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ABSTRACT:

THE THREAT OF INVASIVE ALIEN PLANTS TO FOOD SECURITY AND ENVIRONMENTAL CONSERVATION IN MARA RIVER BASIN ECOSYSTEM, MARA, TANZANIA

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Theme:

Integration and Inclusion: New Ideas for collaboration in River Basins Management Policies and Practices

Sub – Theme

Knowledge Exchange and Water Governance.

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EMERGING ISSUE:

Invasive Alien Plants (IAP's) within Mara River Basin in Mara, Tanzania



The Invasive Alien Plants (IAP's) within Mara River Basin in Mara, Tanzania pose a threat to food security and environmental conservation. *Chromolaena odorata*, is one of the IAP's observed for the first time at villages adjacent to Mara river basin in 2011. It infests crop fields and grazing land leading to a decline in crop production and shortage of fodder for livestock. The weed forms dense impenetrable stands displacing other species. *Chromolaena odorata*, is a fast maturing plant which can survive under low moisture conditions and produces many seeds (up to 25,000) that can remain dormant for 3-5 years.

Where it invades, it displaces pasture species, reducing available grazing.

Degradation and water resources related problems linked to IAS

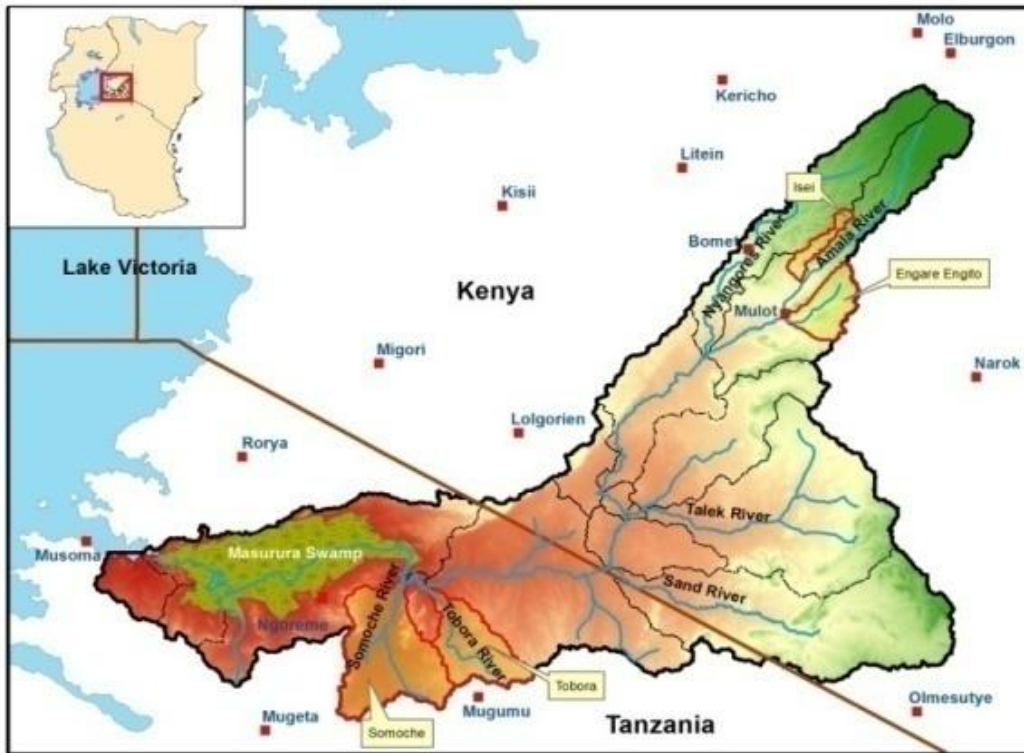
Degradation in Mara river ecosystem occurs when the resources are over exploited in the lowlands as a result of unbalances land use caused by increasing Chromoleana Odolata species in the highlands. The major problems in the sub-catchments includes degradation of water resources both in terms of quality and quantity caused by nutrient loss through erosion, overgrazing, encroachment into riparian land, deforestation, siltation and water pollution. Water is a key indicator of sustainable catchment management as it provides unique information of all the processes that are going on in a catchment interactively. To have clear concept for deep discussion on the problem we need to reconsider the Dublin principles (1992) that provided a concepts of Integrated Water Resources Management (IWRM). The IWRM concept provides key indicators for water governance today, that:

- i. Fresh water is a finite resource essential to sustain life, development and the environment.
- ii. Water development and management should be based on a participatory approach, involving users, planners and policy makers at all levels.
- iii. Women play a central part in the provision, management and safeguarding of water.
- iv. Water has an economic value in all its competing uses and should be recognized as an economic good.

