# Supplementary tables

# Table S1: Summary of sources of data

## AGRA projects

|  |  |  |  |
| --- | --- | --- | --- |
| Country | Project | District/site | Soil type≠ |
| Ghana | 2009SHP005 | Bimbilla | Lixisols |
|  |  | Cheshegu | Plinthosols |
|  |  | Chreponi | Plinthosols |
|  |  | Gushegu | Lixisols |
|  |  | Kpal | Lixisols |
|  |  | Saboba | Plinthosols |
|  |  | Savelugu | Plinthosols |
|  |  | Tolon | Plinthosols |
|  |  | Walewale | Plinthosols |
|  |  | Wulensi | Plinthosols |
|  |  | Zabzugu | Lixisols |
|  | 2010SHP007 | Hohoe | Leptosols |
|  |  | Jasikan | Lixisols |
|  |  | Kadjebi | Lixisols |
|  |  | Kpando | Lixisols |
|  | OFRA | Adidwan | Lixisols |
|  |  | Nkoranza | Alisols |
|  |  | Wenchi | Plinthosols |
|  |  | Woraso | Leptosols |
| Niger | OFRA | Bengou | Arenosol |
|  |  | Tarna | Arenosol |
| Mali | OFRA | Bougouni | Lixisols |
|  |  | Kolombada | Plinthosols |
|  |  | Samanko | Plinthosols |
| Kenya | 2009SHP 002 | Kakamega | Acrisols; Lixisols |
|  | 2009SHP022 | Embu | Humic Nitisols |
|  | 2009SHP030 | Kakamega | Acrisols; Lixisols |
|  | 2010SHP020 | Busia | Acrisols |
|  | OFRA | Embu | Nitisol |
|  |  | Francis Gichuhi | Nitisol |
|  |  | Gabriel Nguya | Nitisol |
|  |  | Alupe | Acrisols |
|  |  | Kitale) | Acrisols |
|  |  | Machakos | Ferralsols |
|  |  | Njoro | Andosols |
|  |  | Kanyuambora primary school | Nitisol |
|  |  | Kariti Secondary school | Nitisol |
|  |  | Oyani | Cambisols |
|  |  | Eldoret | Ferralsol |
| Rwanda | 2010SHP019 | Huye | Acrisols |
|  |  | Kamonyi | Acrisols |
|  |  | Muhanga | Acrisols |
|  |  | Nyanza | Acrisols |
|  | 2009SHP031 | Gatsibo | Acrisols |
|  |  | Kayonza | Acrisols |
|  |  | Kirehe | Acrisols |
|  | OFRA | Bugesera | Ferralsols |
|  |  | Huye | Ferralsols |
|  |  | Ngoma | Acrisols |
|  |  | Nyagatare | Ferralsols |
| Tanzania | 2009 SHP 014 | Arumeru | Leptosols; Andosols |
|  |  | Hai | Nitisols |
|  |  | Kondoa | Leptosols; Luvisols |
|  |  | Moshi | Nitisols |
|  | 2009SHP029 | Biharamulo | Cambisols |
|  |  | Bukoba | Cambisols |
|  |  | Misenyi | Leptosols |
|  |  | Muleba | Cambisols; Leptosols |
|  | 2011 SHP 013 | Mbeya | Nitisols; Andosols; |
|  |  | Mbozi | Nitisols; Andosols |
|  | 2009 SHP 023 | Mbinga | Lixisols; Acrisols; |
|  |  | Songea | Lixisols; |
|  |  | Namtumbo | Lixisols |
| Uganda | 2009SHP001 | Apac | Ferralsols |
|  |  | Dokolo | Vertisols; Leptosols |
|  |  | Iganga | Plinthosols; Fluvisols |
|  | 2010 SHP 008 | Busia | Lixisols; Ferralsols |
|  |  | Namutumba | Plinthosols |
|  |  | Tororo | Ferralsols; Plinthosols |
| Mozambique | 2010SHP003 | Báruè | Ferralsols; Arenosols |
|  |  | Gorongosa | Lixisols; Lixisols |
|  |  | Manica | Luvic Phaeozems |
|  |  | Vanduzi | Lixisols; Arenosols |
|  |  | Sussundenga | Lixisols |
|  | 2010SHP021 | Angonia | Lixisols; Luvisols |
|  |  | Macanga | Ferralsols; Leptosols |
|  |  | Tsangano | Lixisols; Lixisols; |
|  | 2011 SHP 020 | Angonia | Lixisols; Luvisols |
|  |  | Tsangano | Lixisols; Lixisols; |
|  |  | Moatize | Lixisols; Cambisols |
|  | 2011 SHP 016 | Gondola | Lixisols; Lixisols |
|  |  | Gorongosa | Lixisols; Lixisols |
|  |  | Manica | Phaeozems |
|  |  | Muanza | Planosols |
|  |  | Nhamatanda | Lixisols; Fluvisols |
|  | OFRA | Barue | Ferralsols |
|  |  | Cuamba | Ferralsols |
|  |  | Gurue | Lixisols |
|  |  | Malema | Lixisols |
|  |  | Namialo | Lixisols |
|  |  | Nampula | Lixisols |
|  |  | Sussundenga | Lixisols |
| Malawi | 2012SHP 014 | Mzimba | Cambisols; Leptosols |
|  |  | Zomba | Nitisols; Leptosols |
|  | 2011 SHP 009 | Dedza | Lixisols |
|  |  | Balaka | Lixisols; |
|  |  | Blantyre | Nitisols |
|  |  | Chiradzulu | Nitisols; Vertisols |
|  |  | Karonga | Leptosols; Fluvisols; |
|  |  | Kasungu | Lixisols |
|  |  | Lilongwe | Lixisols |
|  |  | Machinga | Luvisols |
|  |  | Michinji | Luvisols |
|  |  | Mulanje | Nitisols; Leptosols |
|  |  | Nkhotakota | Lepthosols; Lixisols |
|  |  | Rumphi | Lixisols |
|  |  | Salima | Fluvisols; Ferralsols |
|  |  | Thyolo | Nitisols; Lixisols |
|  |  | Zomba | Nitisols; Leptosols |
|  | OFRA | Lilongwe | Lixisols |
|  |  | Salima | Fluvisols |
| Zambia | 2009SHP025 | Chibombo | Acrisols; Luvisols |
|  |  | Chipata | Luvisols |
|  |  | Mumbwa | CLuvisols |
|  |  | Choma | Acrisols |
|  |  | Katete | Ferralsols |
|  | 2009SHP20 | Choma | Acrisols |
|  |  | Solwezi | Ferralsols |
|  |  | Kabwe | Acrisols |
|  |  | Kasama | Ferralsols |
|  | OFRA | Misamfu | Ferralsols |
|  |  | Choma | Acrisols |
|  |  | Chipata | Luvisols |
|  |  | Lusaka | Luvisols |

