

Distribution of invasive plant species *Prosopis juliflora*
(mesquite) in relationship to biophysical factors in Rombo,
Mwanga, and Same Districts

Report by:

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1. Introduction

Prosopis juliflora is among aggressive invaders in tropical, arid and semi-arid natural grasslands. This plant which belongs to the Fabaceae family is native to Mexico, South America and the Caribbean, has become established as an invasive weed in many places including Africa (<http://www.cabi.org/isc/datasheet/43942>).

In many areas where it is not native, the plant was firstly intentionally introduced and planted for soil and water conservation purposes, ornamental, as well as for fuelwood and fodder (Choge et al., 2002; de Souza Nascimento, 2014). Its competitive advantage over other vegetation is based on its ability to fix nitrogen and its tolerance against drought and soil saline condition (Felker et al., 1981; Khan et al., 1986; Singh 1996). Its thorniness and bushy habit enable it to quickly block paths and make whole areas impenetrable for human and livestock.

P. juliflora tree is 3-12 m tall, with spreading woody cylindrical branches. It is more or less round- or flat-topped with persistent green foliage and somewhat spiny (Burkart, 1976). The plant grows in a wide range of soils - from sandy to clayey soils. It is generally found in areas where water and soil fertility are the principal agents limiting plant growth.

Prosopis species are generally cross-pollinated (Simpson, 1977), although some limited self-pollination (4%) has been observed in *P. juliflora* (Sareen and Yadav, 1987). The tree produces a very large numbers of flowers, but few are fertile with high rates of ovary abortion (Goel and Behl, 1995).

Negative impacts of the tree include loss in agricultural and pasture productivity, biodiversity loss due to its suppression power, and deaths of livestock due to eating of the pods produced by the tree (Choge et al., 2002). Its pollen has been identified among the respiratory allergens in tropical countries (Killian and McMichael, 2004; Dhyanani et al., 2006). Positive benefits include production of fuelwood, charcoal, timber and sale of the pods to the feed processing industry (Maundu et al., 2009). The tree is also widely planted for soil conservation, hedgerows, and as an ornamental tree (Pasiiecznik et al., 2001).

This study intended to identify areas already infested with the tree in Rombo, Mwanga, and Same districts; and to relate their spatial distribution with biophysical factors such as soils, lithology, landforms, and agroecological zones

2. Methods

A combination of free and transect field survey was carried out. Names and GPS coordinates of sites where *P. juliflora* infestation was noted were recorded in a field form.

Using QGIS open source software (QGIS Development Team, 2014), point shape file was created showing site names. 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. Areas infested with *P juliflora*

Areas with *P juliflora* are shown on Fig 1. In Rombo district, infestations were recorded in near Lake Chala, Mbitini, Lotima and Holili areas. In Mwanga district, areas infested included Kilewo, Kivulini, Kituri, Handeni and Lang'ata Bora. The last two areas are bordering Nyumba ya Mungu dam, and the *P juliflora* trees were grown for conservation purpose. Very dense thickets were observed in Lang'ata Bora at the shores of the Dam. During the survey, no *P juliflora* infestation was observed. However, discussion with natives suggested that the tree is present in some areas within the district, especially close to Pangani River.

