

Research Work and Conservation Initiatives in the Kihansi Catchment Ecosystem, Tanzania

Keynote Address

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The Kihansi Catchment Conservation Management Project (KCCMP) and all its previous phases is due to the great demand for energy for development, which led to the approval of the Tanzania Power VI Project that was approved in 1993 (Credit 2489–TA). The Government of the United Republic of Tanzania through external funding approved this project in order to tap hydroelectric energy from the Kihansi Falls located in the Southern Udzungwa Mountains in the Eastern Arc Mountains. Initially, the project was planned to have three phases producing a total of 300 MW, but only Phase I was implemented to produce 180 MW. The Kihansi Falls with headwaters of about 850 m are the most efficient hydropower-plant producing about 7.45 MW m^{-3} of water as compared to other plants, which produce less than 1.6 MW m^{-3} of water.

The project was preceded by an Environmental Impact Assessment (EIA), which suggested that there were no serious environmental impacts and as such the project could go ahead. It is the policy of the World Bank (WB) that they do not fund projects, which have negative impacts to the environment.

When the USD 200 m project was about 75% to completion, during monitoring as an implementation of the Environmental Management Plan (EMP) in 1996, a toad was discovered amidst the thick spray beneath the

waterfall in a very small area of only about 1.62 ha. Further examination proved that the newly discovered toad was indeed a new amphibian species to science, and named Kihansi Spray Toad (KST). It was known to belong to the genus *Nectophrynoides* and the species was named *asperginis*. The toad is yellowish in colour with dark brown lateral lines and bears live young (ovoviviparous). Females have transparent bellies, intestines and toadlets in gravid females are visible. Males have black marks in the inguinal parts and are morphologically smaller than females.

This discovery of the toad caused a pandemonium at the WB, prompting the then President James D. Wolfensohn to decide that the Kihansi Project should be stopped immediately. This is because the WB Policy prohibits the support of projects that have negative environmental impacts.

After further consultations with the Government of Tanzania, International Union for Conservation of Nature and Natural Resources (IUCN), Wildlife Conservation Society (WCS) and other international conservation agencies, it was agreed that some mitigation measures should be explored and implemented to save the toad, its habitat and at the same time allow the project to proceed.

The first measure was to introduce the Immediate Rescue and Emergency Measures Project (IREM). During IREM, 500 toads

were transferred to Bronx and Toledo zoos in USA as assurance population. In 1999/2000 when the Dam was commissioned, over 90% of the Kihansi River water was diverted for hydropower production. This resulted in denying the toad habitat the mist environment necessary for the survival of the toads. Due to this, artificial sprinklers were installed to create a mist and so mimic the original habitat, which was now under threat.

Other phases of the project, namely the Lower Kihansi Environment Management Project (LKEMP I), LKEMP, II, Tanzania Energy Development Access Programme (TEDAP) and now KCCMP, followed IREM. All these phases were intended to ensure the following:

- a) The original habitat of the toad is restored and maintained;
- b) The KST wild population as well as the toads in the captive breeding facilities also survive;
- c) The Kihansi Catchment Ecosystem is conserved;
- d) The local people's livelihoods in the Kihansi Catchment Ecosystem are improved;
- e) The Tanzania Electric Supply Company (TANESCO) gets enough water to generate electricity, and finally;
- f) The KST is reintroduced into its natural habitat.

The steps taken to protect the KST habitat and KST wild population worked for some time. For about three years, the over 20,000 KSTs wild population survived in the Kihansi Gorge until 2003 when there was a sudden population crash. No concrete reasons have so far been established as to what caused the crash, either due to chytrid fungus attack, sediment flushing from the dam or pesticides from upstream. Nevertheless, from 2003 onwards, all monitoring surveys for KST recorded zero count until 2009 when IUCN officially declared the KST as "Extinct in the Wild" (EW). It is important to note that from its discovery, the KST was rated as "Critically

Endangered" (CE) by the IUCN Red list and was placed in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) due to its very small and restricted habitat. Efforts to determine presence of the KST in the waterfalls in the Kihansi Catchment Ecosystem and other waterfalls in the county proved futile.

Since the discovery of KST, there has been regular monitoring of the key ecological parameters in the Gorge, including amphibians, woody and wetland vegetation, land cover/land use, avifauna, primates, macro invertebrates, limnology, pesticides, weather and water flow. These parameters have helped to understand the conditions of the Gorge as well as any changes that might be taking place in the catchment ecosystem.

