



Mainstreaming gender into prevention and management of invasive species

Global Invasive Species Programme

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GISP's mission is to conserve biodiversity and sustain human livelihoods by minimising the spread and impact of invasive species





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(GISP) is an international partnership dedicated to tackling the global threats of invasive species through policy development, awareness raising and information exchange.

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Summary

Invasive species threaten ecosystems, habitats and species, causing extensive environmental and economic harm. Gender affects people's experiences, concerns and capabilities in natural resource management, and gender relations influence how environments are managed and used. A gender perspective on invasive species can therefore improve understanding of their impacts, increase effectiveness of prevention and control, and contribute to social equity. This study aimed to bring together information on gender and invasive species, to inform those involved with research, policy and practice of invasive species prevention and management.

Gender differences affect natural resource management in a number of ways. Men and women play different roles in the utilisation and management of uncultivated biodiversity, as well as in agricultural production. These differences can be specific to cultures, but women tend to have more responsibility for subsistence crops, they collect fuelwood, and they contribute more of the labour. Coupled with their domestic responsibilities this means they have greater demands on their time, and factors that affect labour are likely to have a greater impact on women. Women often have less ownership and access to resources than men, making them more vulnerable to negative changes in the environment. On average women are less educated than men, and have less access to information; extension systems tend to be male-biased. Women generally have less decision making authority than men.

All these differences mean that gender modifies the direct impacts of invasive species. Crop pests of staples may affect women more than men, but the value of cash crops can be reduced by small losses in quality. Women are usually responsible for small livestock production, while men tend to herd the larger species so are more affected by invasive species that reduce forage availability. Some invasive species have a direct effect on the health of those who come into contact with them, an impact usually of more concern to women. Invasive species can affect the multiple uses of water, and the time and effort to collect it, usually the responsibility of women. Loss of biodiversity affects both men and women, but in different ways according to the different benefits derived. Some invasive plants are have economic uses, and depending on the uses, men or women can derive income. Sometimes one gender can benefit from the species while the other suffers loss. Gender differences in control of income mean that the benefits of using invasive species are not always spread throughout the household.

Prevention and management of invasive species, also have gender dimensions. Generally women rate risks to be higher than men do, though the public probably rate the risk of invasions lower than experts do. Many invasives have been introduced intentionally, with the decisions most likely to have been made by men. Pathways of unintentional introduction are less likely to be related to gender. Trade restrictions imposed to prevent accidental introductions have gender related impacts depending on the product whose trade is limited. Impacts of established invasive species can be mitigated in many ways, which may have gender considerations. Pesticides are commonly used, with many accidental and intentional self-poisonings occurring. In Africa women are the majority of labour in high-value non-traditional crops, where pesticide use is greatest. Under-reporting of sub-lethal poisoning is thought to be lower in women. But manual control of invasive weeds in agriculture is often undertaken by women, so the use of herbicides could reduce the workload of women. Participatory variety selection is used to identify host plant resistant crops, but women's selection



criteria are different from men's. Selection and saving of seeds for planting is often undertaken by women. Integrated pest management as a participatory approach includes gender and other social factors, and is the aspect of invasive species in which gender has been given most consideration.

The Global Environment Facility (GEF) has only recently developed a document on mainstreaming gender. The assessment of projects they have funded shows that gender mainstreaming is still limited, with only a fifth of projects having specific gender-sensitive activities. This low level of attention to gender in environmental management is reflected in the outputs of the Global Invasive Species Programme (GISP). The GEF-funded project Removing Barriers to Invasive Plant Management in Africa (RBIPMA) recognized the importance of gender, but has had limited success in mainstreaming gender considerations in project activities.

A rapid rural appraisal was undertaken in Ethiopia using a gendered perspective to assess the impacts and perceptions in relation to invasions by *Prosopis juliflora*, which was intentionally introduced, and *Parthenium hysterophorus*, which was accidentally introduced. Impacts and uses identified by men and women were sometimes similar and sometimes different, as were their perceptions of gender roles in relation to management. However, there was general agreement that both species should be eradicated or controlled, despite their uses. Women's involvement in household and community decision making in Ethiopia is limited but increasing, and the RBIPMA project has had some success in facilitating women's groups to take part in weed management campaigns.

It is concluded that although the problem of invasive species is not new, until recently much research, policy and practice in relation to invasive species prevention and management has been gender-blind. It is suggested this is because there has been an emphasis on invasion as a technical issue; because of a lack of information on the impacts of invasive species; and because gender mainstreaming in natural resource management has only recently been given serious consideration at the international level. The available toolkits and guides to gender analysis and action in environmental management and sustainable development must be adapted and applied in the context of invasive species, and GISP is well placed to champion this process.

1. Introduction

Invasive species have numerous impacts in many areas of human activity, as well as on the natural environment. The well documented gender differences in use and management of natural resources mean that there must certainly be important gender considerations in the impacts of invasive species and attempts to manage them. However, bibliographic analysis shows there to be very few publications referring to both invasive species and gender or invasive species and women. This preliminary study is therefore a contribution to looking at invasive species with a gender perspective.

1.1 Invasive Alien Species

The term 'Invasive alien species' has been the subject of much discussion, and Valery *et al.*, (2008) recently proposed that the focus should be on the process of biological invasion, which they define as 'a species acquiring a competitive advantage following the disappearance of natural obstacles to its proliferation, which allows it to spread rapidly and to conquer novel areas within recipient ecosystems in which it becomes a dominant population'. Box 1 provides an extract from Decision VI/23 of the Conference of the Parties (COP) to the Convention on Biological Diversity (CBD), where the emphasis is on the threat to biological diversity. However, invasive species have a wide range of impacts so the definition by McNeely *et al.* (2001) is more appropriate in the context of this study, "A species whose establishment and spread threatens ecosystems, habitats or species, with economic or environmental harm". Broadly, invasive species are a threat to food, security, health and economic development as well as to biodiversity, and it is the impact they cause as a result of their "invasiveness" rather than whether or not they are alien that is their most important characteristic for this study. We thus follow a common trend in using the shorter epithet invasive species, without implying whether they are alien or not.

Box 1. Invasive species definitions (from CBD COP Decision VI/23).

- i. "alien species" refers to a species, subspecies or lower taxon, introduced outside its natural past or present distribution; includes any part, gametes, seeds, eggs, or propagules of such species that might survive and subsequently reproduce;
- ii "invasive alien species" means an alien species whose introduction and/or spread threaten biological diversity (For the purposes of the present guiding principles, the term "invasive alien species" shall be deemed the same as "alien invasive species" in decision V/8 of the Conference of the Parties to the Convention on Biological Diversity.);
- iii. "introduction" refers to the movement by human agency, indirect or direct, of an alien species outside of its natural range (past or present). This movement can be either within a country or between countries or areas beyond national jurisdiction;
- iv. "intentional introduction" refers to the deliberate movement and/or release by humans of an alien species outside its natural range ;
- v. "unintentional introduction" refers to all other introductions which are not intentional, and
- vi. "establishment" refers to the process of an alien species in a new habitat successfully producing viable offspring with the likelihood of continued survival
- vii. "risk analysis" refers to: (1) the assessment of the consequences of the introduction and of the likelihood of establishment of an alien species using science-based information (i.e., risk assessment), and (2) to the identification of measures that can be implemented to reduce or manage these risks (i.e., risk management), taking into account socio-economic and cultural considerations.

Invasive species belong to many different groups of organisms, including vertebrates, invertebrates, plants and micro-organisms. Many invasive species are recognized not so much for their impact on biodiversity as on agriculture, where weeds, arthropods, plant pathogens and vertebrates cause large losses pre- and post-harvest. Others are well known as disease causing organisms in human and livestock. Although some plant invasions are well known, such as the water hyacinth *Eichhornia crassipes*, many invasive alien plants are less obvious as they become 'part of the scenery'. The direct and indirect impacts of invasive species, as well as perceptions and other attitudes to their risk and management can all be expected to have gender dimensions. In this study we consider invasive species in general, but with a particular focus on invasive alien plants in Africa.

While invasive species include many human diseases, we are excluding consideration of those species from this review. There is an extensive literature on human health, including an increasing amount in relation to gender, particularly in the context of HIV/AIDS. In this review we confine ourselves to invasives in natural and agricultural ecosystems. Although HIV/AIDS and other diseases have a profound effect on the way in which ecosystems are used and managed, review of the extensive literature on invasive human disease is beyond the scope of this study.