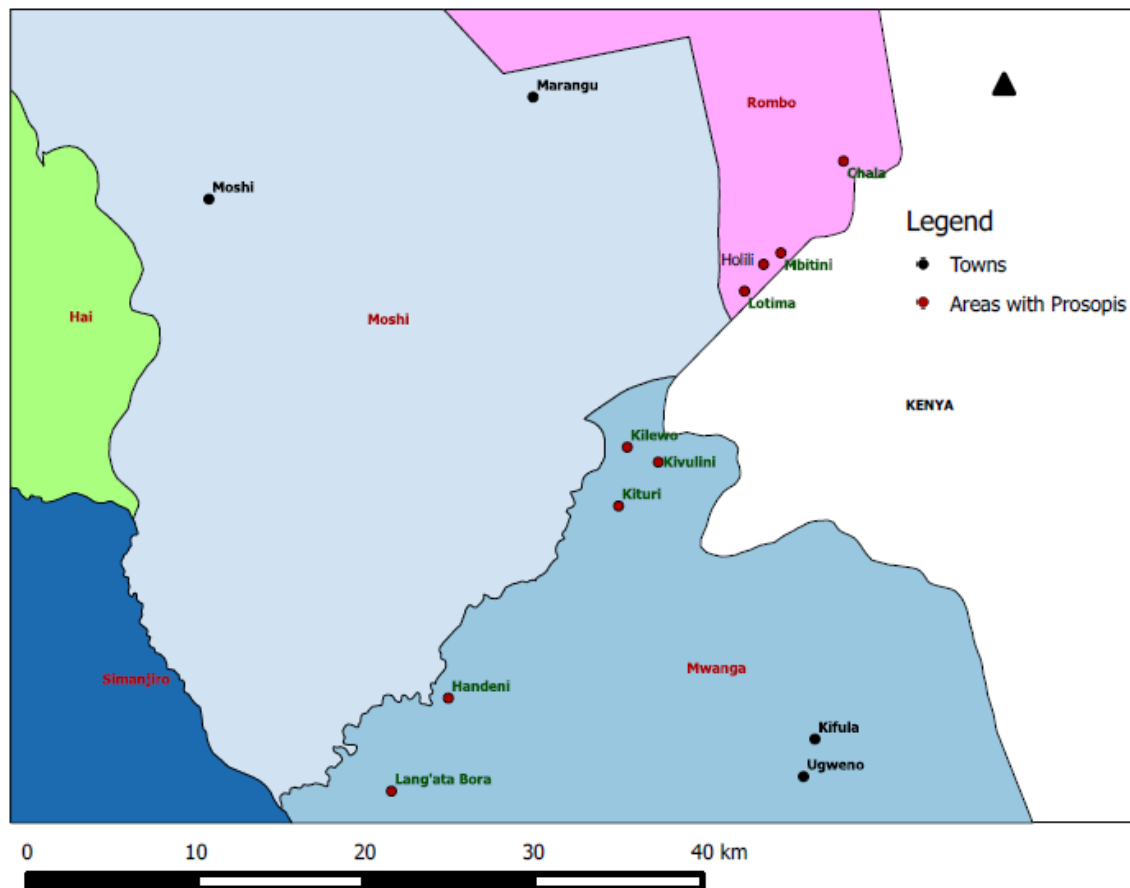


Figure 1. Areas infested with *P juliflora* in Rombo and Mwanga districts

3.2. Infestation vs soil types

All the areas identified to have *P. juliflora* infestation in the surveyed Rombo and Mwanga districts notably fall on landscapes with type of soil known as Chromic Luvisols (Fig. 2). Characteristically, Luvisols have pedogenetic clay differentiation where subsoils have higher clay content due to migration from the topsoil. The subsoils of Chromic Luvisols are strong brown to red in colour. The soil contains high activity clays and high base saturation. Luvisols are generally young and fertile soils (IUSS Working Group WRB, 2014).

Studies, however, have indicated that soil nutrient status and soil type are not as limiting factors to the growth of the tree, as compared to other plants. The plant can fix nitrogen, thus nitrogen, which is commonly a limiting factor in many plants is not commonly an issue with this plant. The plant can survive in conditions of high soil pH (Singh, 1996), high soil salinity (Felker et al., 1981) and high soil water deficits (Felker et al., 1982). Other macronutrients can occasionally be limiting, however (Sharma, 1984). The plant also does not do well in acidic soils (Pasiiecznik et al., 2001).

However, the soil map resource used has a lot of generalizations due to its coarse scale of 1:2000000. This restricts making of conclusive statements on the relationship between distribution of *P. juliflora* and soil properties of the study area. A more detailed soil study will be helpful in substantiating this striking observation.

