



Combating Malaria without DDT in Beer, Senegal



Report on a pilot project to raise awareness of the causes of malaria and initiate non-chemical methods and activities for its prevention



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Executive summary

The people of Beer in Senegal suffer regular attacks of malaria, affecting their health and incomes. Of cases of malaria registered at the local health centre during 2008-2011, on average more than half were children; in Senegal as elsewhere, many children die from the disease.

Between April 2011 and December 2012 PAN Africa and PAN Germany implemented a pilot project for community action in Beer and neighbouring villages to combat malaria. The project demonstrates the feasibility of and interest in an ecological and educational approach to malaria management. The project team worked in three phases to: a) develop material, provide material in French and build partnerships; b) implement activities in the project area; c) evaluate achievements, identify future needs and actions and report to interested parties.

The strategies adopted at village level aimed to: improve knowledge and awareness of the sources of malaria; promote effective ecological management strategies to reduce vector breeding sites; and assist communities to organise themselves to carry out appropriate control activities that avoid unnecessary use of harmful chemicals currently widely used for control of malaria vectors. The project draws on experience obtained in ecosystem and social system based projects in other countries. It supports and liaises with government programmes to combat malaria in Senegal. This report describes activities and achievements up until December 2012 and seeks support to consolidate and build on these activities.

Introduction

The World Health Organization (WHO) estimated 216 million episodes of malaria in 2010. Africa accounted for 81 per cent of cases and 91 per cent of deaths. Children under five are disproportionately affected and make up 86 per cent of malaria deaths (WHO 2011).

Malaria is endemic in Senegal and is not only a major health issue but also an economic problem. The National Programme for the Fight against Malaria (PNLP) estimates that the disease increases poverty and costs the State in the region of 1.3 per cent of the GDP (PNLP 2007). In 2005, approximately two million cases of malaria were identified in Senegal causing more than 2,000 deaths; malaria is responsible for more than 20 per cent of deaths among children under five years in the country (Roll Back Malaria 2010).

Government programmes have achieved some significant successes in Senegal and reduced the prevalence rate of malaria from 30 per cent in 2000 to 5.7 per cent by 2009 (Ndiaye & Ayad 2009). Nevertheless the rate of the disease differs across the country. Many communities lack information about causes and prevention of malaria. In Beer, the area of this pilot project, malaria cases appear to have been gradually increasing since 2008 and 50 per cent of sufferers are children (details below).

The malaria plans of the US Agency for International Development (USAID), President's Malaria Initiative (PMI), are endorsed by the US Global Malaria Coordinator and reflect collaborative discussions with national malaria control programmes and partners. The malaria plan for year 2012 in Senegal indicates concerns and limitations: "In 2013, PMI will support one round of spray operations in each of the current districts of Vélingara, Niore, Guingenéo, Maleme Hodar, and Koumpentoum and in the newly selected district Kounghoul covering a population of approximately 900,000 people and 250,000

structures. With the increasing problems related to insecticide resistance and rising costs, PMI does not plan to expand its support to Indoor Residual Spraying (IRS) beyond these six districts” (USAID/PMI 2011). This statement reflects concerns expressed by the WHO that the future financial support for malaria programmes may be reduced (WHO 2011). The WHO considers that eradication cannot be achieved with existing resources (WHO 2009). These concerns make it essential to consolidate achievements and find control strategies that avoid the negative consequences of dependence on the intensive, systematic use of toxic chemicals.

The global fight against malaria is primarily three-pronged and based on: large-scale distribution of insecticide-treated bed nets; IRS, or household spraying of insecticides; and use of artemisinin-based therapeutic treatments. Senegal has largely adopted these strategies, with some successes but with serious limitations. Malaria vectors are increasingly resistant to the available approved pesticides, which can endanger the effectiveness of reliance on insecticide-treated bed nets (WHO 2011), and limits the impacts of household insecticide-spraying. Resistance to therapeutic treatments is a concern.

The achievements in Senegal could gain greater short- and long-term impact by adopting and adapting appropriate educational and environmental approaches successfully implemented elsewhere. Projects in Mexico, Kenya, Ethiopia and other countries (see examples in PAN Germany 2010 and ICIPE 2012) show that well-defined activities with participation of local communities can provide meaningful and sustained results. Drawing on these strategies, PAN Africa and PAN Germany implemented in Senegal a pilot project of activities to reduce the incidence of malaria in the village of Beer. The project draws on local human resources and social systems. The objective is to combat malaria through community-driven actions and appropriate ecosystem-based integrated vector management (IVM) strategies. These activities aim to supplement current government malaria programmes. This report describes the pilot project area, key actors, and in particular activities implemented between September 2011 and December 2012.



Market gardening: the fields in Beer

The project area

Beer is a Senegalese village with a population of 954 (2010) which lies about fifty kilometres north-east of Dakar in the rural community of Diender, Thiès. The soil and climate are suitable for growing fruit and vegetables, and market gardening is the main economic activity of the community. This agro-ecological area of the Niayes region extends along the north Atlantic coast between Dakar and Saint-Louis. The average annual temperature is between 26°C and 27.5°C, and rainfall is in the order of 430 mm. Soils are characterized by sand dunes between which are wet depressions with an often superficial freshwater phreatic table. This phreatic table is the main water resource in the area. The number, location, kind and maintenance of lakes, rivers, pools, watering places and waste water can influence the scale of malaria incidences as watering places are potential breeding sites for the mosquito vectors of malaria.

