

**SOCIO-ECONOMIC IMPACTS OF PARTHENIUM (*Parthenium hysterothorus* L.) IN PESHAWAR VALLEY, PAKISTAN**

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**ABSTRACT**

An exploratory weed survey of four districts of the Peshawar valley, Khyber Pakhtunkhwa viz. Swabi, Mardan, Charsadda and Peshawar were carried out during 2009-11 to study distribution, socio-economic, environmental and health impacts of Parthenium. Various impacts of the weed were studied by interviewing the farmers. The parthenium weed is well established in Swabi, Mardan and Charsadda districts while in Peshawar it has a little and isolated infestation. The survey depicts that *P. hysterothorus* is the most frequent and dominant species on road sides, waste lands, grazing lands, crops margins and crop lands with 41%, 18%, 15%, 14% and 12%, respectively. According to the farmers there are several ways for spreading of parthenium weed in which two are prominent i.e. water 37% and vehicles-machinery 26% responsible for its rapid spread. The tiny size and light weight of parthenium seeds help them spread through wind and water easily. Farmers are generally aware of the losses caused by parthenium weed to agriculture productivity. These losses are yield reduction (40%), lack of labor (21%) and quality reductions (16%). Ten percent of the respondents reported that this weed has infested grazing lands, thus causing forage shortage. Moreover, 6% of farmers mentioned that parthenium causes allergy and dermatitis. This weed has been reported infesting sorghum crop (by 35% of the farmers), maize (29%), vegetables (27%) and tobacco (6%). As a result it has caused 30% yield losses in sorghum (45% of respondents) and 20% in maize crop (42% respondents). Most of the farmers in the survey area began to take control parthenium weed since 2005, while still large numbers do not control it. Parthenium weed in the valley is mostly controlled through hand weeding (64%) and tillage (17%) which are labor intensive practices. Herbicides and burning methods are also used by some of the farmers. Parthenium weed is also used as a source of fire wood. The findings of study revealed that parthenium weed not only causes problems in crop and fodder productivity but also poses serious threat to biodiversity, animal production and health.

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**Key words:** Invasive weed, *Parthenium hysterophorus*, weeds, Khyber Pakhtunkhwa.

## INTRODUCTION

Biological invasions by non-native species represent one of the most important threats to natural ecosystems and biodiversity. These invasions have almost in every type of native ecosystems and caused hundreds of biological extinctions throughout the world (Baillie *et al.*, 2004; CBD, 2005). The current development of world trade system has strengthened the spread of invasive alien species in general and parthenium weed in particular (McNeely *et al.*, 2001; Perrings *et al.*, 2005). The losses caused by weeds to agriculture worldwide have been estimated to be about \$10<sup>10</sup> annually. The losses estimated in Australia amount to about \$3.3 billion per annum (Adkins and Navie, 2006). While in USA, the estimated losses due to invasive species amounts to more than US\$ 138 billion annually (Pimentel *et al.*, 2005) and approximately one-fourth of this is due to alien plant species. On an annual basis in the major crops alone, the losses caused by weeds in Pakistan exceed Rs.130 billion (Hassan and Marwat, 2001).

*Parthenium hysterophorus* L. an alien invasive weed is becoming a major weed of cropped and non-cropped areas in Pakistan (Adkins and Navie, 2006). It is a recent introduction in the Indian subcontinent through unknown source, recorded first in 1956 from Poona, Maharashtra, India and claimed to be introduced from USA in wheat grains (Rao, 1956). In Pakistan, it was first recorded in 1980s. It is a recent introduction in Islamabad and is spreading to other areas in Khyber Pakhtunkhwa and Punjab (Hussain *et al.*, 2000). Since the existing local weed flora is already a threat to the crop productivity, thus introduction of another alien species, like parthenium weed will further reduce the crop yield drastically and consequently increase the cost of production.

