SOCIO-ECONOMIC IMPACTS OF Parthenium hysterophorus L. IN EAST SHEWA AND WEST ARSI ZONES OF ETHIOPIA

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Abstract

Parthenium hysterophorus L. is non-native invasive plant species belongs to the family Asteraceae. Currently it is a notorious weed in Ethiopia. Socio-economic impacts as well as the local people’s perception towards P. hysterophorus are poorly understood. Thus, the aim of this study was to generate information for a better understanding of the means of dispersal, source introduction and socio-economic impacts, of P. hysterophorus in East shewa and West arsi Zones of the Oromia Regional State of Ethiopia. The study revealed that parthenium was introduced mainly by following vehicles road and railways. This weed grows throughout the year. This results in its fast dispersal. Many mechanisms were assumed by respondents for fast distribution of P. hysterophorus in the study zones. Among these vehicles and wind are the major agents, which proliferate the seeds of the weed. Based on the study it grows in roadsides, grazing land, cropland, village sides and wastelands. Most of respondents also indicated that the weed first appeared on roadside and propagated to other habitats. This finding indicated that the weed high in disturbed habitats. Control methods, which are mostly practiced by local people, were tillage and hand weeding. However, these methods were not an efficient to control the weed distribution; rather it is expanding from time to time since its invasions. P. hysterophorus has a number of socio-economic impacts that include effect on crop and livestock production, human health, soil fertility and biodiversity. This finding showed that it competes and suppress the growth of crops due its allelopathic nature. Seeds of this weed changes the normal flavor of food when mix with it. It also colonized grazing fields, thus causing animal food scarcity, animals’ health defect. This finding also reported that P. hysterophorus has health hazards on human being, which include allergic, skin itching (irritation), cough and hemorrhage. Generally, P. hysterophorus is a foremost troublesome weed and subterfuge threat on agriculture, biodiversity and on human health. Therefore, proper and targeted control methods should be employed to control the further spread and reduce the adverse impacts.

Keywords: Parthenium hysterophorus, Socio-Economic Impact, Health Impact, Allelopatic Effect

Introduction

Parthenium hysterophorus belongs to the family Asteraceae, an extremely diverse family with a cosmopolitan distribution. It has been further classified under the tribe Heliantheae and subtribe Ambrosiinae. It is described as an annual, procumbent, diffused leafy herb with a height of 0.5 - 1.50 m, reaching a maximum of 2 m in good soils (Parsons and Cuthbertson, 1992).

P. hysterophorus was regarded to be introduced accidentally through aid shipments or from Somalia during Ethio-Somali war in 1976/77 (Besufekad et al., 2005; Taye, 2002). Its invasion expanded at alarming rate in all directions mainly following slope gradient and colonizing substantial areas in Ethiopia (Belachew and Tessema, 2015; Niguse et al., 2016). Even though, there are different factors that favor fast distribution of the weed, flooding and movement of vehicles are the major factors. This radiation occurs particularly in the direction of low slope and waterways (Adane, 2008).

P. hysterophorus clearly poses a major threat to rangelands, croplands and cause health problems of animals and human despite its management was suggested with different scholars (Kifle et al., 2011). Overall impact on crop production system is multifaceted, both direct and indirect by affecting grazing land, animal health, milk and meat quality, and marketing of pasture seeds and grain. The main impact of parthenium on crops relates to its allelopathic properties. The chemicals significantly inhibit the germination
and subsequent growth of a range of crop plants (Navie et al., 1996; Evans, 1997). Jayachandra (1971) stated that the parthenium can be a serious problem in grasslands and can reduce the pasture carrying capacity by up to 90%. It is also known to cause human health problems like asthma, bronchitis, dermatitis, and hay fever (Kololgi et al., 1997; Srirama Rao et al., 1991). Evans (1997) and Towers and Subba Rao (1992) also reported that close contact with P. hysterophorus could cause allergic contact dermatitis while inhalation of pollen can cause allergic rhinitis, which can develop into bronchitis or asthma in susceptible humans. Even though parthenium is causing severe damage, on crop production, animal husbandry, and biodiversity in Ethiopia, there is no adequate information available with regard to impact of P. hysterophorus in East Shewa and West Arsi. Thus this study initiated with the objectives of to assess community perception on means and source of introduction, dispersal, habitats infested and practices to control P. hysterophorus in the study area and to assess the socio-economic impacts of P. hysterophorus in study area.

Materials and Methods

To congregate information about socio-economic impacts as well as the local people’s perception towards the parthenium in the study area, data were collected through semi-structured questionnaires. The questionnaires were provided to farmers, development agents (DAs), experts in the different levels of Minster of agriculture who were involved in addressing the impact of parthenium.