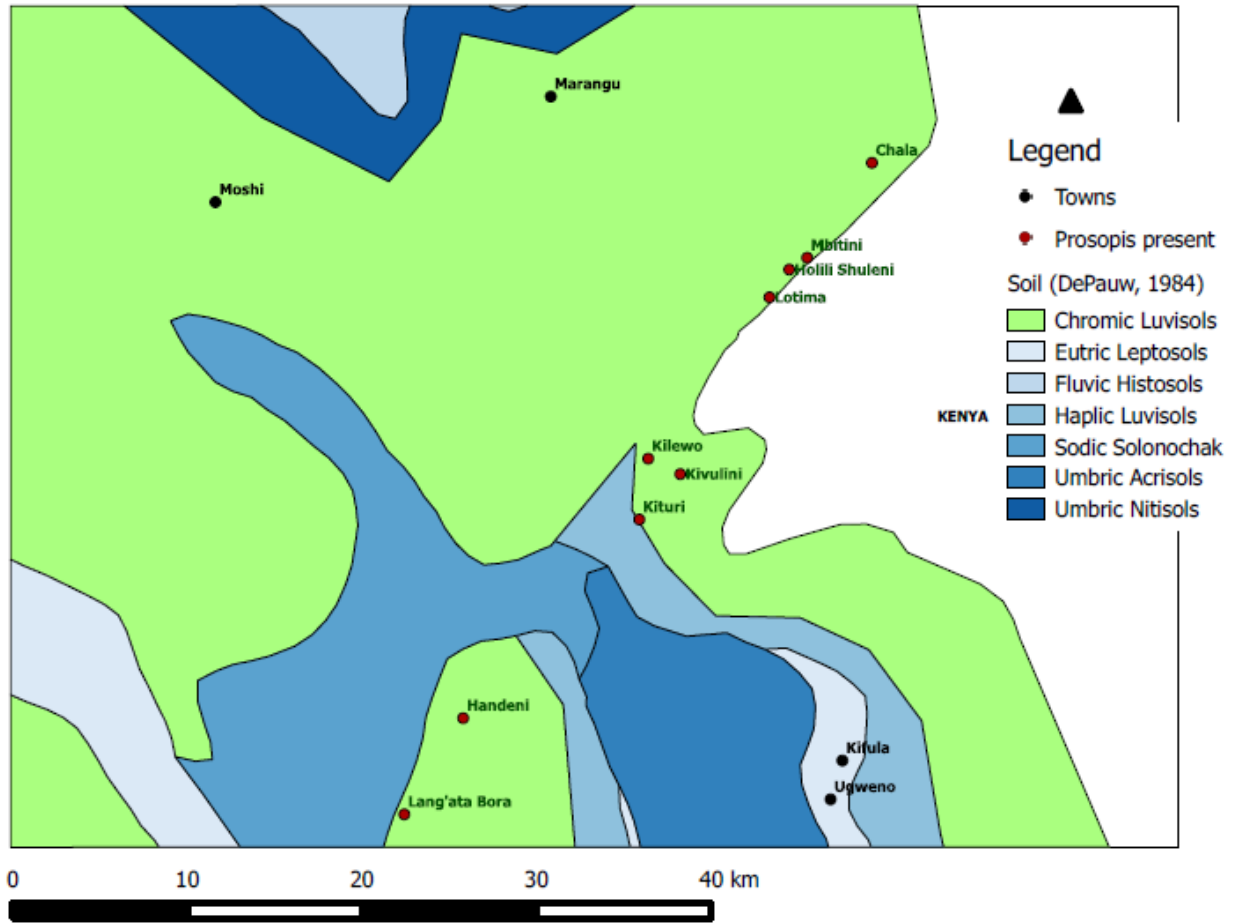


Fig. 2: locations of *P. juliflora* infested areas against soil types

3.3. Infestation vs soil parent material

Figure 3 below shows the areas where *P. juliflora* was identified to grow against the soil parent material. Except for Chala and Mbitini areas in Rombo district where soil parent material was igneous rocks, the rest of the areas (7 sites) infested by the tree are on soils formed from sedimentary rocks. A further study is needed about mineralogy of the rocks since that information is not available from the resource used to provide the lithology map. A finer scale geological map like the 1:135000 quarter degree sheets by Geological Survey Agency may provide better lithological information than the 1:1000000 freely available lithology map (Kalensky, 1998) used in this exploratory study.

