2006. Nitrogen Availability and Soil N₂O Emissions Following Conversion of Forests to Coffee in Southern Sumatra. *Global Biogeochemical Cycles*. VOL. 20, GB4008, doi:10.1029/2005GB002469,
28. Kanyanjua, S.M., J.K. Keter, R.J. Okalebo, and L. Verchot. 2006. Identifying potassium deficient soils in Kenya by mapping and analysis of selected sites. *Soil Science* 171:610-626.
29. Mathimaran, N., R. Ruh, B. Jama, L. Verchot, E. Frossard, and J. Jansa. 2007. Impact of agricultural management on arbuscular mycorrhizal fungal communities in Kenyan ferralsol. *Agriculture, Ecosystems and Environment*. 119:22-32
30. Solomon, D., J. Lehmann, J. Kinyangi, W. Amelung, I. Lobe, S. Ngoze, S. Riha, A. Pell, L. Verchot, D. Mbugua, J. Skjemstad, and T. Schäfer. 2007. Long-term effects of anthropogenic perturbations on dynamics and macromolecular level speciation of soil organic carbon in tropical and subtropical ecosystems: Anthropogenic perturbations alter macromolecular level dynamics of soil organic carbon: evidence from NMR, C (1s) NEXAFS and Sr-FTIR spectroscopy. *Global Change Biology*. 13, 1–20, doi: 10.1111/j.1365-2486.2006.01304.x
31. Verchot, L.V., R. Zomer, O. van Straaten, and B. Muys. 2007. Implications of country-level decisions on the specification of crown cover in the definition of forests for land area eligible for afforestation and reforestation activities in the CDM. *Climatic Change*. 81:415-430.
32. Verchot, L.V., M. van Noordwijk, S. Kandji, T. Tomich, C. Ong, A. Albrecht, A. Mackensen, C. Bantilan, C.K. Anupama, and C. Palm. 2007. Climate change: Linking adaptation and mitigation through agroforestry. *Mitigation and Adaptation Strategies for Global Change*, 12. DOI 10.1007/s11027-007-9105-6.
33. Zomer, R., A. Trabucco, L.V. Verchot, B. Muys, O. van Straaten. 2007. Land area eligible for afforestation and reforestation within the Clean Development Mechanism: a global analysis of the impact of forest definition. *Mitigation and Adaptation Strategies for Global Change*, 12, doi:10.1007/s11027-007-9087-4
34. Dutaur, L. and L.V. Verchot. 2007. A Global Inventory of the Soil CH₄ Sink. *Global Biogeochemical Cycles*. 21, GB4013, doi:10.1029/2006GB002734
35. Achten WMJ, B. Reubens, W. Maes, E. Mathijs, L. Verchot V.P. Singh, J. Poesen and B. Muys. 2007. Root architecture of the promising bio-diesel plant *Jatropha*. *Communication in Agricultural and Applied Biological Sciences*. Ghent University 72(1), 81-85.
36. Achten, W.M.G, E. Mathijs, L. Verchot, V.P. Singh, R. Aerts and B. Muys. 2007. *Jatropha* bio-diesel fueling sustainability? *Biofuels, Bioproducts and Biorefining*. 1:283-291. DOI: 10.1002/bbb.39.
37. KPC Rao, K.P.C., Verchot, L.V., and Laarman, J. 2007. Adaptation to Climate Change through Sustainable Management and Development of Agroforestry Systems. *SAT eJournal*. Vol. 4, 30pp. <http://ejournal.icrisat.org/specialproject.htm>.
38. Zomer, R.J., A. Trabucco D.A. Bossio, O. van Straaten and L. V. Verchot 2008. Climate change mitigation through afforestation / reforestation: a global analysis of hydrologic impacts. *Agriculture, Ecosystems and Environment*. 126:

39. Zomer, R.J., A. Trabucco D.A. Bossio, O. van Straaten and L. V. Verchot 2008. Climate change mitigation: a spatial analysis of global land suitability for Clean Development Mechanism afforestation and reforestation. *Agriculture, Ecosystems and Environment*. 126:
40. Verchot, L.V., and P. Cooper. 2008. International agricultural research and climate change: A focus on tropical systems. *Agriculture, Ecosystems and Environment*. 126: 1–3.
41. Verchot, L.V., S. Brienza Júnior, V.C. de Oliveira, J.K. Mutegei, J.H. Cattaneo, and E.A. Davidson. 2008. Fluxes of CH₄, CO₂, NO, and N₂O in an improved fallow agroforestry system in Eastern Amazonia. *Agriculture, Ecosystems and Environment*. 126: 113–121.
42. Achten, W., L. Verchot, Y.J. Franken, E. Mathijs, V.P. Singh and B. Muys. Submitted. *Jatropha* bio-diesel production and use: a review. *Biomass and Bioenergy*.
43. Kimetu J.M., J. Lehmann, S.O. Ngoze, D.N. Mugendi, J.M. Kinyangi, S.J. Riha, L.V. Verchot, J.W. Recha, and A. Pell. Submitted. Reversibility of soil productivity decline with organic matter of differing quality along a degradation gradient. *Ecosystems*.
44. Kinyangi, J., J. Lehmann, A. Pell, S. Riha, S. Ngoze, D. Mbugua, C. Barrett, L. Blume, and L. Verchot. Submitted. Soil Degradation and Equilibrium Dynamics of Long-term Carbon and Nutrient Losses in the Tropics. *Global Biogeochemical Cycles*.
45. Mutegei, J.K., L.V. Verchot, D.N. Mugendi and J.B. Kung'u. Submitted. The role of contour-hedge technologies in combating soil and inorganic-N losses on arable steepplands of the central highlands of Kenya. *Nutrient Cycling in Agroecosystems*.
46. Thenya, T., P. Verburg, R. Wassmann, L. Verchot, and D. Mungai. Submitted. Dynamics of resource utilisation in a tropical wetland, Yala swamp, Lake Victoria basin: Spatial statistical analysis of land use change. *Environmental Management*