1.2 Gender

Box 2 lists some definitions of commonly used gender concepts. As with invasive species there are different interpretations of these terms (Esplen & Jolly, 2006) but for the purposes of this review, this is what we mean when using a particular term. It should be noted that gender is one of several dimensions of social differentiation, others being ethnicity and age, all of which can be important in natural resource management. Some authors include children's issues under gender analysis, though given the paucity of literature on gender and invasive species that distinction has minor significance here.

Because gender analysis examines the difference and imbalances between men and women, and because the imbalances often favour men, gender mainstreaming may appear to be about promoting the interests and involvement of women. However, as the definitions in Box 2 make clear, gender mainstreaming is about equality. While that is an objective with which few would disagree, how it can best be achieved is a topic of debate. We return to the question of how gender considerations can be integrated within invasive species projects later in this review.

1.3 Why is a gender perspective on invasive species important?

Invasive species have significant negative and sometimes positive impacts, and so how they are managed is a matter of some consequence. Gender affects people's experiences, concerns and capabilities in natural resource management, and gender relations influence how environments are managed and used over time (Masika and Joekes, 1997). Invasive species have impacts on poverty and the sustainable use of natural resources. In both those areas taking a gender perspective has been shown to be important when assessing problems, designing and implementing interventions and monitoring and evaluating the outcomes.

Thus in common with other issues in natural resource management, taking a gender perspective on invasive species can:

- Improve understanding of the impacts
- Increase the effectiveness of invasive species prevention and management
- Contribute to social equality

The third Millennium Development Goal (MDG) is to Promote Gender Equality and empower women. Although the targets and indicators under MDG3 refer specifically to education, non-agricultural employment and parliamentary representation, it is recognized that promoting gender equality is important to achieving MDG1 on poverty and hunger and MDG7 on environmental sustainability. Invasive species have a direct impact on food production and the environment, so a gendered perspective is highly appropriate in addressing development needs (WEDO, 2003).

1.4 Study objectives

The overall aim of this study is to bring together information on the subject of gender and invasive species, and thereby inform and strengthen future projects, activities and interventions in relation to invasive species prevention and management. We hope the information will be of interest to all those involved in research, policy and practice of invasive species prevention and management, but particularly:

- Those concerned with invasive species prevention and management who might not have considered the gender dimension in their work.
- Those concerned with gender and social factors in natural resource management who might not be aware of the importance of invasive species in driving change in natural and man-made ecosystems, and of the impacts they have on the livelihoods of men and women.
- Those who fund, design, manage, implement and evaluate projects and programmes directly or indirectly related to invasive species.

The study has been undertaken alongside a GEF-funded project, "Removing Barriers to invasive plant management in Africa" (RBIPMA project), for which the United Nations Environmental Programme (UNEP) is the implementing agency, and thus draws from that project and seeks to add value to it. The study included desk work and review of literature (including RBIPMA project outputs), key informant interviews, and field work in Ethiopia at two of the RBIPMA project pilot sites to collect primary data.

The study focuses especially on gender and invasive species in the context of sustainable development. There are no doubt important gender considerations in the prevention, management and impacts of invasive species in natural resource management in developed countries, but our study aims to inform and influence those working in and for developing countries. Nevertheless, some of the examples we refer to are from developed countries.

The report is organized as follows:

- Section 2 reviews some of the main themes in gender and natural resource management (including agriculture), and considers how they might relate to invasive species prevention and management.
- Section 3 reviews the impacts of invasive species from a gender perspective, providing examples of gender disaggregated information and highlighting gaps.
- Section 4 looks at the prevention and management of invasive species again from a gender perspective.
- Section 5 reviews programmes and projects (including the RBIPMA project) and the extent to which gender considerations have been incorporated.
- Section 6 presents the results of fieldwork in Ethiopia.
- Section 7 discusses the overall findings of the study.

Box 2. Key Gender Concepts

Summarised from IDRC (1998).

Gender is a culturally-specific set of characteristics that identifies the social behavior for women and men and the relationship between them. Gender refers to social differences, as opposed to biological ones, between women and men that have been learned, are changeable over time, and vary widely both within and between cultures.

Gender analysis is the systematic examination of the roles, relationships and processes between women and men in all societies, focusing on imbalances in (decision-making) power, wealth and workload. Gender analysis can also include the examination of the multiple ways in which women and men, as social actors, engage in strategies to transform existing roles, relationships and processes in their own interest and in the interest of others. Gender analysis is cross-cut by other axes of social differentiation, including class, caste, ethnicity and age.

Gender-blindness means ignoring the different socially determined roles, responsibilities and capabilities of men and women. Gender-blind policies are based on information derived from men's activities and/or assume those affected by the policy have the same (male) needs and interests.

Gender-disaggregation entails the collection and separation of data and statistical information by gender to enable comparative analysis/gender analysis, so includes purposive sampling of both women and men.

Gender division of labour is the allocation of paid and unpaid work between women and men in private and public life.

Gender mainstreaming is the systematic integration of the respective situations, priorities, and needs of women and men in all policies, programs, and projects and with a view to promoting equality between women and men and mobilizing all general policies and measures specifically for the purpose of achieving equality by actively and openly taking into account, at the planning stage, their effects on the respective situations of women and men in implementation, monitoring and evaluation.

Gender neutral policies [and/or programmes] are not specifically aimed at either men or women and are assumed to affect both sexes equally.

Gender relations refer to the relationship and unequal distribution of power between women and men which characterize any specific gender system.

Gender roles are due to social factors that influence or allocate activities, responsibilities, and decision-making authority to groups of people. Gender roles change, often spontaneously and sometimes quickly, as the underlying social, economic and technological conditions change. Social factors which underlie and sometimes reinforce gender differences include religious practices, ethnic or cultural attitudes, class.

2. Gender in Natural Resource Management

In this section we summarise some of the major features of gender differences that have been recognized as important in natural resources management, a number of which also apply in other livelihood contexts. An understanding of existing differences is part of developing a gendered approach to invasive species issues because changes such as those caused by invasive species could magnify the differences. At the same time existing gender differences could amplify the impacts of invasive species on individuals or communities whose livelihoods are affected.

2.1 Gender roles

Prior to the last two to three decades, the role of women in natural resource management was often overlooked, perhaps because the onlookers were viewing communities through the lens of their own developed country experience and perspective. Thus the role of women was seen as that of 'housewife', and in that context the concern of environmentalists was with limiting environmental degradation through population control (Mikkelsen, 2005).

The UN decade of women, which ended in 1985, contributed to the recognition of women as the main producers of food, as well as collectors of natural resources such as fuel wood, water and medicinal plants. The recognition of women as users and therefore managers of natural resources meant they must also be recognized as important players in sustainable development and environmental protection (Dankelman, 2002). Thus women are now seen as part of the solution to environmental degradation, rather than part of the problem (Mikkelsen, 2005), and this is the view that should be taken in regard to invasive species prevention and management.

Some authors contend that women are actually 'closer to the environment' than men, and so are more likely to nurture it in a more sustainable manner. This is also an unhelpful generalization as it not only overlooks the fact that in some circumstances women may be as exploitative of natural resources as men, but also runs the risk of making environmental management a role primarily for women. Agarwal (2000) asserts that there is little evidence that women are inherently more conservationist than men, although their social networks allow greater opportunities for collective action in environmental management.

As collectors of wild food and other useful plant products such as fibres, fodder, dyes, medicines and many others, women are probably more vulnerable to changes in the habitats where these items are collected. In highly diverse ecosystems which provide a wide variety of useful species, any one species might not be common. When invasive plants establish in natural ecosystems, the diversity of plant species generally falls, often dramatically so, and this would affect those who gather and harvest from that diversity. This could result in increased time taken to collect the products, which Gram (1998) found is often underestimated anyway, making a species effectively unavailable. Gathering of wild foods is sometimes a coping strategy when crops have failed, so invasion in this case would increase vulnerability to famine.

The different roles that women and men perform are also apparent in agricultural labour (Table 1). Women tend to be responsible for subsistence or food crops, and men for the cash crops, although this is not always the case. Women may also be required to work as labourers in male-managed cash crops, as well as farming their own food crops. Together with the domestic labour of water and fuelwood collection, women often have a much higher demand on their time than men, meaning the factors that affect labour, such as species invasions or prevention and control methods, may have greater impact on women.

Table 1. Gender structure of agriculture in selected Sub Saharan countries (percent), 2003-2005 (from Fontana & Paciello (2009)).