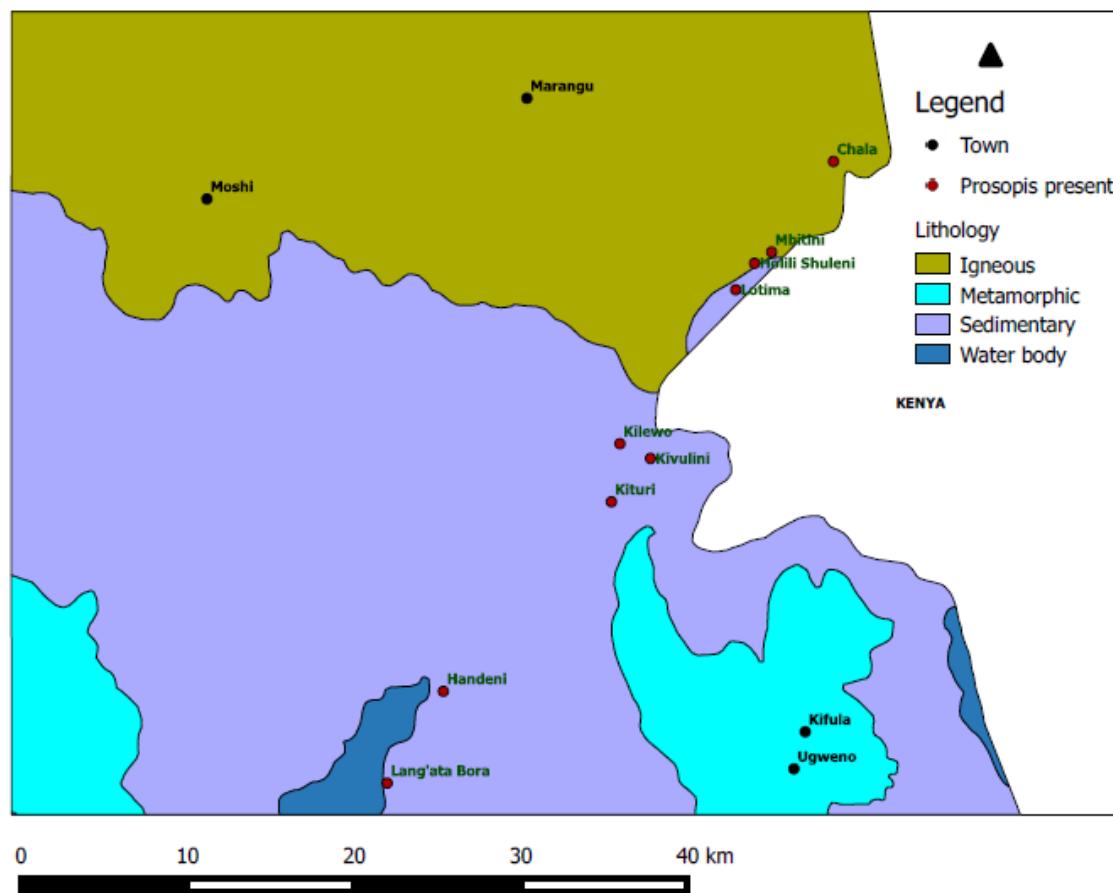


Fig. 3: locations of *P. juliflora* infested areas against soil parent materials

3.4. Infestation vs landforms

Infestations were recorded on mountain footslopes, alluvial plains and depressions (Fig. 4). None was recorded on mountains or footridges.

