

Community expectations and motivations in entomological research activities for the development of innovative malaria vector control tools: Target Malaria as a case study in Bana, Western Burkina Faso

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Abstract

Background

Many field entomology research projects involve local communities in mosquito-collection activities. Since 2012, Target Malaria, a not-for-profit research consortium, has been working with community members in various studies of mosquito collection, release and recapture in the village of Bana, in Western Burkina Faso. Target Malaria's long-term goal is to develop innovative solutions to combat malaria in Africa with the help of mosquito modification technologies. Since the start of the project, members of local communities have shown interest in playing an active role in the implementation of the project's research activities, but their actual motivations for such an interest remain under-investigated. This study therefore aimed to examine the factors that motivate the local community to contribute to the implementation of Target Malaria's activities in the village of Bana.

Methods

A qualitative approach was used to examine the factors motivating the local community to assist in the implementation of Target Malaria's entomological research activities in Bana. 85 individual in-depth and semi-structured interviews were conducted, followed by interviews with three focus groups, one with youths who had participated in mosquito collections and two with men and women from the village. All data collected were fully transcribed, processed, and submitted for thematic content analysis.

Results

Data showed that the willingness of local community members to participate in the entomological research activities of Target Malaria was informed by a wide range of motivational factors. Although the actors interviewed expressed their motivations under different semantic registers, the data showed a degree of consistency between different motivations advanced. These similarities enabled us to classify all of the motivational factors under 5 distinct categories: (a) assist in field research, (b) contribute to a better future, (c) acquire knowledge, (d) earn financial compensation, and (e) gain social prestige.

Conclusion

These varying motivations reflected fundamentally different personal and collective perceptions about the participation process. In addition, this study shows that the interest of research on participation is a useful part of understanding public perceptions.

Background

Despite the efforts made in the control of malaria over the last decades, progress in many regions seems to be coming to a halt [1]. The growth of resistance to mainstay insecticides constitutes the most serious threat to sustainable success with existing tools [2-4]. Different species of *Anopheles* mosquitoes have shown an increasing resistance to multiple pesticides [5,6]. A recent World malaria report [1,7] indicates that malaria mortality is actually increasing in several countries, including Burkina Faso.

There is as a result a growing emphasis on the development of new tools or approaches, and on the improvement of integrated control strategies. This includes the possible use of genetically-modified malaria vectors to achieve population suppression or trait replacement [8,9] as part of an integrated malaria control strategy [10,11].

Target Malaria is an example of this strategy. In the long-term, this collaborative consortium seeks to use genetic modification of specific vector strains to suppress their ability to reproduce [12,13]. By using gene drive constructs, the project seeks to create modified strains of *Anopheles* mosquitoes that will be capable of transmitting this trait to the vast majority of its offspring, thus allowing it to quickly spread through the population [14]. This technology could be a key complementary tool for malaria eradication.

In Africa, Target Malaria operates in four countries: Mali, Uganda, Ghana and Burkina Faso. Target Malaria's technology is currently being developed in three phases: self-limiting sterile males, self-limiting male bias, and self-sustaining male bias or self-sustaining target knock-out. Each of these phases then further entails different stages of technological development. The current paper focuses on work conducted during the period of baseline entomological field research, prior to the release of any genetically modified mosquitoes.

In Western Burkina Faso, these field entomological activities have been underway since July 2012. They include Human Landing Catch sampling of mosquito populations, location and collection of swarms, egg surveys, insecticide spraying catch [15], as well as mark-release-recapture experiments [16,17]. The entomological activities conducted in the field require close involvement of members of the local community. In addition to their participation in entomological work, communities were also engaged through regular group interactions, discussions and dialogue sessions, and general meetings and individual dialogues regarding the project and its objectives. The motivations and aims of Target Malaria's entomological activities were widely explained, including the link between ongoing mosquito collections and the ultimate goal of developing genetically modified mosquitoes to control malaria vectors.