Parthenium weed not only competes with desirable crops and pasture species but also causes farmers and stock animals to suffer an allergic skin condition while in contact with it (Chippendale and Panetta, 1994). Parts of parthenium weed are allelopathic, exhibiting strong competitive ability for soil moisture and nutrients while inhibiting the germination and growth of neighboring plant species (Adkins and Sowerby, 1996). Moreover parthenium weed is the causal agent for serious economic, health and environmental problems (Adkins *et al.*, 1997). In India, parthenium weed reduced yield up to 40% in several crops (Khosla and Sobti, 1981) and it was reported to reduce forage production by up to 90% (Nath, 1988). In India,

parthenium weed is widely spread and infested about two million hectares of land (Dwivedi *et al.*, 2009).

By year 2000, parthenium weed had occupied 5.6% of the total area of Australia which indicates the national importance of the problem (Thorp and Lynch, 2000). The highly invasive nature of this weed indicates that it might have invaded a much larger area since 2000 as documented in literature. Parthenium weed is a serious problem in perennial grasslands in central Queensland (Adkins *et al.*, 2001), where it has been predicted to reduce beef production by AUD \$129 million per year by 2050 (Adamson, 1996). Parthenium weed encumbers pasture production by competing with beneficial forage plants; estimated cost \$109 million per year (Adamson 1996). It is estimated to affect cropping systems to the tune of \$10 million per year, given the \$4 million crash to the sunflower crops through Tobacco Streak Virus. Parthenium weed is considered to be the greatest threat to biodiversity in the Einasleigh uplands bioregion (Sattler and Williams, 1999). Parthenium weed is generally unpalatable, but cattle and sheep will eat it when feed is scarce. Consumption of large amounts will produce taints in mutton (Tudor *et al.*, 1982). The current per capita expenditure in Australia on human health, due to the parthenium weed, is \$6.90 per person or \$19.90 per household in infested areas (AEC group, 2002).

Parthenium is rapidly spreading in Pakistan and causing severe damage to the agriculture productivity of the country. Due to its recent introduction, Parthenium socio-economic impacts are little understood and documented in Khyber Pakhtunkhwa-Pakistan. The objectives of this survey were (1) to assess the distribution and socio-economic impacts of Parthenium in Peshawar valley of KPK Province (2) to investigate the association of Parthenium with other weeds (3) and thus the knowledge generated through survey will assist us to design effective controlling mechanisms to curtail the impact being caused by Parthenium to the livelihood of the country.

## **MATERIALS AND METHODS**

The methodology employed in the study consisted of two stages: The initial information collected and informal and formal survey.

### **Initial Information Collected**

In this stage the initial information regarding the study area and the problem under discussion were collected from different sources i.e. review of literature, discussion with expert and progressive farmers. The purpose of the activity was to identify important issues and problems facing by the farmers and to have a general outline of

questions to be asked from the farmers, later during the survey interview about Parthenium.

### **Informal and Formal Survey**

Informal survey was conducted in order to get maximum information from the selected farmers that could help in improving the interview schedule. Data were collected through a comprehensive interview schedule by conducting formal survey.

### **Research Site and Sample Design**

The surveys of four districts viz. Swabi, Mardan, Peshawar and Charsadda of the Peshawar valley, Khyber Pakhtunkhwa Province (where core infestation of Parthenium is present) were carried out during May-June 2009-11. A total number of respondents were (N=200), 50 farmers from each district were randomly selected and interviewed using a questionnaire (Annexure-I) having a focus on the economic impacts of the Parthenium in Peshawar valley. During the survey the Parthenium identification kit were used for identification purpose and personal observations were also recorded regarding different weeds. This is more reliable and representative method to give accurate analysis inference on the socio-economic impacts of the Parthenium.

### **Data Processing**

The data/information obtained during the survey was tabulated and presented in spread sheet and were converted to suitable tables and figures. The perceptions about the way parthenium weed infests the crops and the major problems of the farmers were analyzed.