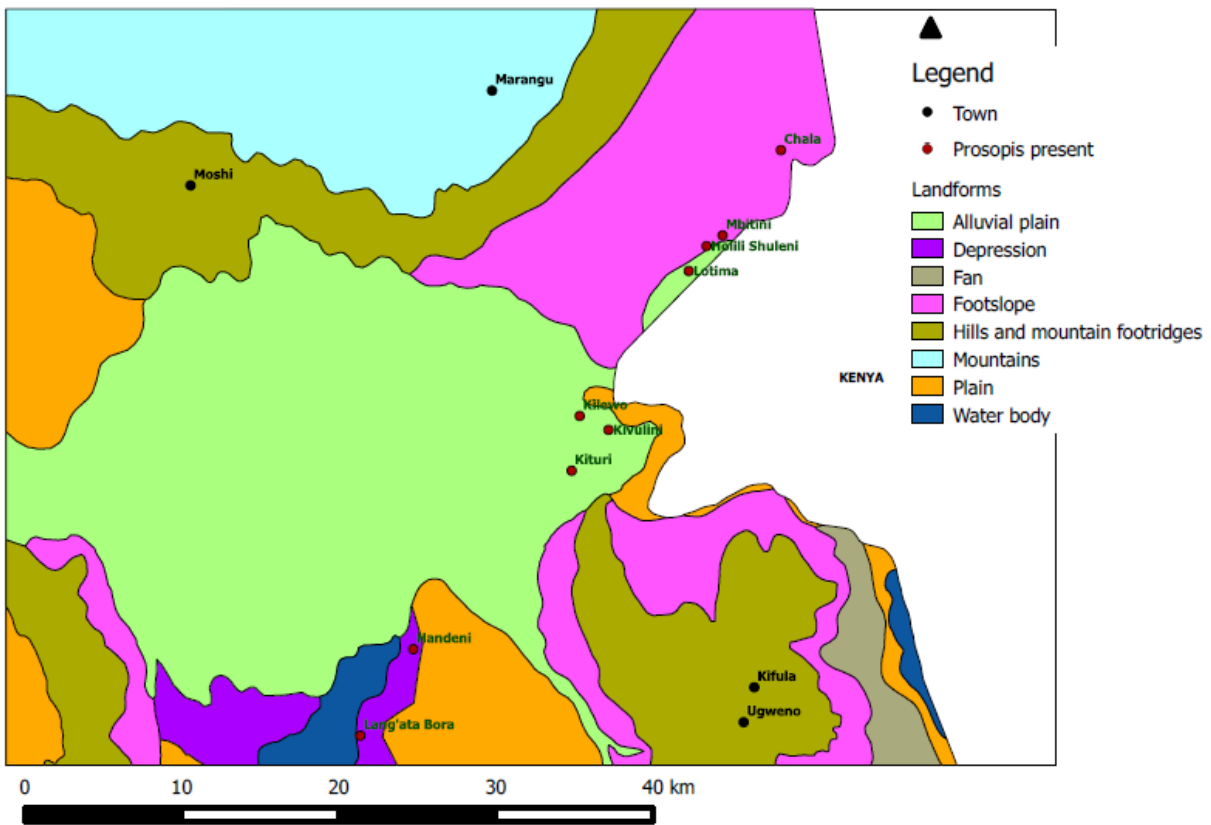


Fig. 4: locations of *P. juliflora* infested areas against landform types

3.5. Infestation vs agro-ecological zones

Infestations were recorded in areas with agro-ecological zones (AEZ) coded E1 and E8 (Fig. 5).

E1 has soils with pH between 5 and 7, maximum temperature between 27 and 30 °C, and minimum temperature between 15 and 18 °C. Altitude of the AEZ ranges between 500 and 1200 m above sea level (asl), and the annual rainfall ranging from 400 to 500 mm in a monomodal pattern supporting one growing period for crops of less than 2 months (DePauw, 1984).

The E1 AEZ includes landscapes which are generally well drained, gently undulating to rolling plains including some poorly drained, flat and wide topographical depressions developed on young alluvium. Dominant soils are moderately deep to deep, dark reddish brown, yellowish red or red sandy clay loams and sandy clays with weak or moderate structure and low natural fertility. Some spots have soils which are moderately well to imperfectly drained, deep, brown, pale yellow, light grey or white mottled sands and loamy sands with poor structure and very low natural fertility. The soils are medium to heavy textured with moderate available water content - AWC (70-120mm/m) and poor moisture acceptance due to surface sealing.

The AEZ E8 is characterized by landscapes which have soil pH between 5.5 and 8.5, maximum temperatures between 27 and 31 °C, and minimum temperatures between 15 and 23 °C. The altitude of the landscape is around 1200 asl, and the annual rainfall is 500-600 in a monomodal pattern.

E8 AEZ is located in flat (flood plains) alluvial plains with poorly drained, clayey soils, severely affected by salinity. Major soils are alkaline and saline with different colours, textures, structures, consistence and drainage but with fertility status and moisture storing properties adversely affected by presence of exchangeable sodium and or soluble salts at high levels enough to interfere with growth of most crops. The zone also consists of an important proportion of dark cracking clays present on topographical depressions. These depressions have moderate to high natural fertility.

Both E1 and E2 AEZs have characteristics which may be limiting to other plants such as low soil fertility status, poor water holding capacity and salinity. But, as discussed in other sections of this document, *P. juliflora* is not much affected by these limiting factors.