The existence of IAS in the ecosystem automatically conflicts with the above IWRM concepts and therefore contradicts with good water governance, particularly a slogan of 3E's meaning Equitable sharing, Economic efficiency and Environmental sustainability that is essential to be observed in any kind of catchment intervention which is a key indicator to ensure that the catchment is well protected while resources are used wisely.

IAS status in Mara River Basin.

The Invasive Alien Species are mostly interfering livelihood system at the highlands and directly threatening the sustainability of Mara river basin Ecosystem particularly the Masurura swamp, and Somoche and Tabora sub-catchments lowlands. The masurura swamp are connected to Kirumi at the mouth of Lake Victoria while Somoche and Tabora are two neighboring sub-catchments located in the lower reaches of Mara River.



2. Infestation on grazing land and threat to conservation.

Traditionally, livestock keepers graze their animals on the upland areas leaving the lowlands for crop farming and water resources. However, most of the uplands areas today in Mara river basin area are infested with *C. odorata* where the weed had displaced the indigenous plant species leading to a shortage of fodder for livestock. To overcome the situation, livestock keepers moved the animals onto the Mara river basin lowland areas along water sources and water sub-catchments. The most affected areas are Rorya, Masurura water Swamp, Somoche and Tabora sub-catchments in Tanzania. The villages under threats are Nyansurura, Marasomoche, Busawe, Borenga, Nyiboko, Buchanchari, Nyamakobiti, Majimoto, Mesaga, Nyagasense, kenyamonta, Kirumi, Bukabwa, Kitasakwa, masurura, Ryamisanga, kamugendi, Kwisaro, Buswahili, Kongoto, Wegero, Kyankoma, Kitaramanka, sirorisimba, Kwibuse, Mara sibora, nyamirambaro, surubu, bisarwi, kembwi, Nkelege and waigita.



C. odorata infestation on grazing land.

BEST PRACTICES AND IMPACTS OF C. ODORATA

Chromolaena odorata, commonly known as triffid weed is now present in Northern and southern Mara River in South east of Lake Victoria Tanzania, threatening the basin ecosystem. The current reports shows the invasive weed has high threat on ecosystem function, biodiversity, water resources, pasture, crop production and human health. It depends on wind, water and motorcars for dispersal.

Characteristics and Impacts of *C. odorata*.

- Can **reduce pasture production by more than 150 per cent**, thus turning it into a “**green desert**” bare of any other species.
- One mature plant being able to **produce over one million seeds in a year**.
- *C. odorata* can be considered as a very serious weed in all types of perennial crops in the humid areas of the Palaeotropics. In low-growing plantations such as coffee and cocoa, *C. odorata* can **completely smother the crop**, whereas in taller plantations such as rubber or teak, as soon as the canopy is closed the weed is no longer a problem.



- In shifting cultivation, *C. odorata* **replaces the natural secondary succession** and becomes the dominant fallow species (De Foresta and Schwartz, 1991; De Rouw, 1991; Gautier, 1992a; Roder et al., 1995; Slaats, 1995). It is often considered as beneficial by local farmers (Baxter, 1995) because it is easier to clear than the secondary vegetation, helps to suppress *Imperata cylindrica*, and is believed to accelerate the recovery of soil fertility. This last aspect is still a matter of debate among scientists, but there is an increasing requirement for further studies on the influence of the *C. odorata* fallow system before any biological control programme is launched (Herren-Gemmil, 1991; De Foresta, 1996).
- *C. odorata* **causes severe problems in pastures** in the Central African Republic (Audru et al., 1988), Java (Indonesia) and the Philippines because it invades overgrazed areas. Due to the high nitrate content of the leaves, *C. odorata* is poisonous to cattle and generally not grazed (Sajise et al., 1974).
- *C. odorata* can also **transmit pathogenic fungi** (Vayssière, 1957; Esuruoso, 1971; Oritsejafor, 1986), and **act as a host for insect pests** including *Zonocerus variegatus* (Modder, 1984; Chapman et al., 1986), whose nymphs feed on leaves, flowers and fruits in Africa; *Aphis citricola* and *Rhopalosiphum maidis* in India; as well as various other polyphagous insects.



Shared knowledge on the Assessment of the situation and Eradication.