### **Description of Peshawar valley**

The Peshawar valley is located at 71°32'41.39"E longitude and 34° 0'15.48"N latitude and at an altitude of 1154 ft above sea level. Peshawar valley is nearly circular, extending from the Indus to the Khyber Hills. It is bounded on the North and North East by hills, which separate it from the Swat Valley. In the Northwest are the rugged mountains of Khyber and to the South is the continuation of spur which branches off from Safed Koh and runs to Indus. Winter in Peshawar valley commences from mid November to the mid of February. Summer months are May to September. The mean maximum temperature in summer is over 40 °C, while mean minimum temperature is 25°C. The mean minimum temperature during winter is 4°C and maximum is 18.35°C. Rainfall is received both in winter and summer. The winter rainfall due to western disturbances shows a higher record during the months of February and April. The highest winter rainfall has been recorded in March, while the highest summer rainfall in the month of August. The average winter rainfall is higher than that of the summer. The average 30-year annual precipitation has been recorded as 400 mm. Wind speeds vary during the year from

5 knots in December to 24 knots in June. The relative humidity varies from 46% in June to 76% in August. The Peshawar valley is known for the production of maize, wheat, sugarcane, tobacco, sorghum and vegetables (Wikipedia, 2011).

## RESULTS AND DISCUSSION

### Major weeds of Peshawar valley

The survey made in Peshawar valley revealed a total of 11 weed species that were widespread and associated with parthenium weed (Table-1). Two of the weeds ranked by farmers as most troublesome and quite recently introduced i.e. *Parthenium hysterophorus* L. and *Coronopus didymus* L. are becoming the most dominant weed species within a short time since its introduction. The major weeds of study area recorded were *Cyperus rotundus*, *P. hysterophorus*, *C. didymus*, *Cynodon dactylon* and *Cannabis sativa* for which the percentage of the respondents were 23, 20, 17, 10 and 9, respectively (Fig. 1).

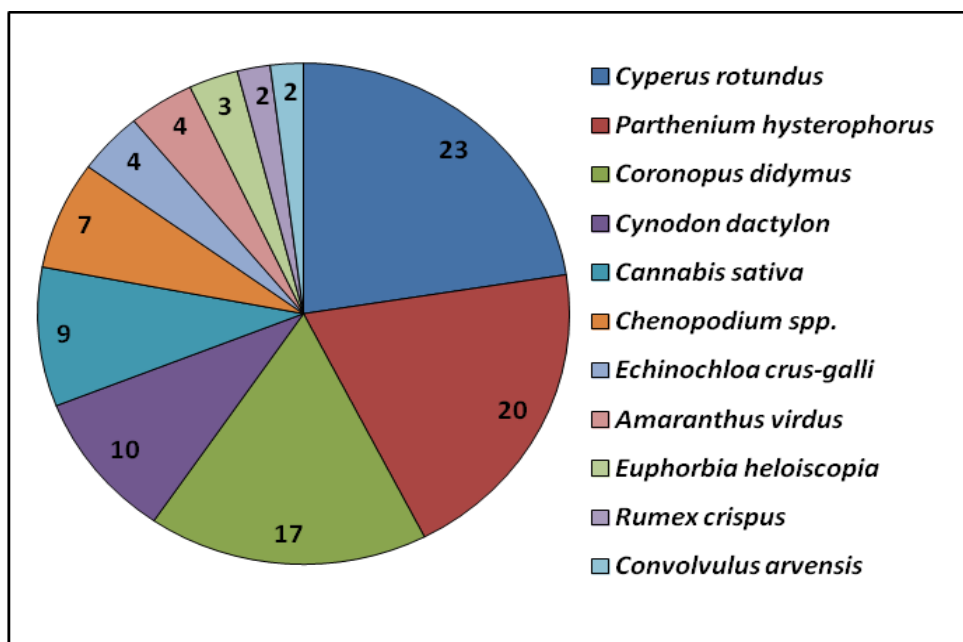
Almost all the selected districts of the Peshawar valley had a heavy infestation of parthenium weed except Peshawar district. In rangelands, and roadsides, one can easily observe dominance of parthenium weed over other weeds. Parthenium weed rapidly invade new surroundings often replace the indigenous species and pose a serious threat to biodiversity. (Lakshmi and Srinivas, 2007) confirmed that parthenium weed causes total habitat change in native Australian grasslands, open woodlands, river banks and flood plains. Haseler (1976) suggested that this may be due to many factors like wider adaptation across climates, photo insensitivity, and drought tolerance. Similarly, Krishnamurthy *et al.* (1997) described the allelopathic nature of parthenium weed and its impact on plant diversity.