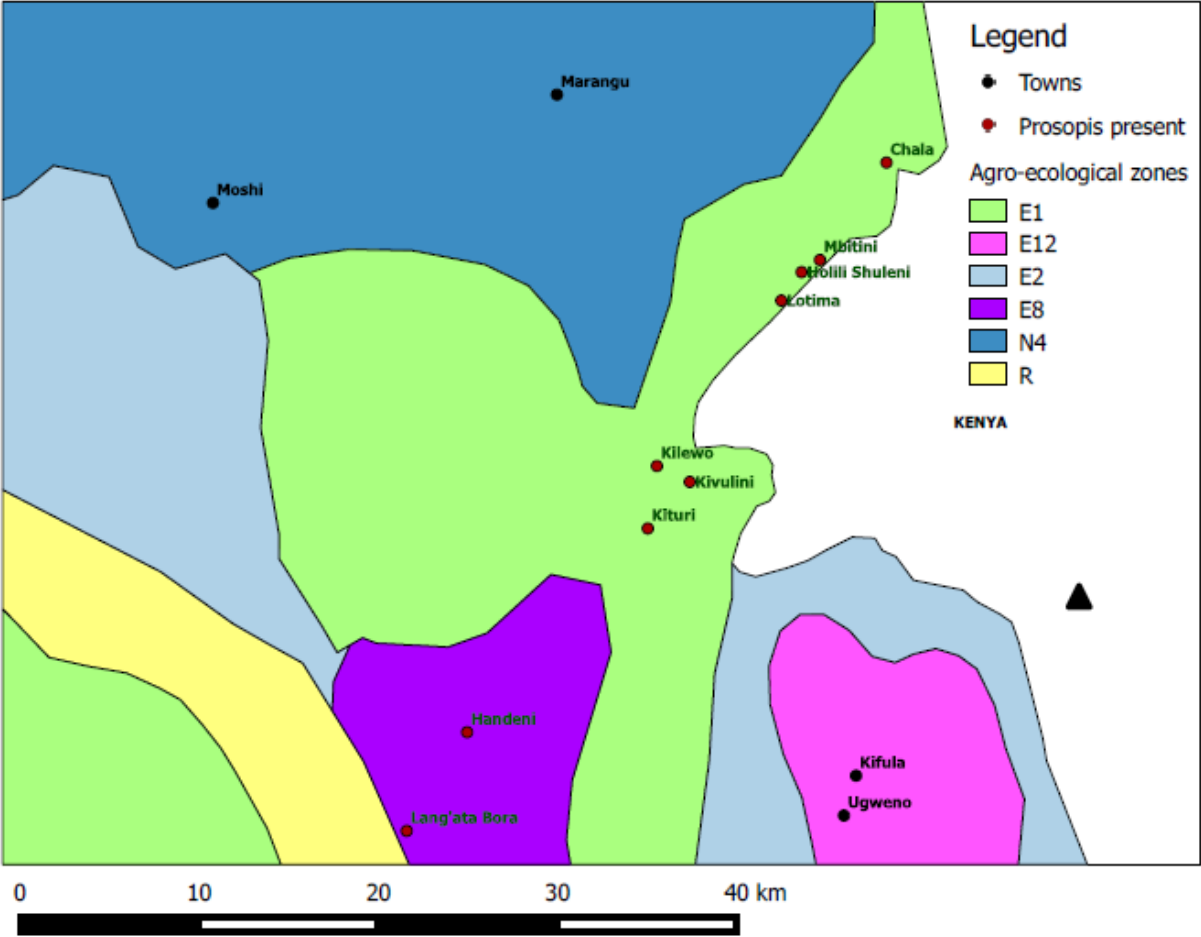


Fig. 5: locations of *P. juliflora* infested areas against agro-ecological zones

4. Conclusion

This work intended to identify areas infested by an invasive species *P. juliflora* in Rombo, Mwanga and Same districts. It also intended to relate the infestation with biophysical factors using available spatial information. Infestations were observed in Rombo and Mwanga districts. Areas visited in Same district did not have *P. juliflora* infestations. However this does not conclude absence of the tree, since not the entire district was covered by the survey.

This preliminary study in Rombo and Mwanga districts shows that *P. juliflora* is associated with Chromic Luvisols; soils developed from igneous and sedimentary rocks. Infestations were observed predominantly on mountain footslopes, alluvial plains and depressions.

Infestation were also associated with agro-ecological zones consisting of high pH and saline soils located generally on somewhat flat terrains and monomodal rainfalls ranging from 500 – 1200 mm per year.

Resources used in this preliminary study are of coarse spatial resolution. It therefore suggested that a more detailed study be done to get more insights on the relations between the distribution of *P. juliflora* and the biophysical factors.

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