	Tanzania	Mozambique	South Africa
Agriculture as share of GDP	45.8	23.1	3.1
Employment in agriculture as share of total employment	75.1	78.0	11.3
Female intensity* of agriculture	53.6	59.5	34.2
Female employment in agriculture as share of total female employment	80.0	90.9	6.0
Male employment in agriculture as share of total male employment	72.7	64.3	8.6
Rural population as share of total population	76.2	66.3	41.2
Share of the rural population which is poor	38.7	71.3	-

*The female intensity of agriculture is calculated as the share of female agricultural employment in total agricultural employment. A share higher than 50 percent would suggest that the sector is female intensive.

2.2 Ownership and access to resources

A major difference between men and women in natural resource management including agriculture is their ownership and access to resources. Chief amongst these resources is land, and while there are local variations, in general there is a marked bias in favour of men being in the control of land as a means of production (Fontana and Paciello, 2009), women being less likely than men to own the land they farm.

The lack of land ownership can affect access to other resources, such as credit, water and grazing rights, limiting livelihood options for women – for example in Kenya women are excluded from contract farming as they lack statutory land rights, and have limited access to irrigation and infrastructure (Dolan, 2001).

Lack of access to resources also increases vulnerability. When times are difficult, such as caused by unfavourable climate, those with fewer resources find it harder to cope.

2.3 Education, knowledge and access to information

Women and girls in developing countries generally receive less education than their male counterparts. In sub-Saharan Africa adult literacy rates are around 70% in men, but only 54% in women, with primary enrolment of 66% in males and 59% in females (<http://stats.uis.unesco.org>). This has profound and far reaching consequences, and it has been said that the best rate of return on investment in developing countries is in educating girls. Lack of education affects many walks of life, but with natural resource management and agricultural production being a major activity for most rural women, its effect must surely be felt there. How this manifests in the context of invasive species is not clear, but it could result in women having less awareness of the problem of invasive species, and of how to manage them effectively.

Access to extension advice is also harder for women than men. In many developing countries most extensionists are men, so tend to focus on the tasks and interests of men, and women may be socially inhibited from interacting with male extensionists. Although the situation may have improved in the last 2 decades, Berger et al. (1984) reported that in Africa less than 3% of agricultural advisers and extension workers were female, and less than 2% of all extension contacts are with women farmers (Steeves, 1991).

2.4 Water

Gender differences in the use and management of water have long been recognized (Khosla and Pearl, 2003). Women are often responsible for domestic use of water in drinking, cooking, washing and hygiene; men are more often responsible for crop irrigation, large livestock production and industries. Thus if invasive species affect the availability or use of water, there are likely to be gender differences in their impacts.

One of the ecological impacts of invasive species can be to reduce the availability of water. This is discussed further in Section 3, but clearly has a significant gender dimension. Reduced availability of water means women and girls spend more time collecting it, with significant opportunity costs. In the case of girls this may be lost time for schooling, and for women less time for other productive or social activities (Brody *et al.*, 2008). Increased time spent collecting water can also mean increased exposure to assault, particularly in areas of unrest or conflict.

Reduced availability of water for men means their productive or income generating activities are likely to be affected. As with women, this can result in longer working hours, reduced income, and the social impacts that can follow such changes.

2.5 Decision making and conflict

Coupled with issues of roles, responsibilities and asset ownership is that of decision making, and associated structures. Again while there are differences between and within societies, women generally have less decision making authority than men. This extends to many aspects of life, including management of natural resources and the decisions that the presence of invasive species create. The differences may manifest in subtle ways, such as community meetings being held at times or places that suit men more than women, but it may also be more formal and part of customary law. Lack of education or access to information also restricts the ability of women to play a part in decision making.

Where decision making processes are imposed rather than agreed, outcomes may be difficult to accept for some parties, leading to conflict at household or community level. While conflict is not necessarily physical, violence against women is a major concern in many countries, and conflict over invasive species issues and decisions could aggravate existing problems.

Westermann *et al.* (2005) found that natural resource management groups are more effective when they are mixed or women-only. Collaboration, solidarity, collective action and conflict resolution all improve with women in the group, emphasizing that a gendered approach to natural resource management problems increases efficiency.

2.6 Gender and climate change

Climate change is now one of, if not the foremost environmental concern, with profound implications for sustainable development and natural resource management. Recently attention has been turned to the relationship and linkages between climate change and gender (Brody *et al.*, 2008), and consideration of how mitigation and adaptation responses can be made gender-sensitive. This is relevant to the current study for two reasons. First, like invasive species, climate change will cause changes to natural resources and the way in which they are managed, which can affect and be affected by gender differences. Even though some of the changes caused by and in response to climate change may be on a different scale to those associated with invasive species, there are perhaps lessons to be learned from climate change work on gender.

Secondly, climate change will have direct effects on invasive species, and so interact with gender differences in natural resource management. Climate change will result in new invasions, modify the impact of existing invasions, and modify the capacity of men and women to cope with their impacts. While this is true for anything that changes or impacts on ecosystems, the strong interaction between invasive species and climate change makes the invasive species/climate change/gender nexus one of particular significance, which to date has not been explored at all.

An additional observation in the context of climate change is that it is creating an upsurge of interest in biofuels. There is much to debate on the potential costs and benefits of biofuels, but here we note that some biofuel species are considered invasive, and Buddenhagen *et al.* (2009) show that in general, biofuel species are more likely to be invasive than other plant species. Depending on the complex interplay of social, environmental and economic factors in a particular context, there could be very marked differences in the gender related impacts of biofuels, which invasiveness could confound further.

3. Impacts of Invasive Species

In this section we consider the impacts of invasive species and how they may be related to gender. We note at the outset that in remarkably few cases have studies on invasive species impact disaggregated the data by gender, including cases where the gender of survey respondents has been collected. We discuss the areas or types of impact that have been recorded, although there are very many ways in which invasive species can have both negative and positive effects on people and their livelihoods. Any single species usually has several impacts, and these may interact with other factors that may magnify or reduce them. We do not consider here the impacts of responses to invasive species by prevention or management; Section 4 examines that in more detail.

Impacts of invasive species may be both direct and indirect, with a whole cascade of impacts following the initial ecological change (Mack et al., 2000; McNeely *et al.*, 2001). For example, the weed *Parthenium* can cause a direct impact on those who contact it in the form of an allergic response. This might change the working practices or reduce the amount of work of those affected, with multiple follow-on social and economic impacts. At the same time *Parthenium* can reduce crop yields by competition, reducing the availability of food or depressing income, each again with myriad potential consequences. The gender differences in the impacts of invasive species occur in the context of the issues identified in section 2. As was noted there, different societies and activities have different traditions and norms, and it is these that set the stage on which gender-related impacts of invasive species are played out.

3.1 Crop production

Worldwide as much as 40% of crop production is lost to pests, with higher losses occurring where farmers do not have the wherewithal to control them. Plant pathogens, arthropods and vertebrates feed on all parts of plants, reducing the quantity and quality of crop produced. Weeds reduce crop yield by competing with crops for resources, and also produce allelopathic chemicals that inhibit growth of other plants. The net effect is a reduction in food production, or a reduction in income for crops grown for the market.

Gender differences in the impacts of crop pests occur when one or other gender has a particular responsibility for a crop. Women tend to be responsible for food crops, so will be more affected by invasives attacking staples, while men tend to be responsible for cash crops (even though women may provide the labour). Quality is more important in cash crops especially in competitive markets, and this can be affected by quite small pest populations.

The loss of food crops, even if production is the responsibility of women, impacts the whole household. However, for cash crops, if the responsible gender is also in control of the income, the impacts may not spread through the household in the same way. While men have tended to be responsible for cash crops, female headed households occur for a number of reasons, including migration of men looking for work, and in these cases women assume responsibility for all the crops produced.

3.2 Animal production

The general pattern in rural communities is for women to be responsible for small livestock, such as would be kept round the house, while men are responsible for large livestock that might need to be herded substantial distances in search of fodder. Invasive species affect livestock production in various ways. Diseases cause loss of production or even death of animals, reducing food production, income, and depleting 'savings' where livestock are the repository of wealth. Invasive plants can affect grazing, reducing the quality or quantity of

pasture available and increasing the effort required to find it, impacts particularly important for pastoral communities. Animals that graze *Parthenium* are reported to have tainted milk, something that women, with their culinary responsibilities, might be more concerned with. Beekeeping is affected by invasive species. The varroa mite has become a major problem for beekeepers in many countries, though whether its impacts are gender segregated is not clear.

Invasive species may also serve as vectors for animal diseases. The Australian brushtail possum introduced to New Zealand can transmit bovine tuberculosis to cattle and deer so large amounts of money are spent to reduce the risks of that happening which would have huge livelihood impacts (Clout, 1999).