## Legacy data

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Source | Country | Site | Soil type |  | Source | Country | Site | Soil type |
| AfSIS | Malawi | Kasungu | Lixisols |  | FAO | Ethiopia | Angot | Luvisol |
|  | Malawi | Nkhata Bay | Leptosols |  |  |  | Bamo | Leptosol |
|  | Tanzania | Mbinga | Acrisols |  |  |  | Beber | Luvisol |
|  | Nigeria | Pampaida | Lixisols |  |  |  | Beberain | Nitisols |
|  | Kenya | Sidindi | Acrisols |  |  |  | Bebine | Luvisol |
|  | Malawi | Thuchila | Nitisols |  |  |  | Bechebulchanu | Andosol |
| ICRAF | Malawi | Makoka | Lixisol |  |  |  | Becherodwelda | Nitisols |
|  | Zambia | Chadiza | Ferralsols |  |  |  | Bekela | Andosol |
|  |  | Feni | Luvisol |  |  |  | Beressa | Nitisols |
|  |  | Jerusalem | Luvisol |  |  |  | Bore | Phaeozm |
|  |  | Kagoro | Ferralsols |  |  |  | Bulgita | Nitisols |
|  |  | Kalichero | Luvisol |  |  |  | Burafer | Nitisols |
|  |  | Kalunga | Luvisols |  |  |  | Choroko | Andosol |
|  |  | Kapita | Luvisol |  |  |  | Dafnikiros | Nitisols |
|  |  | Katete | Ferralsols |  |  |  | Dakadie | Leptosol |
|  |  | Mangwe | Luvisols |  |  |  | Dembechn | Nitisols |
|  |  | Masumba | Luvisol |  |  |  | Dengiroriketi | Vertisol |
|  |  | Msekera | Luvisols |  |  |  | Dengoreahurfa | Leptosol |
| FAO | Botswana | Bodiba | Arenosol |  |  |  | Dengoreachelea | Nitisols |
|  |  | Dithlabi | Lixisol |  |  |  | Deyakebele | Andosol |
|  |  | Ditlharapa | Lixisol |  |  |  | Dobena | Andosol |
|  |  | Foranse | Ferralsols |  |  |  | Dodo | Vertisol |
|  |  | Gethwane | Lixisol |  |  |  | Eyasta | Nitisols |
|  |  | Hebron | Lixisol |  |  |  | Fourmare | Luvisol |
|  |  | Keiretsw | Arenosol |  |  |  | Gajo | Phaeozm |
|  |  | Lekgetho | Lixisols |  |  |  | Galetu | Andosol |
|  |  | Mokatako | Lixisols |  |  |  | Gedeba | Andosol |
|  |  | Mosweu | Arenosols |  |  |  | Gembelto | Andosol |
|  |  | Pelotshe | Arenosols |  |  |  | Godeha | Luvisol |
|  |  | Ramatlab | Lixisols |  |  |  | Gorbi | Andosol |
|  |  | Sechego | Lixisols |  |  |  | Guraga | Leptosol |
|  |  | Sesung | Lixisols |  |  |  | Hamabati | Phaeozm |
|  |  | Benakakona | Feralsol |  |  |  | Harabate | Andosol |
|  |  | Dilunga | Feralsol |  |  |  | Harbu | Leptosol |
|  |  | Mpoyicako | Feralsol |  |  |  | Harche | Andosol |
|  | Ethiopia | Abana | Nitisols |  |  |  | Haro | Nitisols |
|  |  | Abarage | Lixisols |  |  |  | Horolso | Luvisol |
|  |  | Abasem | Luvisols |  |  |  | Ille | Andosol |
|  |  | Abichiki | Luvisols |  |  |  | Iyra | Leptosol |
|  |  | Abicho | Paheozemes |  |  |  | Jajura | Nitisols |
|  |  | Abono | Andosol |  |  |  | Jarso | Phaeozm |
|  |  | Adabakelo | Vertisol |  |  |  | Jata | Nitisols |
|  |  | Adasha | Andosol |  |  |  | Jege | Phaeozm |
|  |  | Adisamba | Luvisol |  |  |  | Jehana | Luvisol |
|  |  | Adulalaboku | Andosol |  |  |  | Jole | Vertisol |
|  |  | Ahuri | Luvisol |  |  |  | Kabessa | Nitisols |
|  |  | Ajedida | Nitisols |  |  |  | Kecha | Leptosol |
|  |  | Alefa | Nitisols |  |  |  | Kechema | Nitisols |
|  |  | Alemtena | Andosol |  |  |  | Kedo | Nitisols |
|  |  | Andegnamekala | Andosol |  |  |  | Kerarabuti | Andosol |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Source | Country | Site | Soil type |  | Source | Country | Site | Soil type |
| FAO | Ethiopia | Kersa | Andosol |  | FAO | Ethiopia | Wogedad | Nitisols |
|  |  | Kongekundle | Luvisol |  |  |  | Wonjikirgitue | Vertisol |
|  |  | Kore | Andosol |  |  |  | Wonjikuruftu | Vertisol |
|  |  | Korkieadie | Vertisol |  |  |  | Wosheba | Nitisols |
|  |  | Kubsa | Leptosol |  |  |  | Woyoalem | Cambisol |
|  |  | Kufle | Andosol |  |  |  | Yayeh | Andosol |
|  |  | Kuyera | Andosol |  |  |  | Yewereda | Luvisol |
|  |  | Laiset | Luvisol |  |  |  | Yudonga | Luvisol |
|  |  | Layignawbedene | Andosol |  |  |  | Zeyew | Nitisols |
|  |  | Leiet | Luvisol |  |  |  | Ziew | Luvisol |
|  |  | Lelema | Nitisols |  |  |  | Zone | Andosol |
|  |  | Lenchadika | Andosol |  |  | Gambia | Fatoto | Acrisol |
|  |  | Lihude | Nitisols |  |  |  | Giroba | Acrisol |
|  |  | Malog | Nitisols |  |  |  | Jambanjali | Acrisol |
|  |  | Mana | Luvisol |  |  |  | Kanjibat | Acrisol |
|  |  | Mankusa | Luvisol |  |  |  | Karantaba | Acrisol |
|  |  | Mannabo | Luvisol |  |  |  | Kunda | Acrisol |
|  |  | Marewoled | Cambisol |  |  |  | Kuntaur | Acrisol |
|  |  | Mekicho | Vertisol |  |  |  | Mamudfana | Acrisol |
|  |  | Mekicho | Vertisol |  |  |  | Njau | Acrisol |
|  |  | Mereba | Leptosol |  |  |  | Sapu | Acrisol |
|  |  | Meshenti | Luvisol |  |  |  | Sarangai | Acrisol |
|  |  | Mocheger | Nitisols |  |  |  | Wellingara | Acrisol |
|  |  | Negalign | Andosol |  |  | Lesotho | Leribe | Leptosol |
|  |  | Oda | Nitisols |  |  | Nigeria | Bokkos | Leptosol |
|  |  | Racho | Phaeozm |  |  |  | Fier | Luvisol |
|  |  | Regdiana | Andosol |  |  |  | Maiidontar | Leptosol |
|  |  | Ropi | Andosol |  |  |  | Pankishin | Luvisol |
|  |  | Sebadar | Nitisols |  |  | Rwanda | Butare | Feralsol |
|  |  | Shekela | Leptosol |  |  |  | Murambi | Feralsol |
|  |  | Shetu | Alisols |  |  | Sudan | Berber | Leptosol |
|  |  | Sinkele | Nitisols |  |  |  | Kiteyab | Vertisol |
|  |  | Sonda | Nitisols |  |  |  | Shindikandato | Cambisol |
|  |  | Tachegnawdamani | Andosol |  |  | Tanzania | Bassuto | Cambisol |
|  |  | Tachgnawbedene | Andosol |  |  |  | Chala | Cambisol |
|  |  | Talma | Nitisols |  |  |  | Dareda | Cambisol |
|  |  | Teffo | Vertisol |  |  |  | Himiti | Cambisol |
|  |  | Tikurbalto | Leptosol |  |  |  | Huruma | Acrisol |
|  |  | Titalado | Andosol |  |  |  | Ifiga | Fluvisol |
|  |  | Torobora | Luvisol |  |  |  | Ikuini | Acrisol |
|  |  | Tuludanko | Phaeozm |  |  |  | Ikumbilo | Andosol |
|  |  | Uyayabiranesh | Nitisols |  |  |  | Inyindi | Leptosol |
|  |  | Wade | Luvisol |  |  |  | Inyonga | Acrisol |
|  |  | Wanebure | Nitisols |  |  |  | Isandula | Leptosol |
|  |  | Wanja | Luvisol |  |  |  | Isangu | Plinthos |
|  |  | Wardamichalel | Luvisol |  |  |  | Isunta | Cambisol |
|  |  | Wegdad | Cambisol |  |  |  | Ivwanga | Lixisols |
|  |  | Wita | Andosol |  |  |  | Iwindi | Andosol |
|  |  | Wodalegawanga | Leptosol |  |  |  | Iyela | Andosol |
|  |  | Wodre | Luvisol |  |  |  | Izuba | Leptosol |

