Eradicating the Tsetse Fly on Zanzibar Island:

A Model Project

Tsetse flies infest vast areas of Africa and transmit a parasitic disease which devastates livestock herds and spreads debilitating "sleeping sickness" amongst people. Past efforts to control the disease - Trypanosomosis - and the carrier insects have met with only limited success. But now an environmentally friendly technology called the ***Sterile Insect Technique (SIT)*** *may provide a lasting solution to this scourge.*

Working with the Tanzanian Government and Zanzibar authorities, the Department of Technical Co-operation has sponsored a "Model Project", with technical support from the Joint FAO/IAEA Division, to eradicate the tsetse fly completely from Zanzibar Island by applying SIT.

IAEA Department of Technical Co-operation (TC)

"A Partner in Development"

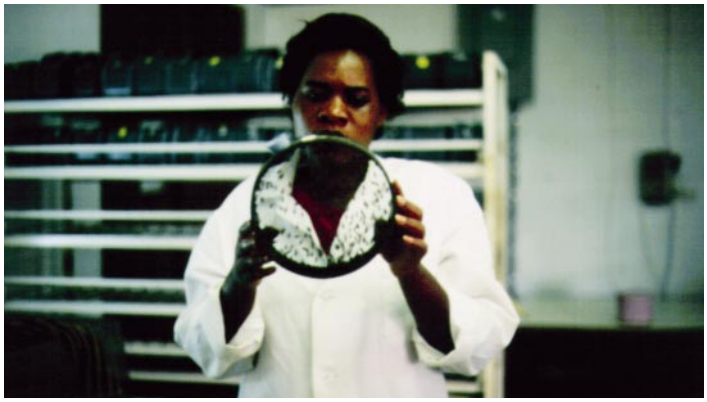
IAEA TC Model Projects:

- respond to priority national and regional needs
- produce sizeable economic and social impacts
- employ nuclear technologies only when they have distinct advantages over others
- demand strong government commitments

Tsetse life-cycle

Tsetse flies are unusual insects. Egg and larval stages develop within the female. The fly gives birth every 9-10 days to a full-grown larva, which immediately burrows into the soil and forms a pupa. Female tsetse produce at most nine larvae, and therefore have the lowest reproduction potential of any insect. A single mating provides sufficient sperm for fertilization through the female´s 90-100-day life-span. Since females usually mate only once, if they are mated by a sterile male they will not produce any offspring. These features of the life cycle make the tsetse fly a good target for SIT.

Conventional methods such as trapping (above) or insecticide spraying on cattle (below) reduce tsetse populations.



Sterile Insect Technique: rearing tsetse flies in specially designed cages.

The Sterile Insect Technique (SIT)

has been used successfully in many parts of the world against other insect pests, such as the Mediterranean Fruit Fly in Chile, Mexico and California, the Melon Fly in Japan and the New World Screwworm in the USA, Central America and in Libya.

The Issue -

Flies, Disease, Livestock and People

Twenty-two species of tsetse fly infest 36 countries and a total area of 10 million km^2 in sub-Saharan Africa. They transmit a debilitating and often fatal disease, Trypanosomosis, which:

- causes tremendous losses of livestock (cattle, sheep, goats and horses);
- deprives the rural population of draught power to improve and increase crop production; and
- reduces output of milk and meat, and manure for fertilizer.

Lost milk and meat production, together with the costs of Trypanosomosis control programs, are estimated to range between US$ 600 million and 1.2 billion annually. In sub-Saharan Africa, lost potential farm production due to Trypanosomosis costs at least US$ 4 billion each year (FAO, 1994).

Human Trypanosomosis, known as “sleeping sickness” is among the most debilitating diseases in sub-Saharan Africa. Over 55 million rural people are at risk and over 300,000 people are infected (WHO, 1995).

Conventional Methods of Control

Efforts to control tsetse flies began more than 70 years ago. For decades, these measures depended on eliminating wild animals that serve as tsetse hosts, clearing bush lands and spraying insecticides.

But continuing environmental contamination, pesticide residues in food and mounting costs of chemicals and personnel have intensified the need for improved pest control. Several safer control measures have recently been developed and applied. One involves odour-bated traps with blue or black attractant cloth screens impregnated with synthetic pyrethrins that can reduce tsetse numbers substantially. Applying persistent insecticides to cattle is another effective control method. But while these techniques suppress tsetse populations, they do not promise complete eradication.

Eradication Using the Sterile Insect Technique

When preceded by such conventional methods, the ***Sterile Insect Technique*** can provide the final component to an integrated tsetse eradication campaign. It is a safe and environmentally sound method that employs nuclear technology as a form of insect birth control.

“Only a combination of several methods in an integrated area-wide pest management approach can lead to sustainable reductions or eradication of the tsetse and thus to a viable agriculture in vast regions of Africa.”
Udo Feldmann, FAO/IAEA

SIT relies on rearing large numbers of insects in purpose-built “fly factories”, sterilizing the males with carefully controlled doses of gamma radiation and finally releasing them by airplane over the target area. The radiation induces sterility, but the treated male flies can still fly and mate with wild females. Mating be-tween the sterile released males and wild female tsetse flies produces no offspring. When sufficient sterile males are released over a long enough period, fertile mating does not occur and the population is eliminated. No other insect is affected and there is no adverse impact on the environment.

