Research perspectives in restoration of watershed ecosystems under a changing climate : success, challenges and opportunities

Jared Amwatta Mullah[1] and Eliud Michura[2]*

[1]Kenya Forestry Research Institute (KEFRI)

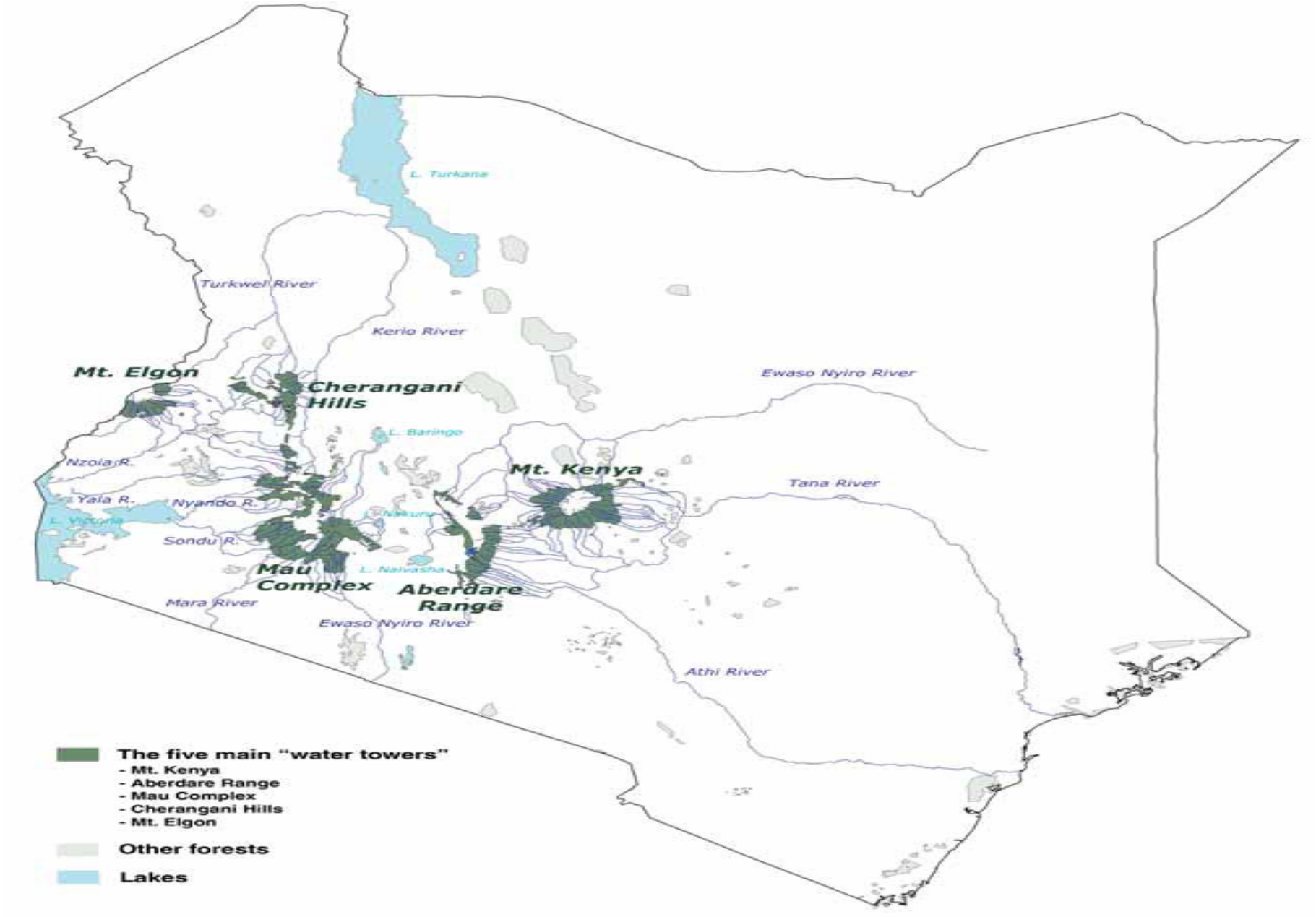
Rift Valley Eco-Region Research Programme, Londiani, Kenya