3.3 Fisheries and aquaculture

Fresh water and sea fishing is an activity often undertaken by men, so the immediate impact of invasive species affecting fish populations would be felt by men. Water hyacinth invasion in the Shire River in Malawi was reported to have reduced fish catches (Chimatiro and Mwale, 1998), though as a source of food the whole family would be affected. The example of Nile Perch in Lake Victoria is discussed further below.

Invasive species also affect aquaculture. The mud blister worm (*Polydora websteri*) was introduced to Hawaii where it has put some oyster farms out of business (Bailey-Brock and Ringwood, 1982). The worm drills into the shells of oysters and other molluscs, reducing their health and marketability.

3.4 Stored products

Stored food, especially grain, can suffer severe losses due to pest attack. Men's and women's responsibilities for different aspects of food storage are different, so impacts of invasive species affecting stored food should segregate by gender. In Africa one of the most damaging of these is the Larger Grain Borer, *Prostephanus truncatus*, thought to have been introduced via food aid shipments (Murphy & Cheesman, 2006).

3.5 Human Health

Although we are not considering invasive human diseases in this study, there are a number of ways in which other invasive species can be detrimental to human health. In general health is a greater concern to women than men, and in the few studies where this has been recorded, health impacts of invasive species are more frequently mentioned by women.

Some invasive species have direct impacts on health. Regular contact with *Parthenium* can produce allergenic eczematous contact dermatitis (AECD) and asthma. As a weed of cropland, women are more likely to come into regular contact with it than men. Thorny invasive plants can inflict wounds on people where they obstruct paths, and Mwangi and Swallow (2005) report a case of a lady losing an eye due to a *Prosopis* thorn. Invasive animals can serve as intermediate or alternate hosts for human disease. Several species of snail are intermediate hosts of rat lungworm (*Angiostrongylus cantonensis*) which can cause fatal eosinophilic meningoencephalitis in people (LoRe and Gluckman, 2003).

Invasive plants harbour other organisms that can be a health hazard. *Prosopis* in Kenya was reported to increase the incidence of malaria, especially by women (Mwangi and Swallow, 2008). Similarly the water hyacinth invasion in Benin was felt by some people, particularly women, to have increased the occurrence of malaria (De Groot *et al.*, 2003).

Invasive plants may also harbour or provide cover for injurious vertebrates. In Malawi water hyacinth was perceived to provide places in which crocodiles would hide. Crocodiles regularly attack people along the Shire River and women were reported to become reluctant to go to the river for water and washing because of the fear of crocodiles in the water hyacinth, (Chimatiro and Mwale, 1998). In Benin a small percentage of respondents reported water hyacinth was associated with increased populations of snakes (De Groot *et al.*, 2003).

Dense thickets of black wattle (*Acacia mearnsii*) in South Africa are considered as a risk to women and children, providing cover and hiding places for would-be attackers (McGarry *et al.*, 2005).

3.6 Water

Water has multiple uses, so there are many impacts of invasive species in relation to water. It was noted in section 2 that collection of water is a role associated with women, so invasives that restrict access to water, reduce its availability, increase the time taken to collect it, and reduce its quality are all areas where the immediate effect will be felt especially by women. Water weeds such water hyacinth, affect the availability or ease of abstraction, while shrubs such as *Prosopis* and others hinder access to water collection points. Water hyacinth was reported to make the water turbid and smelly (De Groot *et al.*, 2003), and in Liberia early in 2009 an outbreak of a moth (*Achaea catocaloides*) resulted in contamination of water under trees with very high densities of the larvae (<http://news.bbc.co.uk/2/hi/7868086.stm>).

Water is used for irrigating crops, in which both men and women may be involved, though setting up irrigation systems is more often a male activity. Invasive species affect irrigation systems by reducing availability and flow of water, and can cause sedimentation problems.

In some communities water is a major transport route, through which trade and other activities occurs. In the study of water hyacinth in Benin (Box 3), the negative impact most reported by both men and women was hindrance to transport. This resulted in reduced trade in fish and food crops, both of which are predominantly women's activities there.

A less obvious impact of invasive plants on water is that they may take up large amounts of water which is 'lost' to the ecosystem. This is the justification for South Africa's Working for Water programme (Box 4), so named because the large scale clearing of invasive trees is greatly improving the flow in water catchments.

3.7 Infrastructure

Various invasive species can cause significant damage to infrastructure. Termites may destroy wooden structures such as houses and grain stores, and rodents gnaw all sorts of items. Different structures have different significance for the genders, so some of these impacts may segregate by gender. Water weeds can block hydroelectric dams, and as was found in Malawi, the fine hairs from water hyacinth roots clogged filters in the turbine inlets.

Box 3. Water Hyacinth in Benin

Summarized from De Groot *et al.* (2003)

Water hyacinth is a major invasive species in many parts of the world, but was first observed in West Africa in the late 1970s and became a problem in the lagoon system of Benin in the 1980s. As part of a study to assess the impact of a biological control programme, impacts of the weed were assessed, disaggregated by gender. Negative impacts reported (in descending order of overall importance) were: transport is hampered; casting fishing nets becomes difficult; health is affected; fish stocks are reduced; water for household use is polluted; causes itching; time to market is increased; artificial fish breeding grounds are destroyed; malaria occurrence increased; causes aching; snake population increases; silting of water points. There were few positive impacts: soil is fertilized; soil is humidified; the plant has medicinal value.

Fishing is only conducted by men, so negative impacts related to fishing were cited much more often by men. Health effects were cited more frequently by women, but although only women reported significant trading in food crops and fish, hampering transport was the impact cited most frequently by both men and women.

Impacts to yearly income for the main activities of men and women were calculated. Men earned an estimated US\$41984/man/year before the invasion, falling by 70% as a result of it. About 97% of trading in fish and food crops is conducted by women, and annual income per woman fell from US\$519 and US\$310 to US\$137 and US\$193 respectively. This is equivalent to 74% and 38% reduction, presumably greater in the case of fish trading because there was less fish caught so less to trade.

Box 4. Working for Water

(Summarised from Magadela and Mdzeke (2004) and Macdonald (2004))

The Working for Water Programme in South Africa was launched in 1995 with the twin aims of reducing alien plants in water catchments, and providing employment to the poor and marginalized. The programme is based on research that shows:

- Removing invasive alien plants increases available water (both surface and underground)
- Removing dense stands of invasive alien plants has the greatest effect
- Removing plants from lowland areas has a greater impact than clearing them from upland areas

The programme has been internationally acclaimed; winning numerous awards, and appears to be successful in achieving both of its objectives. It has been estimated that the clearing of invasive plants has yielded around 50 million m³/year of water, equivalent to the full capacity of a large dam in Western Cape. As noted elsewhere, water availability has significant gender related impacts, but of particular interest here is the second objective of the programme, job creation for the poor.

Since inception the programme has ensured that at least 60% of the work goes to women, a target that has been achieved annually. In addition to providing work, the employees are trained in entrepreneurial skills, work related issues (herbicide application etc), and health, focusing on HIV/AIDS. It is noted that the implications of improving the financial status of women in a male-dominated society, and consequences of offering employment to women when there are many men unemployed, have not been fully explored.

3.8 Biodiversity

Loss of biodiversity is the impact of invasive species that resulted in their inclusion in the CBD, and invasive species are frequently reported as one of the major causes of biodiversity loss, perhaps only second to habitat destruction. In island ecosystems, which may be actual islands or ecological islands such as Lake Victoria, impacts of invasive species on biodiversity are particularly severe (Reaser *et al.*, 2007).

Loss of biodiversity has cascading impacts, but gender differences in direct impacts can be expected when the use or benefit from biodiversity accrues unequally. It was noted in section 2, that indigenous women may utilize a wide variety of plants for nutritional, medicinal, cultural and other purposes, so invasives that reduce that biodiversity would more immediately impact women. As noted elsewhere, health is a particular concern of women, and they more than men collect and use medicinal herbs.

Biodiversity loss can also impact ecotourism. National parks and reserves and the biodiversity they contain are the basis for major tourism industries in a number of African countries, and reduction of that biodiversity reduces their attractiveness. A number of invasive plant species are invading rangeland in East and Southern Africa with potential impacts on tourism if they are not managed. Different jobs in the tourism industry may be done more by one or other gender, so all suffer when tourism is affected. In Seychelles the tourism industry itself initiated a rat control programme on Fregate Island, in order to protect a number of endemic species of birds, reptiles and invertebrates of touristic value.