**Table-1.** Major weeds of Peshawar valley

S. No	Botanical Name	Common Name	Family	Frequency (N=200)	Percent (%)
1	<i>Cyperus rotundus</i>	Purple nutsedge	Cyperaceae	45	23
2	<i>Parthenium hysterophorus</i>	Congress grass	Asteraceae	40	20
3	<i>Coronopus didymus</i>	Swine cress	Cruciferae	34	17
4	<i>Cynodon dactylon</i>	Bermuda grass	Poaceae	19	10
5	<i>Cannabis sativa</i>	Hemp	Cannabaceae	18	9
6	<i>Chenopodium</i> sp.	Lamb's quarter	Chenopodiaceae	14	7
7	<i>Echinochloa crus-galli</i>	Barnyard grass	Poaceae	8	4

8	<i>Amaranthus viridis</i>	Pig weed	Amaranthaceae	8	4
9	<i>Euphorbia helioscopia</i>	Spurge	Euphorbiaceae	6	3
10	<i>Rumex crispus</i>	Curly dock	Polygonaceae	4	2
11	<i>Convolvulus arvensis</i>	Field bind weed	Convolvulaceae	4	2

N=Total Number of Respondents



**Figure 1.** Major weeds of the Peshawar valley

### Infestation of *Parthenium* in Peshawar valley

The findings of the survey indicated that 82% farmers in the Peshawar valley were aware of the parthenium weed problem, but as parthenium weed is invasive and recently introduced in Khyber Pakhtunkhwa Province, so no one know about the local name of this weed. According to the farmers in the study area parthenium weed was found to be the most frequent and dominant species on road sides, waste lands, grazing lands, crops margins and crop lands with 41, 18, 15, 14 and 12%, respectively (Table-2). The invasive ability and allelopathic properties have rendered *P. hysterophorus* with the potential to disturb the natural ecosystems. Very light or sometimes no other vegetation can be seen in parthenium weed dominated areas. These observations are in line with Shabbir and Bajwa (2006a) and

Huy and Seghal (2004). Akter and Zuberi (2009) also reported that *P. hysterophorus* revealed the ability to invade and adapt to new habitats, thereby reducing the number of indigenous plants. This might have helped the dispersal of the weed thereby contributing to severe infestation and invasion of parthenium weed in the Peshawar valley.

Most of the farmers in the study area believe that parthenium weed was introduced into the Peshawar valley in food grains and its invasion in the Peshawar valley started before ten years. Since then it expanded at alarming rate in all directions. Farmers' observation of the infestation habitat confirms to field observation. (Gupta and Sharma, 1977) also confirmed that parthenium weed achenes are usually transported with crop and pasture seeds or in fodder. It was observed that, parthenium weed population is high in places where the soils are disturbed frequently for the purposes of construction of roads, buildings, and waterways. Therefore, the extensive density along roadsides in different villages might be due to the road construction and transportation of soil, sands and gravels from parthenium weed infested to non-infested areas.

**Table-2.** Farmers view about appearance of Parthenium in Peshawar valley

S. No	Habitat	Frequency (N=200)	Percent (%)
1	Road sides	82	41
2	Waste lands	36	18
3	Grazing lands	30	15
4	Crops margins	28	14
5	Crops lands	24	12

### Spread of Parthenium in Peshawar valley

Survey results exhibit that there are several ways for dispersal of parthenium weed in the Peshawar valley like via water (37%), vehicles & machinery (26%), wind (14%), animals (10%) and human activity (8%) as shown in table-3. Among these major dispersal mechanisms like water, vehicles and machinery are responsible for its fast dispersal into different districts of Peshawar valley. These mechanisms identified by farmers agree with studies of Auld *et al.* (1983) who stated that local dispersal of *P. hysterophorus* seeds occur locally by wind and water, while motor vehicles, machinery and livestock movements, crop and pasture seeds add for long distance dispersal. According to farmers view, the parthenium weed was spread into the Peshawar district during Islamabad-Peshawar motorway road

construction. In addition, construction materials had played a significant role for fast rate of dissemination of this weed.

