Controlling invasive species in pastoralist areas

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KNOWLEDGE FOR LIFE

CABI

Some of the worst offenders in Africa!

- *Opuntia* spp.
- *Mimosa* spp.
- *Prosopis* spp.
- *Lantana camara*
- *Chromolaena odorata*
- *Parthenium hysterophorus*

Chromolaena odorata in NW Tanzania

Chromolaena odorata understorey

Devil weed in Tanzania

“Chromolaena has killed us because it has killed our crops and our livestock.” Village elders, Serengeti, Tanzania

“Anyone who would help us to eradicate these weeds, shall be our God on earth." Elizabeth John Stephen, Kwigutu, Tanzania.

"Agriculture becomes very difficult because of this dangerous plant.” John Wambura Gimanje, RWA, Tanzania.

"I lack a place to graze my livestock. My livestock grows thinner and even die of starvation. Government help us folks" Monica Robert, Nyasirori, Tanzania.

“Cows produce very little milk these days and weigh as much as a goat.” Chichi Marwa, Kyankoma, Tanzania.

Devil weed in Tanzania

Costs and benefits	High density	Low density	p value
Costs			
Decrease grass	82	54	$\chi^2 = 19.943$; $p < 0.0001$
Decrease shrubs	80	51	$\chi^2 = 20.181$; $p < 0.0001$
Decrease trees	66	56	$\chi^2 = 2.072$; $p = 0.150$
Decrease wildlife	25	21	$\chi^2 = 0.501$; $p = 0.479$
Decrease water	67	54	$\chi^2 = 4.051$; $p = 0.046$
Decrease movement	94	84	$\chi^2 = 702$; $p = 0.03$
Decrease availability of useful plants	39	31	$\chi^2 = 7.839$; $p = 0.02$
Negative effects of livestock health	80	63	$\chi^2 = 7.810$; $p = 0.005$
Impact livestock (no. lost)	10 ± 12	5 ± 9	$p = 0.002$
Decrease crop yields	90	74	$\chi^2 = 9.074$; $p = 0.003$
Benefits			
Hedge plant	14	14	$\chi^2 = 0.004$; $p = 0.949$
Medicinal plant	17	19	$\chi^2 = 0.312$; $p = 0.577$
No benefits	75	77	$\chi^2 = 0.336$; $p = 0.562$

Current and potential distribution of *Chromolaena odorata* in eastern Africa

Lantana camara in western Uganda

Lantana poisoning

(Queensland Department of Natural Resources, Mines and Energy, 2004)

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Lantana in Uganda

“I have to cut down lantana every three months, if i do not even my door steps will be covered in this weed, I am so exhaused with it that i feel like running away from my land,” Luwoga Christopher, Nakasongola District, Uganda.

“I am a victim of Lantana in many ways. I use to live in Kagonji village years back but i had to find land here and relocate my family because my previous land was totally covered in lantana. We had no farmland, grazing land or space for my grandchildren to play. I even feel ashamed telling people that I ran away because of lantana.”Cosia Lwamanyasi, Nakaseke District, Uganda.

“I own more than 10 acres of land but live as if I have only 2 acres. The land has become so small because the bulk of it has been rendered useless by lantana infestation.” Kasasa Godfrey, Kyeyidula village, Uganda.

Lantana in Uganda

Impacts of lantana	Negative impacts/ costs	Positive impacts/ benefits	No effect/ don't know
Grass	99	1	0
Shrubs	91	9	0
Trees	19	0	81
Wildlife	79	21	0
Useful plants	98	0	2
Water	4	0	96
Movement	99	0	1
Cattle health	87	0	13
Sheep health	86	0	14
Goat health	26	0	74
Drive human relocation	51	0	49
Fuelwood	0	16	84
Green manure	0	11	89
Medicinal plant	0	10	90
Hedge plant	0	5	95

Current and potential distribution of *Lantana camara* in eastern Africa

Parthenium hysterophorus in Kenya

Current distribution of *Parthenium hysterophorus* in East Africa

Impacts:

- Can reduce pasture production by as much as 90% (Jayachandra, 1971).
- Taints the meat and milk of livestock

Opuntia stricta in Kenya

Pest pear in Africa

Reduces pasture production

“This used to be a very beautiful environment before Opuntia colonized our grazing fields. So currently we are having this as a major problem, since it has begun claiming livestock, claiming land and forcing us to move from our homes.”

