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Selecting sites to prove the concept of IAR4D in the Lake Kivu Pilot Learning Site

Andrew Farrow*
GeAgrofía, Wageningen, The Netherlands. E-mail: andrewfarrow72@gmail.com

Chris Opondo
African Highlands Initiative (AHI) (deceased)

KPC Rao
International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Nairobi, Kenya. E-mail: k.p.rao@cgiar.org

Moses Tenywa
Makerere University, College of Agricultural and Environmental Sciences, Kampala, Uganda. E-mail: tenywamakooma@yahoo.com

Rose Njeru
Africa Harvest, Nairobi, Kenya

Imelda Kashaija
National Agricultural Research Organisation (NARO), KAZARDI, Kabale, Uganda. E-mail: ikashaija@yahoo.co.uk

Rick Kamugisha
World Agroforestry Centre, Uganda. E-mail: n.kamugisha@cgiar.org

Michel Ramazani
La plate-forme Diobass du Kivu (Diobass), Goma, Democratic Republic of Congo. E-mail: michoramazani@yahoo.fr

Ephraim Nkonya
International Food Policy Research Institute (IFPRI), Washington DC, USA. E-mail: e.nkonya@cgiar.org

Didace Kayiranga
World Food Programme, Ruanda. E-mail: Didace.Kayiranga@wfp.org

Lunze Lubanga
L'institut pour l'étude et la recherché agronomique DRC (INERA), Kinshasa, Democratic Republic of Congo. E-mail: ilunze@yahoo.fr

Leon Nabahungu
Rwanda Agricultural Board (RAB), Muzanse, Rwanda. E-mail: Nabahungu@yahoo.com

Kambale Kamale
Syndicat de Defense des Interets Paysans (SYDIP), Butembo, Democratic Republic of Congo. E-mail: kamalekambale@yahoo.fr

Josaphat Mugabo
Rwanda Agricultural Board (RAB), Muzanse, Rwanda. E-mail: mugabojosa@yahoo.fr

Sunday Mutabazi
Ministry of Agriculture, Animal Industry and Fisheries, Nakasero, Uganda. E-mail: sundaymutabazi@yahoo.co.uk

* Corresponding author

Abstract

Selecting sites is an essential step in enabling the assessment of the impact of Integrated Agricultural Research for Development (IAR4D) in the Lake Kivu Pilot Learning Site. This paper reports on the process of identifying distinct administrative territories (sites) in which to establish innovation platforms and to monitor similar communities that are experiencing alternative agricultural research for development interventions. We show how the research design for the Sub-Saharan Africa Challenge Programme (SSACP) has been modified to take into account the key conditioning factors of the LKPLS without relinquishing robustness. A key change is the explicit incorporation of accessibility to multiple markets. Candidate sites were stratified according to the national political context, followed by good and poor accessibility to markets and finally according to security considerations and agro-ecology. Randomisation was carried out at all levels, although the need for paired counterfactual sites required the diagnosis of conditioning factors at the site level. Potential sites were characterised in terms of existing or recent agricultural research initiatives, as well as local factors that would have a direct effect on the success of interventions seeking to improve productivity, ameliorate the degradation of natural resources and enhance incomes through better links to markets. Fourteen sites were selected during the initial phase, and a further ten sites were added one year afterwards due to the need for more innovation platforms to test IAR4D. The site selection was successful in pairing action and counterfactual sites in terms of the baseline socioeconomic conditions of farming households. The unavoidable proximity of action and counterfactual sites, however, allows the possibility of spill-over effects and could reduce the measurable impact of IAR4D.

Keywords: accessibility; spatial sampling; targeting; spill-over; conditioning factors

1. Introduction

In order to better assess the impact of IAR4D it is necessary to identify the conditioning factors for the LKPLS (see Buruchara *et al*., this issue) and to incorporate mechanisms within the research design. Mechanisms such as the stratification of potential sites will help to reduce the (unknown) influence of factors that affect the outcome of the IAR4D intervention.

The objective of this paper was to develop and implement the selection of sites within the LKPLS where IAR4D would be implemented via innovation platforms, and to enable a robust assessment of the impact of IAR4D.

The next section describes the methodology used to stratify the potential sites, how candidate sites were appraised, and how new sites were incorporated into the research design. This is followed by a report of our results. The paper concludes with a discussion of the implications of our site selection methodology for assessing impact, and recommendations for future research.

2. Methodology

2.1 Stratification

Much information regarding the characteristics of the LKPLS can be found in the original choice of pilot learning sites (Thornton *et al*. 2006) and the report of the LKPLS validation team (Bekunda *et al*. 2005). All the project partners, however, felt that these ought to be revisited and the quantitative approach of the former combined with the qualitative assessment of the latter. In a partner workshop held in Kigali in October 2007, the members of the three task forces listed conditioning factors that could affect the productivity and environmental sustainability, and the success of agricultural enterprises (Table 1).

Table 1: Conditional factors determined by partners for site characterisation and an assessment of their variability within the Lake Kivu PLS

Variable	Perceived variability	
	Within PLS	*Within sites*
Partners, farmer organisations, networks	large	little
Access to markets	large	moderate
Rainfall	moderate	little
Population density	moderate	little
Infrastructure (roads, hospitals, schools)	moderate	little
Production system	moderate	moderate
Sources of income	moderate	moderate
Terrain	large	large
Soils	large	large
Food security situation	moderate	large
Settlement patterns	?	
Gender issues	?	
Conflict resolution	?	
Land tenure systems	?	

The most important criteria to consider in the site selection phase are those variables that exhibit large variation within the LKPLS, but which are relatively homogeneous within a sub-county, *secteur* or *groupement*. Variables that display large variability in the PLS, but little at the site level, should be controlled for in the choice of counterfactuals, while those variables that show little variability at the PLS but large variations within sites should be controlled for once sites have been selected.

2.1.1 First stage stratification: Country

One of the original reasons for choosing the Lake Kivu Pilot Learning Site was the historical context of emerging from conflict. Uganda, Rwanda and the DRC have emerged from conflict at different times over the past 25 years (Bekunda *et al*. 2005). This has had implications for national policies, the strength and nature of institutions and the physical infrastructure in the three countries, which were confirmed by the project partners (Table 1).