**Table-3.** Farmers view on source for the spread of Parthenium in Peshawar valley

S. No	Means of Spread	Frequency (N=200)	Percent (%)
1	Water	74	37
2	Vehicles & Machinery	52	26
3	Wind	27	14
4	Animal movement	20	10
5	Human activity	15	8
6	Other mechanisms	12	6

#### **Damages caused by parthenium weed in Peshawar valley**

Farmers confirmed that the invasion of parthenium weed causes 40% yield losses, while 21% of the interviewed farmers concluded that the heavy infestation of parthenium weed leads to the use of intensive labor for weeding thus increasing cost of production. According to the results 16% of the farmers recorded quality reductions due to parthenium weed (Table-4). These findings are in line with the studies of Evans (1997) and Kohli & Rani (1992) who reported a number of environmental and agricultural problems. Further 10% of the total respondents showed their concern that this weed has infested grazing lands. In district Charsadda parthenium weed completely dominates grazing land and causing forage scarcity. While 7% farmer's recorded losses to animal production. Some of the farmers also reported that the milk of animals grazing on parthenium is bitter. Evans (1997) indicated that the impact of parthenium weed on livestock production is direct as well as indirect by affecting grazing land, animal health, milk and meat quality. In Australia, Chippendale and Panneta (1994) stated that cattle grazing in *P. hysterophorus* invaded pastures were marketed with a lower weight compared to those from weed free areas, accounting for more losses to the producer. Because of the parthenium weed's recent introduction in the Peshawar valley, it did not show a serious health problem, however 6% of farmers are conscious that parthenium weed cause's allergy and dermatitis. Other scientist like Srirama *et al.* (1991) and Handa *et al.* (2001) also claimed effects of parthenium weed on human health like hay fever, asthma, bronchitis and dermatitis. In India, reports of



committing suicide are available due to the chronic problem of parthenium weed (Kololgi *et al.*, 1997).

**Table-4.** Farmers view about damages caused by parthenium weed in Peshawar valley

S. No.	Types of Damage	Frequency (N=200)	Percent (%)
1	Yield reduction	79	40
2	Intensive labor requirement	42	21
3	Quality reduction	32	16
4	Grazing lands	20	10
5	Animal production	13	7
6	Health problem	12	6
7	Others	2	1

#### **Crops infestation by parthenium weed in Peshawar valley**

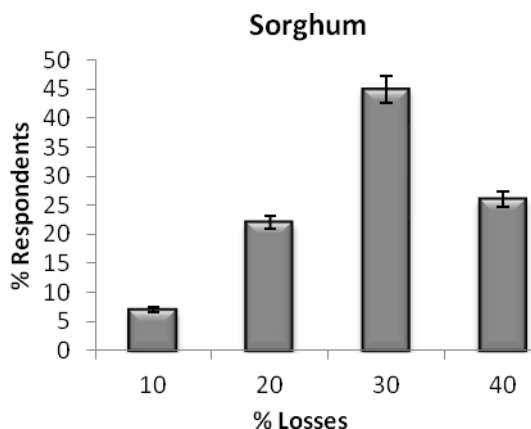
Field crops infested by parthenium weed were sorghum (35%), maize (29%), vegetables (27%) and tobacco (6%) recorded from the farmers (Table-5). However in the surveyed areas, infestation of parthenium weed in the cropped area varied from field to field depending on the time of its introduction into the area and the efforts made by the farmers to control the weed. Heavy infestation of parthenium weed was reported along the margins of the field crops. However, as reported by Haseler (1976) the initial occurrence of *P. hysterophorus* in a new area usually occurs along roadsides and it spreads from this foothold extensively into cropped area, as observed in Swabi district.

Due to the parthenium weed invasion in the study area in sorghum (20%), (30%) and (40%) yield losses were recorded by 22%, 45% and 26% of respondents, respectively (Fig. 2). In maize crop 20%, 30% and 40% yield losses were recorded by 42%, 26% and 14% respondents respectively (Fig. 3). Likewise in India 40% sorghum yield reduction was reported by Channappagoudar *et al.* (1990) and Khosla and Sobti (1981). While in eastern Ethiopia 40 to 97% sorghum yield reduction was observed due to *P. hysterophorus* (Tamado, 2002). Kamble *et al.*, 2005 and Mundra *et al.*, 2003) reported parthenium weed as a major weed in maize crop.