The overarching aim of community engagement activities was to obtain a social license to operate in the villages in question [18–20]. Indeed, as part of the Target Malaria project, local community members were engaged at the consultative, functional, interactive, and/or mobilisational levels corresponding to the four levels of the participatory scale [21–23].

Community participation is broadly considered essential for attaining an effective control of disease vectors [24]. Multiple studies attest to the role played by local communities in the control of those diseases [25–29]. Unfortunately, these studies do not provide information on the factors that motivate local communities to get involved in mosquito control programmes. Thus, the issue of community motivation in such context remains under-investigated. In Burkina Faso in particular, there is generally very little information on the reasons that motivate local communities to participate or not in entomological research programmes. The scant research information available on community participation in health programmes is limited on the theoretical and practical aspects of the local actors' participation [30–32] or the ethical aspects [33]. Where data are available, they generally pertain to clinical research [34] where a direct personal benefit is often assumed. We therefore lack a good enough understanding of the reasons that bring people to participate in entomological research projects for vector control. Target Malaria offers a good opportunity to expand our knowledge of these factors, as it involves long-term baseline field entomological work, as well as the potential release of

genetically modified mosquitoes for research purposes. Target Malaria and its technology have generated opposition and criticism, and that the work of Target Malaria in Burkina and elsewhere has also attracted some national and international critics. However, it is still important to understand what are the motivations of those people who choose voluntarily to collaborate with this project. It thus allows us to study the complex motivations that people have to participate in mosquito collection activities, and in entomological research activities supporting novel methods of malaria control more generally.

Methods

Study site

This study was conducted in the village of Bana, located in Western Burkina Faso, approximately 20 km from Bobo-Dioulasso (Figure 1). In 2012, the population of Bana was estimated to be approximately 982 inhabitants, 498 men and 484 women [35]. Bana has two main inhabited areas, Bana Centre and Bana Market, separated by a small river (usually dry during the dry season). Bana Centre is the principal agglomeration and includes the village administration; Bana Market is the economic centre of the village and hosts a busy weekly market. The whole village is a loose cluster of about 130 compounds (local census, October 2014). Each compound is a family unit consisting of between two and ten houses, generally made of mud. The largest ethnic groups are the Bobo, Dioula, Mossi, Fulani, and Sambla. The Bobo ethnic group is the indigenous group in the area. The most widely spoken language is Dioula. Similar to most rural areas in Burkina Faso, Bana's economy is essentially based on subsistence agriculture [36].

Approach and study population

This was a qualitative study based on an anthropological approach in which the researcher displayed an active and participatory posture. In this approach, emphasis was placed on the stakeholders' perception of their situations, what sense they made of the situations, and their interactions through these situations. As Olivier de Sardan has noted [37], anthropology produces reports and interpretations based directly on the context and coherence of all available facts. The empirical surveys conducted as part of this research enabled us to gather experiential data and relatively

detailed statements from local community members engaged in Target Malaria's ongoing activities in the area.

The study population comprise all of the residents of Bana who have played an active role in the implementation of Target Malaria activities. These actors included youth volunteers participating in various mosquito-collection techniques, village leaders (including traditional leaders such as chief of village, elders, notables; and formal leaders such as members of the village's development council ('Conseil Villageois de Développement' or CVD), as well as all members of the village who have granted access to their households, houses, and rooms for mosquito collection.

Data-collection techniques and tools

This study was conducted by members of the team working for Target Malaria in Burkina Faso. The data were collected between October 2017 to January 2018, following detailed semi-directive interviews and focus groups discussions. Out of a total of 130 households in Bana, all participating in the entomological activities of the project, 80 were visited and surveyed and the survey topics focused on how communities perceive Target Malaria and the reasons for their participation in the project activities. Twenty of these households were selected because they were the ones in which entomological activities (indoor pyrethroid spray catches, swarm collection, and human landing catches) were carried out on a monthly basis. The remaining 60 households were randomly selected. A total of 85 in-depth individual interviews were conducted with members of the local community. Furthermore, three focus groups were conducted, one with the youth volunteers (involved in mosquito collection), and one each with male and female residents of Bana. All participants in the focus group discussions had participated in Target Malaria, primarily by granting access to their premises for project activities. The discussions were held in the Dioula language and recorded with a Dictaphone.