Examples of differences in policies include the (de)centralisation of agricultural research, agricultural extension, collective action (e.g. cooperatives), policies on marketing, and the protection of natural resources (Bekunda *et al*. 2005). In a 31-country decentralisation ranking by Ndegwa and Levy (2004), Uganda is the second most decentralised country in SSA – after South Africa, while Rwanda and DRC are the 5th and 25th most decentralised countries respectively. On a scale of 0 to 4, with 0 indicating the weakest decentralisation, the DRC had the lowest overall decentralisation in SSA (below 2.0), while Rwanda fell into the medium range (2.0–2.9) (**Error! Reference source not found.**). The difference in decentralisation offers a good socio-economic indicator to assess the effectiveness of IAR4D under different levels of governance and institutions.

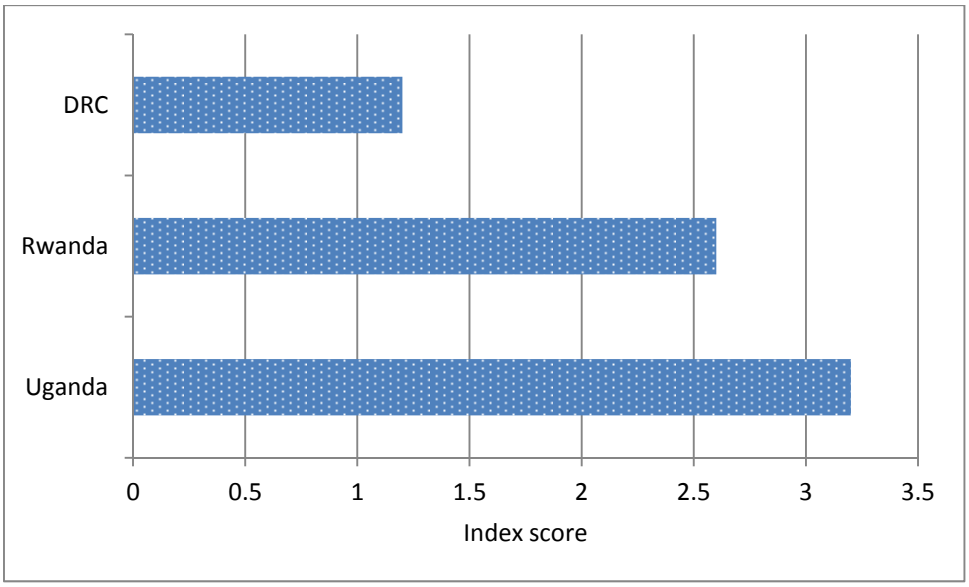

Figure 1: Overall decentralisation of the case study countries
Calculated from Ndegwa and Levy (2004)

These policy differences are likely to have an influence on the ability of IPs to convert the intermediate outcomes of knowledge, awareness and practices (KAP) into positive changes in livelihood indicators, and to a certain extent on the IP composition due to different institutional landscapes.

For this reason we introduced the first stage of stratification at the level of the country, which implied that four IPs in two sites and four counterfactuals in two sites would be established in each country.

2.1.2 Second stage stratification: Market access

Another conditioning factor that was deemed to be large over the whole PLS, and even within countries, was the physical access to markets (Table 2).

The PLS can therefore be stratified to indicate (a) sites accessible to a diverse set of markets (good market access), (b) sites with access to a limited set of markets (poor market access), and (c) sites with very poor access to all market types, which were excluded from the sample of potential sites. Sites were then selected to ensure that, of the two sites in each country, one would have good market access and the other poor market access, with a counterfactual also selected for each site (Table 2).

Table 2: Stratification of sites in the PLS according to market access

	DRC		**Rwanda**		**Uganda**	
	IAR4D	*Counterfactual*	*IAR4D*	*Counterfactual*	*IAR4D*	*Counterfactual*
Good market access	Site 1	Site 3	Site 5	Site 7	Site 9	Site 11
Poor market access	Site 2	Site 4	Site 6	Site 8	Site 10	Site 12

A number of studies have developed or modified methods to determine access to markets (e.g. Deichmann 1997; Farrow & Nelson 2001; You & Chamberlin 2004; Baltenweck & Staal 2007). For this study we followed the methodology developed by ASARECA (2005) for a regional perspective of access to multiple markets. The spatial distribution of access to markets was based on models rather than observations, but was augmented with expert opinion.

The modelling environment was a geographical information system (GIS) and the time was calculated using a cost distance algorithm. The model seeks the shortest path to all potential markets. Both raster-based (grid cells) and vector-based (points and lines) modelling frameworks are possible and each offers advantages. Vector models are useful where movement is principally along paths and

roads, and where cross-country movement is disallowed. The vector framework is particularly appropriate in urban and developed country settings, although it has been utilised (with certain modifications) in Africa (Deichmann 1997; Baltenweck & Staal 2007). For more general purposes, and in developing countries where data on road quality and tracks is less reliable or up-to-date, a raster approach is often more suitable (e.g. Farrow *et al*. 2011). In this case a 'friction' surface is created that describes the ease or difficulty of movement. For this application we chose to use a raster modelling framework[1] in which the size of the grid cell was set at 100 metres by 100 metres.

The model calculates, for each market, the time required to arrive from all the cells in the grid and the path that would need to be taken. Cells are then allocated to their closest market. The algorithm itself is conceptually easy to understand, but the credibility of the results depends on the construction of a friction surface that reflects the prevailing modes of transport and the barriers that constrain movement.

Common variables used in what we call the 'friction surface' include roads, land cover, barriers (such as customs posts at national borders, or rivers), navigable rivers or boat routes (such as on Lake Kivu), and urban areas. Each of these variables has to be given an appropriate friction value depending on the modes of transport most appropriate for a particular context or problem.

For the Lake Kivu PLS it was assumed that producers or traders have access to some form of motorised transport, and the speeds for the roads (and thus the time required to traverse a grid cell) were set according to the quality of the road where that information was available. Boat services are an important means of transport across Lake Kivu.

For the background friction, i.e. those areas between the roads, we used land cover data from the Africover dataset (FAO 1994), which was also used to define urban areas. Barriers were limited to lakes and national borders.

There is another factor that modifies the friction surface, namely the slope of the surface. Slope increases the time needed to cross a cell, irrespective of the fact that one is climbing or descending. While this is less true of a bicycle than of a fully laden truck, it makes the computation easier. The values used for the friction surface can be seen in Table 3.

[1] For a description of this accessibility model, see Farrow and Nelson (2001).

