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USING GOBLET, A GEOGRAPHIC INFORMATION DECISION SUPPORT SYSTEM MODULE TO SELECT LIVESTOCK MULTI-STAKEHOLDER INNOVATION PLATFORMS SITES IN MALI

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ABSTRACT

This study aims at experiencing an approach of platform selection in Mali using the Geographic Overlaying data Base and query Library for Ex-anTe impact assessment (GOBLET). This system was designed as a simple system to overlay maps of different criteria and facilitate the manipulation of scenarios, for targeting global level of pro-poor interventions in Mali. A four-steps methodology was designed starting by selecting a location where a wide range of productions systems and cultural and socioeconomic factors exist; within this area a set of strategies were tested to highlight similarities or dissimilarities, leading to a recommendation domain. For each recommendation domain, summary statistics such as the numbers of poor people in areas with high productivity of vegetable and milk within different livestock production systems were used. It came out from this study that two villages platforms Kouyan Coura and Farakan were selected as of the project sites. This proposition was validated by the project Steering committee. In total, the use of Goblet provides a rich set of components for building customized GIS applications were developers can concentrate their efforts on specific needs, like custom input screens, and not on complex processes like processing, rendering and storing geographic information. The use of this GIS in this project has created avenues for change for local city officials and key community stakeholders. It can be used to communicate important facts about a community.

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INTRODUCTION

African agriculture remains weak and uncompetitive mainly due to non-adoption of improved technologies that are essential to increase productivity and profitability of agricultural systems (Ajayi *et al.,* 2008). According to Beintema and Stads (2004), the low uptake of improved technologies is a result of a number of factors that characterize African agriculture. Despite all efforts, five big challenges facing Africa's food systems are follows: critical inputs, access to financing, property rights, infrastructure for market access and off-farm income (Binswanger-Mkhize *et al*., 2009).

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Therefore, introducing agricultural intensification strategies offering opportunities for smallholders to adopt new production activities for higher value products has become an increasingly attractive approach for exploiting evolving market opportunities and to improve agricultural incomes of the poor. To cope with this situation, several approaches were experimented. Technology Transfer initiated in the 1960s was the main model used for understanding and approaching agricultural innovation (Sidibe *et al*., 2016; Hounkonou, 2012). Then Farming System Research was developed as a response to the reductionist character of the character of technology transfer model (Dixon *et al*., 2001). From 1980s, Participation and Participatory Technology Development became more central to working with farmers and developing knowledge for rural development. Agricultural Knowledge and Information Systems came into vogue in the 1990s (Binswanger-Mkhize, 2007).

In the same line for better integrating the farmers needs, the focus shifted more and more towards joint adult learning through farmer field school (Klerkx *et al.*, 2012). Experiences to date highlight, however, the challenges faced in scaling out such strategies, attempting to catalyze and accelerate the otherwise natural emergence and evolution of production systems responding to market incentives (Lundy *et al*., 2012). In definitive, current approach to agricultural research is often described as sectoral and fragmented with little or no involvement of relevant stakeholders (Malden *et al*., 2009). In the light of above, the most recent waves of thinking made clearer that both constraints and opportunities depend on more than one key stakeholder. Then, multi-stakeholders platforms were established. In addition, the need to focus on market opportunities has lead to strength value chain approaches and to build multi-stakeholder partnerships and coalition (Nederlof and Pyburn, 2012). As a consequence, multi-stakeholder platforms have been shaped and established.

Klerkx *et al*. (op cit.) defined an innovation platform as a space for learning and change. It is a group of individuals (who often represent organizations) with different backgrounds and interests: farmers, traders, food processors, researchers, government officials etc. The members come together to diagnose problems, identify opportunities and find ways to achieve their goals. For Pali and Swaans, (2013), Innovation platforms offer a practical way to deal with the complex issues and multiple stakeholders involved in value chains. They bring together a range of stakeholders: farmers, traders, processors, input suppliers, credit suppliers, market information providers, insurance services, policymakers, extensionists and researchers. Together, these stakeholders design solutions to problems along the value chain. Therefore, Innovation platforms are a systematic attempt to facilitate change through joint action. While they are structured, they are also flexible, changing in response to the current situation (Jiggins *et al.,* 2016.