Data processing and analysis

The data were processed and tabulated with the QDA Miner Lite software, a multi-dimensional database and quality data-processing software used to process large amounts of textual data. There was a thorough qualitative analysis of the data content [38] complying with all of the key stages mentioned about the topic [39]. The interpretation of the results was primarily based on these data,

but relied also on comparison with other surveys and focus group discussions conducted on similar topics from other projects in African countries [31,40-43].

Results

Our data shows that the participation of local communities in the implementation of Target Malaria entomological research activities was informed by a wide range of motivations. Five key themes emerged consistently in the interviews and focus group discussions, even if individual actors often expressed them in different semantic registers. Thus, we classified the motivations into five categories: to support field research activities, to contribute to a better future, to acquire knowledge and improve skills, to enjoy financial benefits from participation in the project, and to gain social prestige.

Concern for mosquito and malaria control

The main reason why members of the Bana local community participated in mosquito-collection through Target Malaria was the desire to protect themselves against mosquito bites and malaria. All of the community actors agreed with this reason. A 35-year-old housewife said, *“My husband and I have agreed for our home to be sprayed because we want to get rid of the mosquitoes in the house”* (**35-year-old housewife, Bana**). Indoor spraying activities (Figure 2) were aimed at assessing the density of endophilic mosquitoes and their variation over time and space. They allow the determination of the numbers of blood-fed mosquitoes, the origin of the blood meals, and the level of infectivity of malaria vectors. Our data show that fear of mosquitoes and of the harm they can cause is an obvious concern in the area, and that entomological research reduced the number of mosquitoes in the households. As another woman stated: *“Whenever they come to spray the house, they drive away a lot of mosquitoes. Again, we know that mosquitoes are not good. This is why I accepted to do the work. Because mosquitoes are not good.”* (**women’s focus group, Bana**). Similar statements were gathered from other participants. Expressions such as *“We want to get rid of mosquitoes from our homes”, “We want good health”, “by spraying our homes, they chase out a lot of mosquitoes”* and *“one day my children will be spared the disease”* all highlighted the concerns that the local communities have regarding the harm caused by mosquitoes and the malaria they transmit.

Thus, local communities perceived that, through its entomological research activities Target Malaria directly reduced mosquito densities in the village and this motivated residents to actively participate in them. *“Mosquitoes are the ones which give us malaria; and to me, combating malaria is a good thing. As for me, I have children and I know that if malaria is controlled, one day my children will be free of this disease and that is good”* (**women’s focus group, Bana**). Despite the project's regularly messages that mosquito collections activities are not intended for vector control (the aim of mosquito collection activities is not to remove mosquitoes from a house, it does not give lasting protection and that, the team always mention the importance for the communities to keep using bednets, etc.), local communities perceive these entomological activities as protecting against mosquitoes and malaria.

‘Contribute to a better future’ and participate in noble research: the meaning of words

A second motivations behind the participation of Bana residents in entomological research activities is the desire to *‘contribute to a better future’*. This theme emerged in a variety of interviews and focus group discussions. Several interviewees considered Target Malaria an example of ‘forward-looking research’, in the sense that it could provide in the long term a solution for malaria. This idea is highlighted in the following statements: *“As for me, I believe that we are contributing to a better future through our participation in the project. The mosquitoes which I catch myself, it’s as if I was working for myself or for my children. Even if I’m not alive tomorrow, at least I might have done something for tomorrow. For example, for those of us who are farmers, if you buy cattle and tomorrow you’re no more, your children can still work with the cattle. That is how this project is; we are searching for a solution to malaria to save tomorrow’s people”* (**A 33-year-old mosquito-collecting youth, Bana**). Local residents perceived that the various mosquito-collection activities in the village aimed at finding a future solution to their mosquito problem. They believed that this was a noble objective, and that by participating in the project they were doing “good” and contributing to a better future for future generations. One can assume that local residents were conveying messages often put forth by the researchers about the ultimate objective of their activities (“contribute to a better future,” “serve tomorrow,” “noble research,” etc.). Several interviewees reported a sense of pride in being actively involved in this work.