Table 3: Time values used in creation of the friction surface

Surface type	Time to cross 100 m cell
Roads:	
Tarmac road	7 seconds (approx. speed 50 km/h)
Murram road	10 seconds (approx. speed 35 km/h)
Other road	14 seconds (approx. speed 25 km/h)
Tracks	24 seconds (approx. speed 15 km/h)
Land cover:	
Urban areas	10 seconds (approx. speed 35 km/h)
Herbaceous cropland	150 seconds
Tree-based cropland	200 seconds
Grassland	200 seconds
Forests	400 seconds
Barriers:	
Lakes	500 seconds
National borders	2 hours
Slope:	
0-12°	has no effect
12-30°	increases friction by *2
slopes > 30°	increases friction by *3

For this study we followed the methodology adopted by ASARECA (2005) and distinguished between four types of markets:

- Regional markets
- Cross-border markets or transit points
- National markets
- Local markets

All partner institutions were requested to identify markets for each of these classes; those that were located and used in the model are listed in Table 4.[2]

[2] Some market locations, mainly in the DRC and in Kisoro (Uganda), could not be located on maps or were thought to be too distant from the PLS.

Table 4: Markets used in the accessibility modelling

Regional markets:	
DRC	Goma, Bukavu
Rwanda	Kigali
Uganda	Kampala
National markets:	
DRC	Goma, Bukavu, Butembo
Rwanda	Kigali, Ruhengeri, Byumba, Gitarama, Kibuye, Gisenyi
Uganda	Mbarara, Kampala
Cross-border locations/markets:	
DRC-Uganda	Bunagana, Ishasha (minor)
DRC-Rwanda	Goma/Gisenyi, Cyangugu/Bukavu, Kibuye
Rwanda-Uganda	Gatuna/Katuna, Rugarama/Kyanika (minor)
Local markets DRC:	
Rutshuru	Rutshuru, Bunagana
Beni	Beni, Kasindi
Butembo	Butembo
Masisi	Sake, Kichanga, Masisi
Nyiragongo	Kibumba, Goma
Kalehe	Minova, Nyabibwe, Kalehe
Local markets Rwanda:	
Rubavu	Mahoko, Gisenyi
Nyabihu	Vunga, Kora, Gasiza
Rulindo	Base
Gakenke	Gakenke
Ngororero	Kabaya
Gicumbi	Byumba, Gatuna
Musanze	Byangabo, Ruhengeri
Elsewhere	Kigali, Kibuye, Gitarama, Cyangugu, Ruhango
Local markets Uganda:	
Kabale	Kabale, Rubanda, Muko, Bufundi, Rubaya, Maziba, Kamwezi, Bukinda, Mparo
Kisoro	Kisoro, Nyakabande, Cyanika, Bunagana
Kanungu	Kanungu, Kayonza, Burema, Rwanga, Ishasha, Kirima, Kambuga
Rukungiri	Rukungiri, Nyarushanje, Kebisoni, Katobo, Kagunga, Ruhinda, Bugangari, Kikarara, Rwenshama
Ntungamo	Rwahi, Ngoma, Rubaare
Elsewhere	Kampala
Local markets Burundi:	
	Kirundo

The accessibility model does not take into account the attractiveness of the markets, and the basic algorithm is unable to discriminate between targets. Nevertheless, an element of attractiveness can be introduced by considering different thresholds for the time needed to reach each of the market types (**Error! Reference source not found.**). A location is considered to have good access to a regional market if it is within three hours, while the threshold for a national market would be two hours and for a local market would be one hour. For cross-border markets the thresholds would be 1½ hours for a minor cross-border market, and three hours for a major cross-border market.

Figure 2: Access time threshold for each market type

Accessibility to different market types was combined (**Error! Reference source not found.**) to indicate which areas were accessible to a diverse set of markets – these were considered 'good' market areas, while those that could only access a limited set of markets (e.g. just local) were our 'poor' market areas. Locations with universally poor areas were excluded from our sample.

2.1.3 Third stage stratification: Security and agro-ecology

The results of this process were shared with the project partners at a meeting in Gisenyi in February 2008. The partners were invited to share their thoughts on the process and the results, and were asked to make modifications to the sets of potential sites (Table 5) and to decide on candidate sites, which would be further characterised by a field visit and appraisal. In Uganda, all sub-counties in the districts of Rukungiri and Kanungu were considered too remote, while sub-counties in the Ntungamo and Bushenyi districts were considered to be in agro-ecosystems that were not representative of the LKPLS. As such, only sub-counties in the districts of Kabale and Kisoro were included in the stratification.

All areas were considered in Rwanda, but the group decided to concentrate on the districts of Musanze, Nyabihu and Rubavu, which have similar agro-ecosystems and are located in the corridor between the towns of Ruhengeri and Gisenyi. However, other sites along the Ruhengeri-Kigali axis were also chosen for further characterisation.

In the DRC, areas at the northern tip of the LKPLS boundary and west of Masisi were not considered due to the remoteness of these areas and the insecurity due to various armed groups operating in these areas in 2008.

After three stages of stratification, a list of good and poor market access sites was available. From this list, at least two sites with both good and poor market access were chosen randomly for each country for further appraisal, before the choice of action and counterfactual sites was made.

2.2 Appraisal of candidate sites

The objective of the characterisation of the candidate sites was to be able to choose sites that would allow the investigation of the efficacy of the IAR4D principles, and to compare the results of the IAR4D with conventional approaches to agricultural research for development.

The appraisal of the sites in order to choose action and counterfactual sites was to ensure that the action and counterfactual sites were as similar as possible in terms of marketing (e.g. number of traders, processors, infrastructure, farmer organisation, telecommunications), productivity (e.g. crop/enterprise choice, soil fertility issues, access to technologies and food security) and national resources management (NRM) issues (e.g. landscape, crop/pasture/wetland/forest mixtures, access to and quality of water, erosion/flooding/land degradation).

Action sites were chosen from the list of candidate sites according to the level of agricultural research for development between 2003 and 2008. All the villages in each site were assessed and classified into two types: (a) 'clean' villages that had experienced neither IAR4D nor conventional research projects in the previous two to five years (see Buruchara *et al*. in this issue for definitions of the terms); and (b) conventional approach villages that had hosted projects identifying, promoting and disseminating technologies in the previous two to five years. Sites with the most clean villages were chosen as action sites, while sites with a mixture of clean and non-clean villages were chosen as counterfactuals.

2.2.1 Developing a diagnostic tool

A tool was developed to ascertain the research and development activities in the previous five years in both the agricultural and other sectors, as well as to identify critical issues in the sites.