3.9 Uses

Many invasive plant species have been introduced because of their benefits, which persist even if the plant becomes a highly invasive. Some invertebrates intentionally introduced for their benefits have also become invasive, such as the Giant Apple Snail in Asia, and the Crayfish in Africa. But even unintentionally introduced species may have uses devised for them. The water hyacinth, although originally introduced to some countries for its beautiful flower, subsequently invaded many other countries unintentionally, and a large number of minor uses have been found for it, including production of briquettes for burning, and making furniture. (Lindsey and Hirt, 2000).

Particular uses of invasive species may be more associated with one gender than the other. The studies by Mwangi and Swallow (2005, 2008) clearly showed how women use the *Prosopis* for fuel wood, while men used it for poles in construction or fencing. Evaluation of the benefits and uses showed differences between locations, as well as between male and female.

Geheb *et al.* (2008) have studied the benefits arising from the Nile perch fishery in Lake Victoria (see Box 5). Their work shows that benefits to men and women are not just determined by the division of labour and roles in relation to the fishery, but also by the social setting including gender relations within which the benefits accrue. Nile perch fishing is done mainly by men, who receive most of the income, but Geheb *et al.* (2008) argue that it is because men retain control over the income that the women benefit in a much smaller way.

Because the benefits of invasive species can be different for men and women, this can create conflict at the household level as well as at community level. This is not specifically associated with the benefits, as costs (and the attempts to reduce them) may also be different and lead to conflict, but the fact that the same species can be both beneficial and damaging increases the potential for conflict.

McGarry *et al.* (2005) have proposed a categorization of invasive species according to their level of use and level of invasiveness and use this to generalize on how impacts change through time for the four broad categories. The four categories are as follows.

1. Low aggressiveness, low benefit. These species are relatively easily managed, and with little or no benefit.
2. Low aggressiveness, high benefit. With high benefit, local exploitation may be sufficient to keep the species in check.
3. High aggressiveness, low benefit. These highly invasive species have little or no benefit, so costs outweigh benefits. Crop pests such as cassava mealy bug exemplify this category.
4. High aggressiveness, high benefits. These species are the most controversial, being highly invasive, but highly beneficial to at least some people. *Prosopis* (Box 6) and Nile Perch are examples of this category.

In each of these categories, the important point for this review is that the benefits accrue differently between men and women, which is often not taken into account.

Box 5. Nile Perch in Lake Victoria

Summarised from Geheb *et al.* (2008)

The Nile Perch (*Lates niloticus*) was introduced into Lake Victoria in 1954. For 20 years the populations remained low, but in the 1980s there was an 'explosion' in numbers with huge ecological impacts. An estimated 200 species of Haplochromines were driven to extinction, and the biomass of *Haplochromis* spp dropped from 90% to less than 1% of the lake's total. The ecological changes allowed another alien species, the Nile Tilapia (*Oreochromis niloticus*) to expand in numbers, driving two native tilapia to actual or near extinction.

At the same time, a huge fishing industry was spawned; Nile perch catches increased from about 335 mt in 1975 to over 380,000 mt in 1990, and in 2006 the value of Nile perch exports from the lake was about US\$250 million. However, men control much of the fishery, as a result of which little of this income contributes to household expenditure, and child malnutrition around the lake remains similar to national

averages. Women tend to end up with peripheral parts of the industry, such as fish processing and trading, though as men enter the processing business they appear to be displacing women from those activities.

Thus although the invasive species has created an economic boom alongside an ecological disaster, traditional gender relations have resulted in women and children benefitting relatively little.

Box 6. *Prosopis* in Kenya

Summarized from Mwangi and Swallow (2005, 2008)

Surveys were conducted in Ng'ambo and Lobo locations of Baringo area in Kenya to determine the livelihood impact of *Prosopis*, intentionally introduced there during the 1980s. Uses and positive impacts of the species reported were: production of poles for construction (house, fencing); fuelwood; pods for livestock fodder or children's snacks; ropes made from the bark; honey; charcoal production; reduced dust storms. Negative effects reported were: invasion of crop fields and costs of clearing; invasion of grazing areas and loss of grazing; wetland invasion, reducing value for watering livestock and dry season grazing; reduction in access to the lakeshore for fishing; damage to bicycle and vehicle tyres; increased wear of cutting tools due to the hardness of the wood; damage to goats teeth from eating the pods; sharp thorns injuring livestock and people; increasing incidence of malaria from thickets close to houses; blocking paths so increasing journey times.

Costs and benefits varies with gender and location, although in most cases differences were not statistically significant. Overall economic value of costs and benefits are shown below.

Location	Gender	Benefit (Ksh/yr)	Loss (Ksh/yr)
Ng'ambo	Male	17427	55399
	Female	12291	16375
Lobo	Male	1002	1598
	Female	17535	3625

In Ng'ambo men had greater benefits than women because they trade in construction poles, while women focus on fuelwood, acknowledging a greatly reduced burden of gathering fuelwood. Ng'ambo men also had higher losses than the women because they are responsible for the livestock affected by *Prosopis*. In Lobo benefits and losses were mainly lower as *Prosopis* densities were lower than in Ng'ambo, but in contrast to Ng'ambo, women experienced greater benefits and losses than men. The greater benefits are largely due to firewood collection by women, but it was also in Lobo that 60% of respondents associated increased incidence of Malaria with *Prosopis*.

In Ng'ambo around half the respondents reported conflicts having arisen as a result of *Prosopis* invasion, though most were resolved. These centre around access to land

and resources, as a result of people being displaced from their homes, and farms by *Prosopis*, or seeking alternative grazing.

Prosopis thus has multiple direct and indirect impacts on livelihoods, including both benefits and costs. There are differences between genders in some these impacts, though the differences are not considered between areas. Policy change could affect the costs and benefits, for example if charcoal production and distribution is legalized.

Overall 85-90% of respondents favoured complete eradication, but would not mind replacement with another non-invasive and thornless tree. The remaining 10-15% of respondents were in favour of retaining the tree because of the benefits they receive from it.

Footnote: A seed-feeding biological control agent for *Prosopis* has been imported into Kenya, but its release was put on hold for two years because of the perceived opportunity to export *Prosopis* pods.

4. Prevention and Management

Decision VI/23 of the CBD Conference of the Parties (COP) included a set of 15 guiding principles concerning the prevention, introduction and mitigation of impacts of invasive species. The principles are designed to give guidance to governments and organizations on effective strategies for minimizing the spread and impact of invasive species, and therefore provide a good framework for examining the gender dimensions of prevention and management, although at no point do the principles specifically mention gender. The principles are divided into 4 groups which we discuss in the following 4 sections.

4.1 General

Guiding Principle (GP) 1 is the precautionary principle as set out in principle 15 of the 1992 Rio Declaration on Environment and Development, and in the preamble to the CBD itself. The principle is a response to risk and uncertainty, and we might ask whether there are any gender differences in perception of invasive species risks and their management. Gender differences in general risk perception are well documented in the literature (eg Bord & O'Connor, 1997), many showing that men rate risks lower than do women. In the context of invasive species, risk perception is important in prevention, not only by the risk analysts but by the general public who may introduce an invasive species. Where legislation exists and is enforced, the perception of the risk of getting caught comes into play. In invasive species management, the risk of the control methods may be perceived differently by men and women. Norgaard (2007) examined risk perception of invasive weed management in rural California, and found that women rated the risks of pesticides more highly than men, particularly in relation to reproductive effects. That study also noted a mistrust between the 'public' and the 'experts' responsible for the weed management. This was traced in part to historical factors, but Sjoberg (1999) has observed that experts and the public frequently disagree in risk assessment. Sjoberg (1999) says there are two types of expert: protectors, who want to inform and warn people of risk, and promoters, who feel people overrate risk and are thus too cautious. In both prevention and management of invasive species both those types of expert are found.

GP2 is the three stage approach; prevention is better than early detection and eradication, which is in turn better than mitigation. These are the stages addressed by later GPs.

GP3 is the ecosystem approach, itself described in 12 principles in COP decision V/6, the first of which is that the objectives of management of land, water and living resources are a matter of societal choice. It is noted that different sectors of society view ecosystems in terms of their own economic, cultural and societal needs, so taken to the individual level, this would include gendered needs and perspectives. However, as described in section 2 of this review, 'societal' views are often male biased, and women are often disadvantaged in decision making. The 2nd principle of the ecosystem approach is that management should be decentralized at the lowest level appropriate, and involve all stakeholders. As key managers of natural resources women as well as men are implied, though not specifically mentioned.