Depending on the severity of the invasion and distribution of parthenium in the Zones, respondents in the districts were stratified into highly invaded, medium invaded and non-infested areas based on preliminary survey and group discussion conducted with the zonal agricultural experts to investigate the economic impacts of parthenium under varying infestation.

This approach allowed comparison of results from infested areas with areas not yet infested. The latter areas served as a ‘control’ and without control communities, it would be difficult to determine the effect of the invasive species on the target group (Wittenberg, 2004). A total of 183 respondents among households, DA’s and experts were selected using systematic sampling technique.

General characteristics of respondents

The respondents have different occupation and source of income. Of all respondents, 56% are farmers, 27% pastoralist, 14% development agent and 3% are experts. The age of the overall sample respondents ranged from 20 to 70. Age is important to estimate year at which parthenium introduced and to compare the problems and impacts before and after introduction.

Of all the total respondents, 77% were able to read and write and they attended formal education from elementary to university. About 56% of all the respondents had attended elementary education, 16% of all the sample farmers had attended second cycle elementary education, 6% of the overall sample respondents had completed high school education and 16% had received diploma and above. Education is crucial to understand the newly emerging problems and their impacts. This is in line with Senayit et al. (2004) which state that education is one of the most important factors that affect the dissemination and adoption of new technologies. Several studies indicate that farmers who attended some level of formal schooling are more likely to adopt new technologies. The fact that a large proportion of the sample farmers in this study are able to read and write, provides a good opportunity to design appropriate technology dissemination and utilization strategies. Both men and women were interviewed with women accounting for 24% of the total sample size.

Table 1. Occupation and education level of respondents in East Shewa and West Arsi Zones, ONRGS.

| Occupation | Frequency | Percent | Education level | Frequency | Percent |
|------------|-----------|---------|-----------------|-----------|---------|
| Farmer     | 103       | 56      | Illiterate      | 42        | 23      |
| Pastoralist| 49        | 27      | Elementary      | 102       | 56      |
| DAs        | 26        | 14      | High school     | 10        | 5       |
| Expert     | 5         | 3       | 10+3 and above  | 29        | 16      |
| Total      | 183       | 100     | Total           | 183       | 100     |

Techniques of data analysis

The questionnaires were coded and the data entered in Computer for analysis. The socioeconomic data were analysed by using SPSS Version 16.0 software.

Results and Discussion

Respondents’ perception on P. hysterophorus means and source of introduction, dispersal, habitats infested and practices to control
Most of respondents in the study area knew the impacts, source of introduction and means of dispersal of parthenium. In high infestation category, all respondents became aware about the weed. However, despite their awareness the rate of infestation increasing from time to time, this may be because of improper action was not done by different stakeholders. In addition, the communities were not mobilized to take action on the weed.

Respondents’ perception on means and source of introduction

This finding also indicated that 88%, 63% and 43% of respondents in high, medium and non-infestation category were perceived that parthenium was introduced by following vehicles road and rail ways. It also introduced by wind, animal, water and human as indicated in table (Table 2). According to many authors *P. hysterophorus* was introduced to certain area by different means.

Table 2. Respondent perception on means of introduction of parthenium into East Shewa and West Arsi zones, Ethiopia.

| Means of introduction | High infestation N=60 | Medium infestation N=60 | No infestation N=40 | Overall sample |
|-----------------------|-----------------------|------------------------|---------------------|---------------|
|                       | n (%)                 | n (%)                  | n (%)               | n (%)         |
| Vehicles              | 53 (88)               | 38 (63)                | 17 (43)             | 108 (68)      |
| Wind                  | 33 (55)               | 27 (45)                | 17 (43)             | 77 (48)       |
| Water (flood)         | 26 (43)               | 12 (20)                | 10 (25)             | 48 (30)       |
| Animal                | 31 (52)               | 14 (23)                | 9 (23)              | 54 (38)       |
| Human                 | 14 (23)               | 2 (3)                  | 1 (3)               | 17 (11)       |

According to respondents in all categories, source of introduction of *P. hysterophorus* was foreign country (57%) and Dire-dawa (23%). Whereas, 16% of respondents believed that it came from nearby districts through different means (Table 3).

Respondents’ perception on means and source of introduction is in line with the study of other scholars’ speculation. Tamado *et al.* (2002) reported that in Ethiopia, it is believed to have been introduced in 1976/77 with army vehicles from Somalia and has become a serious weed both in arable and grazing lands. GISP (2004) also reported that parthenium weed was first seen in 1980s near food-aid distribution centers in Ethiopia. According to Taye *et al.* (2004) the presence of *Puccinia abrupta* on parthenium weed in Ethiopia might also explain indirectly the introduction of parthenium weed from neighbouring countries.