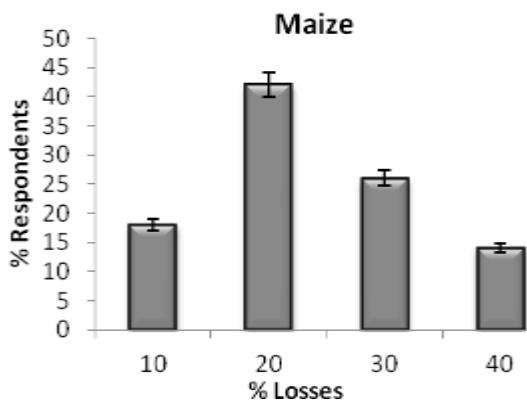
**Table-5.** Crops infested by Parthenium in Peshawar valley

S. No	Crops Infested by Parthenium Weed	Frequency (N=200)	Percent (%)
1	Sorghum	69	35

2	Maize	58	29
3	Vegetables	53	27
4	Tobacco	11	6
5	Others	9	5



**Figure 2.** Losses in Sorghum yield due to Parthenium in Peshawar valley



**Figure 3.** Losses in Maize yield due to Parthenium in Peshawar valley  
**Uses of parthenium weed in Peshawar valley**

Survey data depict most of the respondents 84% where unaware about the good effect of parthenium weed. While very few farmers knew about the use of parthenium weed like fire wood (6%), livestock feed (5%) and soil improvement (4%) in the Peshawar valley

(Table-6). Mane *et al.* (1986) reported that parthenium weed is used as an animal feed due to high potash, oxalic acids and protein content. While Kishor *et al.* (2010) and Javid (2008) used parthenium weed as compost; green manure for maize and mung bean production.

**Table-6.** Farmer's response about use of Parthenium in Peshawar valley

S.No.	Uses of Parthenium Weed	Frequency (N=200)	Percent (%)
1	No Use	167	84
2	Fire wood	11	6
3	Livestock feed	9	5
4	Soil improvement	7	4
5	Others	6	3

#### **Farmers' practices to control Parthenium in Peshawar valley**

Most of the farmers in the study area began to take measures to manage parthenium weed since 2005, while still large numbers do not take any control measure. Parthenium weed in the Peshawar valley is mostly controlled through hand weeding (64%) and tillage (17%), which are labor intensive practices. These control methods are currently practiced by most of the farmers (Table-7). These conventional control methods were not efficient to control parthenium weed; rather it has increase over time since its invasions. This agrees with the finding of Bhan *et al.* (1997) who reported that because of extended root system deep into the soil, mature plants of parthenium weed are difficult to remove completely. Manual and mechanical control methods give temporary solutions because parthenium weed covers large areas. About 10% of the farmers use herbicides for the control of parthenium weed in maize and vegetables. However, farmers do not want to control parthenium weed from communal lands, such as field borders, wastelands, water ways and road sides. Hence, it grows and sets seeds in these areas from where it re-infests and spreads itself to other areas including cropped area.

**Table-7.** Farmers' responses about Parthenium control methods in Peshawar valley

S. No	Control methods of Parthenium	Frequency (N=200)	Percent (%)
1	Hand Weeding	128	64
2	Tillage/Plough	34	17
3	Herbicides	20	10