In establishing innovation platforms, Nederlop *et a*l., (2011) distinguished a 4-phase process starting with the scoping and preparation for the IP establishment. Phase 2 deals with the management of the process. In phase 3, focus is put on learning and restructuring. The exit last phase is related to renegotiation. The first phase and especially, the choice of sites required inter alia: (1) often rather important resources, 2) the availability of the specialists of different domains, 3) the logistics notably the means for travelling; and 4) long time for data collection and analysis. Currently, it is widely accepted that targeting resource allocation and the development of promising interventions should take into consideration a broader range of indicators such as access to markets, population density, and soil erosion, and farm types to ensure appropriate distribution of resources and facilitate adoption of agricultural technologies. Therefore, the process of these data to provide information for decision-making and methods for rapid analysis of complex scenarios needs the use of database such as the Geographic Overlaying data Base and query Library for Ex-anTe impact assessment (GOBLET). GOBLET was also designed as a simple system to overlay maps of different criteria and facilitate the manipulation of scenarios, such as the area of a region where a particular crop could be grown, or in assessing the predictive effects on livestock keeping practices in rural/urban areas with population increases over the next twenty (20) years, for example.

This system was intended to supplement the process with more focused information on the location and numbers of discreet beneficiary groups in defined 'frontline' regions of relevance to development agencies. Based on its performance, GOBLET was experimented in Mali as an approach for describing the different data layers that are available in the database for targeting global level of pro-poor interventions. The present article describes some of the technical details of its implementation and analyses the possibility of it use as assistant to the researchers in the choice of the sites for livestock platforms in Mali.

MATERIALS AND METHODS

The study was carried out to select livestock platforms in Mali using Goblet based- application. To guide the production of spatial domains and niches, four steps were designed. The methodology started by selecting a location where a wide range of productions systems and cultural and socioeconomic factors exist; within this area a set of strategies were tested to highlight similarities or dissimilarities, leading to a recommendation domain. For each recommendation domain, summary statistics such as the numbers of poor people in areas with high productivity of vegetable and milk within different livestock production systems were used.

Processes for sites selection:

A field mission was carried out to collect meteorological data that will be used in the choice of sites using Goblet. The main criteria used for the potential sites selection are as follows:

- Density of the population: the higher the density of the population is, the more the existence of a potential market for the flow of products (milk and garden products);
- Access to market: this was expressed as the time spent to reach the market. This time integrates the state of the road. It is considered that good access needs less than 3 hours to reach the market.
- Soil degradation: it is measured by the erosion risk;
- Coefficient of rainfall variation: The less it is high, the less the zone is subject to major climatic risks, as a result more it is stable;
- Duration of crop period: the longer this period is more it is possible to cultivate for a long time.

Data used were exported from the FAO meteorological database. Each of these criteria constitutes layers that were assembled and superimposed to the administrative national map. For each of these layers, the smallest administrative unit considered is the Commune.

Investigation diagnoses on sites identified by the software GOBLET

A series of missions were carried out to investigate and to collect data for site characterization respectively from the municipalities of Kati and Banguineda. Then followed Konobougou and Baraoueli and later on Niono and Kala Siguida. In this vein, liable information were provided by the technical local services, the authorities and the politics, the NGOS, Women Associations in addition to resources people practicing or knowing about gardening or horticulture

activities and production of milk in their municipalities. Information collected was verified by triangulation.

Ultimately, the main criteria used for this survey were:

- Practice of gardening farming;
- Practice of dairy breeding;
- Access to markets;
- Existence of a milk sale point;
- Existence of a possible integration of gardening farming and milk production;

Notes and weight Criteria for the village selection

According to the Goblet structure, eight main criteria were used to select among all the parameters by giving to each a coefficient (weight) as indicated below for the choice of villages:

- Practice of the gardening farming all the year long (coefficient 3)
- Ownership of a gardening farming plot of land independent from fields for crops (4)
- Surface covered and stretchable of the gardening vegetable plots of land (3)
- Level of use of the animal-derived organic manure in gardening farming (coef 2)
- Production of species residues which can be used to feed animals (coefficient 4)
- Preservation of dairy in the family or the village (coefficient 2)
- Practice of milk production for business (3)
- Practice of compost or complementation with the organic residues for vegetable gardening productions (coefficient 4)

For every village, notes going from 1 to 5 were attributed to these criteria. Then notes were multiplied by coefficients to obtain balanced notes. The sum of these obtained notes by village allowed has permitted to classify this village as shown in table 1. In the framework of the site selection, a great attention was paid to producer organizations or associations working either on gardening farming or on milk production or trade or both at the same time.

RESULTS

The result of the first application of the Goblet system has yielded some maps. But analysis of the maps has motivated important and pertinent observations. Contradictions with some of climatic maps of the country were raised. For example, this application considers Bougouni in a Sahelian zone, while this district is located within the isohyet 900 – 1000 mm. In consequence, the pertinence of some criteria, notably the duration of access to market and the soil degradation were reviewed again. The duration of access to market was reduced from 3h 00 to 2h 00, because this criterion considers Bamako as the only accessible market for all products. The criterion of soil degradation was left. The modification of these two criteria gave the result presented in the Figure 1. Secondary cities of more than 50 000 inhabitants such as Segou, Niono were considered to be potential markets for milk and garden production.

