Distribution of invasive plant species *Chromolaena odorata* (Siam Weed) in Serengert District

Report by:

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1. Introduction

Chromolaena odorata, also known as Siam Weed, is an herbaceous to woody perennial invasive plant species that is considered one of the world's worst weeds. The plant has a bushy habit which forms a very dense thicket about 2 m high. After the first year of growth, the plant develops a strong, woody underground storage organ, which can reach a diameter of 20 cm (http://www.cabi.org/isc/datasheet/23248)

The weed has effective short and long distance dispersal mechanism, jeopardizing pasture and farmlands in the tropical region, including Tanzania (Crutwell McFadyen and Skarrat; 1996; Kriticos et al., 2005; Raimundo et al., 2007). Most of the seeds produced by the plant enter the soil and build up a seed bank which may survive up to 6 years (Waterhouse and Zeimer, 2002). The seeds are generally wind-disseminated but they can also stick to fur, feather and clothes.

Siam weed is highly competitive. It has prolific reproduction, fast growth and branching habit, which ensures rapid domination and suppression of other species. Under its very dense canopy thicket, light is scarce and other fast-growing species cannot survive. Slow-growing, shade-tolerant species are regularly bent to the ground by the continuous pressure of the growth of new *C. odorata* twigs on the upper layer of the thicket (Gautier, 1992b). The plant has a very efficient root system for nutrients absorption (Bennet and Rao, 1968), and allopathic effects may also be involved in suppressing other vegetation (Ambika and Jayachandra, 1980b; Nakamura and Nemoto, 1993).

Siam weed is considered as a weed in all perennial crops of the humid tropics, pasture and forestry. Its aggressiveness is much more serious where it is an exotic plant, rather than where it is native. The weed grows in areas with an annual rainfall below 1000 mm, provided the dry season is not too long and it is limited to around 2000 m altitude. It grows on soils ranging from sand dunes to heavy clays (Liggit, 1983), and it is heavily dependent on the availability of light.

The weed has a lot of negative impact in grassland and cropland. In low-growing annual and perennial crops, *C. odorata* can completely overwhelm the crop, whereas in taller crops, as soon as the canopy is closed the weed is no longer a problem. In shifting cultivation, the weed replaces the natural secondary succession and becomes the dominant fallow species (Slaats, 1995). The weed out competes and causes severe problems in pastures growth (Audru et al., 1988). It has high nitrate content in its leaves leading it to be poisonous to cattle (Sajise et al., 1974). *C. odorata* can also transmit pathogenic fungi (Oritsejafor, 1986), and act as a host for insect pests including *Zonocerus variegatus* (Chapman et al., 1986). In regions where there are dry seasons *C. odorata* can be a fire hazard (Englberger, 2009).

The weed's presence in Serengeti district was first documented in Rung'abure village less than five years ago. Since then, the weed has prevailed and its distribution has been increasing fast to areas which were previously not infested. Both croplands and pastureland are affected, and the magnitude appears to increase rapidly with time. This study intended to establish the extent of the spread of *C odorata* in the Serengeti District at the time of the study, and relate it to some biophysical factors from existing database.

2. Methodology

A combination of free and transect field survey was carried out. A total of 28 sites were surveyed where GPS coordinates were taken using a handheld GPD (Garmin) and relative abundance/ level of infestation was estimated. Visual observations and focused group discussion with the local people and district staff where used to provide the information about level of infestation.

Using QGIS open source software, point shape file was created with relative abundance among the attributes. The points were plotted against existing biophysical spatial layers of the study area from different sources.

These included:

Soils (DePauw, 1984)

Agro-ecological zones (DePauw, 1984)

Lithology (Kalensky, 1998)

Landforms (Kalensky, 1998)

3. Results

3.1. Villages infested with C. Odorata (Siam Weed)

Distribution and relative abundance of the Siam weed in the infested areas of Serengeti District is shown in Figure 1. Higher infestations were observed in Marasomocha, Nyamakobiti, Mesaga, Remng'orori and Gusuhi villages. Other villages with high infestation were Nyambureti, Nyichoka, Rung'abure, Gesarya, Nyichoka, Kemgesi and Nyamatoke. Medium infestations were observed in Nyansusura village and parts of Marasomocha Village.