The five major outputs of the diagnosis of the candidate sites were:

1. Census of villages in each sub-county, *secteur* or *groupement*
2. Inventory of the current agricultural research for development activities for each village
3. Inventory of the agricultural research for development activities in the past five years for each village
4. Assessment of critical issues in the sub-county
5. Inventory of potential stakeholders

2.2.2 Choosing sites using the diagnostic tool

Even after the three levels of stratification the units were likely to be heterogeneous in terms of the capacity for marketing, productivity and NRM issues – for this reason we needed to deliberately pair action and counterfactual sites.

The site appraisal was also able to identify differences in villages according to the levels of agricultural research for development. We assigned treatment and counterfactual categories on the basis of having enough villages of the appropriate type ('clean' and conventional ARD). Due to the relatively small size of the Lake Kivu Pilot Learning Site our units were small and, without a village census and appraisal, we could not assume that there would be enough villages of the appropriate type.

The final stage was to randomly select the villages of each type within the action and counterfactual sites, as per the research design. The average number of villages in each site was 55 in Uganda, 63 in the DRC and 33 in Rwanda.

2.3 New sites

Approximately one year after the original site selection, and once the innovation platforms (IPs) had been established, it became apparent that the original intention of forming two IPs in each site was not practical. The new sites in the LKPLS would increase the number of separate IPs to the 12 originally envisaged in the SSACP research design, with one IP in each site.

In all three countries the original candidate sites were reconsidered, as well as other sites based on the knowledge and experienced gained during the previous year's activities. The differentiation based on market access was maintained and used in the stratification of sites as before. Nevertheless, there were differences in the process of site selection between the three countries.

Two IPs had been formed in the DRC, so two more were required, one with good market access and the other with poor market access. The choice of action and counterfactual sites was based on a rapid reassessment of the previous candidate sites, using local knowledge rather than the diagnostic tool.

Three action sites had already been chosen for Rwanda, meaning that only one more was required. Of the three existing sites, two had been characterised as actions sites having poor market access, so a second good market access site was required. Potential sites were first evaluated during a stakeholder meeting, and the results were used to select sites for field visits. A shorter, revised version of the original diagnostic tool was used in the selection process.

In Uganda, the process of choosing sites did not rely entirely on the use of the diagnostic tool. One site that had been included in the original diagnosis was considered for a potato-based IP enterprise, but had recently started working with another agricultural development partner, which invalidated the site. Instead, the sites were chosen based on market opportunities.

The results from the new sites clearly are different and have bias due to the subjective selection. The discussion in our results points this out clearly.

3. Results

3.1 Market access

The results of the model can be seen in **Error! Reference source not found.**, and it is apparent that the density of the road network in Rwanda facilitates good market access – in clear contrast with the DRC, where the roads are poor, and Uganda, where the major markets are distant. The quality of the spatial sets of data is again an issue, as Rwanda has excellent road data compared to the other two countries. Nevertheless, the accessibility model offered information that would have been difficult and time consuming to collect otherwise, and the project partners were comfortable with the results.