That is why the presence of these cities was considered as more liable criterion. Ultimately, selected criteria were as follows:

- Duration of the crop period (LGP);
- Density of the population;
- Access to the market of the cities of more than 50 000 inhabitants at most in 2 h 30;
- Coefficient of rainfall variation.

Application of these criteria has led to potential sites selection mentioned on the Figure 2. Based on these criteria, administrative Units (Cercle) of Kati, Segou exchange, Niono and Koutiala were selected. Because of budget limitations, the Cercle of Koutiala was removed. Then three Administrative Unit or Circles were identified within different isohyets going from subhumid to sahelian zone. In total, the following Cercles were identified as presented in table 2:

The three identified Circles or administrative units are in varied isohyetes from subhumide zone to the sahélian zone (Figure 2).

From results of the first application of Goblet some important observations came out: because preselected districts didn't match with field reality and are against all climatic charts of the country. For example, this application considered Bougouni and Kadiolo as sahelian zone whereas Bougouni is located within isohyete 900-1000 mmyear and Kodiolo within that of 1000-1200mm/year. The application of these criteria gave the potential sites mentioned on Figure 3.

Choice of villages

On the basis of these criteria villages were selected. Characteristics of the village preselected are presented in Table 3. If at least two respondents indicate the same village this later become villages to be investigated. By using this procedure, the following villages were selected per municipality:

- Kati: Kati city, Babougou, Noumorila, Kati koro, Koko
- Baguineda: Mofa, Farakan, Tanima,
- Konobougou
- Baraoueli: Koulala, Kinta, Bamana,
- Niono: Kouyan coura,
- Kalasiguida: Molodo centers

When integrating the weighted criteria, three villages stand out: Farakan, Baguineda and Kouyan coura. These villages possess lands and practice vegetable gardening and milking business activities during all year. On the other side, these producers are affiliated to organizations. For vegetable gardening, Kouyan Coura village has more reassured lands (approximately 25 hectares) than Farakan (3 hectares). According to the project team survey reports, two possibilities exist in Farakan. A 2,5 km perimeter for vegetable gardening at 3 km of the village and another one covering 1,5 ha are available in Farakan. Konobougou, the third village selected, possesses some advantage with the presence of a 4 ha vegetable gardening perimeter. It was observed that because of the water exhaure, fewer women used this complex. A system of irrigation needs then to be implemented to ensure full use of this perimeter by women.

Table 1. Weighted scores criteria for village selection

Criteria	Kati		Baguinéda		Konobougou		Baraouéli		Niono		Kalasiguida	
	Note	Weighted score	Note	Weighted score	Note	Weighted score	Note	Weighted score	Note	Weighted score	Note	Weighted score
1 (3)	5	15	5	15	3	9	2	6	4	12	2	6
2 (4)	5	20	3	12	3	12	2	8	4	16	2	8
3 (3)	2	6	4	12	3	9	1	3	4	12	1	3
4 (2)	2	4	4	8	5	10	1	2	4	8	4	8
5 (4)	4	16	5	20	2	8	2	8	5	20	1	4
6 (2)	1	2	5	10	3	6	0	0	5	10	5	10
7 (3)	1	3	5	15	3	9	0	0	5	15	5	10
8 (4)	1	4	4	16	2	8	1	4	4	16	0	0
Total		70		108		71		31		109		49

Numbers with brackets indicate coefficients of the criteria.