Since the realisation that the hydropower project will have adverse effects on the toad and its environment, concerted efforts have been undertaken to ensure that:

- a) The hydropower project continues to operate and provide power to the country;
- b) The Kihansi Catchment Ecosystem is conserved to ensure that it continues to provide water for hydropower production, maintain the KST habitat and support people's livelihoods;
- c) The KST habitat in the Gorge is restored;
- d) The factors that caused the extinction of KST are eliminated;
- e) The captive KST population is maintained; and
- f) The captive KST is reintroduced to its natural habitat.

These have been the main objectives of the Kihansi Project for the past two and half decades and beyond.

There have been various efforts by the Kihansi Project in collaboration with the districts of Mufindi, Kilolo and Kilombero in ensuring that the catchment is conserved and people's livelihoods are supported and improved. Activities such as forestry, agriculture, aquaculture, livestock keeping,

beekeeping, water resources management and good governance have been undertaken to ensure that there is enough water to generate electricity but also support people's livelihoods.

The Project has also ensured that the Gorge habitat is restored and maintained to enable the reintroduction of the toads to the area. Monitoring efforts of key ecological parameters have been conducted and installation of artificial sprinklers has been made to produce the mist environment needed for the survival of the toads.

Experiments have been conducted to investigate if the factors presumed to be the causes of the toad extinction have been eliminated and results have suggested that the Gorge environment was conducive for toad reintroduction.

Meanwhile, captive breeding of KST in the Bronx and Toledo Zoos and later, at the University of Dar es Salaam, and Kihansi in Tanzania has been undertaken. These have been the backbone of the whole reintroduction programme by keeping the assurance KST populations. Despite the husbandry challenges, especially on diseases and diet in the facilities, both countries have continued to breed the toads successfully. For example, at one time, the toad numbers in the USA declined to only 70 individuals, which threatened the species from complete extinction. Fortunately, the husbandry challenges were overcome and the toad population started to increase, which enabled the establishment of the Tanzania captive breeding facilities and eventual reintroduction of KST to the Gorge.

To date, all the facilities in the USA and in Tanzania are collaborating not only in maintaining the KST assurance population, but also in the reintroduction process. The captive facilities have also played a key role in providing training in species conservation to various students, pupils and environmental groups, and a platform for practical training and undertaking of various studies in amphibian husbandry and diseases.

Prior to the reintroduction of the toads in the Gorge, experiments were conducted and studies suggested that the environment was conducive for reintroduction, and an International Workshop of amphibian experts was convened in 2010. During this Workshop and under the guidance of IUCN, guidelines for KST reintroduction were prepared. These are being used in the whole process of reintroducing the toads to the Gorge.

The initial process of reintroduction started with soft release experiments, which involved two students, one examining the population dynamics of the reintroduced toads, and another studying amphibian diseases. Two amphibian experts from IUCN were also part of this process. This was followed by the first hard release, an international event, which took place on the 31st October 2012 when over 2,000 toads were released in the Gorge. So far, eight hard releases have been conducted with 12,579 toads released in the Gorge. Studies are also ongoing to monitor the survivorship of the reintroduced toads in the wild. Initial findings have shown that reintroduced toads have been able to survive, attain some limited adaptation and breed. Nevertheless, there is still a long way to go to attain population growth. The process should go through surviving the natural environment, adapt, re-establish and attain population growth and stabilization.

Since the discovery of the toad in 1996, many studies and experiments have been conducted in both the Kihansi Catchment Gorge and the captive breeding facilities. These studies and experiments have involved diverse disciplines, and a huge amount of knowledge has been generated. However, only few of these studies and experiments have been documented and disseminated to the decision makers, stakeholders and the public. As such, little is known about what has been found in the various monitoring and research activities that have taken place in the catchment and the facilities. Consequently, KCCMP organised this Researchers Workshop not only to share research findings,

but also to ensure that the huge volume of research findings accumulated from researchers for about two decades is documented and disseminated to the policy makers and the public. Therefore, this five-day Workshop has received over 25 papers, which will discuss findings from various studies conducted by participating institutions. The submitted papers will be published in a Special Edition of the "Tanzania Journal of Science" and Special Proceedings for the non-scientific papers. The papers provide very relevant information to different stakeholders (policy makers, scientists, practitioners and local communities) locally, regionally and globally. Both scientific and non-scientific papers form

baseline data for similar projects conducted (to be conducted) in biodiversity hotspots elsewhere in the world.

Overall, the project has passed through several phases from IREM, LKEMP I, LKEMP II, TEDAP to KCCMP. The Government of Tanzania in collaboration with WB and WCS have been the main sponsors of the project in previous phases. The Global Environment Facility (GEF) through WB funds the last phase (KCCMP). The Project has also tried to streamline its activities to ensure that local institutions play their roles, not only in the catchment and in KST conservation, but also ensure that the process does not stall when funding from the major funding agencies ceases.