|  |  |  |  |
| --- | --- | --- | --- |
| Source | Country | Location\_name | Soil |
| FAO | Tanzania | Kabungu | Cambisol |
|  |  | Kasense | Fluvisol |
|  |  | Kashaulili | Cambisol |
|  |  | Kate | Cambisol |
|  |  | Katumba | Cambisol |
|  |  | Katuni | Feralsol |
|  |  | Kibaoni | Arenosol |
|  |  | Korogwe | Acrisol |
|  |  | Lambo | Luvisol |
|  |  | Mafeto | Acrisol |
|  |  | Malangali | Fluvisol |
|  |  | Mambwemok | Cambisol |
|  |  | Manga | Cambisol |
|  |  | Matai | Feralsol |
|  |  | Mbebe | Leptosol |
|  |  | Milundikwa | Feralsol |
|  |  | Mishamo | Cambisol |
|  |  | Mlingano | Cambisol |
|  |  | Moshi | Nitisols |
|  |  | Mpanda | Cambisol |
|  |  | Mwashi | Leptosol |
|  |  | Mwese | Cambisol |
|  |  | Nafco | Arenosol |
|  |  | Nandanga | Leptosol |
|  |  | Ndanda | Leptosol |
|  |  | Ndekariota | Luvisol |
|  |  | Ndula | Leptosol |
|  |  | Ngarantoni | Cambisol |
|  |  | Nkomolo | Feralsol |
|  |  | Nkundi | Fluvisol |
|  |  | Nsimbo | Cambisol |
|  |  | Nwanga | Feralsol |
|  |  | Olorien | Cambisol |
|  |  | Paramawe | Feralsol |
|  |  | Rungwa | Acrisol |
|  |  | Sanga | Leptosol |
|  |  | Santilya | Andosol |
|  |  | Sanye | Andosol |
|  |  | Shirimatunda | Nitisols |
|  |  | Usevya | Cambisol |
|  |  | Uyole | Feralsol |
|  |  | Weruweru | Luvisol |
|  |  | Zenasudi | Luvisol |