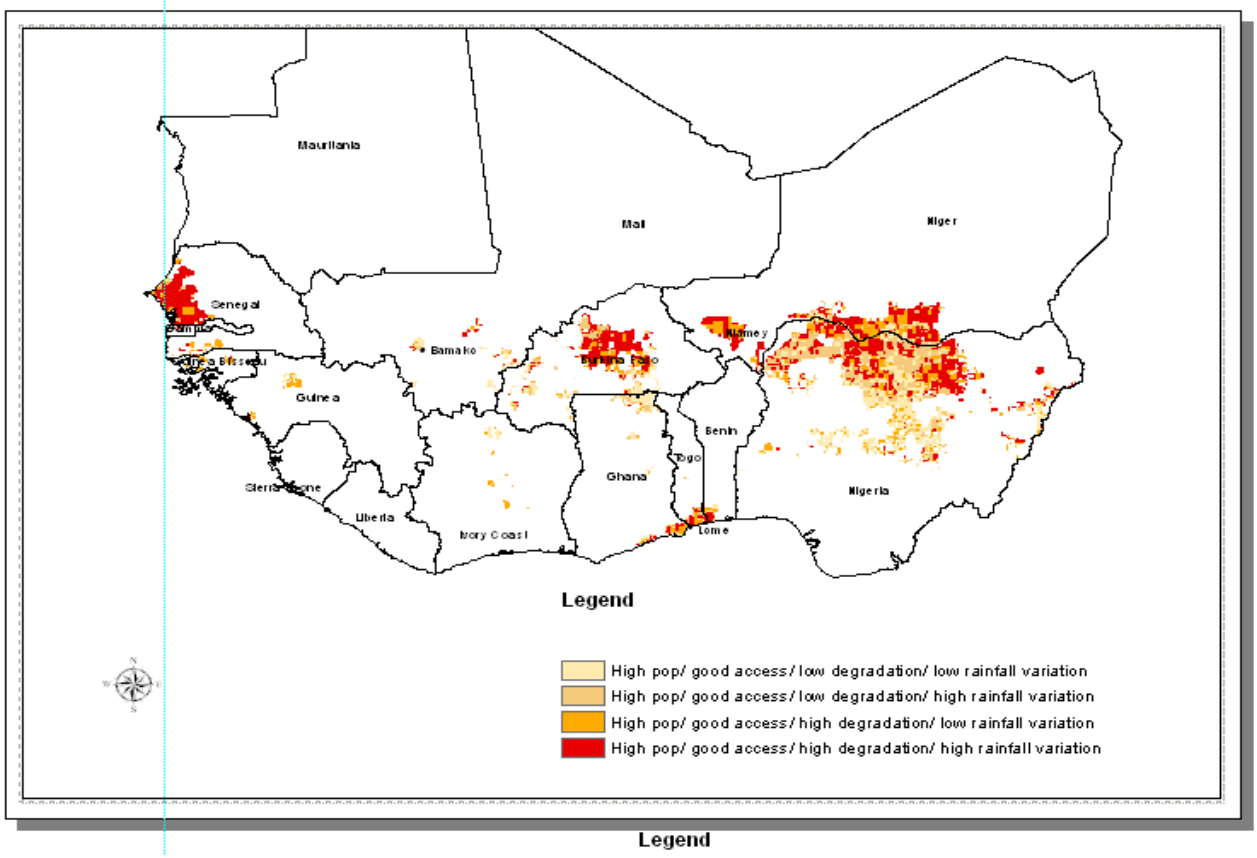

Figure 1: Selected zones using GOBLET, by superimposing population density, access to market, soil degradation, and coefficient rainfall variation

Table 2: Selected Administrative Units (Cercle)

Cercle	Commune
Kati	Urbaine de Kati Baguinéda
Barouéli	Barouéli Konobougou
Niono	Urbaine de Niono Kalasiguida

Among three villages, the choice of the team concerned firstly to Kouyan coura, then Farakan and finally Konobougou. After analysis of the availability, from three preselected localities, finally two villages presenting the best features were retained: Kouyan coura and Farakan (figure 4). At the end of all the procedures, Kouyan coura and Farakan were selected as of the project sites. This proposition was validated by the project Steering committee.

DISCUSSION AND CONCLUSION

As agricultural production continues to diversify, populations' increase, and the effects of climate change become more evident, the need for better targeted agricultural strategies is increasingly important. GOBLET is one tool that can bring the concepts and practical application of niches and recommendation domains to a wider audience of stakeholders and improve the effectiveness of agricultural research and development through the design of well-targeted interventions and investments. The use and integration of open-source solutions in one utility provides rapid development and scalability of computer applications mainly because the development process concentrates on special requirements and not on "re-inventing the wheel". As an open-source tool and kernel module, GOBLET provides a rich set of components for building customized GIS applications were developers can concentrate their efforts on specific needs, like custom input