[2]School of Environmental Studies and Energy Technology, Kabarak University, Kabarak, Kenya

Objectives

- To share the research efforts in restoration of the water towers
- To highlight some of the challenges and opportunities
- To recommend strategies for restoration

Kenya Water Towers



Watershed forest

Importance

- They form the main water towers of the country from which most Kenyan river systems emanate
- The rivers serve as sources of water for hydroelectric generation, irrigation, agriculture and industrial processes
- They act as reservoirs for biodiversity and serve as sinks for carbon.
- In addition they provide goods and services to both the forest-adjacent communities and to the country

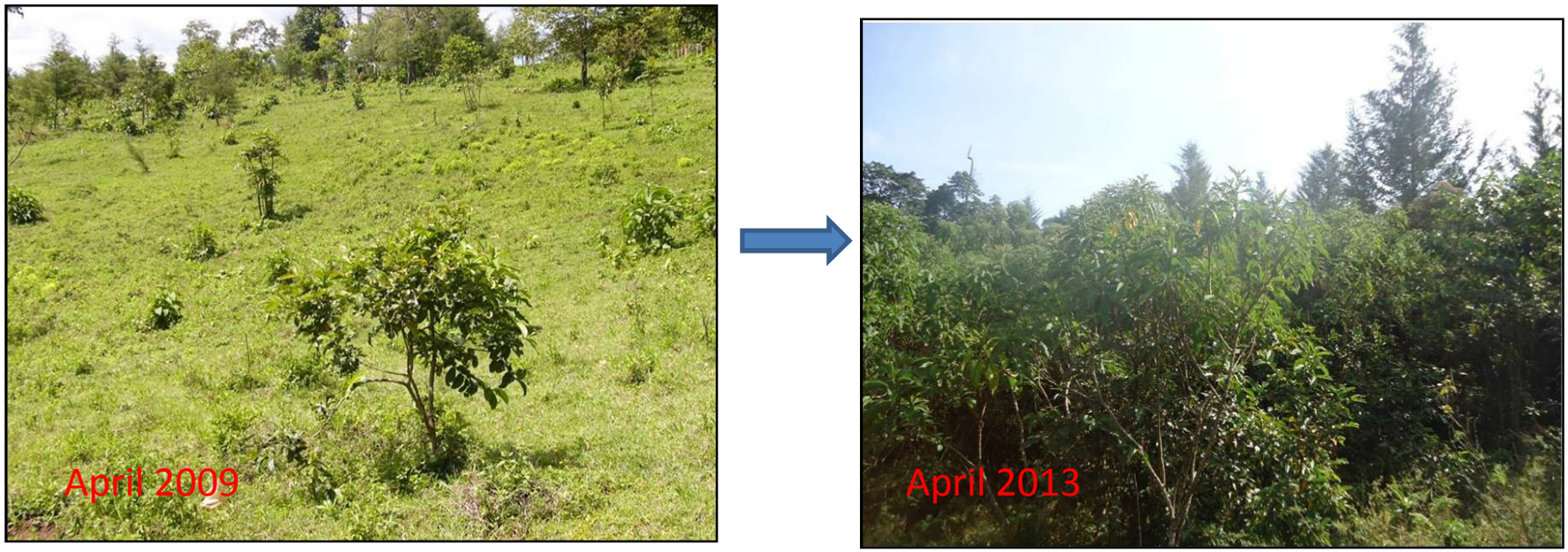
Drivers of the Change

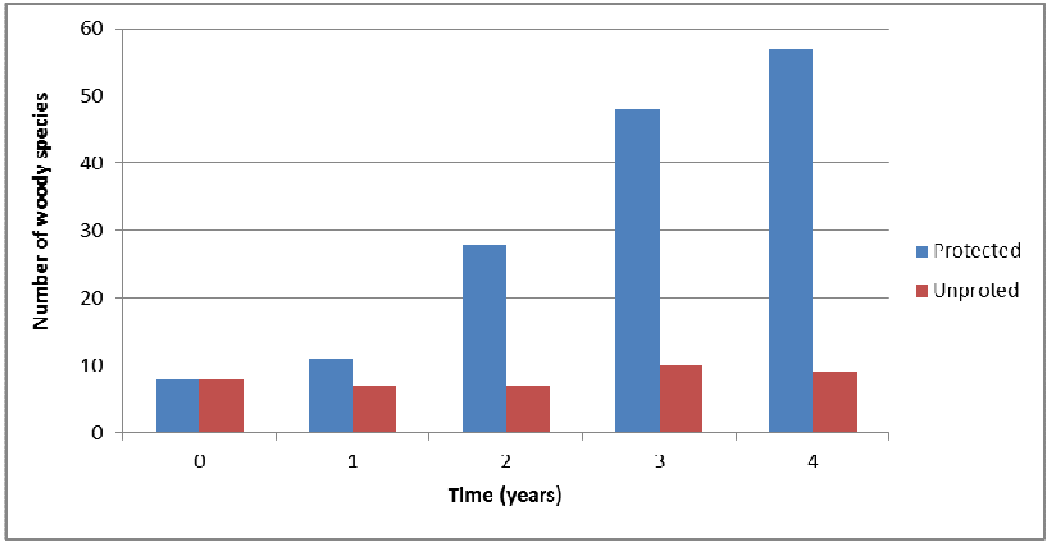
Illegal, irregular and unplanned settlements, livestock grazing, invasion by exotic plant species and Climate change

Water Tower	Area (ha)	Area lost	Catchment for
Mau Complex	400,000	7084.24	•Nzoia, Yala, Nyando, Sondu and Mara (drain into Lake Victoria) •Baringo, Nakuru, Naivasha, Natron and Turkana.
Mt Kenya	220,000	6013.5	•Tana and Ewaso Nyiro rivers, meet more than 40% of the country's water needs.
Mt. Elgon	73,706	Deforestation mainly by fire (Changes could not be detected due to cloud cover)	•Nzoia and Turkwel rivers. •Malakisi (crosses the small-farming area south of the mountain before entering Uganda.
Cherangany Hill	120,000	153	Nzoia, Kerio and Turkwel rivers
Aberdare range	250,000	High cloud cover could not allowed change detection	Tana , Athi, Ewaso Nyiro (North) and Malewa rivers Sasumua and Ndakaini dams,

Restoration Techniques

Changes in vegetation community structure through natural regeneration in a protected plot over a four-year period at Kibiri rehabilitation site (Otuoma, 2014)