Project time-frame, partners and supporters

The pilot project began in April 2011 and ran to the end of 2012 in three stages: initial planning and forming partnerships (from April 2011), implementation in Beer (from September 2011); and evaluation and recommendations (November/December 2012). It was supported by *Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit*



Project staff discussion with the regional hygiene service at Thies

(Germany), private funders *J. and M. Frost* (Germany), and the *Marisla Foundation* through PAN North America.

The project was implemented by PAN Africa and PAN Germany in cooperation with PAN North America. The scientific adviser, Dr Charles Mbogo, was provided by the Kenya Medical Research Institute (KEMRI) / International Centre of Insect Physiology and Ecology (ICIPE). Two key local partners joined the project team and ensured that health and environmental aspects appropriate to the community were maintained in the pilot project. These local partners were:

The *Union of Market Gardeners in Integrated Production and Pest Management (UPM/ IPM)* of the Niayes region, was the key actor for mobilizing community participation. UPM / IPM has 875 members in seven villages in the project area. Its main objective is to contribute to sustainable development through good agricultural and environmental practices. As environmental management is an important aspect of a preventive approach to malaria UPM / IPM was an ideal partner.

The *Beer health centre* is managed by a committee of five village-members and is supported by contributions from the population with no financial subsidies from the State. A volunteer community health worker sees patients, provides consultations, administers first aid and gives health advice. Difficult cases of malaria and sick pregnant women are taken to the head nurse of Bayakh, 16 kilometres away. This nurse is the immediate supervisor of Beer community health worker. He makes weekly visits to ensure the smooth running of the service. The doctor of Pout health district, about 20 kilometres from Beer, is responsible for health facilities in the area.

The project launch

Developing material

Information on experiences with community and eco-system based approaches to malaria prevention and control was translated into French and made available in Senegal (details below). The project team developed an evaluation matrix, drawing on local expertise, to be used to gather baseline data (see Annex 1).

Project 'kick-off' events

The project was launched in Senegal with two meetings. A 'kick-off' workshop of agricultural, environmental, entomological and health professionals and practitioners took place in the capital, Dakar, on 20-21 September 2011. A kick-off event in Beer on 22 September 2011 presented the background and aims of the project and the outcomes of the expert meeting and encouraged community discussion and input.

Expert kick-off workshop in Dakar, September 2011

The objective of the expert meeting was to present and discuss the background, aims and methods of the pilot project with appropriate government and non-government partners and stakeholders working in the field. The meeting collected input and recommendations from participants on the objectives and methodology of the project. It explored opportunities for collaboration in the course of the project activities. The presentations covered the following details: project objectives, planned activities and expected results; aspects of malaria problems in Senegal and current control strategies; problems of resistance of malaria vectors to insecticides and of parasites to drugs; assessment and management of the risks related to use of pesticides in Indoor Residual

Spraying (IRS) in Senegal; experiences from Mexico and Kenya in community-based prevention and control of malaria vectors using both chemical and non-chemical approaches; and the use of an evaluation matrix for generating data, planning and evaluation of the project.

Participants discussed and adopted an evaluation matrix, provided initial data and proposed resource persons and structures to assist the project team to obtain reliable data for the project.

Kick-off event in the project area

The September 2011 kick-off event in Beer, held in the main square of the village, invited all residents and neighbouring villages to a public meeting to discuss the project. The project team presented information on objectives, planned activities and anticipated results. About 300 people from Beer and neighbouring villages attended, including traditional, religious, political and administrative leaders of the area. The project team present was formed of the PAN Africa team members, PAN Germany representative and the KEMRI/ICRPE expert who has been involved in project planning and implementation of community-based initiatives in Kenya.

The feedback and evaluation from participants at the expert and community meetings to the project team made clear that this project was highly welcomed.

Analysis of malaria situation in the project area

Approach to collecting data

A project evaluation matrix adopted at the expert kick-off meeting (see Annex 1) formed the basis for collecting baseline data. The data collection took place mainly between October 2011 and February 2012, and covered: general background on malaria in Beer and Senegal (parasites, vectors, incidences, resistance); malaria victims in the project area (age, sex, social conditions); climate data of the project area (temperature, rainfall); state of malaria knowledge among the population in the project area; national and local stakeholders; and the main means to combat malaria in Beer, including measures for larval control.

The sources and methodology of data collection for the evaluation matrix included:

- literature review of reports, studies and documents on malaria in Senegal and elsewhere;
- examination of the medical register of the health centre in Beer;
- pre-tested questionnaire (Annex 2) developed to meet the project objectives, administered to 15 families comprising approximately 135 women, men and children (on average each family consists of nine people). The families were selected at random and represent 14 per cent of the population of the village. There are no major differences between ethnic groups in the village; most families have similar living conditions and carry out similar activities;
- interviews with resource persons in organizations working on malaria prevention (the NGO Child Fund, Thiès regional health services, National Program for the Fight against Malaria, Bayakh head nurse, the Beer health centre technician and others);
- direct observations in the field.