## Peer reviewed publications used data source

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Author | Journal | Country | Location | Soil |
| Abbas et al. (2007) | Gezira J. of Agri Sci 5 (2) | Sudan | Gezira | Vertisols |
| Abe et al (2013) | Maydica | Nigeria | Mokwa | Lixisol |
| Abera et al (2007) | Afr Crop Sci | Ethiopia | Bako | Nitisols |
| Abunyewa et al (2004) | Asian J. of Plant Sci 3 (1): 1–5 | Ghana | Nyankpala | Plinthosols |
| Admas et al. (2015) | American J. Plant Nutr and Fert Tech | Ethiopia | Chilga (Wujiraba) | Nitisols |
| Allan (1970) | FAO Soils Bulletin 14 | Kenya | Cox | Ferralsols |
| Ayalew (2011) | Innov. Syst. Design Engineering | Ethiopia | Areka | Alisols |
| Amujoyegbe et al (2007) | Afr J Biotech | Nigeria | Ile-Ife | Acrisol |
| Ayuk & Mafongoya (2002) | 14th SADC-ICRAF proceed | Zambia | Chipata | Luvisol |
| Bekeko (2014) | Afr J Agr Res | Ethiopia | Chiro | Leptosol |
| Bogale et al (2001) | CIMMYT Maize Conference | Ethiopia | Jimma | Vertisol |
| Bogale et al (2001) | CIMMYT Maize Conference | Tanzania | Tanga | Arenosol |
| Bonsou & Asibou (2013) | Int J Sci Tech | Ghana | Ejura | Lixisol |
| Carsky et al (1999) | Nutrient Cycling Agroec | Nigeria | Bauchi | Leptosol |
| Carsky et al (1999) | Nutrient Cycling Agroec | Nigeria | Kaduna | Lixisol |
| Carsky et al (2001) | Nutrient Cycling Agroec | Nigeria | Kaduna | Lixisol |
| Chaguala et al. 2011 | Afr Crop Sci Proc. 10: 611–615 | Mozambique | Nampula | Lixisols |
| Chaguala et al. 2011 | Afr Crop Sci Proc. 10: 611–615 | Mozambique | Sussundenga | Lixisols |
| Chamango (2001) | CIMMYT 7th Conference | Malawi | Bembeke Dedza | Lixisol |
| Chamango (2001) | CIMMYT 7th Conference | Malawi | Chisepo | Feralsol |
| Chibudu (1998) | Trans Zim Sci Ass | Zimbabwe | Mangwende | ?? |
| Chiezy (2014) | J. of Agri Sci. 6(3);2014 | Nigeria | Samaru | Lixisols |
| Chilimba and Chirwa (2011) | Sulfur Nutr Def in Malawi | Malawi | Bembeke | Lixisols |
|  |  | Malawi | Chitedze | Lixisols |
|  |  | Malawi | Kanyama | Lixisols |
|  |  | Malawi | Manjawira | Fluvisols |
|  |  | Malawi | Tsangano | Lixisols |
| Chude et al. 1991 |  | Nigeria | Samaru | Lixisols |
| Desta, 2015 |  | Ethiopia | Aykel | Vertisols |
| Detchinli & Sogbedji (2015) | Amer J Ag For | Togo | Lome | Regols |
| Diriba et al (2011) | Ethiop J Appl Sc | Ethiopia | Bako | Nitisols |
| Esilaba et al (2004) | Agric Syst | Uganda | Buyemba | Feralsol |
| Esilaba et al (2004) | Agric Syst | Uganda | Magada | Feralsol |
| Esilaba et al (2004) | Agric Syst | Uganda | Mugaye | Feralsol |
| Eteng et al. 2014 |  | Nigeria | Calabar | Gleysols |
| Ezeaku (2008) | Agric J | Nigeria | Nsukka | Plinthosol |
| Ezeaku (2008) | Agric J | Nigeria | Abakaliki | Nitisols |
| Fofana et al (2004) | Nutr Cycl Agr | Togo | Djaka | Feralsol |
| Franke et al (2004) | Experimental Agric | Nigeria | Kaduna | Lixisol |
| Friesen et al (2003) | CIMMYT proceeding | Ethiopia | Bako | Nitosol |
| Friesen et al (2003) | CIMMYT proceeding | Ethiopia | Jimma | Vertisol |
| Friesen et al (2003) | CIMMYT proceeding | Kenya | Kitale | Feralsol |
| Friesen et al (2003) | CIMMYT proceeding | Tanzania | Mlingano | Arenosol |
| Friesen et al (2003) | CIMMYT proceeding | Uganda | Namulonge | Nitosol |
| Friesen et al (2003) | CIMMYT proceeding | Uganda | Namulonge | Nitosol |
| Friesen et al (2003) | CIMMYT proceeding | Ethiopia | Shoboka | Nitosols |
| Gacheru & Rao (2005) | Int J Pest Manage | Kenya | Ebukanga | Lixisol |
| Gitari et al (2000) | East Afr AgricForJ | Kenya | Embu | Nitosol |
| Jensen et al (2003) | Agr Water Manag | Tanzania | Ikuwala (Iringa) | Luvisol |
| Kaizzi et al (2004) | Nutrient Cycling Agroec | Uganda | Bulegeni | Andosol |
| Kaizzi et al (2004) | Nutrient Cycling Agroec | Uganda | Kibale | Feralsol |
| Kaizzi et al (2012) | Agron Journal | Uganda | Bukanga | Fluvisols |
| Kaizzi et al (2012) | Agron Journal | Uganda | Bulindi | Acrisol |
| Kaizzi et al (2012) | Agron Journal | Uganda | Kapchorwa | Nitosol |
| Kaizzi et al (2012) | Agron Journal | Uganda | Kawanda | Plinthosol |
| Kaizzi et al (2012) | Agron Journal | Uganda | Ngetta | Plinthosol |
| Kaizzi et al (2012) | Agron Journal | Uganda | Tororo | Plinthosol |
| Kamawu et al (1996) | 5th East & Southern Afr | Kenya | Yala | Ferralsols |
| Kamidi et al (2000) | Second Sci Conf Kenya | Kenya | Trans Nzoia | Feralsol |
| Kang and Osiname (1976) |  | Nigeria | Ibadan | Lixisols |
| Kang and Osiname (1976) |  | Nigeria | Ikenne | Luvisols |
| Kang and Osiname (1976) |  | Nigeria | Ikoyi | Lixisols |
| Kang and Osiname (1976) |  | Nigeria | Kishi | Plinthosols |
| Kang and Osiname (1976) |  | Nigeria | Ogbomosho | Lixisols |
| Kang and Osiname (1976) |  | Nigeria | Oyo | Lixisols |
| Kapkiyai (1998) | Afr Crop Sci | Kenya | Kabete | Nitisols |
| Kayode 1984 |  | Nigeria | Ibadan | Lixisols |
| Kayode 1984 |  | Nigeria | Mokwa | Nitisols |
| Kayode and Agboola 1985 |  | Nigeria | Ibadan | Lixisols |
| Kayode and Agboola 1985 |  | Nigeria | Ikenne | Luvisols |
| Kayode and Agboola 1985 |  | Nigeria | Ilora | Lixisols |
| Kimaro et al (2008) | Agric Ecosys Envir | Tanzania | Morogoro | Regosol |