Low infestations were recorded in Nyamihiru, Busane, Magange and parts of Remng'orori village. Other villages with low infestations were Nyangomogo, Rigicha, Nyamisingisi and Mosongo. Observations around Motukeri village showed no infestation at the time of the study.

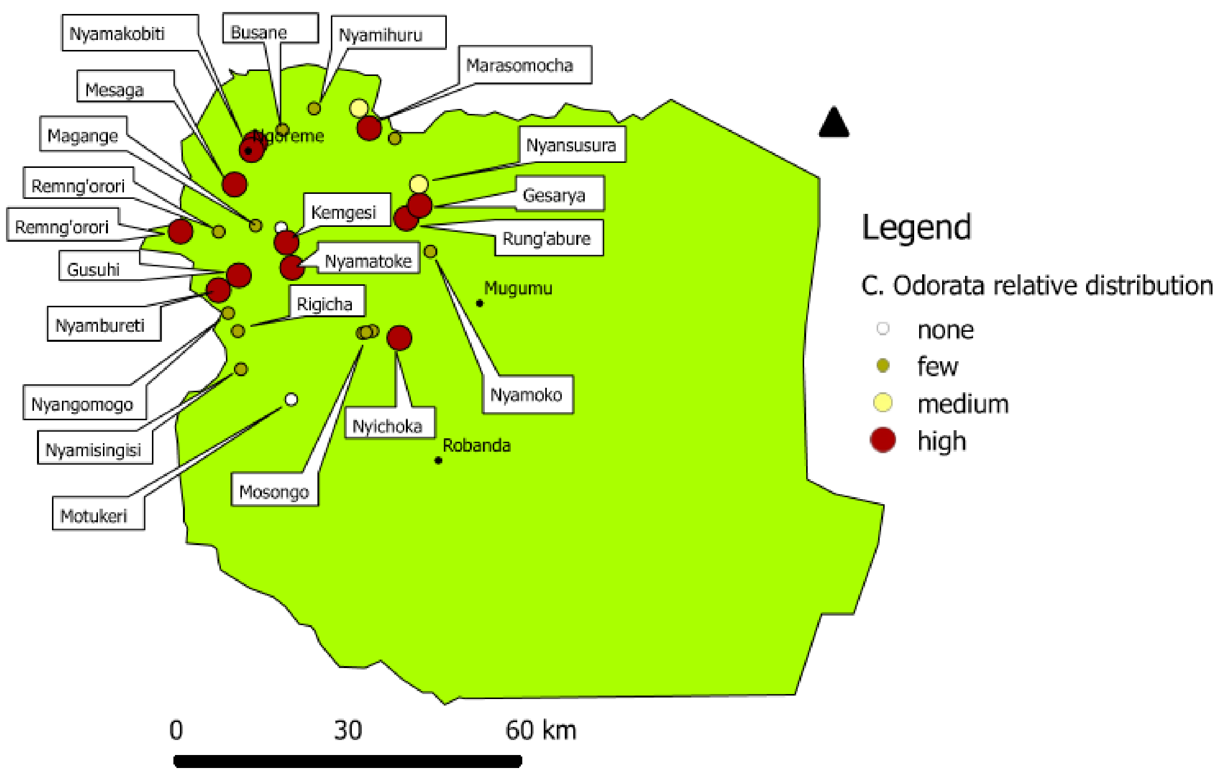

Figure 1. Relative distribution of C. odorata in surveyed villages of Serengeti District.

3.2. Infestation vs soil type

All observations were found to fall on one soil type: Eutric Planosols, or at the boundary with Eutric Leptosols on the 1:2,000,000 scale soil map developed by DePauw (1984) (Figure 2). Eutric Planosols are high base soils with a coarse-textured surface horizon abruptly over a dense and finer textured subsoil. These soils are mostly formed from alluvial and colluvial deposits (IUSS Working Group WRB, 2014). Eutric Leptosols are high base soils with shallow depths. The upper soil horizons of Planosols have weakly expressed and unstable structure. The poor soil structure stability of the topsoil, the compactness of the subsoil, and the abrupt transition from topsoil to sub soil are all disadvantageous for plant rooting. The shallow depths of the Leptosols also challenges rood development of many plants.