Planning meeting to check the health status of the Beer community

Vectors of malaria and resistances to pesticides

Parasites, malaria treatments and resistance

In Senegal, as globally, parasites are now largely resistant to the once widely-used chloroquine and nivaquine treatments. *Plasmodium falciparum* is becoming resistant to pyrimethamine. Currently, malaria is treated with artemisinin-based combination therapies (ACTs) of amodiaquine plus pyrimethamine-sulfadoxine. Pregnant women receive two doses of a combination of sulfadoxine-pyrimethamine for malaria prevention.

Correct dosage and usage of malaria pharmaceuticals is essential to avoid resistance developing to these newer treatments.

A range of health and environmental concerns are associated with pesticides used to control malaria vectors. Locally, some interviewees noted that they or family members often have allergic reactions (itching of the skin, feelings of suffocation and other symptoms) to insecticides used for impregnation of mosquito nets. Some concerns are related to the conditions of use: it is difficult for families in rural settings to follow instructions such as to not enter a room for a specified time after spraying; children can play in the water channels sprayed with larval controls by the health department. These aspects are a constant danger and the consequences are not negligible. Many general environmental concerns are related to pesticides used in malaria control programmes, for example most are toxic to bees which threatening their essential role as pollinators for many crops.

The following are specific concerns regarding human toxicity associated with intensive use of pesticides in malaria control programmes (PAN Germany 2010):

Bifenthrin (pyrethroid): possible human carcinogen according to US EPA. At least one study provides evidence of endocrine disruption in an intact organism, according to EU. Bifenthrin is highly bioaccumulative and very persistent in water/sediment.

Deltamethrin (pyrethroid): at least one study provides evidence of endocrine disruption in an intact organism, according to EU.

DDT: at least one study provides evidence of endocrine disruption in an intact organism, according to EU. According to US EPA it is a probable human carcinogen. According to the International Agency for Research in Cancer (IARC) it is a possible carcinogen. In the EU it is listed as a substance which causes concern for humans owing to possible carcinogenic effects. It is covered by the Stockholm Convention for a progressive reduction and final elimination, and is listed under the Rotterdam Convention as a result of many national bans.

Fenitrothion (organophosphate): according to the EU at least one study provides evidence of endocrine disruption in an intact organism.

Lambda-cyhalothrin (pyrethroid): according to the EU at least one study provides evidence of endocrine disruption in an intact organism, and it is very toxic by inhalation.

Malathion (organophosphate): highly toxic to bees. There is suggestive evidence of carcinogenicity but not sufficient to assess human carcinogenic potential according to US EPA. According to EU it has a potential for endocrine disruption(ED), *in vitro* data indicate potential for ED in intact organisms, and effects *in vivo* that may or may not be ED-mediated, may include structural analyses and metabolic considerations

Propoxur (carbamate): according to US EPA this is a probable human carcinogen

¹ Operated by Abt Associates.

Impact of malaria on the population

The health centre records show a general upward trend in malaria consultations between 2008 and 2011 before the pilot project began. Malaria cases increased from 40 per cent, or 43 of the 110 consultations registered in 2008 (the start of activities at the health centre) to over 50 per cent (82 cases) of the 162 consultations in 2011. It should be noted that the relatively low number of consultations reflects the lack of equipment and drugs at the centre which led most people to travel to Kayar or Bayakh clinics when seriously ill. Figure 1 sets out data on the sex of victims attending the health centre between 2008-2011. With the exception of 2008, more women than men consulted the clinic. Figure 2 demonstrates that children under five are the most affected, representing about 50 per cent or more of sufferers recorded at the clinic between 2008-2011. Adults over 18 represent less than 20 per cent of the consultations at the centre, with the exception of 2009 when the figures rose to 30 per cent.

Knowledge of malaria in Beer village

The survey interviewed representatives of 15 families, of whom 10 were women and five were men. Women are generally more accessible for interviews, being more often at home. Women are more likely to monitor, educate and take care of children's health. In Beer, it is generally men who buy medicines and give permission for malaria sufferers to be taken to hospital; while women are more likely to take sufferers to hospital. As an agricultural and market gardening community, both men and young women work in the fields.