| Kirungu et al (2000) | East Afr Agric For J | Kenya | Kitale | Feralsol |
| Kurwakumire et al. 2015 |  | Zimbabwe | Dendenyore | Lixisols |
| Lisuma et al. 2006 |  | Tanzania | Mpangala | Cambisols |
| Lunze and Ngongo | Book chapter | DRC | South Kivu | Feralsol |
| Manzeke et al. 2014 |  | Zimbabwe | Hwedza | Arenosols |
| Maobe et al (2000) | Second Sci Conf Kenya | Kenya | Bitange | Nitisol |
| Maobe et al (2000) | Second Sci Conf Kenya | Kenya | Kisi | Nitisol |
| Maobe et al (2000) | Second Sci Conf Kenya | Kenya | Matoke | Nitisol |
| Maobe et al (2000) | Second Sci Conf Kenya | Kenya | Mongina | Nitisol |
| Maobe et al (2000) | Second Sci Conf Kenya | Kenya | Mosomi | Nitisol |
| Maobe et al (2000) | Second Sci Conf Kenya | Kenya | Nyamweso | Nitisol |
| Maobe et al (2000) | Second Sci Conf Kenya | Kenya | Omanga | Nitisol |
| Maobe et al (2000) | Second Sci Conf Kenya | Kenya | Ondieki | Nitisol |
| Matata et al (2011) | J Soil Sci Env Manage | Tanzania | Tabora | Acrisol |
| Morse & McNamara (2003) | Experimental Agric | Nigeria | Igalaland | Feralsol |
| Mucheru et al (2007) | Agroforestry System | Kenya | South Meru | Nitisols |
| Mugendi (2007) | Bationo Book | Kenya | Meru | Nitisols |
| Mugendi et al (2010) | 19th World Congress SS | Kenya | Embu | Nitisols |
| Mugwe et al (2009) | Experimental agric | Kenya | Meru | Nitisols |
| Muleba (1999) | J Agric Sci | Burkina Faso | Farako Ba | Plinthosols |
| Muza (2003) | CIMMYT proceeding | Zimbabwe | Makoholi | Acrisol |
| Muza (2003) | CIMMYT proceeding | Zimbabwe | Mlezu | Lixisol |
| Njira et al (2013) | Ag Sci Res J | Malawi | Kasungu | Lixisol |
| Njunie & Wagger (2003) | East Afr AgricForJ | Kenya | Mtwapa | Acrisol |
| Nyalemegbe et al. (2011) |  | Ghana | Kade | Alisols |
| Nyalemegbe et al. (2011) |  | Ghana | Kpong | Lixisols |
| Nyamangara et al (2003) | Afr Crop Sci | Zimbabwe | Domboshawa | Lixisol |
| Nziguheba et al. (2009) |  | Togo | Affem | Leptosols |
| Ojeniyi and Kayode 1993 |  | Nigeria | Ibadan | Lixisols |
| Ojeniyi and Kayode 1993 |  | Nigeria | Ikole | Plinthosols |
| Ojeniyi and Kayode 1993 |  | Nigeria | Mokwa | Nitisols |
| Ojiem et al (1996) | 5th East & Southern Afr | Kenya | Yala | Nitisols |
| Okelabo et al (1999) | Afr Crop Sci | Kenya | Chepkoilel | Feralsol |
| Okelabo et al (1999) | Afr Crop Sci | Kenya | Malava | Acrisol |
| Okelabo et al (1999) | Afr Crop Sci | Kenya | Ndeyi (Kiambu) | luvisol |
| Okoko et al (2003) | East Afr AgricForJ | Kenya | Bogetaorio | Nitisols |
| Onasanya et al (2009) | World J Agr Sci | Nigeria | Akure | Plinthosol |
| Onyango et al (2001) | 7th East South Afr Maiz | Kenya | Trans Nzoia | Feralsol |
| Osiname et al. (1973) |  | Nigeria | Ikenne | Luvisols |
| Osiname et al. (1973) |  | Nigeria | Ilora | Lixisols |
| Osiname et al. (1973) |  | Nigeria | Iwo | Lixisols |
| Osiname et al. (1973) |  | Nigeria | Kishi | Plinthosols |
| Osiname et al. (1973) |  | Nigeria | Ogbomosho | Lixisols |
| Osiname et al. (1973) |  | Nigeria | Sepeteri | Lixisols |
| Phiri et al (1999) | Agroforestry System | Malawi | Ntcheu | Feralsol |
| Phiri et al (2003) | Agroforestry System | Zambia | Msekera | Luvisol |
| Rao et al (2002) | Experimental Agric | Kenya | Vhiga | Feralsol |
| Sime & Aune (2014) | Agronomy | Ethiopia | Hawasa | Luvisol |
| Sime & Aune (2014) | Agronomy | Ethiopia | Melkassa | Leptosol |
| Sime & Aune (2014) | Agronomy | Ethiopia | Ziway | Andosol |
| Sogbedji et al (2006) | Agron Journal | Togo | Lome | Feralsol |
| Teklay et al (2006) | Nutr Cycl Agr | Ethiopia | Wondo Genet | Andosol |
| Thierfelder et al (2013) | Field Crops Res | Malawi | Balaka | Lixisol |
| Thierfelder et al (2013) | Field Crops Res | Malawi | Balaka | Fluvisol |
| Thierfelder et al (2013) | Field Crops Res | Malawi | Dowa | Lixisol |
| Thierfelder et al (2013) | Field Crops Res | Malawi | Machinga | Fluvisol |
| Thierfelder et al (2013) | Field Crops Res | Malawi | Nkhota Kota | Ferralsols |
| Thierfelder et al (2013) | Field Crops Res | Malawi | Salima | Fluvisol |
| Tolessa et al (2007) | S Afr J Plant Sci | Ethiopia | Bako | Nitisols |
| Tolessa et al (2007) | S Afr J Plant Sci | Ethiopia | Guder | Nitisols |
| Tolessa et al (2007) | S Afr J Plant Sci | Ethiopia | Ijaji | Nitisols |
| Tolessa et al (2007) | S Afr J Plant Sci | Ethiopia | Shoboka | Nitisols |
| Tolessa et al (2007) | S Afr J Plant Sci | Ethiopia | Tibe | Nitisols |
| Vanlauwe et al (2007) | Bationo book | Kenya | Emuhaia | Nitosol |
| Vanlauwe et al (2007) | Bationo book | Kenya | Shinyalu | Feralsol |
| Vanlauwe et al (2007) | Bationo book | Kenya | Aludeka | Cambis |
| Waddington et al (2007) | Experimental Agric | Zimbabwe | Domboshawa | Cambisols |
| Waddington et al (2007) | Experimental Agric | Zimbabwe | Domboshawa | Cambisols |
| Weil and Mughogho (2000) |  | Malawi | Balaka | Lixisols |
| Weil and Mughogho (2000) |  | Malawi | Lilongwe | Lixisols |
| Weil and Mughogho (2000) |  | Malawi | Mzuzu | Lixisols |
| Weil and Mughogho (2000) |  | Malawi | Salima | Fluvisols |
| Whitebread et al (2004) | Nutr Cycl Agr | Zimbabwe | Hwedza | Lixisol |
| Wopereis et al (2006) | Field Crops Res | Togo | Mango | Fluvisol |
| Yerokun and Chirwa 2014 |  | Zambia | Lusaka | Luvisols |