Parsito Kitonga, Laikipia District, Kenya

Pest pear in Laikipia County, Kenya

Effects of *O. stricta*	Negative impacts	Positive benefits	No effect/don't know
Tripe quality	100	0	0
Livestock health	100	0	0
Movement/access	96	0	4
Grass	91	6	3
Wildlife	91	0	9
Human health	84	0	16
Useful plants	43	0	57
Shrubs	30	50	20
Trees	19	50	31
Water	8	0	92
Fruit consumption by humans	0	20	80

Pest pear in Laikipia County, Kenya

Negative impact on livestock	Percentage of respondents (those mentioned by 10% and above)
Mouth sores	87
Weight loss	83
General sickness	74
Less milk	63
Blindness/eye injury	58
Death	54
Impacts on gastrointestinal tract	52
Swollen, hardened and sore lips	46
Thorns in body	39
Fewer offspring	12

Opuntia engelmannii, Laikipia, Kenya

Opuntia elatior, Lake Baringo, in Kenya

Opuntia monacantha, eastern Kenya

Austrocylindropuntia subulata, Laikipia, Kenya

Opuntia ficus-indica, Ethiopia

Current distribution of *Opuntia* spp. in East Africa

Prosopis juliflora in Ethiopia

Prosopis juliflora understorey

Current distribution of *Prosopis juliflora* in Eastern Africa

Impacts:

- In Ethiopia, *P. juliflora* has reduced understorey basal cover for perennial grasses from 68 % to 2%, and has reduced the number of grass species from seven to two (Kebede and Coppock, 2015)
- Significantly reduces bird diversity, including that of dung beetles
- Has a negative impact on underground water resources

Mimosa diplotricha

Current distribution of *Mimosa diplotricha*

- Invaded cattle ranches in the Markham Valley, Papua New Guinea, are spending up to US$ 130,000 annually on chemical control (Kuniata, 1994).
- It is apparently also toxic to livestock - in Thailand, 22 swamp buffaloes died 18–36 hours after eating *M. diplotricha* (Tungtrakanpoung and Rhienpanish, 1992).
- Trials in Queensland, Australia, have indicated its toxicity to sheep, and a report from Flores, Indonesia, suggests that it is also toxic to pigs (Parsons and Cuthbertson, 1992).

Cryptostegia grandifora in Ethiopia

Cryptostegia grandifora impacts

- In Australia, estimated to occupy more than 30,000 km^2 in 1990, “being described as the single biggest threat to natural ecosystems in tropical Australia” (McFadyen and Harvey, 1990).
- Dense infestations can reduce livestock carrying capacities by as much as 100%.
- The plant contains toxic glycosides which cause heart malfunction as well as stomach and intestinal disorders in both humans and animals (Cook *et al*., 1990; Parsons and Cuthbertson, 1992; Paman, 2008).
- Economic losses to farmers, through increased management costs and reduced cattle-carrying capacities, have been put at A$ 18 million annually to the north Queensland, Australia, beef industry alone (Agriculture and Resource Management, 2001).

Current and potential distribution of *Cryptostegia grandiflora* in eastern Africa

What will happen to natural grazing lands if we don't manage invasive plants?

71%

of natural grazing could be lost (van Wilgen *et al*., 2008)

IAS Management

- Prevention
- Early Detection and Rapid Response (EDRR)
- Control – cultural, physical, chemical, biological (IPM)

Mimosa pigra infestation in Australia – before …….

……. 30 years later!!!

Mimosa pigra on the Chunga Lagoon, Kafue Flats, Zambia

Cereus jamacaru

Bryophyllum delagoense

Catharanthus roseus

Cultural control - Fire as a management tool

Prescribed burning decreased invader abundance in 20% of cases (reviewed in D'Antonia 2000).

High temperature fires can cause direct damage to plant tissue through combustion, and indirect damage to the physiological processes through radiant heating (Levitt 1972).

Succulents, such as species in the Cactaceae and Crassulaceae, retain high moisture levels throughout most of the year and as a result are generally always sensitive to fires and can therefore be controlled, provided that fuel loads are high enough to carry a fire (Thomas 1991).

Cultural control: Fire for *Prosopis* spp.

Trees – best for low and medium density stands and for seedlings. Burning is also used to clean shrubs that have been stick raked and piled.

Good kill rates of up to 95% for trees
Results in emergence of fewer seedlings.

Need high fuel loads, pasture sacrificed, fire risks – however, costs are low

Osmond *et al*., 2003 – Mesquite Best Practice Manual

Physical control

- Hand pulling
- Chopping and slashing
- Digging or bulldozing
- Cultivation or hoeing
- Ring-barking
- Smothering
- “Harvesting”
- Mowing

Manual control

Ring-barking *Senna spectabilis* in Budongo Forest, Uganda

Manual control

Manual control (hoeing) of *Cymbopogon nardus*
In Uganda

Manual control of *Cymbopogon nardus* In Uganda

Description	Average Cost (Ug. Shs '000')			
Manual removal	**Year 1**	**Year 2**	**Year 3**	**Total**
Labour	67.96	47.57	28.54	144.07
Hoes	26.03	18.22	7.28	51.53
Total Cost				**195.60**