The association of the C. odorata with soils characteristically challenging root penetrations in the study area calls for more detailed study. Elsewhere, the weed has been found to thrive in all types of well-drained soil and on soils that are relatively low in fertility (Mandal and Joshi, 2014). Planosols are generally soils with poor fertility status.

It should be noted however, the scale of the soil map used here is coarse to give conclusive results. The map used has a scale of 1:2,000,000. Further soil studies are therefore recommended.

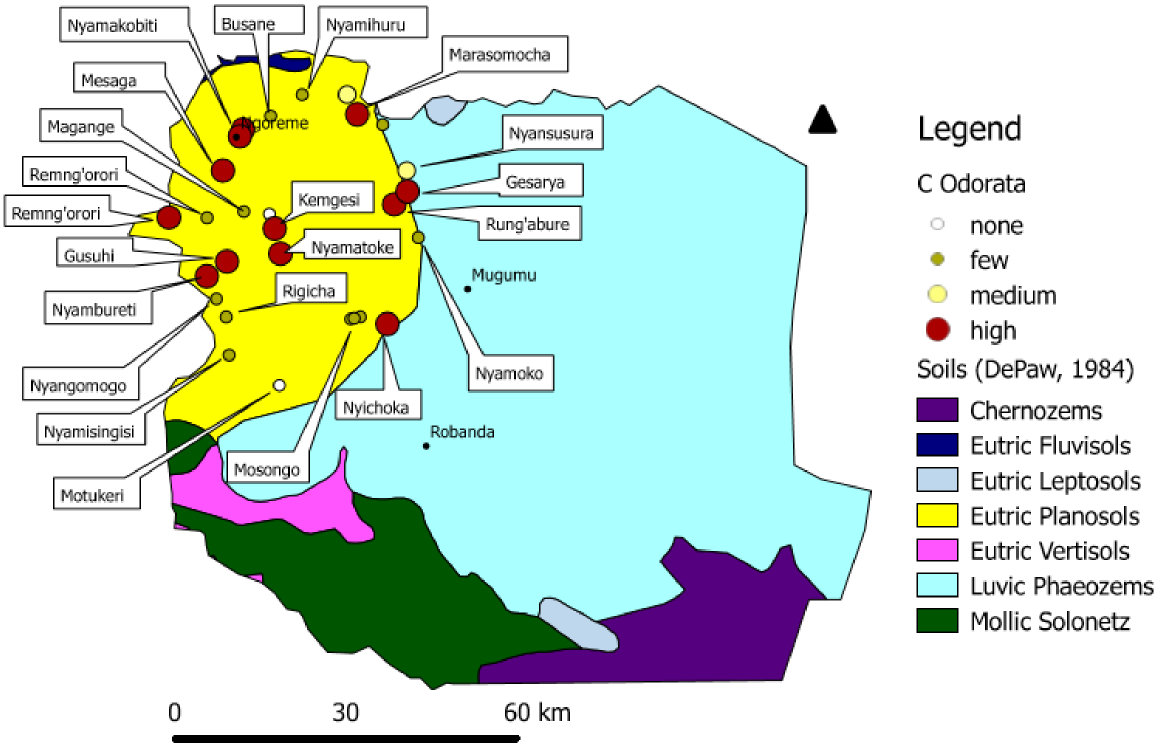

Figure 2. Relative distribution of C. odorata against 1:2,000,000 soil map of Serengeti District.

3.3. Infestation vs soil parent material

The infested area has soils emanating from all three types of rocks (Igneous, Metamorphic, and Sedimentary) as parent materials (Figure 3). Larger parts are covered by metamorphic types of soil parent material. Most of the infested area falls in this part, most likely because it covers a large portion. No clear relationship could be established between the lithology and the Siam weed infestation in the area. However, use of more detailed geological maps would probably give better insights.