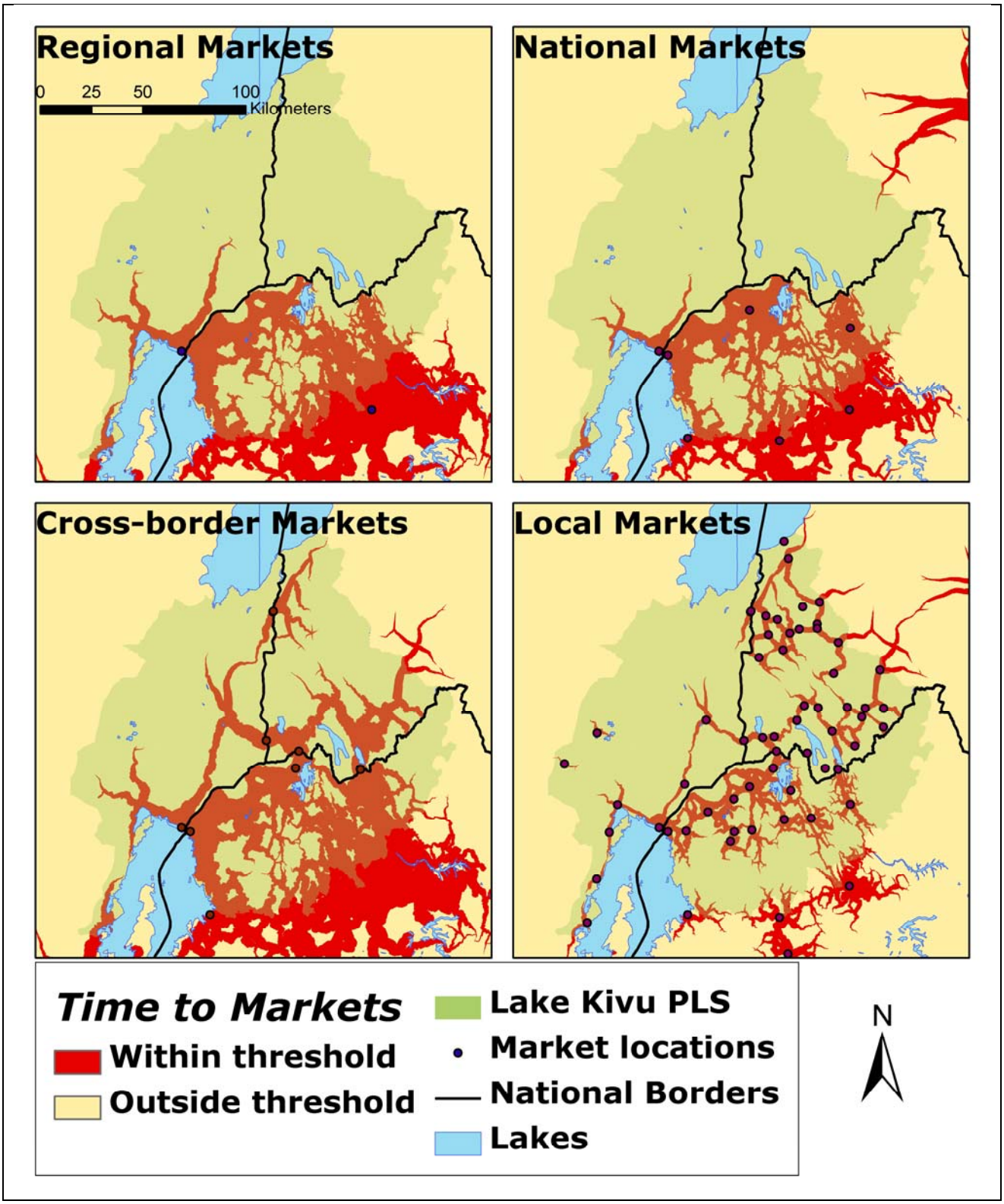

Figure 2: Time thresholds for market types

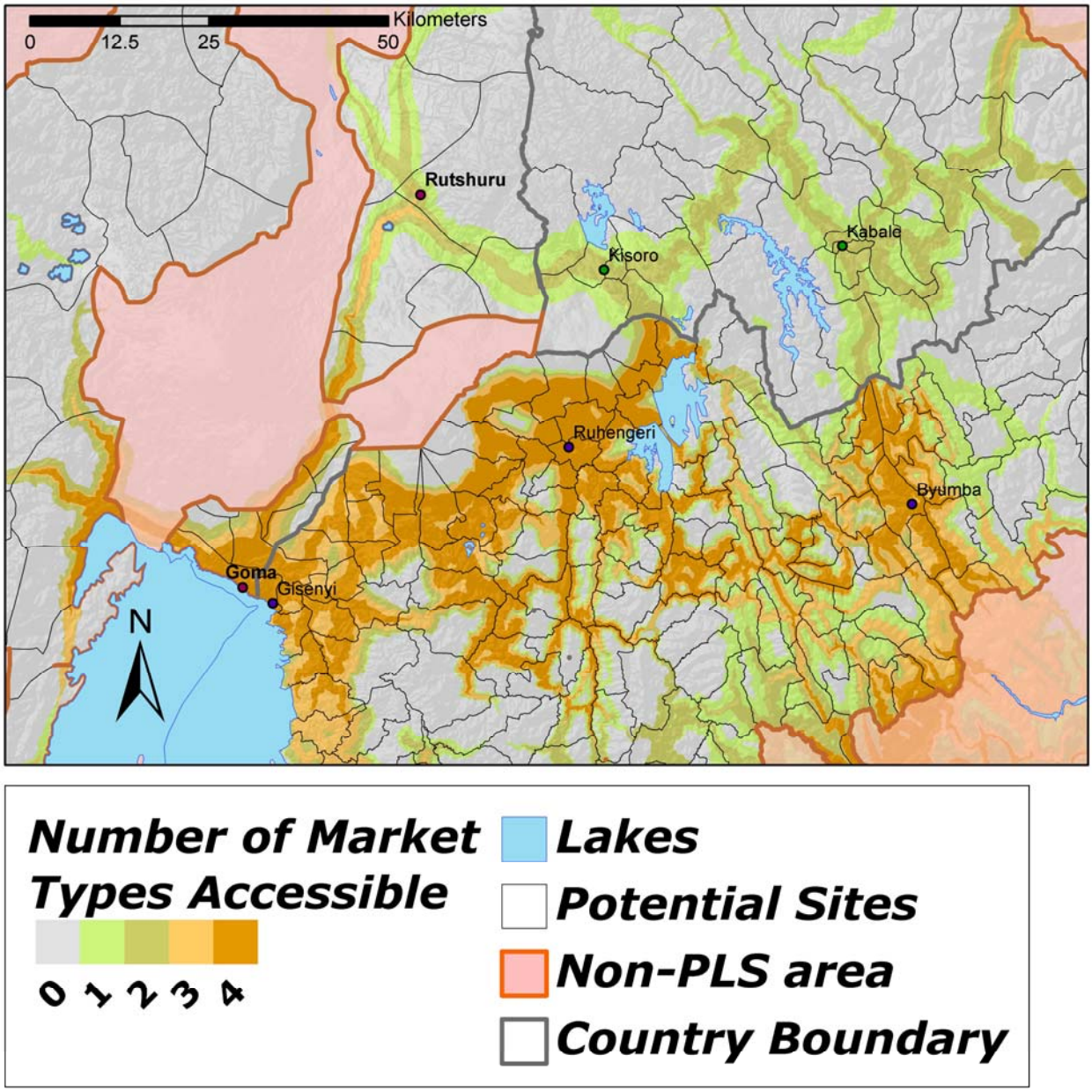

Figure 3: Diversity of market access and potential sites within the LKPLS

The complete list of potential sites was therefore stratified according to market access and further refined by excluding sites with security problems, those which were deemed to be too remote for practical implementation of IAR4D activities, or which were not representative of the LKPLS. This produced a list of sites with poor and good market access for each country (Table 5).

We asked the country teams to choose at least two sites randomly from each list for appraisal. Some country teams chose more than two sites to ensure that there would be enough to find a sufficient number of clean villages, as well as suitable counterfactuals with a mixture of clean and conventional villages.

Table 5: Good and poor market access administrative units and candidate sites (in italics)

Country	Good market access	Poor market access
Uganda	**Kisoro** • *Chahi* • *Nyakabande* • Kisoro Town **Kabale** • *Bubare* • *Hamurwa* • *Muko* • Kabale Municipality	**Kisoro** • Bukimbiri • *Busanza* • Nyabwishenya • *Nyarusiza* **Kabale** • *Bufundi* • Buhara • Bukinda • Ikumba • Kaharo • Kamuganguzi • Kitumba • Kyanamira • *Rubaya* • Rwamucucu
DRC	**Kalehe** • Mbinga-sud • *Buzi* **Masisi** • *Muvunyi-Shanga* • Muvunyi-Shanga North (Kituva) • *Kamuronja* **Nyiragongo** • Monigi • *Kibati* • *Kibumba* **Rutshuru** • *Busanza*	**Rutshuru** • Bwenza • *Jomba* • *Kisigari* • *Kisigari North (Rubare)* • *Rugari* **Nyiragongo** • Buvira **Masisi** • *Muvunyi-Matanda* **Kalehe** • Mbinga-nord
Rwanda	**Musanze** • Cyuve • Muhoza • Remera • Shingiro • Kinigi • *Nyange* • Rwaza • *Gataraga* • Gacaca • Remera **Gakenke** • Cyabingo • *Kivuruga*	**Gicumbi** • Kaniga • Cyumba • Mukarange • Shangasha • Manyagiro • Byumba • Kageyo **Rubavu** • Bugeshi • Busasamana • *Mudende* • Cyanzarwe • Kanzenze • Rubavu • Nyakiliba • Rugerero • Gisenyi • Nyundo **Rulindo** • Kisaro **Burera** • Rwerere

		Nyabihu • Karago • Jenda • *Bigogwe North* • *Bigogwe South* • Kabatwa

3.2 Site appraisal and final choice of sites

3.2.1 Site appraisal in the DRC

In the DRC, five sites with good market access were visited and characterised. The *groupement* of **Kibumba** in the Nyiragongo *territoire* had many villages with non-agricultural development activities. The main market for foodstuffs (such as vegetables, but also beans and potatoes) is Goma. While soil fertility is good, the production is low because of poor service to the producers and a lack of productive crop varieties. Vegetable production was once very competitive in the area, but is no longer so today. NRM problems are severe soil erosion and low soil fertility. Kibumba was identified as a potential action site but had no obvious counterfactual. Closer to Goma was the *groupement* of **Kibati**. This area has many villages with development activities, but has practically no productive soils due to being covered by fresh lava; as a result the main activity is wood production.