Book Chapters

1. Verchot, L.V., A. Mosier, E. Baggs, and C. Palm. 2004. Climate Change: Soil – Atmosphere Gas Exchange and Land-Use Change in Upland Tropical Soils. In C. Ong, M. van Noordwijk, G. Cadisch (Eds.) *Belowground Interactions in Tropical Agroecosystems with Multiple Plant Components*. CABI Publishers.
2. Kandji, S.T., L.V. Verchot, J. Mackensen, A. Boye, M. van Noordwijk, T. Tomich, C. Ong, A. Albrecht, and C. Palm. 2006. Opportunities for linking adaptation to climate change and mitigation of greenhouse gas accumulation in agroforestry systems. *ICRAF 25th Anniversary Book*.
3. Swift, M.J., A. Stroud, K. Shepherd, A. Albrecht, A. Bationo, P. Mafongoya, F. Place, T. Tomich, B. Vanlauwe, L. Verchot and M. Walsh. 2006. *Confronting Land Degradation in Africa: Challenges For The Next Decade*. ICRAF 25th Anniversary Book.
4. Brumme R., L.V. Verchot, P.J. Martikainen, C.S. Potter. 2005. Contribution of trace gases nitrous oxide (N₂O) and methane (CH₄) to the atmospheric warming balance of forest biomes. In: Griffiths, H. (Ed.) *The Carbon Balance of Forest Biomes*. BIOS Scientific Publishers Ltd., Oxford.
5. Verchot, L.V., J. Mackensen, S. Kandji, M. van Noordwijk, T. Tomich, C. Ong, A. Albrecht, C. Bantilan, K.V. Anupama, C. Palm. 2005. Opportunities for linking adaptation and mitigation in agroforestry systems. pp 103 – 119 in G. Suharyanto and Y. Saloh (Eds.) *Tropical Forests and Adaptation to Climate Change: In Search of Synergies*.
6. Groffman, P.M., R.T. Venterea, L.V. Verchot, and C.S. Potter. 2006. Landscape and regional scale studies of nitrogen gas fluxes. In Wu, J. et al. (Ed.) *Scaling and Uncertainty Analysis in Ecology: Methods and Applications*.
7. L.V. Verchot, T. Krug, R.D. Lasco, S. M. Ogle, and J. Raison (Australia). Grasslands. 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Vol. 4: Agriculture, Forestry and other land use. Hayama: IGES, p.6.1-6.49.
8. H. Aalde, P. Gonzalez, M. Gytarsky, T. Krug, W. Kurz, R. Lasco, D. Martino, B. McConkey, S. Ogle, J. Raison, D. Schoene, P. Smith, Z. Somogyi, and L. Verchot. Generic Methodologies Applicable to Multiple Land-Use categories.. 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Vol 4: Agriculture, Forestry and other land use. Hayama: IGES, p.2.1-2.59.

9. J. Jenkins, H.D. Ginzo, S. Ogle, and L. Verchot. Settlements. 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Vol. 4: Agriculture, Forestry and other land use. Hayama: IGES, p.8.1-8.29.
10. R. Lasco, S. Ogle, K. Paustian, J. Raison, L. Verchot, R. Wassmann, and K. Yagi. Croplands. 2006 IPCC guidelines for national greenhouse gas inventories vol. 4: Agriculture, Forestry and other land use. Hayama: IGES, p.5.1-5.65.
11. Mutegei, J.K., D.N. Mugendi, L.V. Verchot and J.B. Kung'u. 2007. Impacts of vegetative hedges on soil inorganic-N cycling and erosional losses in arable steep lands of the Central Highlands of Kenya. In A Bationo (ed). Advances in integrated soil fertility research in Africa, Challenges and Opportunities, Springer, Dordrecht, Netherlands.
12. Baaru, M.W., Mugendi, D.N., Bationo A., Verchot, L., and Waceke, W. 2007. Soil microbial biomass carbon and nitrogen as influenced by organic and inorganic inputs at Kabete, Kenya. in A Bationo, B Wasma, J Kihara and J Kimetu (Eds.) Advances in Integrated Soil Fertility Management in sub-Saharan Africa: Challenges and Opportunities. Springer, Dordrecht, Netherlands.

Proceedings

1. Baggs, E.M., G. Cadisch, L.V. Verchot, N. Millar, and J.K. Ndufa. 2002. Environmental impacts of tropical agricultural systems: N₂O emissions and organic matter management. Transactions of the World Congress of Soil Science. 1164.
2. Walsh, M., K. Shepherd, and L. Verchot. 2004. Identification of sediment sources and sinks in the Nyando river basin. In D. Mungai, B. Swallow, J. Mburu, L. Onyango and A. Njui (eds.), Proceedings of a Workshop on Reversing Environmental and Agricultural Decline in the Nyando River Basin, ICRAF: Nairobi, Kenya, pp. 27-32.
3. Achten WM, Reubens B, Maes W, Mathijs E, Verchot L, Singh VP, Poesens J, Muys B. 2007. Root architecture of the promising bio-diesel plant Jatropha. *Commun Agric Appl Biol Sci.* 2007;72(1):81-5.

Reports

1. Verchot, L.V. and E. Karch. 1990. Financial analysis of agroforestry systems for the peanut basin of Senegal. Senegal Reforestation Project General Technical Report, Ministry of Rural Development and Water Resources. 1991.
2. Verchot, L.V. 1989. Agroforestry - Technical notes and lesson plans for a two week training course. Senegal Reforestation Project for the Ministry of Rural Development and Water Resources. 1990.
3. Verchot, L.V. 1986. Study of the vegetation and soil on the silvicultural experimental parcel in the Tiogo classified forest reserve. General Technical Report, Ministry of Environment and Tourism, Burkina Faso. 1987.
4. Verchot, L.V. 1986. Nomenclature and utilization of plants by the Lélé and Mossi populations around the Tiogo classified forest reserve. General Technical Report, Ministry of Environment and Tourism, Burkina Faso. 1987.
5. Verchot, L.V., E.C. Franklin and J.W. Gilliam. 1997. Nitrogen biogeochemical cycling in Piedmont vegetated filter zones. Water Resources Research Institute of the University of North Carolina, Report No. 310.
6. Kandji, S.T., L.V. Verchot, and J. Mackensen. 2006. Climate change and variability in the Sahel region: impacts and adaptation strategies in the agricultural sector. -- World Agroforestry Centre (ICRAF), Nairobi, Kenya: UNEP, 48p. [B14549] 551.583 KAN ICRAF
7. Kandji, S.T., L.V. Verchot, and J. Mackensen. 2006. Climate change and variability in Southern Africa: impacts and adaptation strategies in the agricultural sector. -- World Agroforestry Centre (ICRAF), Nairobi, Kenya: UNEP, 40p. [B14622] 551.583 KAN ICRAF

8. Kandji, S.T. and L. Verchot. 2007. Impacts and Adaptation to Climate Variability and Climate Change in the East African Community. – World Agroforestry Centre (ICRAF), Nairobi, Kenya, 28p. ICRAF
9. Verchot, L.V.; Place, F.; Shepherd, K.D.; Jama, B. World Agroforestry Centre (ICRAF), Nairobi (Kenya) 2007. Science and technological innovations for improving soil fertility and management in Africa: a report for the NEPAD Science and Technology forum. -- Nairobi, Kenya: World Agroforestry Centre (ICRAF) ICRAF Working Paper no. 31, 96p. 631.45 VER ICRAFP [B15193 B15194 B15195 B15205]
10. Louis V. Verchot. 2007. Opportunities for Climate Change Mitigation in Agriculture and Investment Requirements to Take Advantage of These Opportunities. *A report to the UNFCCC Secretariat Financial and Technical Support Programme.* url: http://unfccc.int/files/cooperation_and_support/financial_mechanism/application/pdf/verchot.pdf