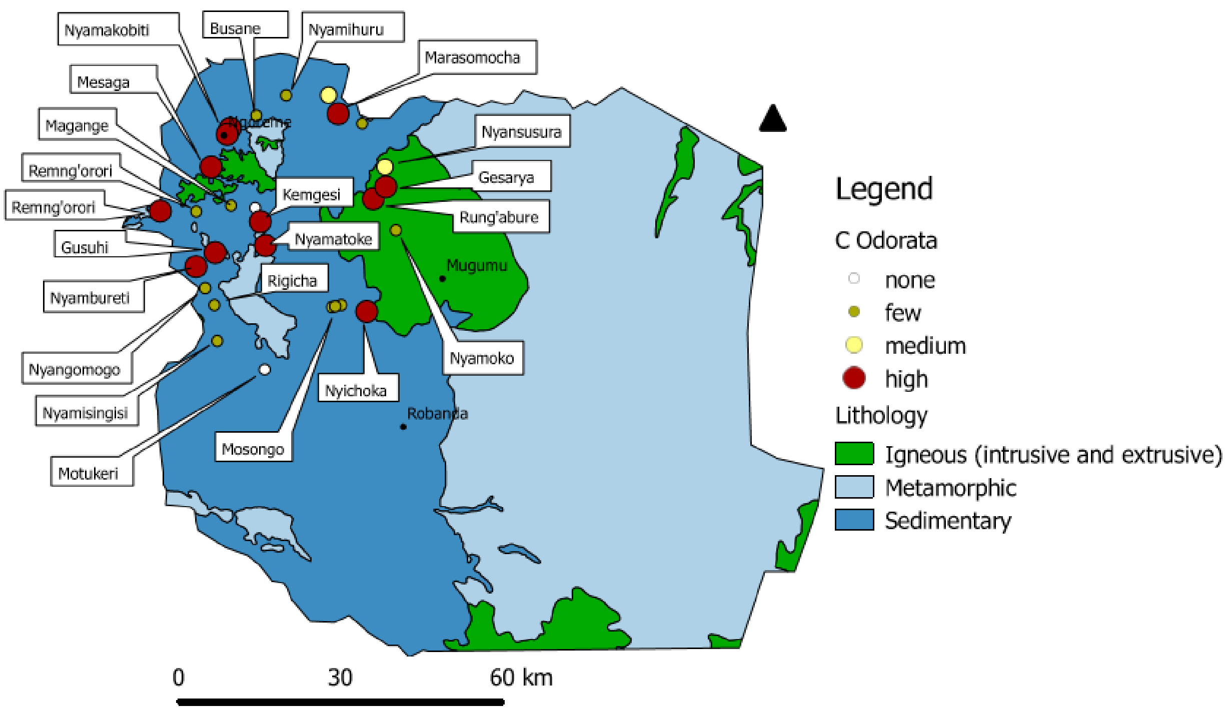

Figure 3. Relative distribution of C. odorata against 1:1,000,000 lithology map of Serengeti District.

3.4. Infestation vs landforms

Most of the infested areas seem to be generally located in the plains and alluvial plains (Figure 4) However, observations in the field proved infestations in the ridges and their footslopes as well. Elsewhere, infestations have been recorded in altitude above 500 m and generally around 2000 m above sea level (Luwum, 2002).