The other candidate sites were to the west of Goma. In the *groupement* of **Kamuronja**, where it was discovered that soil erosion was not a problem, the productivity of crops (like sweet potatoes, beans and cassava) was good due to fertile soils, but suffered from a lack of seeds and poor crop management. There were many villages with little research or development intervention. To the south, in **Muvunyi-Shanga**, there were many villages with little intervention and in general very few service providers, with low prices for agricultural products. Annual crops are produced in the hills, where soil erosion is severe, while banana is produced in the flat lowlands along Lake Kivu, which are subjected to frequent flooding. This *groupement* was chosen as the action site. Neighbouring **Buzi** has similar topographical conditions; however, there were far more villages with development activities, and this area consequently was selected as counterfactual for the Muvunyi-Shanga *groupement*.

Four of the five *groupements* with poor market access that were selected randomly for appraisal were in the Rutshuru *territoire*. **Busanza**, on the border with Uganda, has many villages that had experienced little intervention; however, security could not be guaranteed in that *groupement*. Neighbouring **Jomba** had similar security problems, but was characterised by good agricultural productivity, with a lack of inputs and scarcity of land being the major constraints. Intervention by agricultural development and research was found in a moderate number of villages. **Kisigari** had sufficient villages with little intervention, but was hilly, with land scarcity being a problem. Immediately to the south was the *groupement* of **Rugari**, which had similar terrain, crops and NRM issues, but contained more villages in which there had been intervention over the previous five years. For this reason, Kisgari and Rugari were paired, with Kisigari selected as the action site and Rugari as its counterfactual.

The other *groupement* that was appraised – **Muvunyi-Matanda** – is in the *territoire* of Masisi. Some intervention was found in the villages, but mainly in relation to humanitarian activities. This also was the only *groupement* with a high density of livestock – mainly dairy cattle. Security in Muvunyi-Matanda was a concern, however, with reports of looting on the main road through the *groupement*.

3.2.2 Site appraisal in Rwanda

In Rwanda, three *secteurs* with good market access were visited. **Kivuruga**, located to the south of Ruhenegri, is characterised by non-volcanic soils and steep slopes. There were development activities in some of the villages. To the east of Ruhengeri is the *secteur* of **Gataraga**, which had many villages with no recent intervention and, generally, few service providers. This *secteur* is generally flat and gently sloped, with only a small portion with a steep slope, and is characterised by volcanic soils with high production potential. This was chosen as an action site. **Nyange**, to the north of Ruhengeri, had more villages with development activities and, despite poorer quality soils (than Gataraga), was chosen as the counterfactual site.

Four *secteurs* with poor market access were visited in Rwanda. **Mudende**, to the east of Gisenyi, was found to have many villages with little AR4D, although several NGOs have an education, peace and reconciliation or HIV agenda. The *secteur* is characterised by volcanic soils with gentle slopes and thus high production potential. Mudende was chosen as action site for market and productivity entry points. Closer to the border with Uganda, **Rwerere** was visited and many villages were identified in which there was little intervention. In contrast to Mudende, the site has low-potential soils (mainly oxisols and ultisols) and had been cropped intensively for long time. It also has steep slopes. As a consequence, this was chosen as an action site for NRM issues. To the immediate east of Mudende was **Bigogwe**, which has new open land. The soils are still fertile, but fragile, with a high risk of rapid fertility decline. The land is generally flat and gently sloped in Bigogwe North, with a portion with steep slopes in Bigogwe South. Sufficient villages were encountered which had experienced some intervention over the previous five years, and Bigogwe North was chosen as counterfactual for Mudende, while the counterfactual for Rwerere would be the hilly part of Bigogwe South.

3.2.3 Site appraisal in Uganda

Four sites with good market access were visited and appraised in Uganda. In Kabale district, the sub-county of **Bubare**, to the east of Kabale town, was found to have mixed livestock activities in the valley bottoms, with annual crop production (potatoes, sorghum and beans) on the surrounding hills. Further west was the sub-county of **Muko**, which reported many service providers. A big problem here was a lack of market information, with prices determined by traders. Two sub-counties were appraised in the district of Kisoro, and little evidence of AR4D intervention was found in **Chahi**, between Kisoro town and the border with Rwanda. Chahi is characterised by volcanic soils on gentle slopes, and was chosen as an action site. **Nyakabande** was selected as the counterfactual for Chahi because it has similar soils and terrain, but more villages with AR4D interventions over the previous five years.

Two sub-counties with poor market access were visited in Kisoro district. **Busanza**, on the border with the DRC, is at a slightly lower elevation and had a different crop mixture (including bananas and sugarcane), with good access to water and limited intervention. This was a potential action site, but no obvious counterfactual site could be identified. The other poor market access sub-county in Kisoro was **Nyarusiza**. This site has poor access to water (due to porous soils) and contains many villages with limited AR4D intervention, but has some eco-tourism due to the presence of a national park (Mgahinga). In Kabale district, **Bufundi** sub-county was chosen as an action site due to the numerous villages with little intervention, and the problems of steep slopes and the low productivity of annual crops. A suitable counterfactual site was the neighbouring **Rubaya** sub-county, which has similar terrain but more villages with AR4D intervention.

3.3 New sites

In the DRC, Kamuronja, a candidate site previously characterised as having good market access, was considered, and the other candidate was Kituva, a large *localité* that forms the northern half of

the *groupement* of Muvunyi-Shanga and has the same conditions. It was decided that Kituva would form the action site, with Kamuronja as the counterfactual, based on the development activities being undertaken. The country team in the DRC reported that multiple value chains had been identified in Muvunyi-Shanga and that this would speed up the process of IP formation in Kituva.