The aim is to inclusively sharing the impacts of existing *Chromolaena odorata* that threatened the Masurura water Swamp, and the somoche and Tobora sub-catchments within Mara basin ecosystem that contribute water to Lake Victoria. The experience from a study done between 2005-2008 on Water quality of the sub-catchments as part of the integral water quality and vulnerability of the entire Mara basin through Global Waters for Sustainability Programme (GLOWS), revealed that nutrients levels are effectively attenuated based on results from downstream human activities, turbidity and suspended solids are related high due to erosion from agricultural and rangelands, diminishing flows results in poor attenuation of nutrients hence resulting in high concentration of pollutants in the streams. It also reported that nutrients especially in wetlands are controlled through recycling by aquatic flora. Hence, although there are good indications of good water quality in Mara River today, with the increase of *Clomoleana Odolata* species that lead to increase pressure on downstream, several point sources and non-point sources are on the increase, which sooner or later will accelerate deterioration of water quality.

THE LESSON learned for eradication, containments, control, and mitigation of IAS.

Experience learned from different interventions provides strategies for dealing with established IAS as eradication, containments, control, and mitigation.

Eradication is the elimination of the entire population of an alien species, including any resting stages, in the management area. The eradication is the types of clear-cut decisive intervention that appeals to the public.

The eradication is been achieved using mechanical, chemical and biological control, as well as habitat management:



- a) **Mechanical control**-Mechanical control can be carried out by directly removing individuals of target species either by hand or using tools, but for its effective, it must be followed-up by clearance every 2-3 months because of rapid regrowth (Zachariades and Goodall, 2002). An advanced method of mechanical control is the removal of plants by specifically designed tools

and even machines. i.e. harvesting vehicles for water hyacinth infested lakes and rivers, bulldozing on large open areas like pastures/wildness, etc.

Invasive plants can be cut, hand-pulled or removed by specific tools (Case study: "Conservation management Area in Mauritius")

- b) **Chemicals control** - Herbicides e.g. using toxic baits and spraying insecticides, etc. *C. odorata* is most susceptible to chemical control when it is growing vigorously, such as at the beginning of the rainy season. Best control is usually obtained when herbicides are applied to young shoots after slashing.
- c) **Biological control** - Biological control is the intentional use of populations of upper level organism commonly referred to as natural enemies, or naturally synthesized substances against pest species to **suppress pest populations**. As *C. odorata* is found in forests, pastures and on wasteland as well as in arable areas, biological control is an attractive approach, especially where use of herbicides is uneconomic.
- d) **Habitat management** e.g. prescribed burning, grazing and changing of the human behavior.
- e) **Hunting of prescribed invasive alien species.**

Plants can be best eradicated by a combination of mechanical and chemical treatments by cutting of woody weeds and applying an herbicide to the cut stem (Case study "Eradication program of *Chromolaena* weed in Australia").

Integrated control

In view of the limited success achieved with released biological control agents and the difficulty in preventing the spread of *C. odorata*, integrated control strategies are being explored. These include either excluding fire (coastal forest sites), or using fire prior to seed release to kill plants and soil-stored seeds immediately prior to seed production, together with chemical and/or physical clearing (Witkowski, 2002). The quest for effective control agents is also being pursued and a sustained effort to maintain people's awareness is also seen as a key factor in any management programme (Zachariades and Goodall, 2002). In Australia, herbicide application, hand-pulling or fire are often used in combination depending on local site conditions (Waterhouse and Zeimer, 2002).

Containment - The aim of containment is to restrict an invasive species to a limited geographical range.

The population can be suppressed using a variety of methods along the border of the defined area. If containment of an invasive species in a well - defined area is successful, habitats and native species are safeguarded against the impacts caused by the harmful alien species outside the area (A study from Kakadu National Park, Australia).

Control - Possible means to reduce the density and abundance of the target, lowering the impact to an acceptable extent. The suppression of a population will reduce its competitiveness and, under optimal conditions, native species will regain ground and replace the invasive species.

Mitigation for the various biological groups - If eradication, containment, and control are not options or have failed in managing an invasive alien species, the last option is to **"live with"** this species in the best achievable way and mitigate impacts on biodiversity and endangered species. Mitigation focuses to rescue a critically endangered native species from extinction.