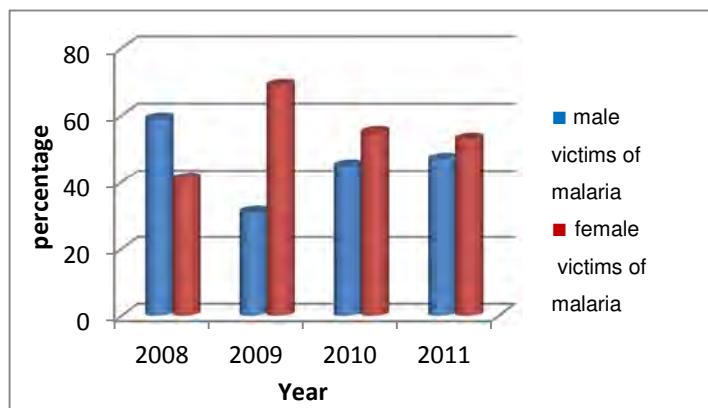


Figure 1: Annual average of victims of malaria by gender in Beer, 2008-2011

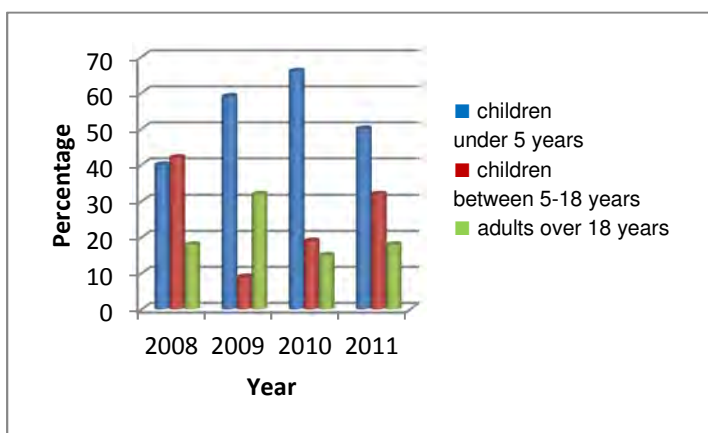


Figure 2: Annual average of malaria victims by age in Beer 2008-2011

The majority of those interviewed (93 per cent) indicated that the household had received no previous information or training on malaria. While most respondents (92 per cent) could correctly identify the signs and symptoms of the disease, 63 per cent had no strategies for prevention (see table 1). Before this project was launched no briefings on malaria were available and no education or information sessions had been held on malaria in the village.

Table 1: Information and knowledge of the population of Beer on malaria (n = 15)					
Have you received information about malaria? (%)		Do you know the signs of malaria (%)		Do you know how to prevent malaria (%)	
Yes	No	Yes	No	Yes	No
7	93	92	8	37	63

Methods used to fight malaria in Beer

Over 80 per cent of households in Beer use chemical insecticides to control mosquitoes (see Figure 3). The most common pesticide products were aerosol formulations of Baygon, active ingredient propoxur; and Yotox Spiral, active ingredients pyrethroids deltamethrin 0.02%, esbiothrin 0.16%, tetramethrin 0.09%, piperonyl butoxide 1.05%. These products are sprayed or placed in rooms to kill or repel mosquitoes. Bed nets treated with the pyrethroid insecticide cypermethrin are frequently used (by 71 per cent of interviewees). Many residents try to avoid mosquito bites, for example by wearing a dress to cover arms and legs. In addition plants such as lemongrass and eucalyptus leaves, both locally available, are used to repel mosquitoes (45 per cent).

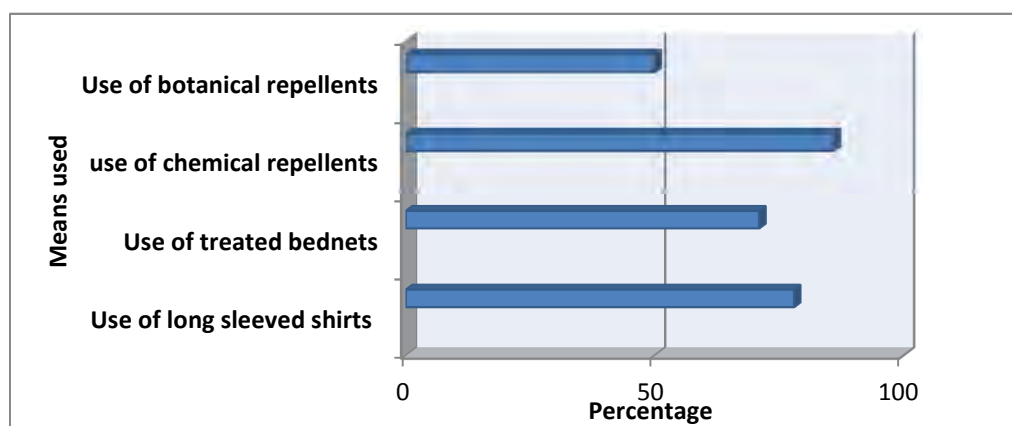


Figure 3: Frequency of measures to avoid vector-human-contact in Beer

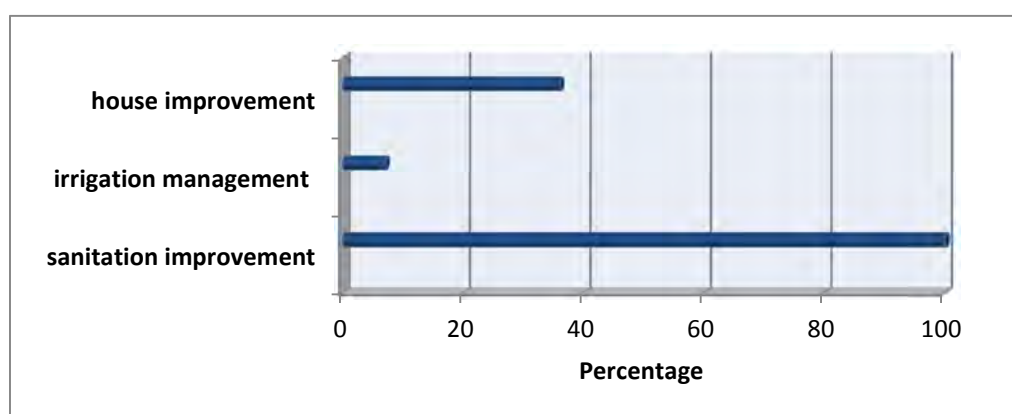


Figure 4: Larval control methods used in Beer

As a result of the pilot project residents became aware of the need to reduce the mosquito population through environmental management. This was demonstrated when *all* (100 per cent) residents made some improvements to household sanitation and about a

quarter undertook other household improvements. A smaller number (less than 5 per cent) additionally made improvements to field irrigation. (see figure 4).