For sites with poor market access, two previous sites were considered – Jomba and Busanza, as well as the northern half of the Kisigari *groupement*, which is a *localité* called Rubare. The security situation had improved in Jomba and Rubare was found to have similar conditions to the rest of Kisigari. As a result, Rubare was chosen as the action site, with Jomba as the counterfactual.

Two new *secteurs*, Cyuve and Remera, were visited in Rwanda. The decision to select Remera was based on the comparison of market access and the partner interaction found in the two sites.

The process in Uganda was different, with existing market opportunities sought first. Two opportunities had been identified: organic pineapples and sorghum porridge (bushera).

In the case of the market opportunity for organic pineapples, a buyer was identified – the National Organic Agricultural Movement of Uganda (NOGAMU) – which was able to receive 400 metric tons per day. Discussions with NOGAMU were followed by meetings with the Ntungamo District and field staff, including the CAO, ACAO, the Africare Project field coordinator, agricultural officers and farmers. The research team then visited the Rugarama and Kayonza sub-counties and had detailed discussions with the Agricultural Officer from Itojo. These were chosen as action sites and counterfactual site respectively. The diagnostic tool used in the original site characterisation was not employed in these selections; instead, the sites were chosen according to the scale of operations, with Itojo (the counterfactual) being characterised by larger-scale pineapple production, and the other sub-counties characterised by smaller-scale production.

The choice of Bubare as the final action site was based partly on the original site diagnosis, as well as another market opportunity – that for sorghum porridge. The choice of Hamurwa as the counterfactual was made based on local knowledge.

A map depicting the final sites is provided in Figure 5.

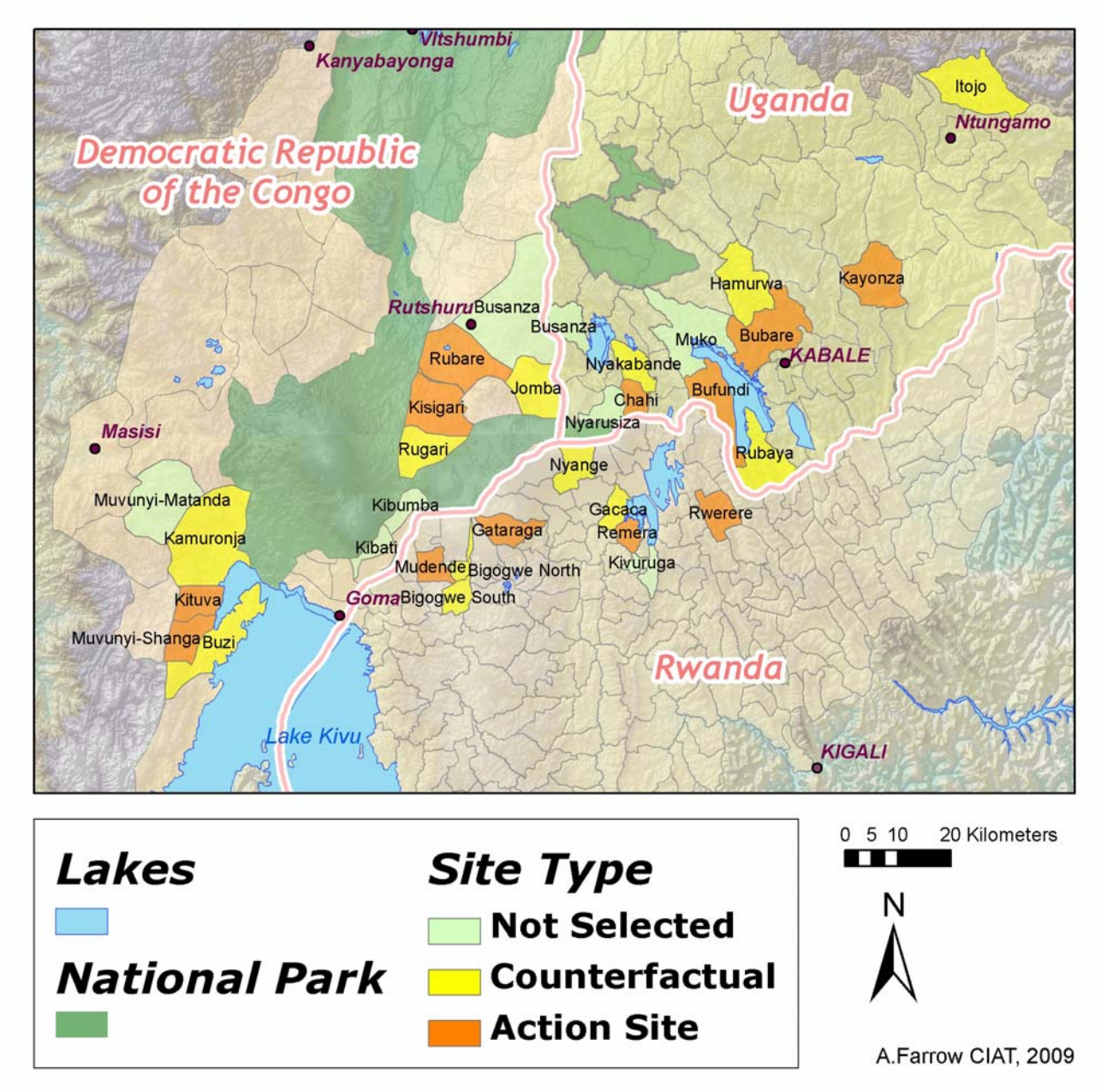

Figure 4: Final choice of action and counterfactual sites in LKPLS

4. Discussion and Conclusion

The site selection in the Lake Kivu Pilot Learning Site evolved with the framing of the overall research design for the Sub-Saharan Africa Challenge Programme, and was accomplished using a mixture of methods, tools and data. While the practicalities of field project implementation were considered, they were never the principal reason for choosing sites.

The rigour of the SSACP research design ensured consistency in the choice of sites between the three countries and offered an objective measure with which to assess the sites. Apart from the scientific rationale behind the research design there are practical advantages to this approach, such as the transparent explanation of the choice of candidate sites to the local participants and policy makers. Nevertheless, the process of site selection allowed for the articulation of local needs and the expression of critical issues within the candidate sites, which resulted in a more nuanced set of information on which to base the choice of action sites and to ensure that counterfactual sites were as similar as possible. In the Lake Kivu Pilot Learning Site we deviated from the research plan

because of the recognition that randomly selecting action and counterfactual sites from a complete list of candidates in the PLS was likely to produce action and counterfactual sites that differed in aspects important for agricultural productivity, markets and natural resource management.