Other Written Communications

1. Verchot, L. 2004 Agroforestry in the CDM: An opportunity for synergy between mitigation and adaptation. In CDM Investment Newsletter. 2004(3): 3-4.
2. Mackensen J, and L. Verchot. 2004. Modalities for small-scale afforestation and reforestation projects under the Clean Development Mechanism. In CDM Investment Newsletter. 2004(3):8-11.
3. J. O. Niles., T. Janson-Smith, C. Kelly, J. Henman, B. Stanley, L. Verchot. B. Locatelli, D. Murdiyarso, M. Dutschke, A. Michaelowa, A. Sari, O. Tanujaya, M. Totten, S. Pandya, S. Stier; and C. Romero. 2005. Climate, Community and Biodiversity Project Design Standards (First Edition). CCBA, Washington DC. May 2005. At: www.climate-standards.org.
4. Agriculture. 2006. National Environmental Management Authority of Kenya. Kenya Technology Needs Assessment for Adaptation to Climate Change. Government of Kenya, Nairobi, Kenya.
5. Forestry. 2006. National Environmental Management Authority of Kenya. Kenya Technology Needs Assessment for Adaptation to Climate Change. Government of Kenya, Nairobi, Kenya.
6. Avoided Deforestation with Sustainable Benefits: A Simple Way to Reduce Carbon Emissions from Deforestation and Degradation. ASB Policy Brief. Nairobi, Kenya. 2007.
7. Submission by the International Centre for Research in Agroforestry (ICRAF) To the UNFCCC: Issues relating to reducing emissions from deforestation in developing countries. Nairobi, Kenya. 2007.
8. Verchot, Louis V. 2007. Europe must admit Africa to carbon trading club. SciDevNet. <http://www.scidev.net/content/opinions/eng/europe-must-admit-africa-to-carbon-trading-club.cfm>
9. Verchot, Louis V. 2008. The Poor Shut Out of Carbon Market [opinion]. Business Daily Africa.

Meeting papers

1. Verchot, L.V., E.A. Davidson and J.H. Cattânio. 1995. Seasonality of trace gas emission from soils in the eastern Amazon. Ecological Society of America.
2. Verchot, L.V. and E.A. Davidson. 1995. The global soil methane sink -- impact of human activities. International Symposium on Environmental Biogeochemistry.
3. Verchot, L.V. and E.A. Davidson. 1995. Exchange of N₂O, NO CH₄ and CO₂ between soils and the atmosphere in forests and pastures in eastern Amazonia. Soil Science Society of America
4. Davidson E.A., and L.V. Verchot. 1995. Effects of land use change on the fluxes of trace gases between soils and the atmosphere in eastern Amazonia. Soil Science Society of America
5. Verchot, L.V., J.H. Cattânio, I.L. Ackerman, E.C. Olivera and E.A. Davidson. 1996. Fluxes of NO, N₂O and CH₄ in pastures and forests of eastern Amazonia. Ecological Society of America.
6. Verchot, L.V., J.H. Cattânio, I.L. Ackerman, E.C. Olivera and E.A. Davidson. 1996. Fluxos de NO, N₂O e CH₄ em pastagens e matas da Amazônia oriental. Brazilian Ecological Society.
7. Verchot, L.V. and P.M. Groffman. 1998. Soil microbial biomass and microbial activity in riparian forests of Costa Rica. International Soil Science Society.

8. Verchot, L.V. and E.A. Davidson. 1998. Land-use change and biogeochemical controls of soil methane fluxes in eastern Amazonia. Soil Science Society of America.
9. Verchot, L.V. and E.A. Davidson. 1998. Effects of land-use change on soil nitrogen oxide fluxes in eastern Amazonia. Soil Science Society of America.
10. Verchot, L.V. . 2000. Think globally -- act locally: Linking local sustainable agriculture with global climate change mitigation. WMO-USAID Preparatory Conference for SBSTA on Climate Change Mitigation.
11. Verchot, L.V. 2000. *Carbon Sequestration: The Role of Agroforestry and Sustainable Agriculture* UNFCCC – COP6 The Hague
12. Verchot, L.V., P. Grace, P. Sanchez, J. Ingram, c. Palm, R. Wassman, M. Fisher, R. Thomas, F. Chandler, W. Bowen, R. Reid, M. Wopereis, and S. Waddington. 2001. The consequences of international agricultural research on greenhouse gas emissions and global climate change. IGBP Open Science Meeting on Climate Change, Amsterdam.
13. Verchot, L.V., C. Palm, T. Tomich, J. Alegre, M. van Noordwijk, S. Vosti, and J. Gockowski. 2001. Opportunities and constraints in mitigating GHG in slash-and-burn systems. Tropical Agriculture in Transition – Opportunities for Mitigating Greenhouse Gas Emissions. Bonn.
14. Bossio, D., L. Verchot, and M. Swift. 2001. Biological Management of Soils: A Soil Microbiology Approach. 2001. Soil Biology meeting at Maasai Mara.
15. Borelli, T. and L. Verchot. 2001. Enzymes and phospholipids as bioindicators of soil fertility in western Kenya. Soil Science society of East Africa, Arusha, Tanzania.
16. Baggs, E.M., G. Cadisch, L.V. Verchot, N. Millar, and J.K. Ndafa. 2002. Environmental impacts of tropical agricultural systems: N₂O emissions and organic matter management. World Congress of Soil Science. Bangkok, Thailand.
17. Venterea, R., P. Groffman, L. Verchot Controls over nitrogen oxide gas emissions from forest soils along a gradient in atmospheric N deposition. Soil Science Society of America Annual Meeting St. Paul, MN.
18. Verchot, L.V. 2002. Linking adaptation and mitigation in agriculture and forestry. South Asia Expert Workshop Adaptation to Climate Change for Agricultural Productivity
19. Borelli, T., L.V. Verchot, and D. Bossio. 2002. Enzymes and phospholipids as bio-indicators of soil quality. 2002. ISCO Meeting, Beijing, China.
20. Verchot, L.V., T. Borelli, D. Bossio, M. Girvan, A. Ball, J. Pretty, A. Albrecht, and M. Swift. 2002. Does Belowground Biodiversity Matter? Soil Microbial Communities and Microbial Function. i. World Congress of Soil Science. Bangkok, Thailand.
21. Verchot, L.V.. 2002. Beyond the Production Function of Soil Fertility Management: What are the wider consequences of bad soil management? Bellagio Soil Fertility Replenishment in Sub-Saharan Africa. Bellagio, Italy.
22. R. Brumme; P. Martikainen; C. Potter and L. Verchot. 2003. Trace gas contribution (N₂O, CH₄) of forest soils to GWP balances. The Carbon Balance of Forest Biomes, Univ. Edinburgh, April 2003.
23. Gikonyo, E. W., P. Smithson, L. Verchot and H. Recke. 2003. Laboratory estimations of phosphorus fertilizer factors for quantitative fertilizer recommendations: An example using Kenya soils. International Conference on Agricultural Science and Technology. Houston, Texas.
24. Verchot, L.V., M. van Noordwijk, C. Ong, T. Tomich, J. Mackensen, and C. Bantilan. 2003. Climate Change: Linking adaptation and mitigation through Agroforestry. ICRAF 25th anniversary meeting.
25. Verchot, L.V., M. van Noordwijk, C. Ong, T. Tomich, J. Mackensen, and C. Bantilan. 2003. Climate Change: Linking adaptation and mitigation through Agroforestry. Adaptation Research Workshop, 9-12 November 2003, Delhi
26. Venterea, R.T., P.M. Groffman, L. Verchot, A. Magill, J. Aber, I. Fernandez, M.B. Adams, M. Castro, G. Lovett. 2003. Nitrogen oxide trace gas efflux and soil n dynamics in response to N inputs in temperate forests of the northeastern U.S. American Geophysical Union Meeting, Fall 2003.