Conditions potentially encouraging malaria in Beer

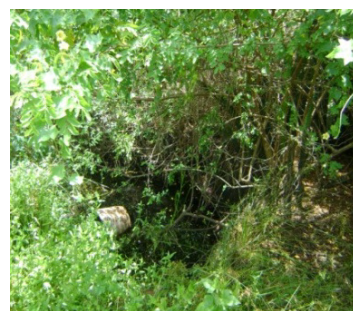
Before the pilot project provided information and training, villagers were unaware that environmental conditions can influence the prevalence of malaria. Some of the conditions that encouraged mosquitoes to breed included: food and other refuse were discarded behind houses in 60 per cent of households; and stagnant water was present in 90 per cent of houses. While the importance of sanitation was recognised, stagnant waters often came from cesspits and septic tanks that collect water from the toilets. The photos demonstrate some of the conditions that encourage mosquito breeding. The pilot project recorded GPS points of all potential mosquito breeding sites around the village.

Validation of the malaria situation and planning of activities in Beer

A workshop on 24 May 2012 for residents of Beer and the surrounding villages was well attended, with 58 participants (27 women and 31 men) including market gardeners, members of UPM/IPM, community health workers, the head nurse of Bayakh and the PAN Africa team. The project team shared findings of the surveys on the malaria situation in Beer. Participants validated the report and proposed a schedule of activities for the remainder of the pilot project, for implementation between July and December 2012. The proposed activities included:

- build capacity of Community Health Workers;
- support home visits by Community Health Workers to raise malaria-awareness;
- hold talk sessions on malaria to inform, educate and communicate with the population for a 'Change of Behaviour';
- introduce environmental education in schools focusing on combating malaria;
- develop interactive radio programmes between specialists and the population;
- run sanitation training sessions in the village and provide appropriate materials (such as additional wheelbarrows, carts and shovels to clean and remove garbage).
- distribute insecticide-treated mosquito nets;
- provide basic medical equipment, water and electrification to support the health
- treat mosquito breeding sites

As detailed below, these activities were initiated within the pilot project period.



Superficial well in Beer fields, August 2012



Stagnant water behind a house in Beer, May 2012



Artificial reservoir of water in Beer, May 2012



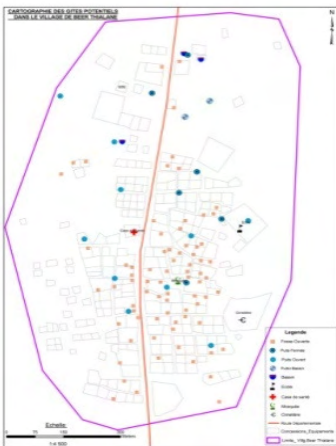
Garbage dump next to houses in Beer, May 2012



Artificial reservoir of water in Beer



Training for Community Health Workers on strategies to combat malaria, Keur Abdou Ndoye, 19-20 September 2012



Map of potential Anopheles breeding sites in and around Beer (May and August 2012)

Implementation of activities

Elaboration of information and awareness raising tools

PAN Africa and PAN Germany developed briefing material for information and awareness both before and during the project. Two detailed papers from PAN Germany were important resource materials for training and action, providing guidance on effective strategies for mosquito control that avoid dependence on chemical pesticides:

- Environmental strategies to replace DDT and control malaria, 2nd edition, PAN Germany, Hamburg, November 2012
- Control malaria without DDT! There are more options than currently used, PAN Germany, Hamburg, 2010

PAN Africa provided the French translation of these briefings and distributed them in Senegal as well as more widely in Africa.

PAN Africa produced and broadcast a film for the general public, entitled “Pilot Project on environmental strategies in the fight against malaria at Beer, Senegal”. This 15-minute information and training film was screened at the validation workshop of the preliminary report on the malaria situation in Beer. It is displayed at meetings of the UPM/IPM. The film is available for wider use, and provides:

- details of the project objectives, activities and expected results;
- views of stakeholders combating malaria in Senegal on the state of the disease, control strategies and their efficiency (strength and weaknesses);
- information about adverse effects of chemicals used indoors to fight malaria;
- testimonies of malaria problems from the Beer community and officials of its health centre.

Mapping of potential breeding sites in the village of Beer

In order to monitor and manage potential breeding sites of the *Anopheles* larvae, it is first essential to locate these. Between May and August 2012, the project mapped 206 water points in the village using Global Positioning System (GPS) technology. The GPS surveys were carried out in both the dry and rainy seasons. The maps identified all ponds, marshes, streams, artificial water reservoirs and potential breeding sites in fields near houses, as well as in and around houses. The mapping demonstrated particular sanitation problems with stagnant waters from many septic tanks which are often shallow and uncovered.