The success of the site selection can be measured by comparing the summary statistics of household attributes in the different types of villages selected for the baseline household survey. Significant differences between attributes associated with productivity issues, marketing and NRM would indicate that the deliberate pairing of counterfactual and action sites had not been successful, and that bias had been introduced that would make the subsequent testing of the hypotheses of the effectiveness of IAR4D difficult. Three types of villages had been identified: clean villages within action sites, clean villages in counterfactual sites, and conventional villages in counterfactual sites. Households had been selected randomly within each type of village. The baseline survey collected asset variables at the household level. A number of these were subsequently grouped (Nkonya *et al*. 2010) into asset groups: human capital, physical capital, social capital and financial capital, as well as according to interactions with community-level attributes such as access to rural services, participation in groups and collective marketing. In addition, the incomes of households were measured, including the sources of incomes.

There were very few significant differences between households in clean counterfactual, clean action and conventional villages. Of the 31 variables measured, only three (network density in the DRC and Uganda, livestock improved breeds in Rwanda, and income in Rwanda) displayed any significant differences between groups (Nkonya *et al*., this issue). Of these three, only one – network density – could have been predicted by the diagnostic tool used to appraise the candidate sites. These results therefore suggest that the deliberate pairing of action and counterfactual sites would allow for the analysis of impacts and the effectiveness of IAR4D.

Nevertheless, a result of the methodology was the selection of action and counterfactual sites that are physical neighbours. Consequences of this proximity are spill-over effects, resulting from either the 'natural' diffusion of agricultural innovations (Hägerstrand 1967; Van der Horst 2011) via skills or knowledge (Keilbach 2000; Ravallion 2002), or from a more direct influence of the intervention – such as extension messages that have been communicated via local radio, which would be equally accessible in the action and counterfactual sites, such as in Chahi and Nyakabande respectively (Fungo, personal communication, 2011). Another possibility (albeit not reported in the LKPLS) is natural resource management interventions that have downstream effects (either positive or negative externalities [Lewis *et al*. 2007]) on neighbouring areas, which may have been selected as counterfactual sites.

The result of these spill-over effects, assuming that they are positive, would be to reduce the measurable effect of IAR4D (Garren & White, 1981) when comparing the action and counterfactual sites.

The new sites were selected one year after the selection of the initial sites for IP formation. These sites can be considered a different treatment to those selected previously, given that the time available for IAR4D to permeate the community was significantly less. In addition, the method used to select these sites was more variable according to the country, with Uganda in particular using a radically different method to select sites.

References

ASARECA, 2005. Fighting poverty, reducing hunger and enhancing resources through regional collective action in agricultural research for development. ASARECA (Association for

Strengthening Agricultural Research in Eastern and Central Africa) Strategic Plan 2005-2015, August 2005, Entebbe, Uganda.
Bekunda M, Mudwanga EB, Lundall-Magnuson E, Makinde K, Okoth P, Sanginga P, Twinamasiko E & Woomer PL, 2005. Findings of the Lake Kivu Pilot Learning Site Validation Team: A mission undertaken to identify key entry points for agricultural research and rural enterprise development in East and Central Africa, 5–30 October, FARA, Accra, Ghana.
Baltenweck I & Staal S, 2007. Beyond one-size-fits-all: Differentiating market access measures for commodity systems in the Kenyan Highlands. Journal of Agricultural Economics 58(3): 536–48.
Deichmann U, 1997. Accessibility indicators in GIS. New York: United Nations Statistics Division, Department for Economic and Policy Analysis.
FAO, 1994. Africover – Eastern Africa module: Land cover mapping based on satellite remote sensing. Available at http://www.africover.org/documents.htm
Farrow A & Nelson A, 2001. Accessibility modelling in ArcView 3: An extension for computing travel time and market catchment information. Software manual, CIAT, Cali, Colombia. Available at www.ciat.cgiar.org/access/pdf/ciat_access.pdf
Farrow A, Risinamhodzi K, Zingore S & Delve RJ, 2011. Spatially targeting the distribution of agricultural input stockists in Malawi. Agricultural Systems 104(9): 694–702.
Garren NM & White FC, 1981. An analytical framework for the efficient allocation of agricultural research expenditures by states. Agricultural Administration 8(4): 279–87.
Hägerstrand T, 1967. Innovation diffusion as a spatial process, transl. A Pred (originally published in 1953). Chicago: University of Chicago Press.
Keilbach MC, 2000. Spatial knowledge spillovers and the dynamics of agglomeration and regional growth. Heidelberg: Physica-Verlag.
Lewis DJ, Barham BL & Zimmerer KS, 2007. Spatial externalities in agriculture: Empirical analysis, statistical identification, and policy implications. Agricultural and Applied Economics Staff Paper Series, Department of Agricultural and Applied Economics University of Wisconsin, Madison.
Ndegwa S & Levy B, 2004. The politics of decentralization in Africa: A comparative analysis. In Levy B & Kpundel S (eds.), Building state capacity in Africa: New approaches, emerging lessons. Washington DC: World Bank Institute.
Nkonya E, Pali P, Oduol J, Andam K & Kato E, 2010. Establishing baseline socioeconomic conditions in East and Central Africa for the Integrated Agricultural Research for Development (IAR4D) approach. Mimeo, International Food Policy research Institute, Washington, DC.
Ravallion M, 2002. Externalities in rural development: Evidence for China. World Bank Policy Research Working Papers 2879, World Bank, Washington DC.
Thornton PK, Stroud A, Hatibu N, Legg C, Ly S, Twomlow S, Molapong K, Notenbaert A, Kruska R. & Von Kaufmann R, 2006. Site selection to test an integrated approach to agricultural research for development: Combining expert knowledge and participatory geographic information system methods. International Journal of Agricultural Sustainability 4: 39–60.
Van der Horst D, 2011. Adoption of payments for ecosystem services: An application of the Hägerstrand model. Applied Geography 31: 668–76.
You L & Chamberlin J, 2004. Spatial analysis of sustainable livelihood enterprises of Uganda cotton production. EPTD Discussion Paper 121, International Food Policy Research Institute, Washington DC. Available at http://www.ifpri.org/divs/EPTD/DP/eptdp121.htm