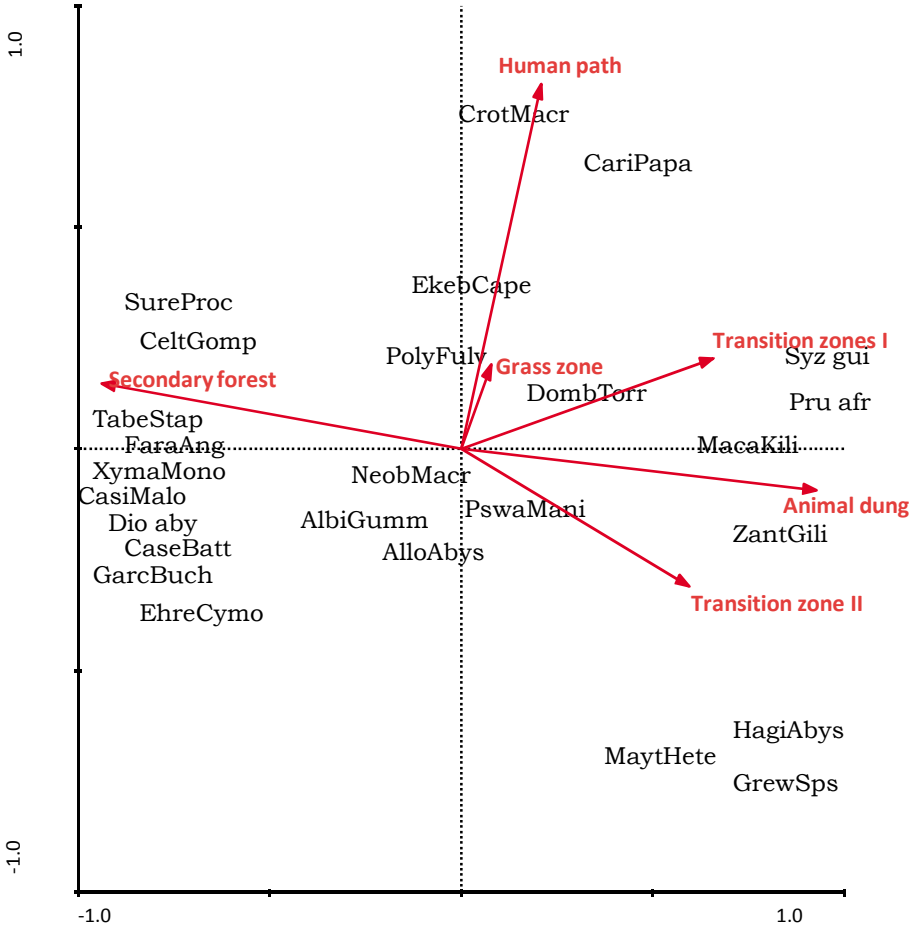




Restoration Techniques

- Insufficient information on appropriate rehabilitation technologies
- Poor species – site matching and over reliance on a few woody species
- High tree mortality due to grazing, drought and termites

Selection of appropriate woody species for rehabilitation require long term ecological studies



Available option is to use natural recovery of degraded forest – generalist species

Insufficient information on potential restoration species interactions

	Transition zones				Secondary forest			
	Albizia		Neoboutonia		Albizia		Neoboutonia	
	R^2	P	R^2	P	R^2	P	R^2	P
Richness								
Seedlings	**0.11**	**0.034**	ns	ns	ns	ns	ns	ns
Saplings	**0.17**	**0.008**	ns	ns	**0.16**	**0.033**	**0.30**	**0.002**
Shrubs	ns	sn	ns	ns	**-0.27**	**0.005**	**0.27**	**0.001**
Herbs	ns	ns	**-0.13**	**0.039**	ns	ns	**-0.19**	**0.022**
Lianas	**0.13**	**0.014**	ns	ns	ns	ns	ns	ns
Abundance								
Seedlings	ns	ns	ns	ns	ns	ns	ns	ns
Saplings	ns	ns	**0.37**	**0.043**	**0.23**	**0.009**	**0.14**	**0.004**
Shrubs	ns	ns	ns	ns	ns	ns	ns	ns
Herbs	ns	ns	ns	ns	ns	ns	ns	ns
Lianas	**0.61**	**0.023**	ns	ns	ns	ns	ns	ns

Forest Restoration to support invaded forest areas

- Increasing forest degradation in watershed forests, coupled with climate change, increase opportunities for woody species invasions
- Invasion by *Lantana camara*, *Acacaia mearnsii*, *Acacia melanoxylon*, *Fraxinus pennsylvanica*, *Cestrum aurantiacum* are already documented diversity
- Lack of skills and technologies to manage and utilize the species

Page 32 / RIFT VALLEY NEWS

County raises the alarm over invasive weed threatening forests

ELGEYO MARAKWET COUNTY

By FRED KIBOR

Environmentalists have raised the alarm over an invasive weed species that is threatening the survival of forests in Elgeyo Marakwet.

The weed, scientifically known as cestrum aurantiacum, or Yellow cestrum has invaded over 4,000 acres in the indigenous Cherangany forest.

Locally, it is referred to as chemaam araa, translated as uneaten by livestock.

It is distinguished by its lush evergreen leaves, yellow flowers and a pungent choking smell. It grows in clusters with each bunch having over a thousand seedlings and absorbs moisture at high rate.

Residents say the weed, which is very toxic, was first spotted at a colonial farm in Trans Nzoia County in the 1970s where it was being used as an ornamental plant, but has since been dispersed by wind to great distances.

It has invaded Chebai, Kipsero, Kipsotit, Kipkutung areas that form the Cherangany forest, one of the country's water towers.