# Table S2: Classification of parent materials

Classification of parent materials is based on Gray *et al*. (2011)

|  |  |  |
| --- | --- | --- |
| Parent material class | Silica range (%) | Mineral |
| Extremely siliceous | >85 | Quartz sands, quartzite, chert, jasper (>90% quartz) |
| Highly siliceous | 68–85 | Granite, rhyolite, adamellite, quartz sandstone, quarts siltstone, siliceous tuff |
| Intermediate | 52–68 | Granodiorite, dacite, trachyte, syenite, monzonite, diorite, andesite, greywacke, lithic sandstone, argillaceous materials (mudstone, shale, slate, phyllite), clay, loess (generally 0–30% quartz) |
| Mafic | 45–52 | Gabbro, dolerite, basalt, mafic tuff (generally no quartz) |
| Calcareous | 0 | Limestone, dolomite, calcareous shale, calcareous sands (generally low quartz) |

# Table S3: Relative contribution of discrete variables in general linear models

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  | Percentage (%) of variation explained out of the total variation | | | | | |
| Analysis | Effect |  | Control yield | NPK yield | *ln*(RR) | AEN | AEP | AEK |
| 1 | **Soil type** |  | **7.9** | **7.5** | **4.5** | **6.0** | **7.0** | **10.7** |
|  | Agroecology§ |  | 0.5 | 0.1 | 0.9 | 0.9 | 0.2 | 1.3 |
|  | Location‡ |  | 0.4 | 0.0 | 0.1 | 1.0 | 1.1 | 1.7 |
|  | *Residual* |  | *91.2* | *92.3* | *94.5* | *92.1* | *91.7* | *86.3* |
|  | *Model R2* |  | *0.092* | *0.078* | *0.057* | *0.085* | *0.081* | *0.145* |
|  |  |  |  |  |  |  |  |  |
| 2 | Agroecology |  | 0.32 | 0.14 | 0.80 | **1.67** | 0.71 | 0.76 |
|  | **Parent material** |  | **1.67** | **1.50** | 0.35 | 0.24 | 0.72 | 0.95 |
|  | Resilience |  | 0.86 | 0.27 | **1.15** | 0.76 | **2.88** | 1.00 |
|  | Clay activity |  | 1.17 | 0.28 | 0.11 | 0.14 | 0.01 | 1.27 |
|  | P fixation |  | 0.69 | 0.31 | 0.13 | 0.56 | 0.11 | **1.49** |
|  | *Residual* |  | *95.3* | *97.5* | *97.5* | *96.6* | *95.6* | *94.5* |
|  | *Model R2* |  | *0.054* | *0.053* | *0.023* | *0.031* | *0.042* | *0.084* |

§ AEZ (agroecological zones): Humid, subhumid and semiarid/arid

‡ Location: on farmers’ field vs research stations

Variables that contributed the highest to the explained variation are given in bold face.