GP4 is on the role of states, which involves policy and legislation. In general policy and legislation in relation to invasive species is poorly developed, and what there is usually gender-blind. A paper by Young (2006) for the World Bank addressed the topic of national and regional legislation for promotion and support to the prevention, control and eradication of invasive species but made no mention of women or gender.

GP5 concerns research and monitoring. States are encouraged to undertake research on invasive species, including on the ecological, economic and social impacts. In this study we have found that there are few studies in developing countries on the social impacts of invasive species, and fewer in which data are disaggregated by gender. Some of the best examples are summarized in boxes in this paper.

GP6 is on education and public awareness. We noted in section 2 that women usually have less access to information than men, and we have found little evidence of public awareness messages on invasive species being developed with a gender perspective. A study by the RBIPMA project in Uganda examined public awareness of invasive species but didn't analyse gender differences.

4.2 Prevention

GP7 concerns border controls and prevention, GP8 exchange of information and GP9 cooperation, including capacity building. There are no clear gender dimensions to these principles, other than general ones relating to the provision of equal opportunities to men and women in education and employment. In section 5 we note that the RBIPMA project is building capacity but in post-graduate degrees has favoured men. Border controls are a major responsibility of National Plant Protection Organizations and in Sub-Saharan Africa most are led by men, reflecting the general gender imbalance in technical employment. The draft strategy for national phytosanitary capacity building developed under the International Plant Protection Convention makes no mention of gender.

One aspect of prevention is early detection and rapid response, and Flora (2008) has pointed out that for this to be effective, local communities must be involved, with their knowledge of what is "abnormal" in their local plant communities. Thus understanding and tapping into social capital, in which gender is clearly an important dimension, is important for the establishment of effective prevention programmes.

4.3 Introduction of species

GP10 and GP11 concern intentional and unintentional introductions respectively. Intentional introductions of species that have subsequently become invasive have been made because there was a perceived benefit, such as in agroforestry, as an ornamental, or in biological control. Ecofeminists would argue that much of the development paradigm is driven by men from a men's viewpoint (Warren, 1997), so that even in the introduction of species there is gender imbalance. A senior (male) researcher at an international research centre once told one of this review's authors that solving poverty was more important than protecting the environment, and that concerns about invasiveness should not hinder the import of useful species.

Unintentional introductions occur through a number of pathways, but we have not found data to indicate any gender dimension to this. International travel is an important invasion pathway (Djoghla, 2007) through checked-in or hand luggage, in the cabin, in the cargo holds and wheel wells, or on passenger clothes. Some years ago a passenger returning to Australia from Timor was found to have 12 different weed species in the treads of their shoes (<http://www.abc.net.au/rural/breakfast/stories/s1014538.htm>). Data from UK (CAA, 1999) suggest equal numbers of male and female passengers travelling for leisure, but a much higher proportion of males (around 80%) travelling for business, although the proportion of females travelling for business is increasing. These data would then need to be weighted by the probability that a particular gender would be carrying an invasive species. Examination of interception data disaggregated by gender would be interesting.

Other pathways thought to be significant in unintentional species introductions are sectoral activities such as agriculture, forestry, horticulture, fisheries, shipping (including the discharge of ballast of waters), general transportation, construction projects, landscaping, aquaculture, tourism, the pet industry and game farming. Food aid shipments and military operations are also invasion pathways (Murphy & Cheesman, 2006). In all these cases there may be a gender dimension, though research on it would perhaps not be a high priority.

In order to prevent or reduce the risk of introductions, importing countries can require exporting countries to undertake sanitary and phytosanitary (SPS) measures as provided for in the WTO SPS Agreement. Complying with these requirements imposes extra cost, and on occasion can lead to loss of market access. If the export business is one that has gender differentiated benefits, then impacts of SPS measures may be gender specific. The export of fish from Lake Victoria to Europe has on occasion been banned on SPS grounds, causing a marked decline in income for fishing communities (Geheb *et al.*, 2008). While the whole community benefits from the fishery, much of the income is controlled by men, so they were more affected than women by the ban.

4.4 Mitigation of impacts

GP12 to GP15 concern the management of introduced invasive species, from their early detection and eradication (if possible) through to control of established species.

Early detection of new invasions requires effective surveillance and if in the general environment rather than at a port of entry, may depend on members of the public alerting the relevant authorities. If women are doing much of the agricultural labour, as well as managing other natural resources, their awareness and observation is a major source

of surveillance information. But if extensionists are male biased, reporting could be inhibited. Rural plant clinics, an approach to plant health care being developed by the Global Plant Clinic (CABI and partners) provide a mechanism to collect this information (Boa, 2009).

GP13 notes that for eradication to be successful community support is often essential, and should be developed through consultation. Depending on the affected ecosystem and the roles and responsibility of people managing its resources, there could be a significant gender dimension.

Control of invasives (GP15) is a large area of activity, and we will consider the possible gender dimensions of some of the major control methods in turn.

4.4.1 Chemical control

It is estimated that globally there are three million cases of severe pesticide poisoning annually, and of these at least 300,000 are fatal, and a high proportion are in developing countries (Konradsen, 2007). Many acute episodes of poisoning are intentional self-poisoning, and pesticides are now one of the commonest methods of suicide. In South India, over 50% of all deaths of young women in the 10-19 year age group are from self-poisonings with insecticides (Aaron *et al.*, 2004). Two factors contribute to the high death rate: the high availability of pesticides, and their high toxicity resulting in a higher fatality rate than in countries where the most toxic chemicals are unavailable. Thus reducing the toxicity of available chemicals would reduce the fatalities, even if the number of self-poisonings did not decline. Pesticides also cause a host of sub-lethal effects, some through long-term exposure. Pesticides tend to be applied more in cash crops so men would be more exposed. But women, with less education and access to information, might be more likely to mishandle pesticides. The situation is unlikely to be that simple, as indicated by a study on gender differences in pesticide use and handling in Malaysian tobacco farmers (Nordin *et al.*, 2001). Use of personal protective equipment and clothing, and adoption of safe working habits, was significantly lower in women. But following the instructions on the label, and proper handling and maintenance of spray equipment was significantly lower in men.

London and Bailie (2001) show that reporting of non-fatal pesticide poisoning in South Africa may be as low as 10% of actual cases, with underreporting more prevalent amongst women. They also comment that the effects of long-term low-dose exposure are probably even more seriously underestimated.

Such long-term exposure may be increasing as more non-traditional agricultural exports are produced. Table 2 reproduces data from Fontana and Paciello (2009) showing that the majority of labour in non-traditional high value production in Africa is female.

Table 2. Employment in high value agricultural export production by region (data mostly from the 1990s) (from Fontana & Paciello (2009))

Country	Sector	Total numbers of workers (including men and women)	Female intensity	Average age of female workers	Demographic Characteristics
Kenya	Cut flowers	40000	75	20-34	-
	Vegetables	20000-32000	66	18-29	-
Senegal	French beans		90		
	Cherry tomatoes		60		
South Africa	Fruit	280000	53	31	90% percent of the women had children, most of them under five years old
Uganda	Cut flowers	3000	75-85		
Zambia	Vegetables	-	65		
Zimbabwe	Cut flowers	27000	70-87		

4.4.2 Manual Control

Most agricultural weeding in developing countries is undertaken by women, and it has been estimated that women in Africa spend 27 billion hours a year removing weeds (Gianessi, 2009). This is a huge input of time, even if not all the weeds being removed count as invasive species. Weeding by hand is generally undertaken by women, who may provide labour for weeding their husband's cash crop as well as for weeding their own food crop. An invasive species that increases weeding time (such as *Parthenium*) is likely to have a particularly significant impact on women. Similarly a management practice such as reduced or zero tillage will have a greater benefit to women.

Weeding in crops is the most important form of manual control of invasive species, but there are other instances. *Mimosa* in Zambia has been cleared by hand, and there it is men who are involved, probably because it is organized as paid employment. Manual removal of water weeds from fish landing sites may also be undertaken by men as the weeds interfere with their fishing activities.

Hand picking of insect pests is also sometimes undertaken. It is not feasible over large areas, and is time consuming, but is sometimes appropriate. Commercial coffee farmers in Zambia have used hand picking of *Antestia* bugs, and a range of pests are hand-picked in small scale vegetable farming.

4.4.3 Resistant varieties

Much research and development expenditure goes into the breeding of crop varieties that are resistant to arthropods and especially to plant pathogens. In the past, selection of desirable traits has often been the task of the breeder or research scientist, most of whom were and still are men in developing countries. Participatory varietal selection is now more common, but there is a risk that men's varietal preferences are given priority

if heads of households are invited to participate in selection activities. This is significant because women's preferences may be different from men's, and include traits related to preparation and cooking, storage or nutritional value of the crop, with other criteria such as pest resistance and yield being less important (Howard, 2003).