27. Gikonyo, E.W., P. Smithson, L. Verchot, H. Recke and A.R. Zaharah. 2003. Incorporating Soil Phosphorus Buffering Coefficients in Fertilizer Recommendations. Soil Science Conference of Malaysia, Kota Bharu, Kelantan, Malaysia. April 2003.
28. Swift, M., A. Stroud, K. Shepherd, A. Albrecht, A. Bationo, P. Mafongoya, F. Place, T. Tomich, B. Vanlauwe, L. Verchot, and M. Walsh. 2003. Confronting land degradation in africa: challenges for the next decade. Paper presented at the ICRAF 25th Anniversary and Scientific Forum, 2-6 November, Nairobi.
29. Gikonyo, E., P., P. Smithson, L. Verchot, and H. Recke. 2004. Laboratory estimations of phosphorus buffering coefficients for quantitative fertilizer recommendations PSILPH conference, Japan.
30. Kinyangi, J., J. Lehmann, J. Thies, A. Pell, L. Verchot, S. Ngoze, C. Barret, D. Mbugua and S. Riha. 2004. Biogeochemical Characteristics of Organic Matter Fractions that Confer Thresholds during Soil Degradation. ASA/SSSA/CSSA, Seattle , WA , November 1-4, 2004 . CD ROM. Program p. 396.
31. Ngoze, S., S. Riha, L. Verchot, J. Kinyangi, A.N. Pell, D.M. Mbugua, and J. Lehmann. 2004. Nitrogen fluxes in Soils Amended with Animal Manure and Tithonia Biomass on a Soil Degradation Chronosequence. ASA/SSSA/CSSA, Seattle , WA, November 1-4, 2004 . CD ROM. Program p. 239.
32. Verchot, L.V. Climate Change and Food Security. Development Day at the 10th Conference of the Parties to the Kyoto Protocol, Buenos Aires, December 2004.
33. Verchot, L.V., O. van Straaten, and R. Zomer. Implications of Country-Level Decisions on the Specification of Crown Cover in the Definition of Forests for Land Area Eligible for Afforestation and Reforestation Activities in the CDM. ENCOFOR Side event at the 10th Conference of the Parties to the Kyoto Protocol, Buenos Aires, December 2004.
34. Marennya, P.P., H.A. Markewich, A.O. Odenyo, S.J. Riha, L.V. Verchot, and J. Wangila. 2005. Dynamics of poverty and soil degradation on smallholder farms in central and western Kenya . Workshop for Enhancing Collaborative Research on the Environment in Sub-Saharan Africa, National Science Foundation on Sub-Saharan Africa, Arlington , VA. January 24-6, 2005.
35. Kinyangi, J., J. Lehmann, A. Pell, J. Thies, S. Ngoze. S. Riha, D. Mbugua, and L. Verchot. 2006. Soil organic matter stabilization and associated degradation threshold dynamics. In World Congress of Soil Science, 9-14 July 2006, Philadelphia . Abstract 18131, poster 138-54.
36. Ngoze S., S.J. Riha. J.M. Kinyangi, J. Lehmann, L. Verchot, D. Mbugua, and A.N. Pell. 2006. Soil fertility degradation and management in the highlands of Kenya. In World Congress of Soil Science, 9-14 July 2006, Philadelphia . Abstract; poster 147-11.
37. Riha S.J. , C.B. Barrett, L.E. Blume, J.M. Kinyangi, C.J. Lehmann, P.P. Marennya, D.M. Mbugua, C.F. Nicholson, S.O. Ngoze, D. Parsons, L.V. Verchot, and A.N. Pell. 2006. Long-Term Human and Biophysical Dynamics of Soil Degradation in the Kenyan Highlands. In World Congress of Soil Science, 9-14 July 2006, Philadelphia . Abstract 18227, poster 156-2
38. Verchot, L.V. Smallholder carbon development projects: linking climate change mitigation with poverty reduction. 12th Conference of the Parties to the UNFCCC, 6 November 2006, Nairobi, Kenya.
39. Achten, W., B. Muys, E. Mathijs, AND L. Verchot. 2006. Biodiesel production from *Jatropha* in developing countries: life cycle and relevant impact categories. In: Conference biomass for energy: challenges for agriculture, 25-26 September 2006, Bruges, Belgium. Book of abstracts, p 106.
40. Achten, W., E. Mathijs, L. Verchot, V.P. Singh, and B. Muys. 2007. Bio-diesel from *Jatropha*: life-cycle and environmental impact. In: International energy farming congress, 13-15 March 2007, Book of Abstracts.
41. Achten, W., E. Mathijs, L. Verchot, V.P. Singh, and B. Muys. 2007. Bio-diesel from *Jatropha*: the life-cycle perspective. FACT seminar on *Jatropha curcas* L.: Agronomy and Genetics. 26-28 March 2007, Wageningen, the Netherlands. Book of abstracts.
42. Achten, W., E. Mathijs, L. Verchot, V.P. Singh, and B. Muys. 2007. Life-cycle assessment of Bio-diesel from *Jatropha curcas* L.: energy balance, impact on global warming, land use impact. In: 5th

International Conference on LCA in foods, 25-26 April 2007, Gothenburg, Sweden. Book of Abstracts.