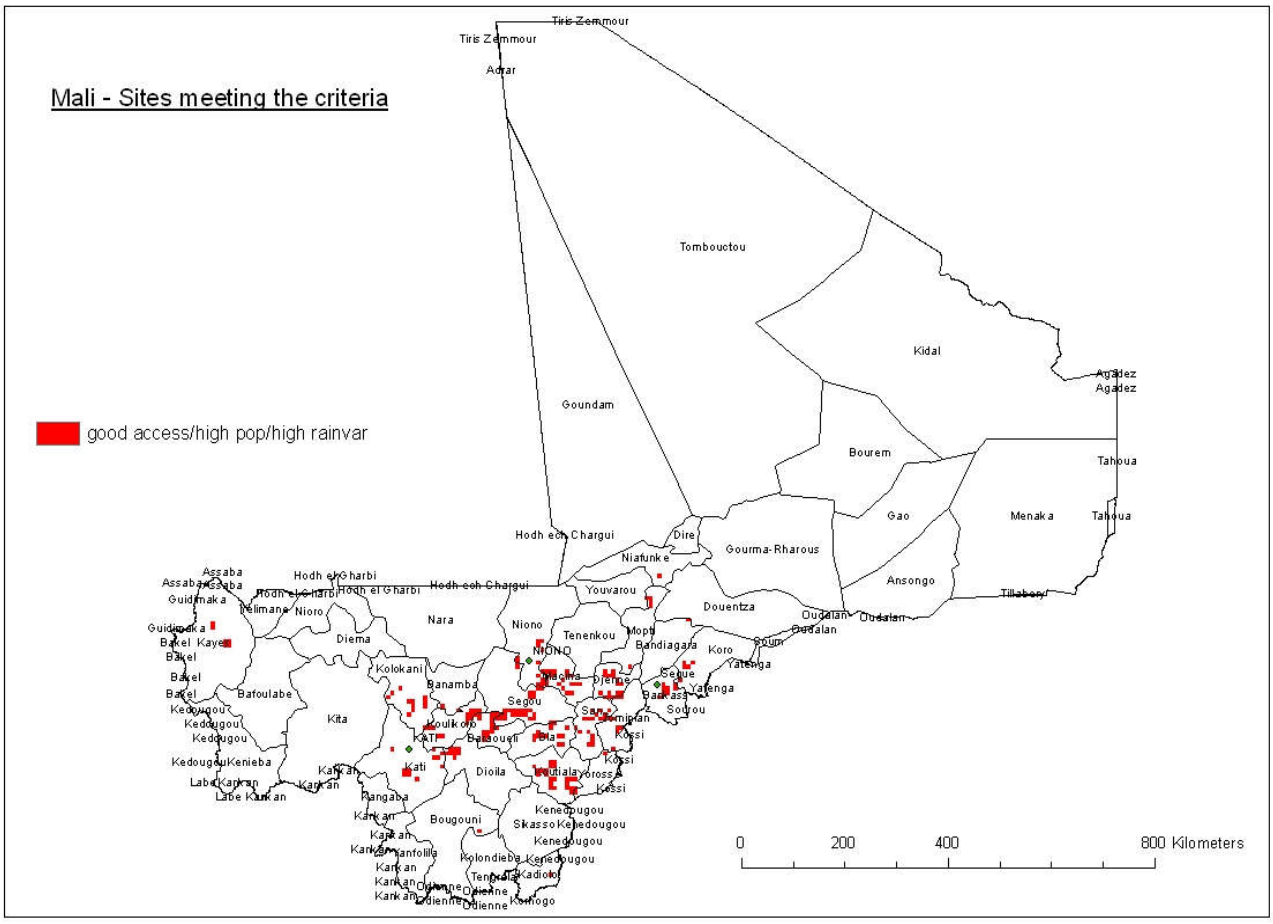

Figure 2. Potential Sites selected from the criteria by GOBLET

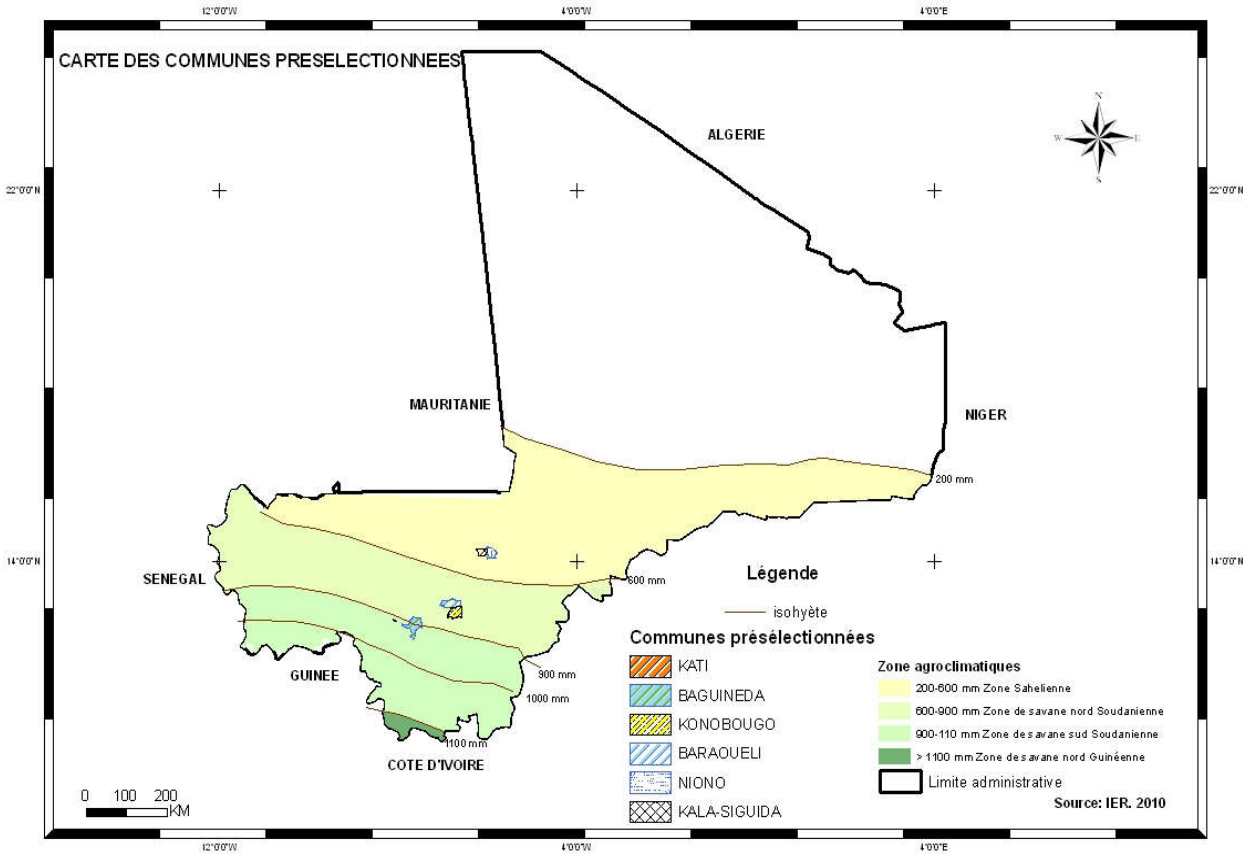

Figure 3. Distribution of preselected sites according to agro-climatic zones