Cultural Control

Slashing *C. odorata* stems manually or mechanically is not a solution, because the plants coppice profusely from the roots. The root itself must be dug out, which can sometimes be done by hand if the soil is moist, or by mechanized equipment. This type of control must be conducted at least twice during the growing season (Liggit, 1983; Audru et al., 1988; Muniappan and Marutani, 1991). Cultural practices involving other competitive species have been proposed: using *Leucaena leucocephala* in pastures in the Philippines (Castillo et al., 1977); *Tephrosia purpurea* in cocoa plantations in Sri Lanka (Salgado, 1972); and signalgrass (*Brachiaria decumbens*) in Yunnan, China (Wu and Xu, 1991). For perennial plantations, a ground-cover crop such as *Pueraria phaseoloides*, *Calopogonium mucunoides*, *Centrosema pubescens* or *Vigna unguiculata* can control *C. odorata* in the first years, before the crop canopy is closed (Liggit, 1983; Audru et al., 1988; Muniappan and Marutani, 1991).

In South Africa, an annual burning regime can effectively control the plant in grassland situations by killing mature plants and preventing new seedlings from establishing (Goodall and Zachariades, 2002).

Uses

A very important though facultative use of *C. odorata* is as a green manure or fallow component. Being invasive, it has replaced native secondary successional species in much of the tropical Old World, and farmers have learnt to live with as a component of the farming system, especially in shifting cultivation and rotational practices. It is often preferred over native species as it is easier to cut and clear, and is observed to suppress another invasive species, *Imperata cylindrica*, which has much worse impacts on agriculture. Reports that *C. odorata* improves soil fertility require confirmation, though clearly the fallow period will have a positive effect. *C. odorata* can also be cut and cleared prior to seed set, composted and used as a valuable organic soil amendment.

It is generally regarded as poisonous to animals and thus not recommended as a livestock feed. However, some studies show its benefits in low concentrations, such as up to 5% for egg-laying chickens which also improved yolk colour (Fasuyi et al., 2005).

In Malaysia, where *C. odorata* is an invasive exotic, plant parts are used by traditional practitioners for treatment of burns, wound healing, skin infections, post-natal wounds, and as an anti-malarial (Nurul Huda et al., 2004). Several medical studies have confirmed that leaf extracts have certain anti-microbial, anti-inflammatory and wound-healing effects, and are identified as a potential source of human medicines.

Designing monitoring approaches

It is worth pointing out that monitoring the numbers of a pest species killed or removed is a measure of the work being done but is not a measure of success of the project. Success of the project can only be measured by monitoring numbers of the pest species that remain, and ultimately the condition of the ecosystem they are in. Monitoring of the impact of control actions need to be put in place, preferably starting with small - scale activities to verify the impact of control operations, and if the results are not as expected, the management plan may need to be reconsidered and adapted in light of this new knowledge.

CHALLENGES

- a) Slashing *C. odorata* stems manually or mechanically is not a solution, because **the plants coppice profusely from the roots**. The root itself must be dug out, which can sometimes be done by hand if the soil is moist, or by mechanized equipment. This type of control must be conducted at least twice during the growing season. The act adds workload to farmers and forced to new livelihoods system to local people. Alternatively, they shift to new habitats that create land and water resource use conflicts.
- b) There has been quite some debate in recent years about the safety of classical biological control, particularly with regard to the potential of introduced **biological control agents to have adverse effects on non - target organisms**. In order to avoid adverse effects, today the safety standards of biological control are very rigorous; it is a normal requirements (e.g.IPPC Code of Conduct) to assess the specificity of all agents proposed for introduction. This involves extensive laboratory and field screening tests.
- c) In certain environments, the practice of prescribed burning can change the vegetation cover in favour of native plant species, thereby decreasing population levels of weeds. *Chromolaena odorata*, is a **fast maturing plant** which can survive under low moisture conditions and **produces many seeds** (up to 25,000) that can remain dormant for 3-5 years.
- d) Habitat management with grazing mammals can be a suitable option to obtain the desired plant cover. The *C. odorata* are toxic species that **cannot be grazed by animals**.
- e) Mitigation of negative impacts by the invasive species could be achieved by changes in the human behavior that has led to the invasive. The common way of local communities to mitigate the weed are to shift from original place to new place, the case that **increasing pressure to water resources in the lowlands**.
- f) Plants can be best eradicated by a combination of mechanical and chemical treatments by cutting of woody weeds and applying an herbicide to the cut stem (Case study of Australia).This is the best alternative control measure, however, this **need appropriate program within longtime**.
Also, in most cases, well - established populations and large areas of infestation are unsuitable for this eradication program.
- g) The population can be suppressed using a variety of methods along the border of the defined area. **The challenges here are national land policies**. In Tanzania, principally the land belongs to the nation that limits individual person commitment to eradication program through containment of an invasive species. Although, it is well to be applies in conservation areas, A study from Kakadu National Park, Australia).