"We are very worried of this plant because it is ruthless in its growth and cannot be eaten by livestock. Bees cant suck its nectar

because it is ruthless in its growth and cannot be eaten by livestock," said Kipsero assistant chief Daniel Kibet.

The administrator said hundreds of livestock have died after they consumed the plant, which also traps and kills bees that suck its nectar.

NATURAL DANGER

"Our livestock develop swollen stomachs and die suddenly. When you slaughter it, there is a lot of foam in the stomach," said Kibet.

He added that honey harvested in the area has drastically reduced because bees cannot suck nectar from the plant.

The residents are now appealing for urgent intervention from research agencies, warning that the spread of the weed was detrimental to the dents and livestock, as well as the vironment.

Reuben Tegeroi, a member Community Forest Association, they have forwarded their conc to the Kenya Forest Service (KFS appropriate action.

"We are foreseeing a desert c ing up in this area if urgent interv tion from relevant agencies is not ried out," warned Tegeroi.

ENVIRONMENT THREAT

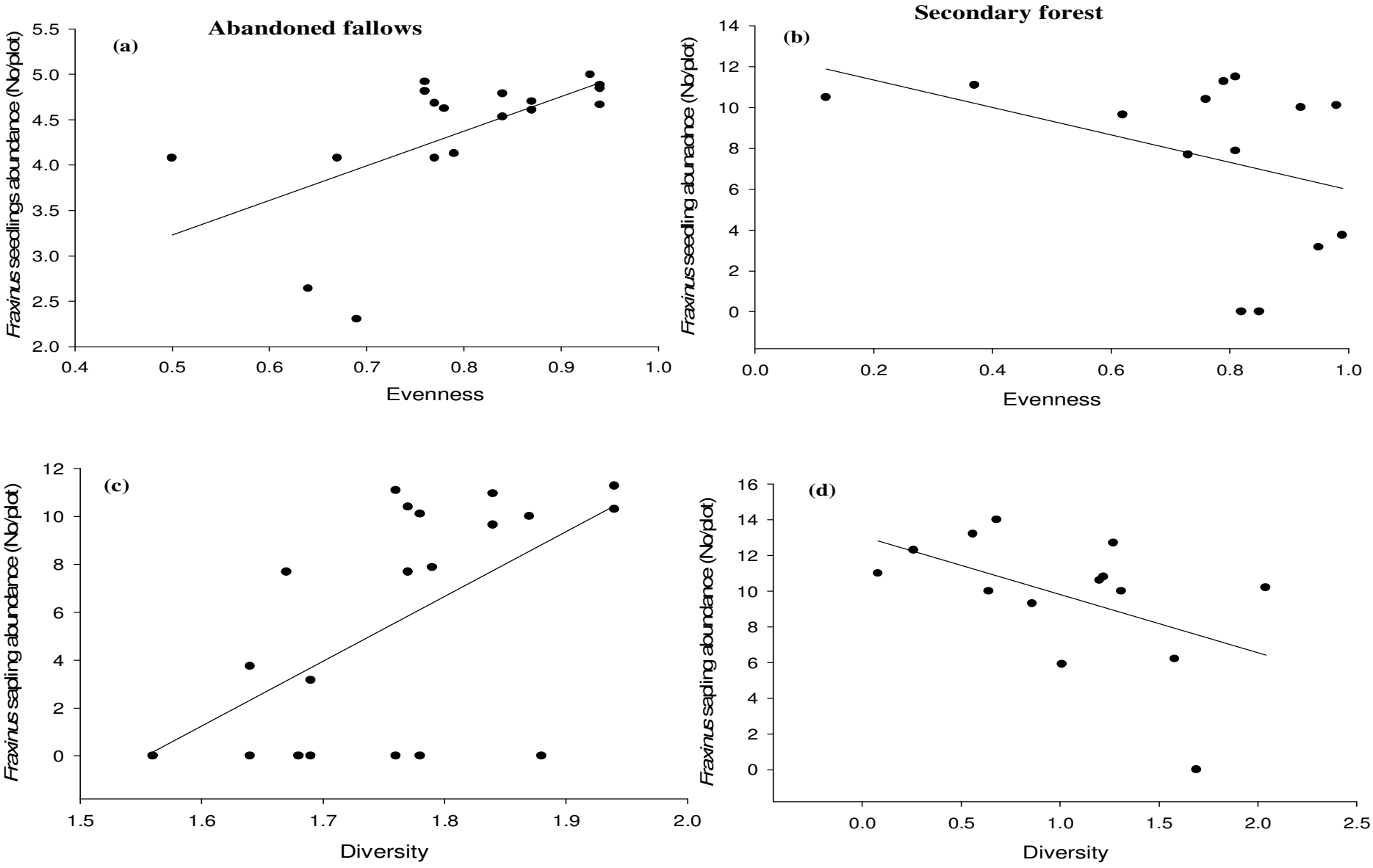
He called on the Governmen use the same passion it employe getting the squatters out of Embo forest to destroy the weed.