Non-significant variables are highlighted orange

# Table S4: Significance of continuous variables in multiple regression analyses

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Full model | | | | | |  | Stepwise regression model | |
| Response |  | Parameter | Standard |  |  | Adjusted |  | Partial | Model |
| Variable | Effects | Estimate | Error | t value | *P* > |t| | R2 |  | R2 | R2 |
| NPK yield | Intercept | 0.307 | 0.431 | 0.71 | 0.4754 | **0.129** |  | **--** | **0.131** |
|  | N rate | 0.019 | 0.002 | 11.01 | <0.0001 |  |  | 0.036 |  |
|  | P rate | -0.001 | 0.003 | -0.53 | 0.596 |  |  | **--** |  |
|  | K rate | -0.020 | 0.002 | -10.58 | <0.0001 |  |  | 0.059 |  |
|  | SOC | -0.235 | 0.067 | -3.51 | 0.0005 |  |  | 0.004 |  |
|  | pH | 0.377 | 0.064 | 5.90 | <0.0001 |  |  | 0.011 |  |
|  | Clay | 0.016 | 0.002 | 7.60 | <0.0001 |  |  | 0.021 |  |
|  |  |  |  |  |  |  |  |  |  |
| *ln*(RR) | Intercept | 1.4705 | 0.17431 | 8.44 | <0.0001 | **0.078** |  | **--** | **0.078** |
|  | N rate | 0.007 | 0.001 | 10.15 | <0.0001 |  |  | 0.042 |  |
|  | P rate | -0.002 | 0.001 | -1.83 | 0.0677 |  |  | **--** |  |
|  | K rate | 0.002 | 0.001 | 2.05 | 0.0403 |  |  | **--** |  |
|  | SOC | 0.014 | 0.028 | 0.5 | 0.6136 |  |  | **--** |  |
|  | pH | -0.244 | 0.025 | -9.61 | <0.0001 |  |  | 0.032 |  |
|  | Clay | 0.002 | 0.001 | 1.86 | 0.0623 |  |  | 0.005 |  |
|  |  |  |  |  |  |  |  |  |  |
| AEN | Intercept | 26.23082 | 4.55976 | 5.75 | <0.0001 | **0.028** |  | **--** | **0.030** |
|  | P rate | -0.017 | 0.033 | -0.52 | 0.6038 |  |  | **--** |  |
|  | K rate | -0.092 | 0.023 | -3.98 | <0.0001 |  |  | 0.007 |  |
|  | SOC | 2.477 | 0.815 | 3.04 | 0.0024 |  |  | 0.003 |  |
|  | pH | -1.764 | 0.744 | -2.37 | 0.0178 |  |  | 0.002 |  |
|  | Clay | 0.123 | 0.025 | 4.92 | <0.0001 |  |  | 0.018 |  |
|  |  |  |  |  |  |  |  |  |  |
| AEP | Intercept | -65.732 | 19.578 | -3.36 | 0.0008 | **0.152** |  | **--** | **0.153** |
|  | N rate | 1.104 | 0.085 | 13 | <0.0001 |  |  | 0.072 |  |
|  | K rate | -0.800 | 0.087 | -9.19 | <0.0001 |  |  | 0.030 |  |
|  | SOC | -3.517 | 3.305 | -1.06 | 0.2874 |  |  | **--** |  |
|  | pH | 6.693 | 3.007 | 2.23 | 0.0261 |  |  | 0.001 |  |
|  | Clay | 1.231 | 0.097 | 12.7 | <0.0001 |  |  | 0.050 |  |
|  |  |  |  |  |  |  |  |  |  |
| AEK | Intercept | 113.857 | 17.319 | 6.57 | <0.0001 | **0.203** |  | **--** | **0.205** |
|  | N rate | 1.065 | 0.069 | 15.48 | <0.0001 |  |  | 0.150 |  |
|  | Prate | -1.090 | 0.099 | -11.06 | <0.0001 |  |  | 0.028 |  |
|  | SOC | 5.920 | 2.884 | 2.05 | 0.0403 |  |  | 0.001 |  |
|  | pH | -20.737 | 2.518 | -8.24 | <0.0001 |  |  | 0.025 |  |
|  | Clay | -0.108 | 0.088 | -1.22 | 0.2214 |  |  |  |  |

Non-significant predictors were highlighted in orange colour

**--** Variable excluded by stepwise procedure

# Table S5: Significance of effects in linear mixed effects modelling

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Response variable | Effect | DF | Den DF | F Value | P > F | Interclass correlation coefficient (ICC) |
| NPK yield | Soil type | 13 | 10000 | 40.2 | <0.0001 | 0.31 |
|  | Agroecology | 2 | 53.4 | 2.1 | 0.1298 |  |
|  | Location | 1 | 9725 | 1.9 | 0.1675 |  |
|  | N rate | 1 | 10000 | 350.3 | <0.0001 |  |
|  | P rate | 1 | 9979 | 0.8 | 0.3753 |  |
|  | K application | 1 | 9919 | 114.2 | <0.0001 |  |
|  |  |  |  |  |  |  |
| *ln*(RR) | Soil type | 13 | 8641 | 20.0 | <0.0001 | 0.21 |
|  | Agroecology | 2 | 65.3 | 17.2 | <0.0001 |  |
|  | Location | 1 | 8009 | 46.5 | <0.0001 |  |
|  | N rate | 1 | 8696 | 32.9 | <0.0001 |  |
|  | P rate | 1 | 8638 | 88.9 | <0.0001 |  |
|  | K application | 1 | 8313 | 1.1 | 0.2852 |  |
|  |  |  |  |  |  |  |
| AEN | Soil type | 13 | 8396 | 16.9 | <0.0001 | 0.12 |
|  | Agroecology | 2 | 66.2 | 5.0 | 0.0095 |  |
|  | Location | 1 | 6795 | 144.8 | <0.0001 |  |
|  | P rate | 1 | 8667 | 44.9 | <0.0001 |  |
|  | K application | 1 | 7201 | 63.7 | <0.0001 |  |
|  |  |  |  |  |  |  |
| AEP | Soil type | 13 | 8744 | 12.3 | <0.0001 | 0.23 |
|  | Agroecology | 2 | 73 | 38.9 | <0.0001 |  |
|  | Location | 1 | 8229 | 143.4 | <0.0001 |  |
|  | N rate | 1 | 8782 | 103.1 | <0.0001 |  |
|  | K application | 1 | 8499 | 2.1 | 0.1455 |  |
|  |  |  |  |  |  |  |
| AEK | Soil type | 13 | 5974 | 12.6 | <0.0001 | 0.31 |
|  | Agroecology | 2 | 58.6 | 84.5 | <0.0001 |  |
|  | Location | 1 | 5714 | 89.8 | <0.0001 |  |
|  | N rate | 1 | 5981 | 128.6 | <0.0001 |  |
|  | P rate | 1 | 5925 | 28.0 | <0.0001 |  |