43. Verchot, L.V., 2007. Mitigation Potential in Agriculture. 2007. In: Mitigation Potential, Effectiveness, Efficiency Costs And Benefits of Promising Current and Future Policies, Measures and Technologies at the Sectoral Level and Within a National/Regional Strategy. Third Meeting of the Ad-Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol. Bonn, Germany, 14 May 2007.
44. Verchot, L.V., O. van Straaten, R. Zomer, and B. Muys. 2007. Analysis of the impact of the crown cover specification on land suitability for the CDM. ENCOFOR Final Workshop: Tools for CDM A/R Project Developers. Bonn, Germany, 14 May 2007.
45. Muys, B., W. Achten, E. Mathijs, V.P. Singh and L. Verchot. 2007. Bio-diesel production from *Jatropha curcas* L.: energy balance, global warming potential and land use impact. Book of abstracts of the Third International Conference on Renewable Resources and Biorefineries, 4-6 June, 2007, Ghent, Belgium. 55.
46. Mutegi, J.K. and L.V. Verchot. 2007. Soil-atmosphere Exchange of Greenhouse Gases and their Biogeochemical Drivers as Influenced by Land Use Change in Western Kenya. Soil Science Society of East Africa. Embu, Kenya. December 2007.
47. Verchot, L.V. and J.K. Mutegi. 2007. Opportunities for Climate Change Mitigation Through Sustainable Land Management: A Semi-quantitative Assessment of Costs and Reductions Levels. Embu, Kenya. December 2007.

Education

Doctor of Philosophy Degree (Ph.D.) in Forestry with a minor in Soils at North Carolina State University, 1994. Raleigh, N.C. Dissertation Title: Nitrogen Biogeochemical Cycling in Piedmont Vegetated Filter Zones.

Master of Science (M.S.) in Silviculture, 1987, State University of New York, College of Environmental Science and Forestry at Syracuse. Thesis title: Relationships of Soil Physical Properties to Soil Compaction in Timber Harvesting Operations.

Bachelor of Science (B.S.) in Forest Management, 1980, Rutgers University, Cook College, New Brunswick, NJ.

Languages

English:	Native		
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Portuguese (Brazil):	Speaking – very good	Reading – very good	Writing – fair

Professional Memberships

American Geophysical Union, International Union of Soil Science, Soil Science Society of America, International Soil Science Society, American Society of Agronomy, Ecological Society of America.

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EDUCATION

1995 – 1997	Post-doctoral research fellow, Dept. Rangeland Ecology & Management, Texas A&M University, College Station.
1991 – 1995	PhD Rangeland Ecology, Texas A&M University, College Station.
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1981 – 1986	BSc, Animal Science, BSc Agricultural Mechanization, Iowa State University, Ames.

PUBLICATIONS

Peer reviewed:

- Walsh, M. G. in progress. Critical soil condition: a spectral indicator for early detection of irreversible ecosystem change. *Global Change Biology*.
- Walsh, M. G. and A. Awiti. in progress. Soil organic carbon turnover and associated fertility impacts following rainforest conversion in western Kenya. *Ecology*.
- Cohen M. J., K. D. Shepherd and M. G. Walsh. in press. Measuring, predicting and mapping surface infiltration across a tropical watershed. *Geoderma*.
- Vagen T. G., M. G. Walsh and K. D. Shepherd. 2006. VNIR spectroscopy for characterization of landscape levels change in soil quality following deforestation in the highlands of Madagascar. *Geoderma*.
- Vagen T. G., K. D. Shepherd and M. G. Walsh. 2006. Stable carbon isotopes as evidence of past land use and soil organic carbon dynamics under land use conversions in Madagascar. *Geoderma*.
- Brown D., K. D. Shepherd and M. G. Walsh. 2005. Global soil characterization using VNIR reflectance libraries and boosted regression trees. *Geoderma*.
- Cohen M. J., K. D. Shepherd and M. G. Walsh. 2004. Empirical reformulation of the Universal Soil Loss Equation for erosion risk assessment in a tropical watershed. *Development Policy Review*, 22 (4): 381-403.

Cohen M. J., K. D. Shepherd and M. G. Walsh. 2004. Watershed scale validation of the universal soil loss equation in Western Kenya. *Geoderma*.

Shepherd K. D. and M. G. Walsh. 2003. Rapid soil analysis using diffuse reflectance spectrometry. In: R. Lal. *Encyclopedia of Soil Science*, 2nd edition.

Shepherd, K. D. and M. G. Walsh. 2002. Development of reflectance spectral libraries for characterization of soil properties. *Soil Science Society of America Journal*, 66(3): 988-998.

Walsh M. G., I. Hary and H. J. Schwartz. 1999. Use of GIS and methods for processing uncertain knowledge for evaluating natural resource management strategies in pastoral systems. In: K. J., Peters (ed.). *Resourcenknappheit und Erhaltung der Lebensgrundlage - die Herausforderung an die Zukunft*. Humboldt University Press, Berlin.

Schwartz H. J., M. G. Walsh and I. Hary. 1999. Evaluation of options for natural resource management in pastoral systems in East Africa: Case studies in Uganda and Eritrea. In: K. J., Peters (ed.). *Resourcenknappheit und Erhaltung der Lebensgrundlage - die Herausforderung an die Zukunft*. Humboldt University Press, Berlin.

Walsh M. G. 1995. A bayes network for modeling landuse intensity in pastoral ecosystems in Northern Kenya. Ph.D dissertation. Dept. of Rangeland Ecology and Management, Texas A&M University, College Station, Texas, 77840.

Walsh M. G. and H. J. Schwartz. 1993. The productive potential of the camel: In: H.J. Schwartz and M. Dioli M. (eds). *The one-humped camel in Eastern Africa: A pictorial guide to diseases, health care and management*. Verlag Joseph Margraf, Weikersheim, Germany.

Schwartz H. J. and M. G. Walsh (1993-1994, 6 volumes including 36 maps). *Range Unit Inventory*. *Range Management Handbook of Kenya*, vol. II b, c, d, e, f, g. Min. of Agriculture, Range Management Division, Nairobi, Kenya.

Technical reports:

Swallow B., M. G. Walsh, D. Nyantika, S. Murithi, Q. Noordin, C. Ong, and K. D. Shepherd. 2002. Improved Land management in the Lake Victoria Basin: annual technical report July 2001 to June 2002. *Natural Resource Problems, Priorities and Policies Programme Working Paper Series 2002-2*. Nairobi: ICRAF.