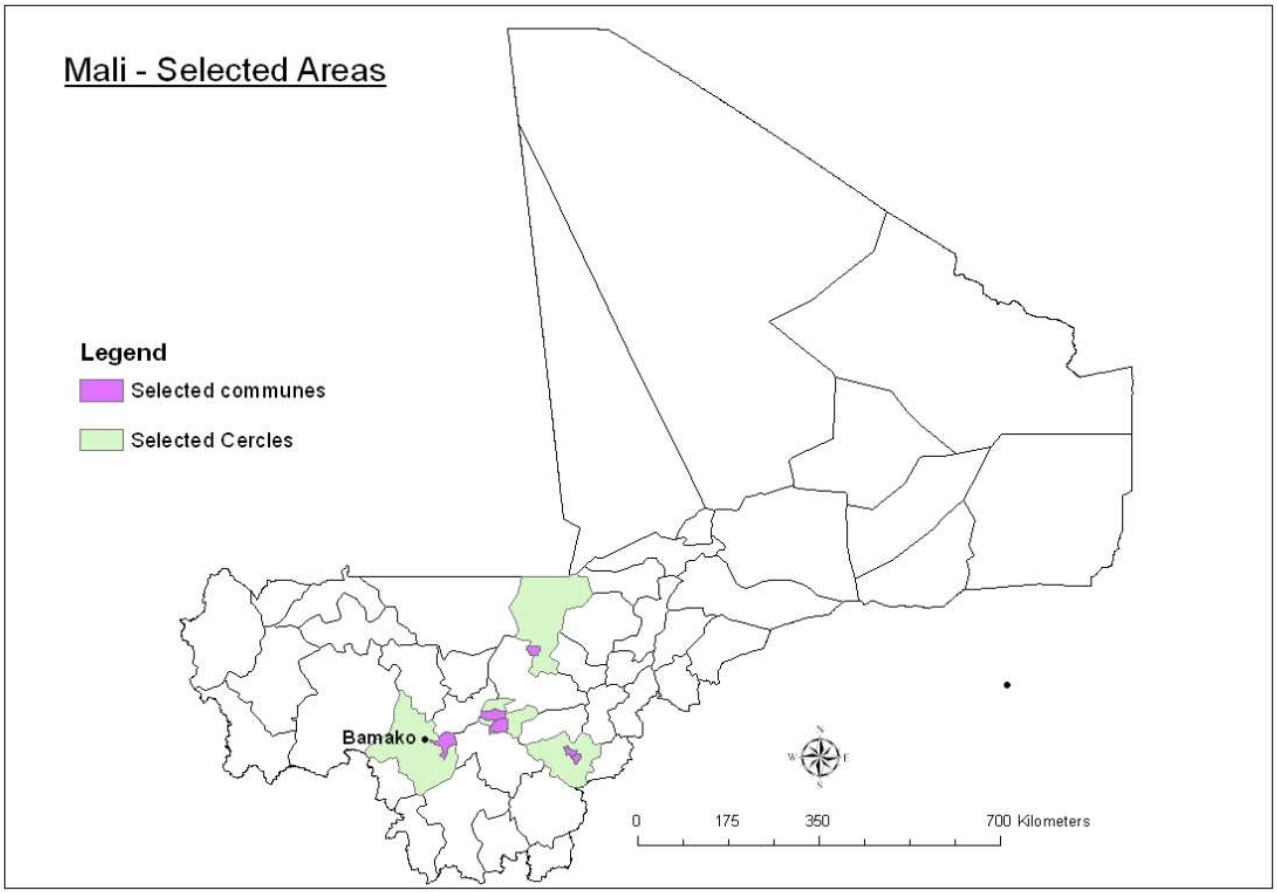

Figure 4 : Potential sites chosen by GOBLET after elimination of the soils degradation variable, reducing time for market availability and inclusion of secondary towns over than 50 000 inhabitants