Mosquito collection activities: the stages of learning

Some local residents interviewed also considered their participation in the entomological research activities as an opportunity to improve their knowledge on mosquitoes. The desire to understand mosquitoes and learn more about mosquitoes and mosquito collection techniques were identified as reasons for their participation. This category of motivation was particularly salient among mosquito collectors (Figure 3): *"I came to do the work because it is a research which they are conducting. I want to learn this work. Knowing the mosquito, knowing how to catch them in order to combat malaria"* (**28-year-old mosquito collector for Target Malaria, Bana**). Most of the interviewed youths said that their involvement in Target Malaria would allow them to acquire specific knowledge on mosquitoes and mosquito-collection techniques that would enable them to contribute in the fight against malaria. As another participant in the same focus group said, *"As for me, I wanted to learn how to capture a mosquito. I know that a mosquito is small. How they are able to catch it. This way, I can also learn how the mosquito transmits the disease"* (**34-year-old mosquito collector for Target Malaria, Bana**). Several statements were collected to identify the type of knowledge acquired by community actors. One of the mosquito collectors said this: *"Thank to the project, I learned how to catch mosquitoes. And then now I can differentiate between the kinds of mosquitoes according to whether they are male or female. I know that the male is the one who has a lot of hair on his mouth, he doesn't bite. While the female has a small mouth and a long pointed beak and it is she who bites. In the evening I can identify swarms of mosquitoes, whereas in the past I thought it was dust. Concerning the night, people may wonder how to catch these little bugs, we were shown this. For the third, which is spraying, I learned how to pick them up on the sheet with a pair of pliers and put them in a box. I learned all this in the project."* These comments, which are widely shared by the mosquito collectors, reflect some of the forms of knowledge acquired through participation in the project's entomological activities.

Although the participation of the village youths in the entomological activities may be perceived as a means to learn about mosquitoes and mosquito collection techniques, it sometimes obscured another motivational factor. Indeed, when they said *"Do the work," "to work,"* or *"how to work,"* the mosquito

collectors were referring to mosquito-collection techniques (Figure 4) that they perceived as elements of a “trade” they could learn, and that could be useful for future activities in Target Malaria or in similar activities in the future. In fact, although for research purposes, this activity necessitates the availability of mosquitoes: “catch the mosquito” and “capture the mosquito”. Meanwhile, the action words “to catch” or “to capture” come from a knowledge model also directed by research. This new “job” must be learned. Capture at night (“*Sufè minè*” (*Sufè* = night, *minè* = catch) and capture during the day (“*Téléfè minè*” (*Téléfè* = day, *minè* = catch) required awareness, learning, and knowledge regarding mosquitoes and their environment.

Desired resources: how local communities perceive their collaboration in the project?

The participation in Target Malaria activities in Bana included a form of financial compensation for the local actors involved. Target Malaria included this in its research protocol submitted to the ethics committee and discussed the issue during information sessions and when seeking volunteers for research activities in the village. In this protocol, Target Malaria insisted that this was not a “remuneration” or “salary”, but rather “compensation” for the time spent by local residents on research activities. Target Malaria understands remuneration as an amount paid directly to employees in exchange for their work, and it requires the establishment of a services contract. This is not the case for the activities studied in this study, which were conducted in the absence of a contractual arrangement – hence the preference for the term compensation, which describes a lump sum granted to volunteers for the loss of income due to the time they invest in the project.

Regardless of the terminological nuances, however, this financial compensation was a significant factor for some of the participants, especially the mosquito-collector youths, and attracted significant interest. One of those interviewed provided the following reasons: *“Some of us, we are interested in this work because of the monetary reward attached to it. Something which helps us solve our petty financial problems. If someone asks me how is your work, I will tell them the mosquito-catching job is very good and that it is economically good to do this job. It is because of the money given after the work.”* (**28-year-old mosquito collector for Target Malaria, Bana**). In their statements, the local expressions used by the volunteers to qualify the financial compensation were very clear:

“Timinandiya” (motivation or encouragement), *“Tɔnɔ”* (gain, interest, or profit) or *“Nusɔndiya”* (cheerful or being happy). These expressions, specially *“Tɔnɔ”*, referred to the financial resources provided by the project. This compensation serves as a direct motivation for those involved in mosquito collection.