Swallow B., M. G. Walsh, F. Mugo, C. Ong, and K. Shepherd. 2001. Improved Land management in the Lake Victoria Basin: annual technical report July 2000 to June 2001. *Natural Resource Problems, Priorities and Policies Programme Working Paper Series 2001-4*. Nairobi: ICRAF.

- Shepherd K. D. and M. G. Walsh. (2001). Light reflectance provides rapid assessment of soil quality. Natural Resource Problems, Priorities and Policies Programme Working Paper 2001-1. International Centre for Research in Agroforestry, Nairobi, Kenya.
- Shepherd K. D., M. G. Walsh, F. Mugo, C. Ong, T. Hansen, B. Swallow, A. Awiti, M. Hai, D. Nyantika, D. Ombalo, M. Grunder, F. Mbote and D. Mungai. (2000). Improved land management in the Lake Victoria Basin: Linking land & lake, research & extension, catchment & lake basin. First technical report start-up phase, July 1999 to June 2000. (Working Paper 2000-2). ICRAF, Ministry of Agriculture and Rural Development, Soil and Water Conservation Branch & National Soil and Water Conservation Programme.
- Shepherd K. D. and M. G. Walsh. (2000). Sensing soil quality: Evidence from Africa. ICRAF Working paper. November, 1999. Nairobi: ICRAF, 27 pp
- Shepherd K. D. and M. G. Walsh. 2000. Diffuse reflectance spectrometry in the NARL long-term experiment—preliminary results. A report to the Kenya Agriculture Research Institute. October 1999. Nairobi: ICRAF.
- Kirschnick F., K. D. Shepherd and M. G. Walsh M. (1998) A framework for strategic planning and priority setting for an international agricultural research organization. Working Paper, ICRAF.
- Walsh M. G. and H. J. Schwartz (1996). A study of land use potential in Gash-Setite, Eritrea. Technical report. German Development Agency (GTZ) – Ministry of Agriculture, Asmara, Eritrea.
- Schwartz H. J., M. G. Walsh and I. Hary. (1996). Land use potential in the Ankole Ranching Scheme, Uganda. Technical report. German Development Agency (GTZ), Kampala, Uganda.

Proceedings:

- Awiti A. O., M. G. Walsh, and K. D. Shepherd. 2005. The effects of land use land cover change on soil functional capacity: patterns, process and implications. Paper at Deutscher Tropentag, October 11-13, 2005, Hohenheim "The Global Food & Product Chain—Dynamics, Innovations, Conflicts, Strategies".
- Awiti A. O., M. G. Walsh and C. Omuto. 2004: Consequences of land cover change: Land management and policy options. In Mungai, D. B. Swallow, J. Mburu, L. Onyango, A. Njui (Eds.). Proceedings of a workshop on Reversing Environmental and Agricultural Decline in the Nyando River Basin December 9th-11th 2002, Kisumu, Kenya.
- Awiti A. O., M. G. Walsh and K. D. Shepherd. 2004. Spectral discrimination of changes in soil properties associated with tropical forest conversion. In Woerner, P. L. and Lynam, J. K. (Eds.). Enhanced Soil Productivity in East

and Southern Africa: Rockefeller Foundation Grantees Workshop, 20 to 23 September 2004, Safari Park Hotel, Nairobi, Kenya.

Walsh, M. G. 2004. Identification of sediment sources and sinks in the Nyando river basin. In D. Mungai, B. Swallow, J. Mburu, L. Onyango and A. Njui (eds.), Proceedings of a Workshop on Reversing Environmental and Agricultural Decline in the Nyando River Basin, ICRAF: Nairobi, Kenya.

Walsh, M. G. 2002. Sensing soil quality: diffuse reflectance spectroscopy. Multidisciplinary Training Programme on Tropical Lakes and Wetland Ecosystem Management, 14 December 2002, Naivasha, Kenya.

Brown D. J., K. D. Shepherd and M. G. Walsh. 2003. Soil classification based on VNIR diffuse reflectance spectroscopy. Paper presented at ASA-CSSA-SSSA Annual Meetings, 2-6 November 2003, Denver, Colorado, USA.

Shepherd K. D. and M. G. Walsh. 2003. Rapid characterization of soil quality and organic resource quality using reflectance spectroscopy. Paper presented at the APSIM Workshop "Integrated Nutrient Management in Tropical Cropping Systems: Improved Capabilities in Modelling and Recommendations", 20-22 January 2003, World Agroforestry Centre, Nairobi, Kenya

Shepherd, K. D. and M. G. Walsh. 2003. Why nutrient balances? A Framework for Large-area Surveillance of Soil Degradation. Paper presented to the Wageningen University – FAO Workshop on Scaling Soil Nutrient Balances, 17-18 February 2003, Fairview Hotel, Nairobi, Kenya.

Shepherd K. D. and M. G. Walsh. 2003. Scientific advances in baseline methodologies for carbon offset projects. Paper presented at the UNEP-IUCN-FAO Technical Workshop on Forests and the Clean Development Mechanism in Africa, 22-24 January 2003, UNEP, Nairobi, Kenya.

Shepherd K. D., M. G. Walsh and A. O. Awiti. 2003. Use of soil spectral indicators for assessing and monitoring soil quality. Paper presented at ASA-CSSA-SSSA Annual Meetings, 2-6 November 2003, Denver, Colorado, USA.

Shepherd K. D. and M. G. Walsh. 2003. Improving accuracy and quality control of routine soil analyses using diffuse reflectance spectroscopy. Paper presented at ASA-CSSA-SSSA Annual Meetings, 2-6 November 2003, Denver, Colorado, USA.

Walsh M. G., and K. D. Shepherd. 2003. Quantifying effects of historic land use change on soil organic carbon using soil reflectance libraries. Paper presented at ASA-CSSA-SSSA Annual Meetings, 2-6 November 2003, Denver, Colorado, USA.