Table 3. Respondents’ perception on source of introduction of *P. hysterophorus* in East Shewa and West Arsi Zones, Ethiopia.

| Source of introduction | High infestation N=60 | Medium infestation N=60 | No infestation N=40 | Total N= 160 |
|-----------------------|-----------------------|------------------------|---------------------|-------------|
|                       | n (%)                 | n (%)                  | n (%)               | n (%)       |
| Foreign               | 43 (72)               | 31 (52)                | 17 (43)             | 91 (57)     |
| Dire-Dawa             | 22 (37)               | 14 (23)                | 1 (3)               | 37 (23)     |
| Near Districts        | 5 (8)                 | 14 (23)                | 7 (18)              | 26 (16)     |
| I do not know         | 1 (2)                 | 8 (13)                 | 16 (40)             | 22 (14)     |

Respondents’ perception on dispersal of *P. hysterophorus*

According to 95% of respondents in high infestation category and 85% in medium infestation, *P. hysterophorus* grows through out of the year. Fifty-five of respondents in non-infestation category also believed that the weed grows all time in the year. This results in its fast dispersal. All respondents in high infestation category and 83% in medium infestation perceived that *P. hysterophorus* is highly invasive.

Many mechanisms were assumed by respondents for fast distribution of *P. hysterophorus* in the study zones. These dispersal mechanisms include vehicles (65%), wind (55%), flood (46%), livestock (45%), seeds (41%) and construction materials (28%). Among these vehicles and wind are the major agents, which proliferate *P.
**Respondents’ perception on habitats infested**

According to the respondents in high infestation category roadside (98%), pastoral (97%), village (95%), crop land (92%) and waste land (67%) were the highly infested habitats, while respondents in no infestation category observed parthenium on roadside (25%), pastoral (25%), village (24%), crop land (25%) and wasteland (20%) in nearby districts (Table 5). Most of respondents also indicated that the weed first appeared on roadside and propagated to other habitats. This finding indicated that the weed was very high in disturbed habitat. This is in line with Taye (2002) who stated that parthenium weed population was high in places where the soils are disturbed constantly for purposes of construction of road, buildings, and waterways for irrigation channels. Therefore, the extensive density along roadsides might be due to the routine disturbance and grading of road verges and transportation of sands and gravels from parthenium weed infested to non-infested areas.

**Table 5. The infested habitats with *P. hysterophorus* in East Shewa and West Arsi Zones.**

| Infested habitats | High infestation N= 60 | Medium infestation N= 60 | No infestation N= 40 | Total N= 160 |
|-------------------|------------------------|--------------------------|---------------------|-------------|
| Road side         | 59 (98)                | 57 (95)                  | 95 (10)            | 126 (79)    |
| Pastoral          | 58 (97)                | 28 (47)                  | 10 (25)            | 96 (60)     |
| Village           | 57 (95)                | 57 (95)                  | 9 (24)             | 123 (77)    |
| Crop land         | 55 (92)                | 50 (83)                  | 10 (25)            | 115 (72)    |
| Waste land        | 40 (67)                | 35 (58)                  | 8 (20)             | 83 (52)     |

**Respondents’ practices to control *P. hysterophorus***

Control methods, which are mostly practiced by local people, were tillage and hand weeding (63%). Chemicals (45%) also used to reduce the impact of parthenium from their field crop. However, these methods were not an efficient to control parthenium weed distribution; rather it is expanding from time to time since its invasions. Taye (2002) reporting on current management practices stated that the control of Parthenium is entirely based on cultural and labour intensive practices such as tillage, hand weeding, mowing, hoeing and slashing. Small-scale farmers prepare their land using repeated oxen ploughings and/or hoeing. Because of Parthenium extended tap-root system deep into the soil, mature plants of Parthenium are difficult to uproot. Hence, ploughing aimed at the control of Parthenium should be done at its early period of growth.

**Impacts of *P. hysterophorus***

The respondents interviewed and suggested that *P. hysterophorus* has a number of socio-economic impacts that include effect on crop and livestock production, human health, soil fertility and biodiversity.

**Impact of parthenium on crop production**

Of the interviewed respondents, 93% in high infestation category and 87% in medium...
infestation were aware of the impact of the weed on crop. They reported that after introduction of this noxious weed, yield of crops reduced (74%). These finding also indicated that seeds *P. hysterophorus* change the normal flavor of food (69%) when mix with it, suppress the growth of crops (69%), and cause loss of soil fertility (42%). This finding showed that the *P. hysterophorus* compete and suppress the growth due its allelopathic nature. The chemical also reduces the fertility of soil. This in line with Navie *et al.* (1996) and Evans (1997) who reported that the main impact of parthenium on crops relates to its allelopathic properties. The chemicals significantly inhibit the germination and subsequent growth of a range of crop plants.