However, as Howard (2003) also notes, women may also be responsible for the selection of seed to be saved for planting the next season, and thus act as informal plant breeders, particularly for indigenous crops. Whether, for the same crop, more emphasis would be placed by women on pest resistant traits when an invasive was present than when it was absent or less severe would be interesting to investigate.

Genetic modification is now providing new opportunities for developing pest resistant varieties. However, World Bank, FAO & IFAD (2009) state "the lack of gender-disaggregated data on the adoption and benefits of GM crops makes it impossible to draw gender-specific conclusions, apart from pointing out the gender-specific constraints encountered with other interventions in crop protection and in plant breeding more generally".

4.4.4 Biological control

Sometimes an effective natural enemy for an invasive species can be found and introduced to the area of invasion as a biological control agent. When successful this can give a huge cost benefit ratio, and there are a number of good examples in Africa (Neuenschwander *et al.*, 2003).

An interesting aspect of classical biological control is that often it can be implemented successfully with little involvement of farmers. Thus biological control can be seen as being neutral, but this is not the case when the invasive also has some uses. Gender differences in utilization of an invasive mean that control will have gender related costs and benefits. A strategy for reducing the invasiveness of plants while allowing their continued use is to introduce seed feeding insects as control agents that depress the number of viable seeds produced, but which do not prevent vegetative growth. In the case of *Prosopis*, for example, the species could continue to be grown where it was required for fuelwood, but its unintentional spread to other areas would be curtailed. This approach has been adopted in South Africa for a number of species.

4.4.5 Other control methods

There are various other control methods used as variations of or totally distinct from those discussed above, such as changes to agronomic practices to reduce the likelihood of infestation or spread, trapping (especially for vertebrates, but including pheromone-baited traps for insects), organic methods (such as planting or making concoctions of plants that repel pests), the mass release of sterile insects for area-wide control. In each case, a gender dimension can occur through the following routes.

- The benefits of control may accrue differently to men and women, particularly when the invasive is used by one or other gender, or when the damage caused by the invasive segregates by gender.
- The costs of control may be different for the genders depending on the social setting. A man may judge a control method for a pest in his cash crop as being financially worthwhile, but if it requires labour from his wife, the time cost to her may be significant.

- Control methods requiring access to technical knowledge and technology may be more accessible to men than women, unless specific actions are undertaken to avoid that situation.
- Control approaches requiring additional time to implement may be less favourable to women.

4.4.6 Integrated pest management (IPM)

IPM has been defined in many different ways, but the description by the CGIAR system-wide programme on IPM covers many of the aspects of other definitions (Box 7).

Box 7. Integrated Pest Management

From SP-IPM In brief, www.spipm.cgiar.org/

Integrated Pest Management is an approach to enhancing crop and livestock production, based on an understanding of ecological principles, that empowers farmers to promote the health of crops and animals within a well-balanced agro-ecosystem, making full use of available technologies, especially host resistance, biological control and cultural control methods. Chemical pesticides are used only when the above measures fail to keep pests below acceptable levels, and when assessment of associated risks and benefits (considering effects on human and environmental health, as well as profitability) indicates that the benefits of their use outweigh the costs. All interventions are need-based and are applied in ways that minimize undesirable side-effects.

Originally IPM was defined as a combination of technologies, and Huffaker (1980) wrote a book on IPM titled "The new technology". However, IPM was then promoted on a wide scale in Asian Rice through Farmer Field Schools (FFS), groups of farmers who learn about pest management through discovery learning (Braun et al., 2000). This approach to IPM had a major focus on developing social capital rather than implementing technology, and so ensuring FFS and pest management methods addressed women's needs was part of the approach (van de Fliert and Proost, 1999).

Although there has been debate over the cost-effectiveness of FFS, there is little argument that effectively run FFS empower farmers in many ways, developing human and social capital, particularly in women (Mancini *et al.*, 2007). An evaluation (Loevinsohn et al., 1998) of the earliest FFS established in East Africa (on IPM in Kenya) showed that there were multiple benefits, including giving women more decision making in coffee, a cash crop traditionally the responsibility of men (although there was a question as to whether the women gained control over the proceeds). Communication by FFS participants to neighbouring farmers was almost entirely along gender lines (i.e. woman to woman and man to man), emphasizing the need to have gender balance in FFS enrolment.

Heong and Escalada (1997) found that in Thailand women were usually reluctant to participate in capacity building activities, when they conflicted with domestic commitments. Thus FFS and other activities for IPM need to be scheduled appropriately, and sometimes all-women groups help. This points to what can sometimes be a constraint to implementation

of IPM which is that it can be more time consuming, and in general this would be more of a constraint for women with many other demands on their time. However, IPM should reduce the need for pesticide application, and this could be a greater benefit for women.

IPM is perhaps the aspect of invasive species management where gender considerations have been most effectively included. Malena (1994) reviewed gender issues in IPM in Africa, and concluded that due to the gender differences summarized in section 2 of this report, the technological needs of women are different from those of men. More recently the US-funded IPM Collaborative Research Support Program (CRSP) has explicitly included social, gender, institutional and policy analysis as part of its approach (Hamilton & Norton, 2001; Heinrichs, 2005), with a gender specialist as part of the advisory and management team. Research under IPM CRSP in Uganda, for example, has suggested that due to their greater appreciation of the benefits of IPM, targeting women may expedite IPM adoption (Erbaugh *et al.*, 2003).

5. Gender in Invasive Species Programmes and Projects

5.1 Global Environment Facility

The Global Environment Facility (GEF) is a financing mechanism for implementation of the Rio UN conventions on biodiversity, climate change and desertification. It has recently published a document entitled "Mainstreaming Gender at the GEF" (GEF, 2008) from which the following material is summarized. The document "provides an account and a first analysis of the scope, content and depth of gender mainstreaming in GEF projects". A strong case is made for gender mainstreaming, as GEF recognizes that for its project interventions to achieve their global environmental objectives, particular attention should be paid to enhancing both women's and men's contributions. It is noted that achievement of the 3rd MDG on promoting gender equality will have a key role in achieving the 7th MDG on environmental sustainability.

GEF's policy on gender is traced back to a document on Public Involvement in GEF-financed Projects, approved by the council in April 1996. The document addresses social issues, and emphasizes stakeholder participation throughout the project cycle, with particular attention to including women in the design and implementation of GEF projects. Similarly the GEF operational strategy (GEF, 2004) provides 10 operational principles, the 7th of which relates to public participation including gender. In the Biodiversity Focal Area, some of the now operational programmes, such as agricultural biodiversity, recognized the role of gender in GEF activities.

A total of 172 GEF-funded projects approved and implemented in 2003-2006 were analyzed to assess the nature and extent of gender mainstreaming, including 74 in the biodiversity focal area. The assessment was desk-based, mainly through an assessment of the project document, but including annual or terminal reports where available. Six criteria were assessed (Box 8).

Box 8. Criteria used for assessing GEF projects for gender mainstreaming

From GEF (2008).

- 1. Gender Analysis:** Projects that conducted gender analysis as part of the social assessment or as a separate analysis;

- 2. Consultation with women and men:** Projects which conducted consultation with groups of women and/or men during project preparation, implementation, and/or monitoring and evaluation;
- 3. Gender in project objective(s):** Projects that have a gender keyword within the project objective statement;
- 4. Gender targeted project component, outcome, output, and/or activity:** Projects that include gender-sensitive actions in the project framework and associated project description;
- 5. Gender informed monitoring and evaluation:** Projects that include gender-specific project performance indicators in their monitoring and evaluation process; and
- 6. Budget allocated to gender activities:** Projects that explicitly allocate financial resources for gender-related activities, including gender specialists and consultants.

The report makes observations on the results for the different criteria (Table 3), but the overall conclusion was that gender mainstreaming in GEF-funded projects is limited, and much less than has been achieved by the World Bank, for example. Further analysis of the data separated by Executing Agency showed that only 12% of projects executed by UNEP included gender mainstreaming activities.

Table 3. Results of the GEF Project Review based on Six Gender Mainstreaming Criteria/ Actions (Box 8). From GEF (20018).