Capacity building workshop for health officers

A capacity building workshop on combating malaria held on 19-20 September 2012 in Keur Abu Ndoye trained 20 Community Health Workers from five villages in the project area. Three experts conducted the training: an entomologist from the Laboratory of Vector and Parasitic Ecology of the Department of Animal Biology of the Faculty of Sciences and Techniques of Dakar Cheikh Anta Diop University; the head nurse of Bayakh (Ministry of Health and Prevention) supervisor of Beer health centre; and an environmental toxicologist from PAN Africa. The workshop covered details of:

- bio-ecology of mosquitoes;
- existing vector and parasite control methods;

- resistance of malaria vectors and parasites to chemicals;
- environmental strategies to combat malaria;
- management of simple malaria cases by Community Health Workers;
- roles, responsibilities and code of conduct of Community Health Workers;
- talks, themes and key messages for awareness raising sessions.

An easy-to-read and use training manual on malaria and control strategies is being developed for Community Health Workers and will be distributed shortly after completion of the pilot project.

Public relations, information and community awareness raising activities

Interactive radio programs

Two interactive radio programmes on malaria were broadcast on 25 April (World Malaria Day) 2012 and 8 November 2012 through the community radio station MBambilor FM in the Niayes region. The radio broadcasts cover all the Niayes and extend to part of Dakar and Kaolack regions. It is the most widely listened radio in the region. These broadcasts aimed to raise widespread awareness and increase action to combat malaria through exchanges between malaria experts and the local population.

The programmes informed the public of the causes of malaria, with information on: the potential to combat the disease using environmental strategies and other available prevention methods; the particular situation of pregnant women; the main habitats of mosquito larvae; environmental control methods in mosquito breeding sites; environmental and health problems associated with pesticide use; and the difficulties encountered in malaria-eradication in the Niayes region.

Talk sessions

Talks on malaria were organized at the Beer health centre on 4 October and 28 November 2012, led by the health centre nursing assistant and two Community Health Workers. The meetings attracted over 80 participants. The first had 28 participants (22 women, of whom four were pregnant, and six men); and the second attracted 51 (33 women of whom six were pregnant, and 13 men from the village as well as five students – four young women and one young man). Women are the primary carers with concern for the health of the family. While not all women in the village could attend meetings, those who came shared the information with those who could not come.

These meetings aimed to raise awareness among the local population and initiate behavioural changes that could help reduce malaria-related morbidity in the village. The topics introduced by the three leaders and discussed by the villagers included:

- traditional beliefs that hamper the fight against malaria: for example it is assumed that a sick person with red eyes has yellow fever, and it is believed that pharmaceutical drugs for this illness will kill the patient. Sufferers are thus kept at home and cared for with local plants and patients are only taken to hospital when in a state of lethargy at a late stage of the illness;
- care of toilets and houses; elimination of stagnant waters;
- importance of weeding to control malaria as mosquitoes rest among weeds;
- methods of malaria prevention, such as wearing clothes with long sleeves in the evening during the rainy season;



Awareness-raising and suggestions for action to fight malaria: broadcast via community radio, MBambilor, April 2012



Talk session on malaria in Beer covered wide ranging issues related to malaria including an assessment of the participant's level of knowledge, October 2012



Talk session on malaria, in Beer in November 2012



Sanitation sessions in Beer,
December 2012

- hazards and risks of insecticides, including all related health and safety matters and potential impact of insecticides on human health and the environment;
- use of treated mosquito nets;
- mosquito resistance to chemicals

The discussions were mindful of the division of labour between women and men in the village in order to: encourage work sharing; avoid adding to women's workload; and if possible to modify rather than increase workloads. In this area, traditionally, men clear and weed and women sweep houses and remove garbage, so it appeared that there could be positive advantages in adopting many of the proposed reduction strategies. For example, current remediation activities increase the workload of women, who must travel some distance to dispose of rubbish and pay for disposal. Providing bins, collections and carts would facilitate the work of women and encourage men to undertake this task.

Home visits

Within the period of the pilot project, Community Health Workers visited 32 households to meet families and discuss malaria-related causes and prevention. The purpose is to inform, educate and communicate strategies that can assist people to change behaviour towards malaria prevention. The visits stressed the importance of activities to remove or prevent conditions that favour malaria vectors such as: cleaning toilets, cleaning homes and surrounding areas, covering septic tanks, and avoiding uncovered standing water as a potential breeding site for mosquitoes. The visits raised awareness of adverse impacts of pesticides used to fight malaria on human health and the environment; resistance of mosquito vectors to pesticides; resistance of malaria parasites to drugs; and ways to prolong effectiveness of the newer drugs.

Sanitation activities

Sanitation days were held each week in the village during November and December 2012. Residents and others eliminated garbage dumps and stagnant water and repaired flowing dry pits. About 300 women and 200 men participated in the sanitation activities. The community needs more equipment such as carts, wheelbarrows and brooms to encourage further work, and put in place a committee to monitor activities to encourage sustained efforts.

Evaluation of project activities

In November 2012 meetings in Beer and Dakar were held to evaluate the activities that took place during the 14 months between the kick-off events in September 2011 and November 2012.

Evaluation of pilot project activities in Beer

On 12 November 2012, 51 participants attended an evaluation workshop in the project area of Beer village. Participants included health workers, market gardeners, teachers, local authorities, religious, traditional leaders, students, and a journalist from the community radio. The aims and objectives, and the assessment matrix of the pilot project, were recalled. The project team presented an overview of activities implemented since September 2011. Participants gave feedback and recommendations to the meeting. Direct observations from the participants included:

This is the first time that our village has benefited from such a programme. The work with PAN has led to many improvements. Now we understand the role of sanitation in the battle against malaria and so children, women and men are now committed to improving standards in our village.