In Bana, vegetable growing has a crucial importance as it is one of the only ways to collect revenues during the 5- to 6-month dry season and compensate for potential bad yields. Almost all of the youths do regular gardening as an income-generating activity, yet this activity is insufficient to meet their needs. This partly explains the value they attribute to income opportunities offered by Target Malaria. The observation was confirmed by statements from the other focus groups. As the mother of a mosquito-collector youth said: *“The village youths are our children. We know them very well. They offer to catch the mosquitoes because they gain something like financial benefit from it.”* (**46-year-old housewife, mother of a mosquito-capturing youth, Bana**). These financial benefits acquired from their participation in Target Malaria activities have a significant socioeconomic impact on their cultivation or gardening activities. The money received from the project is used by some youth to buy for some equipment (motor pump, petrol, manpower) for their economic activities which could improve their yield.

“Social prestige” and “village reputation”

Some statements from local residents, especially village leaders, highlight the role of prestige as one of the factors motivating them to host the project. *“As for me, I really understand the objectives of your project in our village... And I know that, thanks to this project, the name of the village will be projected into the limelight. And people all over the world will wonder where the village of Bana is located. The fact that such research is being conducted in this village is an immense motivation for us, for, in any case, it would bring immense social benefits to the village”* (**46-year-old village leader, Bana**). This statement suggests that, in the perception of some residents, the entomological activities conducted by Target Malaria enhance the village’s image, both at the national and international levels. This was explicitly stated by one of the village residents interviewed: *“And, if in*

the meantime the project achieves the expected results and success in the work, even if we are not alive, people will say that research has been done in Bana. Bana's name will be mentioned everywhere. And as a resident of the village, I will be very proud. That's why I think it's important to get involved" (38-year-old men resident, Bana).

Discussion

This survey assessed the perceptions that Bana residents had of their participation in Target Malaria. Specifically, the study examined the factors that motivated members of the local community to become actively involved in an entomological research project. These motivational factors can be described as voluntary service, an activity to which time is allocated for the benefit of another person, group, or cause. Motivation, in this context, as some authors [44] reported, can be defined as an intra-personal need or desire that stimulates a behaviour and gives it direction. Studies on voluntary service have shown that successful participation is due to the specific motivations attached to the voluntary service [43,45] and that these motivations can predict the preferences of the voluntary service in the future.

Thus, the range of motivational reasons gathered from our local actors highlight the multiple reasons that sustain public participation in entomological research work. Through their motivations, the actors interviewed became aware of their need to join the fight against malaria, to which all of them are vulnerable. In fact, the vulnerability to mosquitoes and malaria and the need to find an efficient way of managing this disease seem to be the most important motivation influencing the decision to actively engage with Target Malaria. This vulnerability affects all categories of local residents, as malaria remains a main cause of hospitalisation and mortality in rural areas of endemic countries like Burkina Faso [7,46]. This motivation reflects the confidence that the local communities have in Target Malaria, and in its commitment to introduce innovative methods of malaria control. Among African countries, Burkina Faso has acquired a reputation as a pioneer in the development of new methods for the control of malaria vectors, including mosquito modification technologies [17,47,48]. This might explain the sense of pride reported by some of the participants.

Data shows that participants often acquire useful knowledge and skills. All the local communities

interviewed highlighted the opportunity to take advantage of their involvement in the project to learn or improve their knowledge. Bana inhabitants, especially youth mosquito collectors, reported the variety of skills they have learned since 2012 thank to this project. For the majority of those youth, Target Malaria is their first experience in mosquito collection. Thus, they perceived this as a real opportunity for which they are proud, especially since they intend to capitalize on this knowledge in order to use it later, beyond Target Malaria, in other similar projects requiring entomological collections.