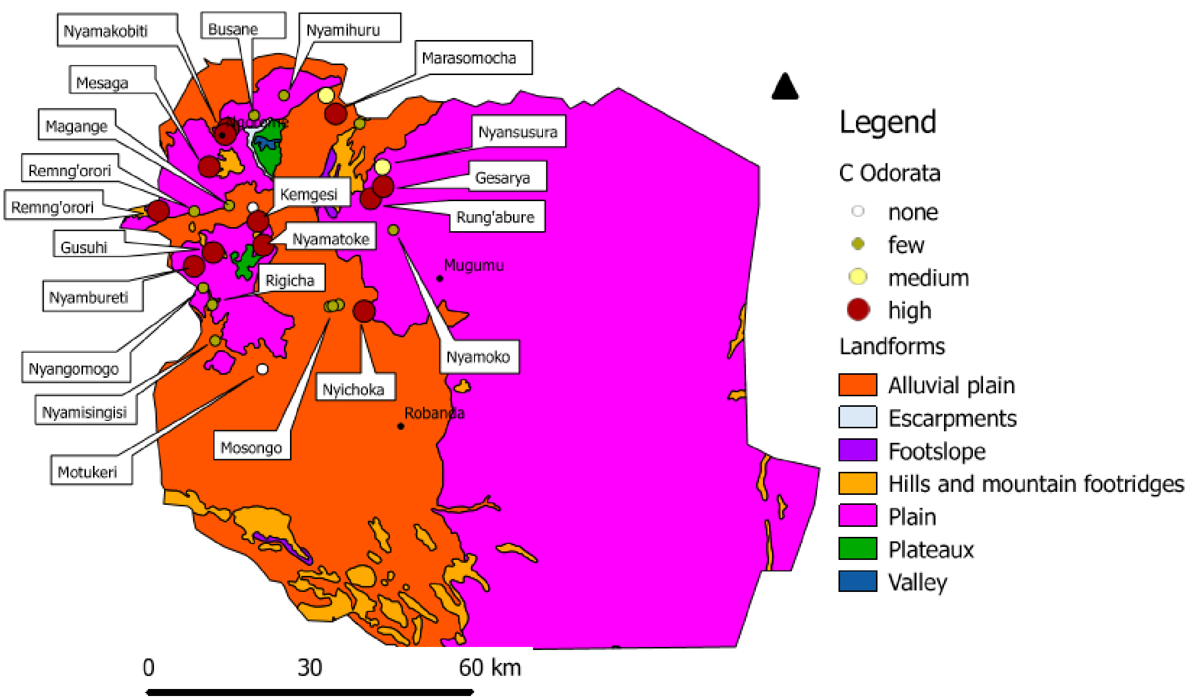

Figure 4. Relative distribution of C. odorata against 1:1,000,000 landform map of Serengeti District.

3.5. Infestation vs agro-ecological zones

The infested area mostly falls in agro-ecological zone P8 (DePauw, 1984) as depicted in Figure 5. The zone is characterized with soil pH ranging from 6.5 – 8. Major soils of the P8 agro-ecological zone are:

- imperfectly drained, shallow, dark grey or brown sands to sandy clays with hardpan within 50 cm from the surface, often calcareous and sodic in the subsoil (ESP 10-15) with moderate natural fertility
- moderately well to imperfectly drained, shallow to deeper, usually calcareous, black, dark grey or brown cracking clays often overlying paler subsoil with ephemeral structure and with high natural fertility
- well drained, moderately deep to deep, red or brown often gravely, sandy loams and sandy clay loams, with weak structure and low natural fertility

The zone mainly covers the hardpan soils with poor moisture storing properties (available water content - AWC 30-100 mm/m). Has important proportions of dark cracking clay soils of topographical depressions with moderate moisture storing properties (AWC 75-150 mm/m); and sandy and medium textured with moderate to high moisture storing properties (AWC 50 – 300 mm/m).

The maximum temperature ranges from 27-30°C and the minimum ranges from 15-18°C. The terrain is generally flat to gently undulating plains developed partly on granites, partly on old colluvium, with the altitude ranging from 1000-1200 m above sea level. The average total annual rainfall ranges from 600 – 1200 mm, with a monomodal pattern supporting one annual crops growth season per year lasting between 3 and 3.5 months.

Since there is no another study in the country to relate performance of Siam weed on different agro-ecological zones, it will not be concluded here that the weed prefer this type of agro-ecological zone. This, therefore calls for further research.