Mr Pape Abdoulaye Diouf, Président UPM/GIPD

Before this pilot project, pregnant women had great difficulty in accessing care when ill. The support material on malaria provided to the health centre gave us a lot of satisfaction. Furthermore, the programme produced by PAN Africa and broadcast on FM radio Mbambilor has helped us to better understand how to protect ourselves against malaria.

Ms Marième Fall, Beer resident and patient at the health centre



Evaluation of project activities- the community in Beer jointly with PAN Africa director Abou Thiam and the PAN Germany director Carina Weber, 12 November 2012



Expert workshop to evaluate the activities of the pilot project, Dakar, 14 November 2012

Expert evaluation of the project

The expert meeting to evaluate project activities between September 2011 and November 2012 took place in Dakar on 14 November 2012. The 16 participants assessed project outputs, including the film and information developed for local use. New information presented at the meeting included consideration of non-chemical alternatives recommended by the National Programme on malaria in Senegal, a study of the use of *Azadirachta indica* (neem) against mosquito larvae, and developments relating to vector resistance to chemical insecticides and parasite resistance to treatments.

The professionals and practitioners at the meeting expressed their satisfaction with the direction and current achievements of the pilot project, noting that only limited improvements could be expected within the 14 month timescale. Participants made the following recommendations:

- extend and expand the pilot project into a four-year programme to achieve sustainable and replicable results that may be incorporated into the national malaria prevention programme;
- extend the implementation period with support to assess the impacts on the population of Beer;
- carry out further detailed mapping of water sites around the village area, and in particular identify priority areas for reducing mosquito breeding;
- organise a symposium to disseminate the results of the programme and benefits of the activities

Comments from participants at the expert evaluation observed that ecological strategies would be welcome in Senegal:

Dr Alioune Badara Gueye, PNLP:

For us [the national malaria programme, PNLP] these are promising strategies because they help in the fight against malaria with less negative impacts on the population than pesticide-based strategies. If we know that the environment influences the development cycle of malaria, we can utilize the appropriate, less-aggressive, control strategies. We know it takes many diverse and complementary strategies to get to grips with malaria.

Ms Mbaye Gueye, Deputy Mayor of Kayar:

The activities of this project should be extended to neighboring villages. The populations of these villages must also be aware and know that they can fight malaria without chemical products.

Ms Aita Sarr Seck, Directorate of Environment and Classified Establishments:

Dr Lassana Konaté, Laboratoire d'Ecologie Vectorielle et Parasitaire (Vector Ecology and Parasite Laboratory), C.A.Diop University, Dakar:

Project achievements

Benefits of greater information on malaria causes and prevention

Community Health Workers are better equipped for the fight against malaria

During the normal rainy season a majority of our patients came from Beer but in 2012, following the pilot project, no patients from Beer came to the health centre.

The Beer health centre now has water and electricity. It has acquired rapid diagnostic tests to confirm malaria cases with certainty, and has available antimalarial drugs for treating patients. It has acquired more general health equipment, such as thermometers.

A family in Beer valued the changes: In 2008 my family suffered greatly from malaria. Three of my children were hospitalized in Thiès health district hospital due to severe malaria. We were not kept informed. The health hut Beer could not help as it was suffering from a cruel lack of equipment.
Mr Pape Diouf, Beer resident.

Table 2: Rate of absence of students from school	
Year	Absenteeism
2009	20.10%
2010	30.43%
2011	21.26%
2012	4.63%

School absenteeism has declined

The rate of absence of students from school has decreased as the local health centre has improved its ability to treat children with malaria. The Director of the Beer Elementary School noted between October and November (the beginning of the school year and a prime malaria period) there are normally significant absences of children due to malaria. Student absences recorded between 2009 and 2012 dropped significantly as seen in table 2.

Map of water sites available and action to avoid potential for mosquito breeding initiated

Using GPS equipment, the project mapped all potential breeding sites of mosquitoes in the village in order to establish priorities for reduction in the vector populations. The village has formed groups responsible for monitoring sanitation activities: the village is divided into seven neighbourhoods, each with a group composed of young men and women responsible for directing the work. Remediation sessions are held every Monday, a day when no work is carried out in the fields.

Conclusions and outlook

Before this pilot project village residents in the Niayes region, and specifically in Beer, had not been provided with any information on malaria vectors and parasites. Never before had meetings taken place to discuss the problems of malaria, strategies to combat it, and methods of control that could be implemented by the villagers themselves. The project has significantly raised awareness as noted in this report.