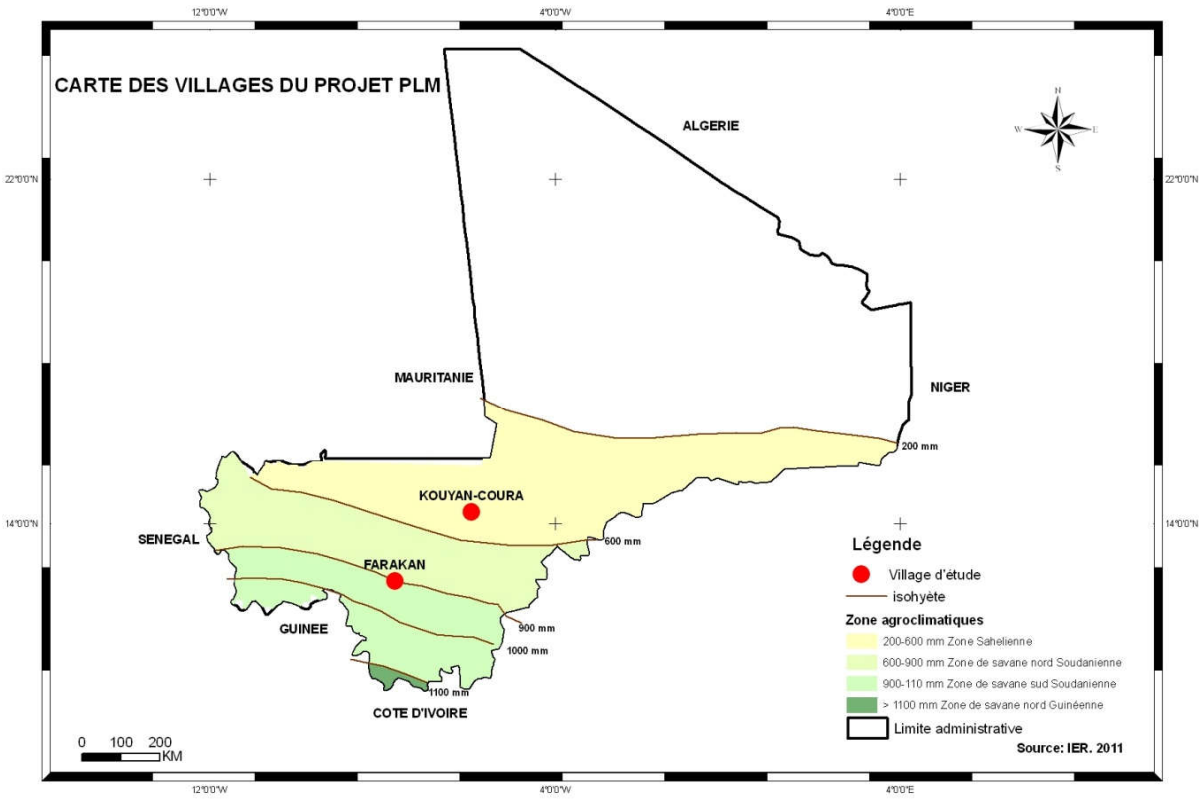

Figure 4. Final Selected villages

Characteristics of Preselected villages

	Kati	Baguinéda	Konobougou	Baraouéli	Niono	Kalasiguida
1. Gardening practice	Yes	Yes	Yes	Yes	Yes	Yes
Gardening period	All seasons	-All seasons at Farakan -Dry season elsewhere	-Rainy season -All seasons at women's garden	Rainy season	-All seasons at Kouyancoura - Dry season elsewhere	Dry season
Existing organizations	- Gardening Association - Animal production Cooperative (not functional)	- Gardening Cooperative - Milk production Cooperative	Women's Association	No	Women's Association	Women's Associations
Presence of gardening domains in a village of the district	Yes	Yes at Farakan	Yes (Women's gardening domain)	No	Yes at Kouyancoura	No
Surface of individual parcels, m²	20 to 400	5000 – 50 000	300 – 5000 Total surface 40 000 for Women's association	Not evaluated	300 – 10 000	300 – 10 000
Main garden cultures	Cabbages, salad, potato, Persil, cucumber, eggplant	Cabbages, salad, potato, French bean, tomato, eggplant, cucumber, gumbo, hot pepper	Tomato, cucumber, watermelon, - Salad, hot pepper, eggplant, papaya	Tomato, cucumber, watermelon, melon	Shallot, tomato, potato, peanut, soybean, corn	Shallot, tomato, okra, ail
Source of water used for watering	Rivers	Irrigation channels, wells	Rains, wells	wells	Irrigation channels	Irrigation channels
Utilization of organic compost from animal origin	Often	Very often	Often	Often	Very often	Very often
Utilization of garden waist for feeding sheep	Scarcely	Very Often	Often	Small	Very often	No
Which kinds of waists are used for feeding animals?	Cabbages, potato	Cabbages, potato, French bean	Watermelon	Watermelon	Potato, peanut, soybean, corn	None
Main products selling sites	Bamako, Kati	Bamako, Baguinéda	Konobougou	Barouéli, Konobougou	Niono, Bamako	Niono
Locality of the buyers	Bamako	Bamako	Bamako	Bamako	Bamako	Bamako
Principal problems	- Lands availability - Bad organization of markets (high waist levels due to non sold products)	Water availability	Water availability	Water availability	- Bad organization of markets -Seeds not available	-Lack of the training of the gardeners -Lack of fertile lands
2. Milk production	Kati	Baguinéda	Konobougou	Baraouéli	Niono	Kalasiguida
	Yes	Yes	Yes	Yes	Yes	Yes
Practice importance	Low	High	Low	Very low	High	High
Garden waist complementation practice	Scarce	Beginning	Scarce	Scarce	Exists	No
Principal locality for milk sale	Kati	Kassela Milk industries and Wassa milk (Baguinéda)	Konobougou	In villages	Danaya nono (Niono)	Danaya nono (Niono)
Type of animal production	Traditional	Traditional	Traditional, free in dry season	Traditional, free in dry season	Traditional	Traditional
Grass research travelling	Some animals in dry season	Some animals in dry season	Rainy season	Rainy season	Rainy season	Rainy season
Presence of some milk production animals during grass research travelling	Yes	Yes	Yes	Yes	Yes	Yes