- Walsh M. G., K. D. Shepherd, A. O. Awiti and R. Coe. 2003. Spectral detection of erosion phase transitions in large watersheds. Paper presented at ASA-CSSA-SSSA Annual Meetings, 2-6 November 2003, Denver, Colorado, USA.
- Brown D. J., K. D. Shepherd and M. G. Walsh. 2003. Soil classification based on VNIR diffuse reflectance spectroscopy. Paper presented at ASA-CSSA-SSSA Annual Meetings, 2-6 November 2003, Denver, Colorado, USA.
- Cohen, M. J., K. D. Shepherd and M. G. Walsh. 2003. Soil erodibility estimation using diffuse reflectance spectroscopy. Paper presented at ASA-CSSA-SSSA Annual Meetings, 2-6 November 2003, Denver, Colorado, USA.
- Vagen T. G., K. D. Shepherd and M. G. Walsh. 2003. Deforestation and land use change in the highlands of Madagascar: sensing change in soil quality using near infrared reflectance spectroscopy. Paper presented at ASA-CSSA-SSSA Annual Meetings, 2-6 November 2003, Denver, Colorado, USA.
- Thine C. O., M. G. Walsh, K. D. Shepherd and R. Coe. 2003. Prediction of field-measured infiltration rates using diffuse reflectance spectroscopy. Poster presented at ASA-CSSA-SSSA Annual Meetings, 2-6 November 2003, Denver, Colorado, USA.
- Vagen T. G., M. G. Walsh, and K. D. Shepherd. 2003. Change Detection Using Image Classification and Spectral Mixture Analysis Techniques: Biomass Burning in the Highlands of Madagascar. Poster presented at ASA-CSSA-SSSA Annual Meetings, 2-6 November 2003, Denver, Colorado, USA.
- Swift M., A. Bationo, E. Barrios, G. Brown, F. Place, J. Ramisch, K. D. Shepherd, A. Stroud, B. Vanlauwe, L. Verchot and M. G. Walsh. 2003. Land and soil problems: advances in methodological and empirical research and key challenges. A paper presented at World Agroforestry and the Future: A conference on the occasion of the 25th anniversary of ICRAF, 1-5 November 2003, Nairobi, Kenya.
- Walsh M. G., A. Albrecht and K. D. Shepherd. 2002. Diffuse reflectance spectrometry for quantifying erosion and land cover effects on soil carbon stocks. Paper presented at International Colloquium on Land Use, Erosion and Carbon Sequestration, 23-28 September 2002, Agropolis Center, Montpellier.
- Shepherd K. D. and M. G. Walsh. 2002. Sensing soil quality: A protocol for large-area diagnostic surveillance of soil condition. Transactions of the 17th World Congress of Soil Science, 14-21 August, Bangkok, Thailand.
- Walsh M. G. and K. D. Shepherd. 2002. Sensing soil quality: A protocol for large-area diagnostic surveillance of soil condition. Transactions of the 17th World Congress of Soil Science, 14-21 August, Bangkok, Thailand, p.1886.
- Walsh M. G. and A. Albrecht. 2002. Diffuse Reflectance Spectrometry for Assessment of Carbon Sequestration Niches and Management Opportunities

- in Western Kenya. Proc. Int. Carbon Sequestration and Erosion Workshop, 17-19th September, IRD, Montpellier, France.
- Awiti A. O., M. G. Walsh and K. D. Shepherd (2001). Assessment of erosion potential in the Lake Victoria Basin. In: Proc. 5th Africa GIS Conference, UNEP, 5-9 November, 2001, Nairobi, Kenya.
- Walsh M. G., K.D. Shepherd, A. O. Awiti, O. Ochieng and T. Svan Hansen. 2000. Diagnostic surveillance of soil erosion and nutrient runoff in the Lake Victoria Basin. In: Proc. KL-2000 UNESCO/IUFRO Symposium: Forest – Land – Water – People in the Humid Tropics. 30 July – 4 August, 2000, University of Kebangsaan, Malaysia.
- Walsh M. G., H. J. Schwartz and M. M. Kothmann. 1995. Modeling spatial decision processes in pastoral ecosystems in Northern Kenya. In: Proc. of Wild and Domesticated Ruminants in Extensive Landuse Systems, Humboldt University, Berlin.
- Walsh M. G., Kothmann M. M. and K. L. Risenhoover. 1995. Spatial decisions of mobile pastoralists. In: Proceedings of Decision Support 2000 Conference, Jun 18th - 23rd, 1995 Toronto, Canada.
- Risenhoover K. L., M. G. Walsh, S. B. Murden and C.M. Doucet. 1995. Fine-scale resource heterogeneity and its influence on ungulate use of landscapes. Invited paper In: Proceedings of the Wildlife Society Annual Meeting 1995, Seattle Washington.
- Doucet C. M., M. G. Walsh, K. L. Risenhoover and S. B. Murden. 1995. Landscape-level foraging responses of White-Tailed deer to temporal changes in resource heterogeneity. In: Proceedings of the Wildlife Society Annual Meeting 1995, Seattle Washington.
- Murden S. B., C. M. Doucet, M. G. Walsh and K. L. Risenhoover. 1995. Assessing fine-scale resource heterogeneity using low-level aerial photography. In: Proceedings of the Wildlife Society Annual Meeting 1995, Seattle Washington.
- Risenhoover K. L., J. Price and M. G. Walsh. 1994. Influence of mining on landscape structure. In: Proceedings of the Wildlife Society Annual Meeting 1994, Albuquerque, New Mexico.
- Walsh M. G., D. K. Loh, M. M. Kothmann and K. L. Risenhoover. 1993. Feeding resource based habitat partitioning in multi-species grazing systems in Northern Kenya. In: Proceedings of the Society for Range Management Annual Meeting. Albuquerque, New Mexico.
- Walsh M. G. 1991. Niche structure of domesticated herbivores in a semi-arid thornbush savanna in Northern Kenya. In: Proceedings of the IVth International Rangeland Congress, Montpellier, France.

Herlocker D. J., M. G. Walsh, W. Schultka, H. J. Schwartz and D. Walther. 1991. Range condition change in Northern Kenya and its consequences to pastoral production systems. In: Proceedings of the IVth International Rangeland Congress, Montpellier, France.

Schwartz H. J. and M. G. Walsh. 1990. Improving the reproductive capacity of the camel: consequences to production systems. In: Proc. Is it possible to improve the reproductive capacity of the camel ? Maison-Alfort, Paris, France.

KEY MEMBERSHIPS

Society for Range Management

Ecological Society of America

PRIZES AND AWARDS

Tom Slick graduate research fellowship, College of Agriculture, Texas A&M University (1994).

Sid Kyle graduate research fellowship, Dept. of Rangeland Ecology and Management, Texas A&M University (1993).