The training, information outreach activities that focused on the ecology of parasites and vectors causing malaria has been understood and the strategies provided for non-chemical controls, in particular improvements in household cleanliness and storage and village sanitation, can be implemented within the resources available in the village. The pilot project demonstrates the potential to expand this work and consolidate successes. Future priority activities identified by the village and expert evaluation meetings covered a range of developments:

- the pilot project identified all water sources using GPS technology ; the next step is to identify actual mosquito breeding sites in both the rainy and dry seasons in order to focus activities on reducing mosquito populations at priority sites;
- develop a typology of breeding sites as a basis for prioritising action, as some breeding sites might be highly important to eliminate to prevent malaria transmission, while others might be relatively easy to deal with;
- regularly monitor breeding sites and monitor positive effects of water management activities;
- organise local key stakeholder meetings to support continued awareness and action;
- train members of the community in monitoring Beer deposits of mosquito larvae;

Annex 1: Project evaluation matrix

1.	Data basis needed	When	By whom (data source/ institution)	How	Equipment needed	Costs
1.1.	'Community needs assessment' (important to implement a bottom-up approach instead of a top-down approach Behavioural changes					
1.2.	Parasites identified					
1.3.	Vectors identified					
1.4.	Resistance in parasites identified					
1.5.	Resistance in vectors identified					
1.6.	Malaria victims identified (gender, age, education level, economic status, geography)					
1.7.	Number and kind of infections - No./ kind of infections per household - No./ kind of repeated episodes per household - No./ kind of repeated episodes per person			e.g. questionnaire		
1.8.	Status of other illnesses that could be reduced as a side effect of the project					
1.9.	Number and kind of existing ecological vector habitats and vector niches associated to malaria transmission and analyses of insect activities (a. mating/ oviposition, b. feeding, c. protection and rest) (man-made/ natural, depending on season)					
1.10.	Larval species in different habitats/ larval densities (depending on season)					
1.11.	Entomological human biting rate/ inoculation rate					
1.12.	Climate data (confounding data)					
1.12.1.	Rainfall					
1.12.2.	Temperature					
1.13.	Knowledge/ awareness about malaria			e.g. interviews		
1.14.	Community behavioural changes (the behaviour of the community members are essential for a successful malaria control program. Therefore actions to prevent malaria need to be noticed and monitored. Increase knowledge (see 1.13) is only one important step – essential is the use of the knowledge)					
1.15.	Structural elements to implement malaria control interventions					
1.16.	Responsibilities for the local anti-malaria program					
1.17.	Involvements in the local anti-malaria program a) institutions (local NGOs, research institutions, governmental institutions) b) women/men/children					
1.18.	Advocacy Means of communication used: e.g. - annual mosquito or larval day - Seminars, Workshops - Theatre - Media etc					

Annex 2: Questionnaire guide for survey on malaria in Beer

Guide d'entretien Sur la Lutte contre le paludisme dans la localité de Beer (Sénégal)

Enquêteur:.....

Date de l'enquête:...../...../.....

Personne interrogée: Sexe: M () F ()

I. Gestion de l'Environnement :

Avez-vous des eaux stagnantes dans votre maison? Oui () Non ()

Si oui, dans quelles parties de la maison

Avez-vous des Ordures ménagères dans votre maison ? Oui () Non ()

Si oui, sont- elles éliminées? Oui () Non ()

Si oui, Comment?

II. Réduction du Contact Homme- vecteur :

Portez vous une tenue spéciale (Chemises avec manches longues, Sabador etc.)

pour vous protégez des piqures de moustiques? Oui () Non ()

Utilisez-vous des moustiquaires? Oui () Non ()

Si oui, sont- elles imprégnées? Oui () Non ()

Le nombre de moustiquaires est il égal au nombre de lit? Oui () Non ()

Combien

Qui distribue ces moustiquaires?

A quelle fréquence les moustiquaires sont elles distribuées?

Les moustiquaires sont elles imprégnées après une certaine durée d'utilisation? Oui () Non ()

Si oui, à quelle fréquence et par qui ?.....

Utilisez- vous des grillages (Portes, fenêtre) contre les moustiques? Oui () Non ()

Si non, utilisez- vous des rideaux ? Oui () Non ()

Si oui, les rideaux sont ils imprégnés de produits chimiques? Oui () Non ()

III. Contrôle des vecteurs par des produits chimiques :

Bénéficiez-vous d'opération de Pulvérisation Intra domiciliaire? Oui () Non ()

Si oui, avec quelles structures?

Si non, le village a t'il bénéficié d'aspersion Intra Domiciliaire dans le passé? Oui () Non ()

Si oui, en quelle année et avec quelle structure ?.....

Y'avait il eu des problèmes liés à la pulvérisation Intra Domiciliaire? Oui () Non ()

Si oui, citez quelques problèmes

Utilisez- vous des insecticides pour lutter contre les piqures des moustiques? Oui () Non ()

Si oui, Quel (s) produit (s) utilisez- vous ?

IV. Contrôle des vecteurs par des produits Biologiques :

Utilisez- vous des produits répulsifs botaniques? Oui () Non ()

Si oui, nom du (des) produit (s) ?

Utilisez- vous des pesticides biologiques? Oui () Non ()

Si oui, nom du (des) produit (s) ?

Utilisez- vous des herbes Médicinales pour le traitement contre le Paludisme? Oui () Non ()

Si oui, nom du (des) produit (s) ?

V. Autres Méthodes

Utilisez- vous d'autres méthodes pour la prévention ou le traitement contre le paludisme?

Oui () Non ()

Si oui, expliquez :.....

VI. Formation/ sensibilisation sur le paludisme

Avez-vous déjà été formé ou sensibilisé sur le paludisme? Oui () Non ()

Si oui, quand et Où?.....

Par qui ?.....

Connaissez-vous des moyens de prévention du paludisme? Oui () Non ()

Si oui, citez quelques moyens de prévention :.....

Connaissez-vous les signes du paludisme? Oui () Non ()

Si oui, citez quelques signes :.....