The Campaign to Eradicate Tsetse on Zanzibar

The presence of Trypanosomosis was first identified around 1900 on Unguja, the main island of Zanzibar, located 35 km off the eastern coast of Tanzania. It took another 50 years to discover the vector of the disease, the tsetse species *Glossina austeni*. The economic impacts of the disease were considerable and, since the 1980s, various control efforts have been undertaken with support from UNDP and FAO. Effective on-the-ground interventions employing conventional methods resulted in suppression of the fly population but failed to achieve complete eradication.

TC Model Project Success

With international donor support and technical assistance from IAEA, a Model Project to eradicate tsetse and eliminate the Trypanosomosis problem from Unguja island (1600km^2), applying the Sterile Insect Technique, was initiated in 1994.

After three years, the project´s success is quite evident: *no wild fly has been captured since September 1996* despite continuous trapping and monitoring all across the island. *Trypanosomosis cases in sentinel animals decreased to a negligible level of less than 0.1 percent.*

Project Accomplishments

This successful outcome is based on three key activities supported by IAEA's Model Project:

- **mass rearing** of flies at the Tsetse and Trypanosomiasis Research Institute (TTRI) at Tanga, Tanzania, which now has the world´s largest tsetse production system;
- **aerial release** of tsetse from aircraft, providing optimal dispersal of sterile insects even in remote areas; and
- **entomological and veterinary analysis to monitor** project progress.

Mass fly production: Three newly refurbished insectaries at TTRI, supported by quality control measures, have contributed to a steady rise in the female fly colony. This now produces more than 50,000 sterile males per week. Gamma-sterilized flies, marked with fluorescent dye to distinguish them from indigenous flies, are packed for aerial release into specially designed, bio-degradable cardboard boxes which open as they are ejected from the airplane.

Widespread Aerial Releases: Following ground releases of tsetse in the early phase of the project, aerial releases were introduced in August 1994. After a test period, mass releases began in May 95. Almost 8 million sterile male flies have been dispersed over Unguja island since August 1994. In 1996, an average of 72,000 sterile males were released per week. The southern half of Unguja island, including the Jozani forest - the primary tsetse habitat - was targetted with the majority of all sterile flies available. Releases of tsetses are continuing throughout 1997.

Continuous On-the-ground Monitoring: Monitoring sites were set up across the island, and by 1996 more than 500 sticky coloured traps were being deployed. Insects captured by the traps provided data on the distribution and survival of the released insects and on mating behaviour of wild females. Traps also helped establish effective ratios of sterile to fertile males in all habitats. A ratio of 15 or more sterile males to one wild male tsetse was shown to gradually reduce the population. But only after a 50-100 to one ratio was attained during 1995 did the population crash in early 1996. The last wild fly was captured at the beginning of September 1996.

Blood sampling from sentinel herds across the island monitored the extent of Trypanosomosis and therefore the presence or absence of tsetse flies. Disease incidence in sentinel animals declined to a negligible level by early 1997.

Releases of sterile tsetse flies will end at the close of 1997, but fly and disease monitoring on Zanzibar and limited production of flies in Tanga will continue to ensure the enduring success of this TC Model Project.

Zanzibar - An excellent location for the Tsetse Project

- *Presence of only one tsetse species, Glossina austeni*
- *Opportunity to conduct research and refine aspects of tsetse SIT*
- *Expected sustainability of eradication due to isolated location*
- *Lasting impact on livestock development due to significant Trypanosomosis decrease and better agricultural land use.*

TTRI insectary at Tanga: male and female tsetses are handsorted.

Weekly flight routes for aerial releases over Unguja island.

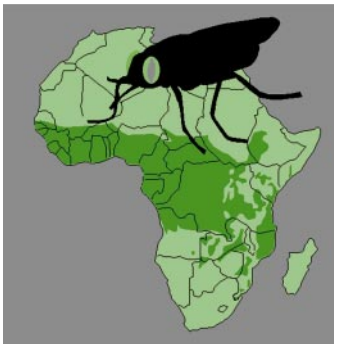
Loading boxes of sterile tsetse flies for aerial release over Unguja Island.

A blood sample is being taken to monitor cattle for trypanosomosis.

Beyond Zanzibar

SIT´s strong potential for other African regions has been demonstrated on Zanzibar, where tsetse flies and Trypanosomosis now appear to be problems of the past. But tsetse continue to threaten many regions of sub-Saharan Africa and to invade new agricultural areas aggressively. To combat this, tsetse SIT is now being considered in a number of affected countries as a new tool in integrated area-wide eradication campaigns. One effort is already underway: the Ethiopian government and the IAEA are co-operating on the initial phase of a tsetse eradication program which is planned to evolve into a 10-year multimillion dollar activity. Its final aim is to eradicate tsetse flies from 25,000 km^2 of potentially productive land in the Southern Rift Valley, where tsetse and Trypanosomosis have had detrimental effects on farming. If tsetse can be eradicated from the region, sizeable environmental and social advances can be achieved.

SIT could be the **key missing link for integrated tsetse and Trypanosomosis management** in many parts of Africa. Not only can it contribute to improving agricultural production, but it also has great potential in man´s battle against "sleeping sickness". Over the longer term, SIT may be used, together with conventional methods, to attack the tsetse belt running across sub-Saharan Africa, with the aim of establishing large geographically or biologically isolated tsetse free zones. This could then clear the path for new development activities to improve the life and health of subsistence farmers and rural people across the African continent.



The regions of Africa overshadowed by tsetse.

Healthy cattle are improving the lives of Zanzibar´s rural people in numerous ways.

"Nuclear science has identified another valuable tool that can improve people´s lives while preserving and protecting the natural environment"

(Qian Jihui,
IAEA Deputy Director General,
Department of Technical Co-operation)

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