4	Burning	11	6
5	Others	7	4

### CONCLUSION

*Parthenium hysterophorus* is an invasive alien weed that can be predicted to continue its dissemination because of the negligence of not only of the farming community but also the agriculture department to control it. It has been accidentally introduced into Pakistan, infesting vast areas like Peshawar valley. Due to its effective adaptability to varying conditions and absences of their natural enemies parthenium weed has replaced our precious native flora and poses a strong threat to our biodiversity. As per findings area and density of Parthenium infestation over the past 5 years were highly increased. Parthenium weed in the valley is mostly controlled through hand weeding and tillage. The finding of study revealed that Parthenium causes significant agricultural and environmental problems, such as the loss to crop productivity, forage production, biodiversity, animal production and health problems and it has the potential to spread all over the Khyber Pakhtunkhwa, a serious threat to social, economic and food security of our country. Consistent effort should be practiced to control *P. hysterophorus* till the complete seed bank is exhausted. Quarantine measures should be adopted to stop the introduction and spread of Parthenium to non-infested areas. Vehicles and implements passing through Parthenium infested areas should be washed down with water. Farmers should be trained on how to prevent and control further introduction and dissemination of *P. hysterophorus* at national level. Further study is required to identify the impacts of Parthenium on human and animal health and biodiversity. Effective control measure needs to be devised for sustainable management of Parthenium.

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**Annexure-I**

**Survey Questionnaire**

Date of interview: ..... Name of respondent: ..... Age:

Education level ..... Village: ..... District:

**1. Land Information:**

	Question	Yes/No
1.1	Do you know parthenium weed?	1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No
1.2	What is the local name of parthenium?	
1.3	Do you currently have parthenium on your farm?	1. Yes 2. <input type="checkbox"/> No 3. <input type="checkbox"/> Unsure If <b>No</b> , go to 1.10.
1.4	Where did it first appear?	1. Pastures 2. Road side 3. Cropland 4. Wasteland 5. Others
1.5	In which crop?	1. Vegetables 2. Maize 3. Sorghum 4. Others
1.6	How long has parthenium been on your farm?	1. <input type="checkbox"/> < 5 years 2. <input type="checkbox"/> 5-10 years 3. <input type="checkbox"/> 10-20 years 4. <input type="checkbox"/> 20-50 years 5. <input type="checkbox"/> > 50 years 6. <input type="checkbox"/> Unsure
1.7	How do parthenium weed spread?	1. Wind 2. Human 3. Animal 4. Vehicles 5. Water
1.8	Does parthenium affect:	
i.	The operation of your farm?	1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No 3. <input type="checkbox"/> Unsure
ii.	The income of your farm?	1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No 3. <input type="checkbox"/> Unsure
1.9	What are the problems due to parthenium?	1. Yield reduction 2. Quality reduction 3. Intensive labor 4. Health problem 5. Damage pastures 6. Animal production 7. Others

1.10 Is your farm mainly for:

	Land Use	Yes/No	Area (Hectare)
I	Cereals	1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No	
Ii	Cash crops	1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No	
Iii	Vegetables	1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No	
Iv	Orchards	1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No	
V	Range management /pastures	1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No	
Vi	Other	1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No	
<b>Total Land Area (Hectare)</b>			

**2. Infestation (Density and Extent):**

2.1 Has there been any change in the area infested and density of parthenium infestation over the past 5 years?

		Stayed the same	Increased	Decreased
I	Area infested	1. <input type="checkbox"/>	2. <input type="checkbox"/>	3. <input type="checkbox"/>
Ii	Density of infestation	1. <input type="checkbox"/>	2. <input type="checkbox"/>	3. <input type="checkbox"/>

2.2 In your estimate, what % of your land area is currently infested with parthenium?

	Density of infestation	Percent of total land area
I	Not infested	
ii	<b>Light:</b> 1 plant or less plant/M <sup>2</sup>	

iii	<b>Medium:</b> 1to 2 plant/M <sup>2</sup>	
iv	<b>Heavy:</b> More than 2 plant /M <sup>2</sup>	
	<b>Total</b>	<b>100 %</b>

2.3 If you stop the current level of control, what % of your land would be infested in:

	<b>Time</b>	<b>% Infested</b>
i)	1 year	%
i)	5 years	%
iii)	15 years	%

### 3. Control

3.1 Do you actively control parthenium in:

	<b>Type of area controlled</b>	<b>Yes/No</b>
i	Cropped areas?	1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No 3. <input type="checkbox"/> Unsure
ii	Non- cropped areas?	1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No 3. <input type="checkbox"/> Unsure
iii	Range management/ Pastures	1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No 3. <input type="checkbox"/> Unsure
iv	Other public areas?	1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No 3. <input type="checkbox"/> Unsure