"This is a very destructive w and if the Government values er ronment, then it should send resou es to save this forest," said Tegeroi

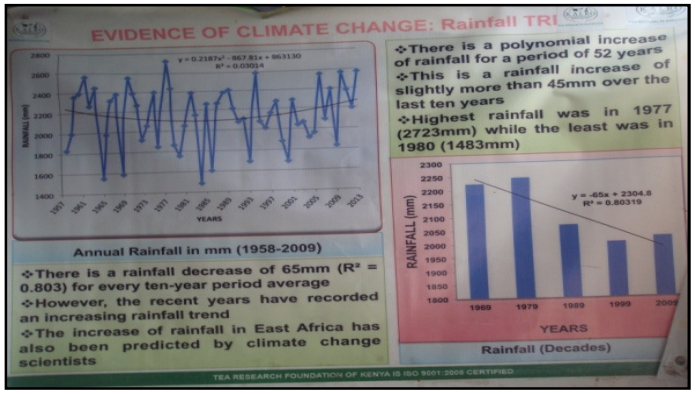
Area KFS Zonal Manager Alf Nyaswapu said they are aware of weed and have sent samples to Kenya Forest Research Institute f for analysis.

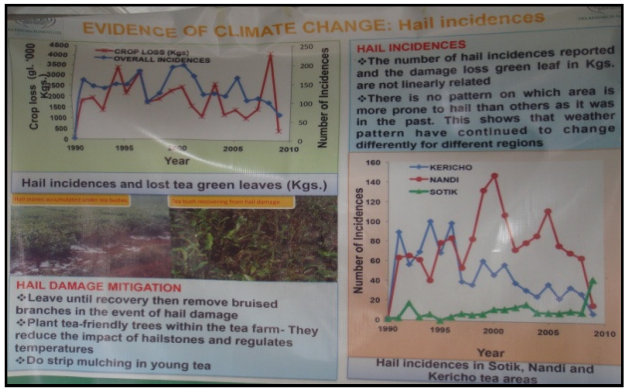
"This is one of the alien invas species in the country that is sprea ing fast. It is also very dangerous the environment," said the KFS o cial.

Relationship between *Fraxinus pennsylvanica seedling and sapling density and* evenness (a, b) and community diversity (c, d) in abandoned fallows and in secondary forest in Mau forest, Kenya (Mullah et al. 2014)



Forest restoration to support climate change mitigation and adaptation





- Climate change is likely to change plant population dynamics, succession, species composition and incidences of plant invasion

Involvement of Communities

- Inadequate involvement of communities in forest rehabilitation through establishment of tree nurseries to provide seedlings for rehabilitation of catchments, river and water reservoirs
- Capacity building of communities on appropriate woody species including bamboo for rehabilitation of catchments, riverines and wet lands

Recommendations

i. Establish and promote appropriate mixes of species for forest restoration /rehabilitation of degraded forests to increase their resilience to climate change.

ii. Promotion of Participatory Forest Rehabilitation

iii. Identifying strategies for short and long-term protection and management of rehabilitated sites.

Acknowledgements

- Dr. John Otuoma for data
- Tea Research Foundation for Data
- KEFRI for Support

THANK YOU