Table 6. Respondents’ perception on effects of *P. hysterophorus* on crop production in East Shewa and West Arsi Zones, Ethiopia.

| Effect on crop production                  | High infestation N= 60 | Medium infestation N= 60 | No infestation N= 40 | Total N= 160 |
|-------------------------------------------|------------------------|--------------------------|---------------------|--------------|
| Yield loss                                | n = 56 %               | n = 52 %                 | n = 10 %            | n = 118 %     |
| Change normal flavor of food              | n = 54 %               | n = 46 %                 | n = 10 %            | n = 110 %     |
| Suppress crop growth                      | n = 50 %               | n = 41 %                 | n = 20 %            | n = 111 %     |
| Loss of soil fertility                    | n = 46 %               | n = 19 %                 | n = 2 %             | n = 67 %      |

*Effect on livestock production*

Impacts of *P. hysterophorus* on animal productivity were recognized by many respondents. Its impact on grazing land was reported by 98%, 80% and 35% of the respondents in high, medium and non-infestation, respectively (Table 7). Large number of respondents incited that grass species are disappearing from the area furthermore their livestock endangered. This indicated that the weed colonized grazing fields, thus causing feed scarcity. This agrees with report of the Jayachandra (1971) who stated that the weed can be a serious problem in grasslands in and can reduce the pasture carrying capacity by up to 90%.

Respondents in all categories also reported that the milk (53%) and meat (46%) of animals that graze on *P. hysterophorus* infested field is bitter and not palatable. Sixty three percent (63%) of respondents also reported that animals feed on parthenium dominate grazing land lost weight and get diarrhea. In high infestation places *P. hysterophorus* could completely overlook grazing field, resulting in displacing grass species and animals forced to eat the weed especially during dry season.

Table 7. Respondents perception on effect of *P. hysterophorus* on livestock production in East Shewa and West Arsi Zones, Ethiopia.

| Effect on life stock                  | High infestation N= 60 | Medium infestation N= 60 | No infestation N= 40 | Total N= 160 |
|--------------------------------------|------------------------|--------------------------|---------------------|--------------|
| Grazing land                         | n = 59 %               | n = 48 %                 | n = 14 %            | n = 121 %    |
| Animal Health                        | n = 52 %               | n = 40 %                 | n = 8 %             | n = 100 %    |
| Milk Product                         | n = 39 %               | n = 39 %                 | n = 7 %             | n = 85 %     |
| Meat product                         | n = 29 %               | n = 36 %                 | n = 8 %             | n = 73 %     |

*Impact of parthenium on human health*

*P. hysterophorus* has health hazards on human being, which include allergic, skin itching (irritation), cough and hemorrhage. 70% of respondents in high infestation category, 55% in medium and 33% in non-infestation category grumble the effect of *P. hysterophorus* on human health. Fifty eight percent of respondents in high infestation, 57% in medium infestation category reported that *P. hysterophorus* cause allergy and dermatitis when contact with body (Table 8).

*P. hysterophorus* also causes cough and hemorrhage as reported by 38% and 23% of the respondents in the high infestation category and 15% of the respondents in the medium infestation categories, respectively (Table 8). Evans (1997) and Towers and Subba Rao (1992) also reported that close contact with *P. hysterophorus* could cause allergic contact dermatitis while inhalation of pollen can cause allergic rhinitis, which can develop into bronchitis or asthma in susceptible humans.
Parthenium hysterophorus belongs to the family Asteraceae, an extremely diverse family with a cosmopolitan distribution. It was regarded to be introduced in Ethiopia accidentally through aid shipments or from Somalia during Ethio-Somali war in 1976/77. Its invasion expanded at alarming rate in all directions mainly following slope gradient and main road. This investigation was initiated with the objectives to assess the community perception on means and source of introduction, dispersal, habitats and practices to control and to assess the socio-economic impacts of P. hysterophorus in study area. Semi-structured questionnaires and focused group discussion were conducted with farmers, development agents (DAs), experts in the different levels of Minster of agriculture to collect data on the impact of parthenium. Most of respondents in the study area knew the impacts, however, many mechanisms were practiced by local people, were tillage and hand weeding (63%). Chemicals (45%) also used to reduce the impact of parthenium from their field crop. The respondents interviewed suggested that P. hysterophorus has a number of socio-economic impacts that include effect on crop and livestock production, human health, Soil fertility and biodiversity.

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