Some authors have shown that in most developing countries, especially in Sub-Saharan Africa, health research collaboration between actors in the north and those in the south, even though unequal and complex to some extent [49,50], is perceived by each as a promising collaboration in the sense that it brings on board expertise, funds, and diverse resources to Africa [51]. According to those authors, health research projects have provided and enhanced knowledge and expertise to African countries, particularly in the health policy and planning sectors, improved hospital and laboratory infrastructure, and research institutions. Thus, these factors have enabled the identification of preventive and therapeutic interventions for the principal causes of mortality such as HIV/AIDS and malaria, among others.

Furthermore, comparing the motivations gathered from our actors to those presented by some authors in the context of biomedical research, we reached the conclusion that there were differences in the actors' motivations. For example, in malaria clinical trials several studies have examined the motivational factors provided by the participants for taking part in these trials. A research study conducted in Tanzania on the motivational factors given by mothers and guardians for authorising their children and wards to participate in some malariometric trials demonstrated that most chose to participate in these trials to access better quality health services that are often lacking in public health institutions [52]. A similar survey conducted in Malawi found that financial and material gains, such as soap, groundnut paste, orange juice, transportation money, tablecloths, mosquito nets, water basins, and iron tablets, motivated the community participation [42,53]. These reasons aligned with those obtained from the actors we interviewed on financial compensation or pecuniary interests

desired by those who participated in the implementation of Target Malaria.

But apart from individual gain, our data show a variety of altruistic motivations, particularly the desire to contribute to a better future by participation in scientific activities with a less direct material benefit. This is the most common finding in this study. In Bana, almost all of the interviewees acknowledge that the result Target Malaria is aiming for can only be achieved in the long term. It was clearly explained that the research activities of Target Malaria will only achieve the expected result in the long term. Our data show that local communities are aware of this. But despite this, the motivation to support this research project in its experimental activities remains visible in the village of Bana. The challenge for this project could then be to think about how to maintain this motivation while knowing that the benefits of its implementation will only be visible in the long term.

Study limitations

These results provide more information of Bana residents (Western Burkina Faso) motivations and expectations in entomological research activities for the development of innovative technology for malaria control. However, since data were collected by the project team members, one would think that the respondents would give answers that would appeal to the project team. These risks were therefore minimized by the fact this study was carried out by people who were not involved in the main entomological activities. In addition, the long period of immersion of the data collector in Bana has created a trusted relationship with the respondents throughout the course of the interviews, resulting with limited bias.

Conclusions

This survey considered the factors motivating local communities to join in entomological research activities for malaria vector control in Western Burkina Faso. A qualitative social science methodology is used to reveal an in-depth understanding of the factors motivating those Bana residents that agree to participate in research activities sponsored by Target Malaria. Our data show multiple reasons for engagement, with different categories of actor identifying different factors for their participation. Their accounts reflect the reasons for a positive perception of research activities associated with the development of novel vector control strategies, especially the desire to build a world devoid of

malaria. The in-depth analysis of these different motivational factors provided new information to complement efforts to improve and maintain an active participation of local actors in entomological research programmes.

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Declarations

Ethics approval and consent to participate

This study was part of a project which aimed to eradicate malaria through the development of innovative technology for the vector control by using genetic modification of the few specific strains of the *Anopheles* mosquito that transmit the disease. In Burkina Faso, the project received approval from the local institutional ethics committee (Centre Muraz Institutional Ethics Committee), reference number 009-2012/CE-CM.

Consent to publication

Not applicable

Availability of data and material

The datasets generated and/or analysed during the current study are not publicly available due to the fact that they are part of a bigger research project that is still ongoing; but are available from the corresponding author on reasonable request.

Competing interests

The authors declare that there is a competing interests, because data were collected and analyzed by the member of Target Malaria in Burkina Faso.

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Authors' contributions

NB led the study design, data collection, analysis, interpretation of the results and drafting of the manuscript. NB oversaw the manuscript with inputs from PT, LPT, JL, MD, RKD and AD. All authors read and approved the final manuscript.