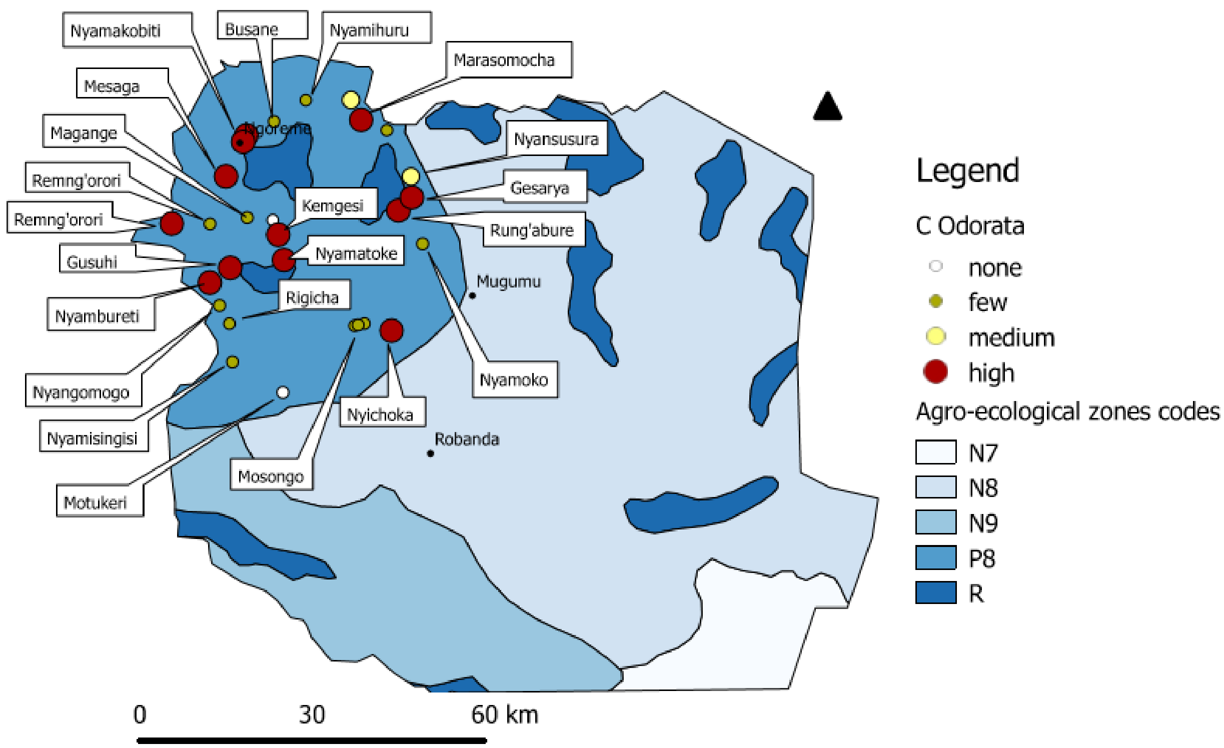

Figure 5. Relative distribution of C. odorata against 1:2,000,000 agro-ecological zones map of Serengeti District.

4. Conclusions

C. odorata has been spotted for the first time in one village of Serengeti District for a period not exceeding five years. Within this short time, the noxious weed has been invading farmlands and pasture at a devastating speed, causing alarm to environmentalists, pastoralists and farmers. This brief study show high infestations in Marasomocha, Nyamakobiti, Mesaga, Remng'orori and Gusuhi villages. Also; in Nyambureti, Nyichoka, Rung'abure, Gesarya, Nyichoka, Kemgesi and Nyamatoke villages. Medium infestations were observed in Nyansusura village and parts of Marasomocha Village. Low infestations were recorded in Nyamihiru, Busane, Nyangomogo, Rigicha, Nyamisingisi, Mosongo, Magange and parts of Remng'orori village. Some villages are not yet infested with the weed.

Though not conclusively, the distribution of the weed in the study area is associated with high base, root restrictive soils developing mainly from metamorphic rocks. The infested area mostly falls in agro-ecological zone P8 with soil pH ranging from 6.5 – 8. The zone mainly covers the hardpan soils with poor moisture storing properties (available water content - AWC 30-100 mm/m), and generally flat to gently undulating plains terrain on 1000 – 1200 m altitude. The average total annual rainfall ranges from 600 – 1200 mm, with a monomodal pattern supporting one annual crops growth season per year lasting between 3 and 3.5 months.

Further studies are highly recommended to ascertain the relationships between C. odorata distribution and the above biophysical parameters

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