# 7. Recommendations and conclusions

**Important findings from this study were:**

- Cattle trypanosomosis is objectively (as shown by prevalence) and subjectively (as perceived by farmers) of pre-eminent importance in that part of the cotton zone extending from east Guinea, through south Mali to west Burkina Faso. In the west, AAT is of concern to farmers, but has minor (yet not negligible) impacts; in the east, losses from sickness and death are substantial.
- Mathematical modelling of AAT transmission and resistance suggests that in the absence of interventions, the disease situation in the east will deteriorate and in the west prevalence, sickness and death will increase and drug resistance emerge, spread and worsen.
- AAT is currently managed almost exclusively at community level by a mixture of strategies among which use of trypanocides is the most important.
- Although farmer knowledge of AAT aetiology and treatment is good, knowledge gaps lead to treatment failures and injection complications; this also fosters resistance to trypanocides.
- Inadequate treatment encouraging resistance is the result of inappropriate rather than excessive drug use. Problems which need to be urgently addressed are:
    - Ignorance of specific signs of trypanosomosis
    - Systematic under-dosing of heavier animals
    - Practice of giving repeated DIM treatments for AAT prophylaxis
    - Using standard dosages of DIM where *T. brucei* predominates
    - Unsafe injections with resultant high levels of complications
- Practices widely used by farmers and useful in combating disease and resistance are:
    - Selective treatment (treating only valuable animals during periods of risk)
    - Treatment heterogeneity (use of different trypanocides)
    - Nutritional supplementation, de-worming and watering at wells and pumps
    - Integration of drug use, vector avoidance and trypanotolerant cattle
- In Guinea clinical services and advice are effectively provided by state veterinarians and paravets, but drug supply is dysfunctional. In Burkina Faso, a regulated private veterinary sector is failing to provide clinical services, advice or affordable drugs. In Mali a liberalised private sector provides cheap drugs, but fails to provide quality assurance, clinical services or advice.
- Current trypanocide use policy is at best ineffective and at worst likely to foster trypanocide resistance. There is minimal awareness of resistance among farmers and service providers.

**The main conclusions from the testing of strategies for AAT control under risk of resistance were:**

- Community vector control is effective but, even in the presence of resistance, not sustainable. This is due to: the high transaction costs of maintaining institutions for delivery of vector control

given the impossibility of excluding farmers from the benefits of control, the prophylactic (and hence non-essential) nature of control, and the existence of other individual methods of control.

- Much lower prevalences are found in the trypanotolerant homelands, but in intensive systems, where *T. congolense* and non-N'Dama predominate the advantage of trypanotolerant cattle is less. Farmers acknowledge the superior disease resistance and strength of trypanotolerant cattle, but prefer Métis (and even Zebus) for their higher sale price, better temperament, and other production characteristics. The large price differential implies farmers with cross-breeds would suffer considerable asset loss by switching to trypanotolerant cattle.
- Providing farmers with simple information on diagnosis and drug use results in significant and substantial improvements in farmer knowledge and practice and in cattle health outcomes, but is not in conformity to current policy and is opposed by some important stakeholders.
- Establishing primary animal health services can improve AAT treatment. Paravets are the most trusted and available service provider at village level, and compare well with other service providers in terms of affordability and expertise on AAT. Paravets are not in conformity to current policy in Mali and Burkina Faso and are opposed by most private and some government veterinarians, but are successful and appreciated in Guinea.
- Continued professional development for existing service providers is effective at improving the quality of diagnosis, treatment and prescription; and has low cost and high cover.

Based on the results of our study, we make the following recommendations:

***To improve the management of AAT under risk of resistance development:***

1. Encourage rational drug use and wise-buying by the main users of drugs:
    a. Inform farmers on drug use, drug quality, drug side effects and drug alternatives
    b. Legitimise the role of farmers in treatment of their own animals
    c. Promote formulations and pack sizes that encourage correct drug use
2. Support trained service providers:
    a. Legitimise the role of paravets and technicians in treatment of trypanosomosis
    b. Improve linkages and relations between paravets and veterinarians
    c. Make funds available for training new and re-training existing service providers
    d. Incorporate rational drug use and resistance in service provider training/curricula
3. Ensure an adequate and affordable supply of quality trypanocides and accompanying advice:
    a. Harmonise regulations governing animal heath services in neighbouring countries
    b. Establish quality control and assurance systems for trypanocides
    c. Develop, disseminate and monitor practicable guidelines for drug use
    d. Minimise market distortions that unnecessarily push up the price of goods and services
4. Safeguard the genetic resource of trypanotolerance:
    a. Inform farmers of the advantages of trypanotolerance in the presence of resistance
    b. Characterise, preserve and study the genetics of trypanotolerance

***To proactively manage emerging drug resistance:***

1. Continue and extend the surveillance and monitoring of drug resistance:
    a. Extend detection of resistance and monitor its development in time and space
    b. Simplify and standardise resistance tests; develop cheaper, easier more accurate tests
    c. Communicate the problem of resistance to all stakeholders
2. Slow emergence and deterioration of drug resistance, preserving the utility of trypanocides:
    a. Promote alternatives to drugs (vector control, trypanotolerance, nutrition and health)
    b. Promote the rational use of drugs at all levels (including the informal sector)
3. Containing and living-with drug resistance where developed:
    a. Support and fund vector control and promote trypanotolerant breeds

***To promote evidence-based practice and policy that meets farmer and consumer needs:***

1. Make available scientific studies, best practice examples, and guidelines:
    a. Disseminate project results to stakeholders and develop uptake pathways
2. Support further action-oriented research into:
    a. Quality and quality assurance of trypanocides
    b. Genesis, epidemiology and impact of resistance
    c. Mechanisms, feasibility and cost effectiveness of containing and preventing resistance
    d. Impact of current, proposed and alternative animal health regulations

The objectives of this study were to describe the epidemiology of bovine trypanosomosis and develop and test best-bet strategies for its management in villages under risk of resistance. This is the first reported field study to address the problem of managing trypanocide resistance.

The situational analysis confirmed AAT was the most important cattle disease in the cotton zone and showed how the farming and animal health delivery systems influence management of AAT and development of trypanocide resistance.

The strategies evaluated for AAT control given risk of drug resistance were found to be effective and beneficial; inexpensive and appropriate; acceptable to farmers and other stakeholders. Unfortunately effective and acceptable strategies (vector control and trypanotolerant cattle) are costly and not always appropriate, while appropriate strategies preferred by farmers (informing farmers, establishing paravets and training service providers) are less effective and sometimes controversial. This implies a need for carefully targeted interventions, integrating strategies, and creation of an enabling policy environment.

Further research is needed on the epidemiology of trypanosomosis and trypanocide resistance (in particular genesis, transmission and reversibility of resistance) but also into economic and institutional aspects. Surveillance of resistance is an essential first step; completed over much of the cotton zone, it should be continued in time and space.

This study developed and tested strategies for better management of trypanosomosis and both the prevention and containment of resistance. These are now ready to go to scale, and to be evaluated as working rather than experimental strategies.