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Figures

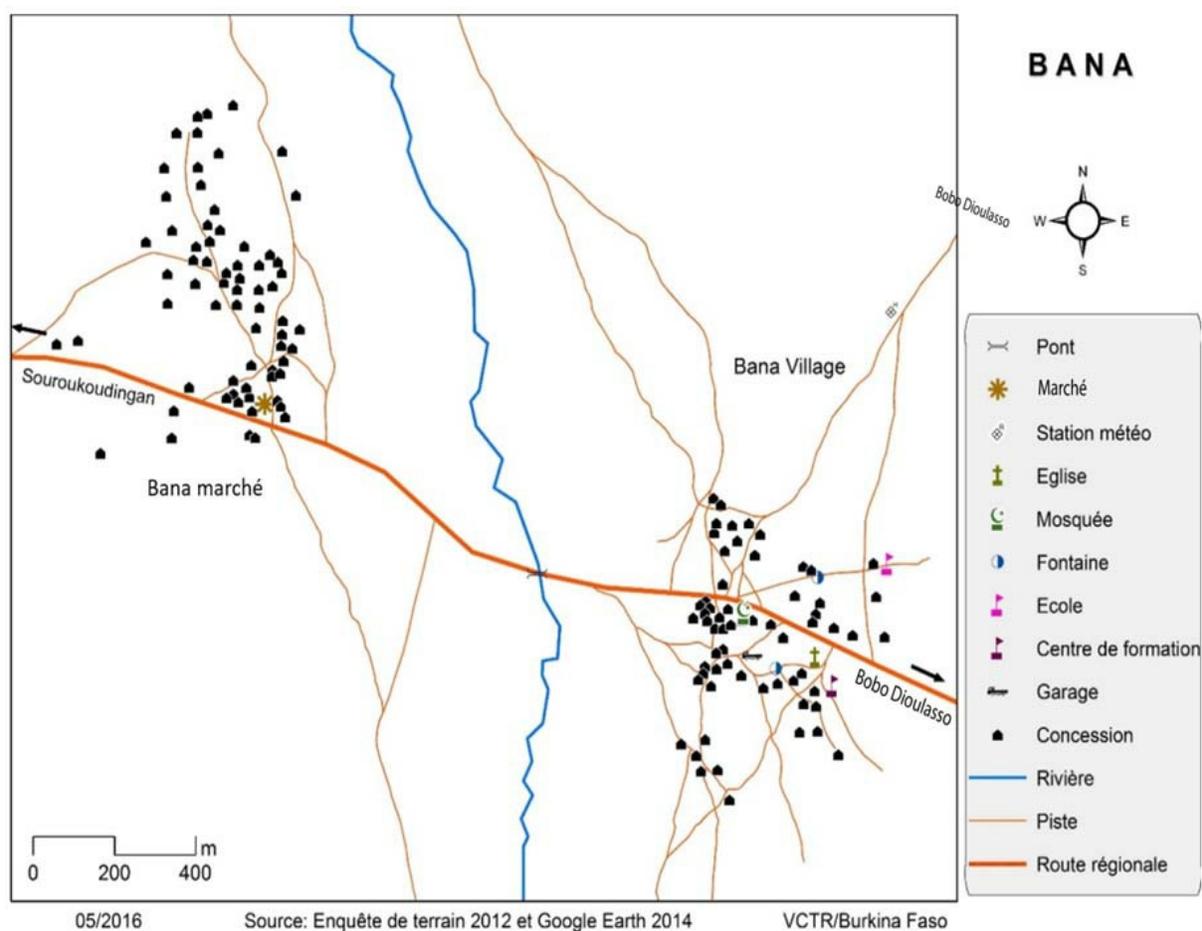


Figure 1

The location map of the village and the distribution of the area's inhabitants



Figure 2
Spraying activity



Figure 3

Session of preparation and setting up of mosquito collector



Figure 4

A collector of mosquito swarms in the village of Bana