Main problems	-Absence of animal production in some gardening villages -Lack of milk producers' organization -Lack of pastures -Existence of diseases	- Absence of animal production in some gardening villages - Lack of milk producers' organization - Lack of pastures - Existence of diseases	Water Availability	- Water Availability -Lack of people for animals survey during dry season	- Lack of ways for pasture; - Lack of pastures for animals	- Lack of ways for animals - Charge of produced animals for harvested waists - Availability difficulties of the gardening domain

screens, and not on complex processes like processing, rendering and storing geographic information (Quirosa, *et al.,* 2009). The internal processes, like the ones for manipulating geographic information or creating niches and recommendation domains, are encapsulated but accessible to the software developers. Much of the future utility of a tool such as GOBLET depends on the nature and quality of the spatial data that is part of it. Key ingredients include such basic information as the spatial and temporal distribution of crops and livestock, and improved estimates of the numbers, location and characteristics of poor and vulnerable social groups. The information on the location of targeted social groups, like poor livestock keepers, with particular characteristics adds considerable value to a tool such as GOBLET (Thornton and Herrero, 2001). The limited research resources also seem to have increasingly misallocated. Given the heterogeneity, the poor borrowing opportunities, and the enormous challenges from water scarcity and water stress, basic innovations at the science level are urgently needed in a wide variety of crops and livestock development (Lundy *et al*., 2012). Yet, the proportion of research going to basic sciences has been declining in national and international research systems alike. Instead the resources have gone to agronomic and farming systems and environmental research that has little record of high rates of return. The African Challenge program continues the same unfortunate trend. Scarce scientific resources have also been diverted to implementation of programs, rather than research (Tshiebue, 2010; Sidibe *et al*., 2016).

In total, the use of Goblet provides a rich set of components for building customized GIS applications where developers can concentrate their efforts for specific needs, like custom input screens, and not on complex processes like processing, rendering and storing geographic information. The use of this GIS in this project created avenues for change for local city officials and key community stakeholders. It can be used to communicate important facts about a community. Grassroots interventions might be more easily achieved as a result.

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