STUDENT SUPERVISION

- Alex Awiti (PhD, Botany Dept., University of Nairobi, current)
- Christian O. Thine (PhD, Agricultural Engineering Dept. University of Nairobi, current)
- Paul Abuom (PhD, Dept. Environmental Sciences, Edgerton University, current)
- Jeff de Graffenried (PhD, Soil Science Dept., University of Alabama, current)
- Samuel Kithuku (MSc, Agronomy Dept., Moi University, current)
- Julius Onyango-C'Oredo (MSc, Dept. Rural and Urban Planning, Maseno University, current)
- Tor Gunnar-Vagen (PhD, Dept. of Soil Science, Norwegian Agricultural University, 2005)
- Thomas Owiyo (PhD, Soil Science Dept. Cornell University, 2005)
- Kelebogile Mfundisi (PhD, Zenter fuer Entwicklungsforschung, Bonn University, 2005)
- Mathew Cohen (PhD, Center for Wetlands Research, University of Florida, 2003)

CAREER SUMMARY

2000 –	Senior ecologist, Team Leader Western Kenya, World Agroforestry
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	Center (ICRAF), Kisumu, Kenya.
1997–2000	Landscape Ecologist, and GIS/RS Laboratory Supervisor, International Center for Research in Agroforestry (ICRAF), Nairobi, Kenya.
1989–1991	Rangeland ecology consultant. German Development Agency (GTZ), project feasibility and environmental impact assessment missions in Kenya, Eritrea, Uganda, Ethiopia and Djibouti.
1986–1989	Research station manager, German Development Agency (GTZ) / University of Nairobi Small Ruminant and Camel Research Station, Ngare Ndare, Kenya.

Keith D Shepherd – Curriculum Vitae

CONTACT DETAILS

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EDUCATION

University of Reading, UK: PhD in Agricultural Botany, 1985: BSc (Upper second class) in Soil Science, 1976.

APPOINTMENTS

Principal Scientist: Soil Scientist, Land & People Theme, ICRAF, Nairobi, Kenya, July 2002 – present.

Development and testing of new methods for rapid assessment of soil fertility and soil degradation and their application to improved land management in the tropics and sub-tropics.

Senior Scientist: Soil Scientist, Natural Resources Strategies and Policy Programme, ICRAF, Nairobi, Kenya, May 2000 – July 2002.

Development and testing of new methods for rapid assessment of soil fertility and soil degradation and their application to improved land management in eastern and southern Africa.

Senior Scientist: Systems Agronomist, Natural Resources Strategies and Policy Programme, ICRAF, Nairobi, Kenya, June 1993 – March 2000.

Ecological-economic impact assessment of agroforestry interventions in eastern and southern Africa. Development of new methods for remote sensing of soil degradation using remote sensing and diffuse reflectance spectroscopy.

Scientist: On-Farm Agronomist, Characterization and Impact Programme, International Centre for Research in Agroforestry (ICRAF), PO Box 30677, Nairobi, Kenya, December 1989 - June 1993.

Development of methods for participatory on-farm agroforestry research in eastern and southern Africa.

Chief Adaptive Research Officer, Jebel Marra Rural Development Project, South Darfur, Sudan, for Hunting Technical Services Limited, February 1988 - December 1989.

Adaptive research work on crop-livestock farming systems and agroforestry in a remote area of western Sudan.

Research Fellow, Department of Soil Science, University of Reading, August 1984 - December 1987; and Collaborative Research Fellow, Physics Unit, Soils Department, International Rice Research Institute, Los Banos, Philippines, October 1985 - June 1986.
Research on crop growth and soil water relations in rice-based cropping systems.

Research Student, Department of Agricultural Botany, University of Reading, January 1984 - August 1984.

PhD thesis on growth, water use and yield of barley in Mediterranean-type environments.

Research Assistant, Farming Systems Programme, International Centre for Agricultural Research in the Dry Areas (ICARDA), Aleppo, Syria, August 1979 - December 1983.

Research on crop growth, nutrient and soil water relations in Mediterranean areas.

Dryland Crop Agronomist, Agricultural Research Division, University College of Swaziland, Luyengo, Swaziland, August 1976 - August 1978.

Soil and water conservation research for dryland crops.

SELECTED PUBLICATIONS

Papers in refereed journals (chronological order)

Shepherd KD and Soule MJ (1998) Economic and ecological impacts of soil management on west Kenyan farms: a dynamic simulation model. *Agriculture, Ecosystems & Environment* 71:131-146

Bashir Jama, Buresh RJ, Ndufa JK and Shepherd KD (1998) Vertical distribution of roots and soil nitrate: tree species and phosphorus effects. *Soil Science Society of America Journal* 62:280-286

Ndufa JK, Shepherd, KD & Buresh, RJ and Bashir Jama (1999) Nutrient uptake and growth of young trees in a P-deficient soil: Tree species and phosphorus effects. *Forest Ecology & Management* 122:231-241

Soule MJ and Shepherd KD (2000) A regional economic analysis of phosphorus replenishment for Vihiga Division, western Kenya. *Agricultural Systems* 64:83-98

Shepherd KD and Walsh MG. (2002). Development of reflectance spectral libraries for characterization of soil properties. *Soil Science Society of America Journal* 66:988-998.

Shepherd KD, Palm CA, Gachengo CN and Vanlauwe B (2003). Rapid characterization of organic resource quality for soil and livestock management in tropical agroecosystems using near infrared spectroscopy. *Agronomy Journal* 95:1314-1322.

Cohen MJ, Shepherd KD, and Walsh MG (2004). Improved application of the Universal Soil Loss Equation in tropical watersheds. *Geoderma* 124:235-252.

Shepherd, KD, Vanlauwe B, Gachengo CN Palm CA. 2005. Decomposition and mineralization of organic residues predicted using near infrared spectroscopy. *Plant and Soil* 277:315-333.

Vanlauwe B, Gachengo C, Shepherd KD, Barrios E, Cadisch G, Palm CA. 2005. Validation of a resource quality-based conceptual framework for organic matter management. *Soil Science Society of America Journal* 69:1135-1145.

Cohen MJ, Brown MT and Shepherd KD. 2006. Estimating the environmental costs of soil erosion at multiple scales in Kenya using emergy synthesis. *Agriculture, Ecosystems and Environment* 114:249-269.

Brown D, Shepherd KD, Walsh MG. 2006. Global soil characterization using a VNIR diffuse reflectance library and boosted regression trees. *Geoderma* 132:273-290.

Vågen T-Gunnar, Walsh, MG and Shepherd KD. 2006. Stable carbon isotopes for characterisation of past land use and trends in soil carbon following deforestation and land use change in the highlands of Madagascar. *Geoderma* (in press)

Vågen T-Gunnar, Shepherd KD and Walsh MG. 2006. Sensing landscape level change in soil quality following deforestation and conversion in the highlands of Madagascar using Vis-NIR spectroscopy. *Geoderma* (in press).

Mutuo PK, Shepherd KD, Albrecht A, and Cadisch G (2006)
Prediction of Carbon Mineralization Rates from Different Soil Physical Fractions Using Diffuse Reflectance Spectroscopy
Soil Biology & Biochemistry (in press)

Other publications

Shepherd KD and MG Walsh (2004) Diffuse reflectance spectroscopy for rapid soil analysis. In: R Lal (ed) Encyclopedia of Soil Science. Marcel Dekker Inc, New York.
Online Published by Marcel Dekker: 04/26/2004.