Equivalent of ~ US$115/hectare

Costs of physical/mechanical control: *M. pigra*

Mimosa pigra **physical control in Lochinvar National Park - 2007**

Costs of manual control of *Mimosa pigra* in Zambia

~US$637per hectare

Manual control of *Prosopis* spp. - removing bud zone

Handsaws, hoes and spades used to remove aboveground parts and the sub-surface bud zone (10 cm)
Very effective if done properly

Time consuming and labour intensive

Manual control of *Prosopis* spp. costs

Costs of clearing a 10x10 m plot – 2-4 m high trees (3-4 yrs old) in Kenya

	Person-days	Daily cost (KSH)	Total cost (KSH)
Baringo	4	300	1200
Garissa	7	400	2800
Loiyangalani	5	200	1000

(Maundu et al., 2009)

Average cost of KSH 1700 or US$ 22.7 to clear a 10x10 m plot or KES 17,000 = **US$ 227 to clear one hectare**.

To "eradicate" 500 000 ha. of prosopis in Kenya would therefore cost about **US$ 113,500,000**

Chemical control

Foliar herbicide treatment

Chemical control: Cut stump technique

Example of *Prosopis* spp. control:

Good for trees at low densities but also suitable for shrubs in scattered and low-density stands. Better kill rates than basal bark spraying, and results in limited regrowth.

Time consuming and labour intensive – uses less chemical than basal bark spraying.

Osmond *et al*., 2003 – Mesquite Best Practice Manual

Chemical control: Basal bark spraying

Example of *Prosopis* spp. control:

Both tree and shrub form – best for use in scattered, low- to medium density stands and for regrowth.

Greater than 97% kill rate if applied properly, kills quickly and is target specific.

Is labour intensive so can be costly if large and dense areas are treated

Osmond *et al*., 2003 – Mesquite Best Practice Manual

Cymbopogon nardus control trials in Uganda

1) Control
2) Burning
3) Burning and hoeing
4) Burning and hoeing and pasture spp.
5) Burning and glyphosate
6) Burning and glyphosate and pasture spp.
7) Unburnt and hoeing
8) Unburnt and glyphosate

Estimated cost per acre in controlling *Cymbopogon nardus* in Kiruhura district, Uganda

Description	Average Cost (Ug. Shs '000')			
Manual removal	**Year 1**	**Year 2**	**Year 3**	**Total**
Labour	67.96	47.57	28.54	144.07
Hoes	26.03	18.22	7.28	51.53
Total Cost				**195.60**
Chemical control per acre				
Glyphosate (roundup) (540gm)	32.40	6.48	6.48	45.36
Labour	24.00	4.80	4.80	33.6
Water (180lts)	1.80	0.36	0.36	2.52
Brush (1)	2.00	2.00	2.00	6.00
knapsack sprayer (rent)	3.00	-	-	-
String (1 role)	3.00	3.00	3.00	9.00
Total cost				**96.48**

Manual: US$115/acre

Chemical: US$56/acre

Costs of chemical control of *Prosopis* spp. in South Africa

Working-for-Water (South Africa) clearing norms

Person days/ha. required for cut-stump treatment at various densities

Size class	Occ.	V. Scat.	Scat.	Med.	Dense	Closed
Young	1	1	2.3	6	25	25
Adult	2.3	2.3	3	6.7	25	25
Mature adults	2.3	2.3	3	6.7	25	25

Mixed adults and young, but extremely closed – 40 person days/ha.

Manual vs. cut stump control of *Prosopis* spp.

Manual control for medium stand in Kenya

	Person-days/ha
Baringo	40
Garissa	70
Loiyangalani	50

(Maundu et al., 2009)

Cut-stump control (person days/ha.) in South Africa

Size class	Occ.	V. Scat.	Scat.	Med.	Dense	Closed
Young	1	1	2.3	6	25	25
Adult	2.3	2.3	3	6.7	25	25
Mature adults	2.3	2.3	3	6.7	25	25

WHAT IS BIOLOGICAL CONTROL?

The use of
host-specific natural enemies
to bring about
the long-term or sustainable control
of the target species

Successful biocontrol does not eradicate the target weed

Aim of weed biocontrol

✓ To reduce the invasive potential of the target plant to a level where the plant is no longer problematic

✗ NOT total eradication of the target plant

Before biocontrol of *Opuntia stricta*

A few months later ……

And a few months later ……

And a few months later ……

Red water fern *(Azolla filiculoides)*

Long-leaved wattle (*Acacia longifolia*)

An integrated management plan is required to control invasive plant species

شكرا جزيلا
merci
शुक्रिया
zikomo
xie-xie
obrigado
efharistó
ありがとう
kiitos
thank you
gracias
zikomo
tak
ke itumetse
asante
urakoze
danke
terima kasih
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