3.2 What type of control methods do you use in the **non-cropped** areas and which is the most commonly used?

	<b>Control Method</b>	<b>Yes/No</b>	<b>Most commonly used control method (✓ one only)</b>
i	Physical (Hand weeding, Machine)	1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No 3. <input type="checkbox"/> Unsure	1. <input type="checkbox"/>
ii	Herbicides	1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No 3. <input type="checkbox"/> Unsure	2. <input type="checkbox"/>
iii	Fire	1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No 3. <input type="checkbox"/> Unsure	3. <input type="checkbox"/>
iv	Other	1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No 3. <input type="checkbox"/> Unsure	4. <input type="checkbox"/>

3.3 What type of control methods do you use in the **cropped** areas and which is the most commonly used?

	<b>Control Method</b>	<b>Yes/No</b>	<b>Most commonly used control method (✓ one only)</b>
i	Physical (hand weeding, machine)	1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No <input type="checkbox"/> Unsure	1. <input type="checkbox"/>
Ii	Herbicides	1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No <input type="checkbox"/> Unsure	2. <input type="checkbox"/>
iii	Fire	1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No <input type="checkbox"/> Unsure	3. <input type="checkbox"/>
iv	Other	1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No <input type="checkbox"/> Unsure	4. <input type="checkbox"/>

3.4 What is the estimated amount (Rs) you currently spend on the control of parthenium weed.

	Infested area	Expenses estimate Rs/Hectare/year						Total Rs/year
		<300	300-500	500-1000	1000-2000	2000-4000	4000-7000	
i	Expenses on control in <b>light</b> infestations	1. <input type="checkbox"/>	2. <input type="checkbox"/>	3. <input type="checkbox"/>	4. <input type="checkbox"/>	5. <input type="checkbox"/>	6. <input type="checkbox"/>	Rs_____
ii	Expenses on control in <b>medium</b> infestations	1. <input type="checkbox"/>	2. <input type="checkbox"/>	3. <input type="checkbox"/>	4. <input type="checkbox"/>	5. <input type="checkbox"/>	6. <input type="checkbox"/>	Rs_____
iii	Expenses on control in <b>heavy</b> infestations	1. <input type="checkbox"/>	2. <input type="checkbox"/>	3. <input type="checkbox"/>	4. <input type="checkbox"/>	5. <input type="checkbox"/>	6. <input type="checkbox"/>	Rs_____

**4. Other Economic Impacts:**

4.1 Please indicate how parthenium affect your farm and livelihoods in any of the following ways.

	Impact	Significant/ Insignificant	Rs/Hectare/year						Total Rs/year
			<300	300 - 500	500 - 1000	1000 - 2000	2000 - 4000	4000 - 7000	
i	Fire wood	<input type="checkbox"/> Significant <input type="checkbox"/> Insignificant <input type="checkbox"/> Unsure	1. <input type="checkbox"/>	2. <input type="checkbox"/>	3. <input type="checkbox"/>	4. <input type="checkbox"/>	5. <input type="checkbox"/>	6. <input type="checkbox"/>	Rs_____
ii	Livestock feed	<input type="checkbox"/> Significant <input type="checkbox"/> Insignificant <input type="checkbox"/> Unsure	1. <input type="checkbox"/>	2. <input type="checkbox"/>	3. <input type="checkbox"/>	4. <input type="checkbox"/>	5. <input type="checkbox"/>	6. <input type="checkbox"/>	Rs_____
iii	Soil improvement	<input type="checkbox"/> Significant <input type="checkbox"/> Insignificant <input type="checkbox"/> Unsure	1. <input type="checkbox"/>	2. <input type="checkbox"/>	3. <input type="checkbox"/>	4. <input type="checkbox"/>	5. <input type="checkbox"/>	6. <input type="checkbox"/>	Rs_____

**5. Major weeds of your farm?**

(1).....(2) .....(3) .....(4).....

Are there any other issues that you would like to tell us regarding the control of Parthenium weed or its impact? \_\_\_\_\_