Non-significant predictors were highlighted in orange colour

# Table S6: Significance of effects in the logistic regression modelling

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Response variable | Effect | DF | Wald χ2 value | P > χ2 | R2 | Adjusted R2 |
| YD ≤ 0.5 | Soil | 13 | 286.7 | <0.0001 | 0.055 | 0.089 |
|  | Agroecology | 2 | 6.3 | 0.0425 |  |  |
|  | Location | 1 | 1.2 | 0.2815 |  |  |
|  | N rate | 1 | 69.5 | <0.0001 |  |  |
|  | P rate | 1 | 7.0 | 0.0082 |  |  |
|  | K application | 1 | 38.8 | <0.0001 |  |  |
|  |  |  |  |  |  |  |
| RR ≤ 1 | Soil | 13 | 240.8 | <.0001 | 0.045 | 0.094 |
|  | Agroecology | 2 | 1.0 | 0.6218 |  |  |
|  | Location | 1 | 20.5 | <0.0001 |  |  |
|  | N rate | 1 | 24.5 | <0.0001 |  |  |
|  | P rate | 1 | 0.7 | 0.4099 |  |  |
|  | K application | 1 | 15.1 | 0.0001 |  |  |
|  |  |  |  |  |  |  |
| AEN ≤ 0 | Soil | 13 | 231.1 | <0.0001 | 0.042 | 0.095 |
|  | Agroecology | 2 | 0.3 | 0.8551 |  |  |
|  | Location | 1 | 42.6 | <0.0001 |  |  |
|  | P rate | 1 | 0.5 | 0.4651 |  |  |
|  | K application | 1 | 8.8 | 0.003 |  |  |
|  |  |  |  |  |  |  |
| AEP ≤ 0 | Soil | 13 | 231.7 | <0.0001 | 0.044 | 0.101 |
|  | Agroecology | 2 | 0.6 | 0.7413 |  |  |
|  | Location | 1 | 30.9 | <0.0001 |  |  |
|  | N rate | 1 | 21.8 | <0.0001 |  |  |
|  | K application | 1 | 17.5 | <0.0001 |  |  |
|  |  |  |  |  |  |  |
| AEK ≤ 0 | Soil | 13 | 243.1 | <0.0001 | 0.062 | 0.134 |
|  | Agroecology | 2 | 5.1 | 0.078 |  |  |
|  | Location | 1 | 23.5 | <0.0001 |  |  |
|  | N rate | 1 | 19.8 | <0.0001 |  |  |
|  | P rate | 1 | 10.1 | 0.0015 |  |  |

Non-significant predictors were highlighted in orange colour

The adjusted R2 = R2/[1 – exp(2 logL(0)/*n*)]. In the SAS system it is labelled as “Max-rescaled R-Square”. The adjusted R2 is used to compare the fitted model with the “null” model as a reference

# Table S7: Effect of potassium omission on yields on different soils

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Estimated Yield t ha-1 | |  | Yield difference (∆) | |
| Soil type | K omitted | K applied |  | ∆ in t ha-1 | ∆ in % |
| Acrisols | 3.1 (0.3) | 4.5 (0.4) |  | 1.4 | 45.2 |
| Alisols | 3.2 (0.4) | 3.4 (0.5) |  | 0.2 | 6.2 |
| Andosols | 4.6 (0.3) | 5.2 (0.4) |  | 0.6 | 13 |
| Arenosols | 2.4 (0.5) | 3.7 (0.5) |  | 1.3 | 54.2 |
| Cambisols | 4.0 (0.3) | 3.5 (0.4) |  | -0.5 | -12.5 |
| Ferralsols | 3.5 (0.3) | 3.9 (0.4) |  | 0.4 | 11.4 |
| Fluvisols | 3.6 (0.3) | 4.7 (0.4) |  | 1.1 | 30.6 |
| Leptosols | 3.3 (0.2) | 3.0 (0.4) |  | -0.3 | -9.1 |
| Lixisols | 3.9 (0.2) | 3.8 (0.4) |  | -0.1 | -2.6 |
| Luvisols | 4.1 (0.3) | 4.9 (0.4) |  | 0.8 | 19.5 |
| Nitisols | 4.0 (0.2) | 5.1 (0.4) |  | 1.1 | 27.5 |
| Phaeozems | 3.6 (0.3) | 3.0 (0.5) |  | -0.6 | -16.7 |
| Plinthosols | 3.9 (0.3) | 3.6 (0.4) |  | -0.3 | -7.7 |
| Vertisols | 3.9 (0.3) | 4.3 (0.4) |  | 0.4 | 10.3 |
| Across soils | 4.5 (0.4) | 3.8 (0.4) |  | -0.7 | -15.6 |

∆ represent the change (increase or decrease) relative to sites where K was omitted

Yield suppression due to K application were highlighted in orange colour