Focal Areas	Number of Projects	Gender Key words	Gender Analysis	Consultation	Project Objective	Project Component and Activities	M&E, Including Indicators	Budget for Gender Activities
Biodiversity	74	44	17	11	0	24	15	8
Climate Change	36	8	1	2	1	2	1	1
International Waters	23	6	3	4	0	3	1	2
Land Degradation	10	5	3	2	0	2	2	1
POPs	4	3	0	2	0	0	0	0
Ozone	2	0	0	0	0	0	0	0
Multi-focal Area	23	12	7	8	0	5	4	0
Total	172	78 (45%)	31 (18%)	29 (17%)	1 (0.6)	35 (21%)	23 (13%)	12 (7%)

On the basis of the results of the review, while noting the need for further analysis, 8 steps are proposed.

- Develop a vision and plan for reviewing gender mainstreaming in GEF operations
- Identify and work on specific thematic issues with strong gender dimensions, such as sustainable forest management, indigenous peoples climate change and adaptation
- Create a focal point to strengthen the institutional framework for gender mainstreaming and socioeconomic aspects in general.
- Strengthen GEF staff capacities in gender mainstreaming
- Pay increased attention to socioeconomic aspects of projects, including gender elements
- Incorporate gender as an explicit element for review in monitoring and evaluation at all stages of the project cycle
- Ensure funding is allocated within GEF projects to implement gender mainstreaming actions
- Strengthen networking with partners that have substantive experience working on gender issues

5.2 Global Invasive Species Programme

The Global Invasive Species Programme (GISP) was established in 1997, initially as a consortium between the Scientific Committee on Problems of the Environment (SCOPE), CAB International (CABI) and the World Conservation Union (IUCN), in partnership with the United Nations Environment Programme (UNEP). It involved voluntary contributions from a substantial group of scientists, lawyers and managers from all parts of the world (McNeely *et al.*, 2001). Phase I of GISP was supported financially by GEF through UNEP, along with a number of other organizations.

GISP's mission is to conserve biodiversity and sustain human livelihoods by managing the spread and impact of invasive species. In Phase I, GISP sought to:

- Improve the scientific base for decision making on invasive species
- Develop capacities to employ early warning and rapid assessment and response systems
- Enhance the ability to manage invasives
- Reduce the economic impacts of invasives and control methods
- Develop better risk assessment methods
- Strengthen international agreements
- Develop public understanding of the ecology of invasives
- Examine legal and institutional frameworks for controlling invasives

- Develop new codes of conduct for the movement of species
- Design new tools for quantifying the impact of invasives

GISP also serves as a clearing house mechanism on invasive species on behalf of the CBD, and is thus frequently referred to in COP decisions on invasive species. The 2008-2010 GISP strategy places emphasis on policy influence.

Since its foundation, GISP has produced a substantial number of outputs in relation to the aims listed above, including:

- Material for the general public
- Training guides and packages
- Technical monographs
- Toolkits and methodological guides
- A website and a database

In Table 4 we list some of the outputs and give comments on their content in relation to gender. While gender is mentioned in some of the outputs, nowhere is there a full treatment, and in many cases is not mentioned at all.

Table 4. Content of selected Global Invasive Species Programme publications

Title	Reference	Content	Gender coverage
Invasive alien species: A Toolkit of Best Prevention and Management Practices.	Wittenburg and Cock (2001)	Extensive set of guidance with numerous examples	No examples of gender considerations in any aspect of invasive species prevention and management.
A toolkit for Developing Legal and Institutional Frameworks for Alien Invasive Species.	Shine (2008)	Set of 6 modules and numerous examples	No mention of gender or women's issues
A Toolkit for the Economic Analysis of Invasive Species	Emerton and Howard, (2008).	Set of 6 modules and numerous examples	No mention of gender or women's issues
The Socioeconomic links between Invasive Alien Species and Poverty	Perrings (2005)	Report examining the relation between poverty and strategies for the prevention and management of invasive species; and the connection between poverty and the costs or benefits of invasions.	One mention of women, who are said to have suffered more from declining macroeconomic conditions.
A Global Strategy on Invasive Alien Species	McNeely et al. (2001)	Clear elucidation of the problem and a 10 point plan for addressing it.	No mention of gender or women
The Great Reshuffling: Human Dimensions of Invasive Alien Species	McNeely (2001)	Based on a synthesis workshop focusing on human aspects of invasive species	Only significant mention of gender or women in the chapter on the Working for Water Programme

A review was conducted of the UNEP/GEF MSP under which GISP was established and conducted many of its early activities (Given, 2003). The review noted that an “impressive array” of outputs was produced, and indeed many have become frequently cited and used. At no point does the review mention gender or gender-related issues. It could be argued that this would have been a greater level of detail than was required, but the review did note that a view had been heard that GISP had “a few too many theoreticians and too few people who worked at the ‘coal face’ on the practicalities of alien species”. The review also reported comments it heard from COP delegates who had expressed surprise at what they perceived as naivety on the part of some academics when promoting the project, particularly when it came to translating ideas into a policy and diplomacy setting.

These observations may help to explain why relatively little attention has been given to gender in GISP’s outputs. However, GISP is certainly not the only programme in natural resource management that could have that comment made about it, so GISP’s gender-blindness is also likely to be a function of a more widespread shortcoming.

5.3 Convention on Biological Diversity

We saw in a previous section that while GEF projects have made progress in incorporating and addressing gender issues, there is clearly still some way to go before it can be said that gender has been properly mainstreamed. GEF projects cover the implementation of three UN conventions, but our particular concern here is with the CBD in which invasive species feature. Prior to COP 9, gender had appeared in a number of decisions, but on a somewhat *ad hoc* basis. Gender and women were mentioned in a number of decisions and associated documents, but as far as we can ascertain, never in relation to Article 8(h).

We noted in the previous section that GISP has not emphasized gender in its work, and the absence of gender in CBD documentation and COP decisions on Article 8(h) may explain this. There may also be a reverse effect, as GISP has clearly had some influence on COP decisions.

However, Decision IX/24 at COP 9 adopted the CBD’s first Plan of Action (Document UNEP/CBD/COP/9/INF/12/REV1), and agreed to support its implementation by the secretariat.

5.4 Removing Barriers to Invasive Plant Management in Africa (RBIPMA)

5.4.1 Background to the project

The RBIPMA project is a collaborative initiative amongst four countries: Uganda, Ethiopia, Ghana and Zambia. The United Nations Environmental Programme (UNEP) is the Implementing Agency (IA), with responsibility for project management, overview, monitoring, and liaison with, and reporting to the Global Environment Facility (GEF). International project coordination is undertaken by CABI and the World Conservation Union (IUCN) and there are National Executing Agencies (NEA) in each of the four project countries. The RBIPMA project was launched in December 2005 and is expected to be completed in mid 2010.

The RBIPMA aims to reduce and eventually remove barriers to the management of invasive species through effective implementation of CBD Article 8(h) in 4 pilot countries using a multisectoral ecosystems approach.

In each country, an enabling policy environment is being promoted through the establishment of appropriate institutional arrangements to ensure that invasive species strategies are mainstreamed. Awareness of invasive species issues is being raised and access to information on invasive species is being provided to various stakeholders. Prevention and control programmes have been established, including ecosystems management at pilot sites and capacity building activities for the sustainable management of invasive species are being undertaken.

5.4.2 Gender in the RBIPMA project

We review the project here using the six criteria applied in the GEF portfolio analysis (Box 8).

Gender Analysis. Stakeholder analysis was conducted as part of the PDF-B, but it did not include a specific gender analysis.

Consultation with women and men. The project includes a number of participatory activities. Table 5 shows data on the gender of staff and participants in the project.

Table 5. Data on gender participation in various project activities and decision making structures in Zambia and Ghana.

	Ghana			Zambia		
	M	F	Total	M	F	Total
Coordination Unit: Directors	1	0	1	0	1	1
Coordination Unit: Technical	2	0	2	2	0	2
Coordination Unit: Fin. and Admin.	2	2	4	0	2	2
Pilot Site Coordinators	2	0	2	2	0	2
National Steering Committee	9	3	12	9	2	11
Pilot Site Committees	53	12	65	23	3	26
Post-graduate students	1	0	1	2	1	3
Annual workshop				19	4	23
MTR Review workshop	35	8	43			
Consultants	6	0	6	8	4	12
invasive species Clearing teams				232	3	235
Drivers	2	0	2	2	0	2
Awareness Creation Workshop	115	32	147			
Media Awareness Workshop	23	2	25			
NISSAP Review Workshop	17	2	19			
Stakeholders Workshops	73	11	84			
Committee - Integration of invasive species issues				2	3	5
Committee - invasive species information packs				3	3	6
Total	341	72	413	304	26	330

Gender in project objective(s). The project does not have a gender keyword within the project objective statement, as implementing Article 8(h) is not a gender specific activity,

Gender targeted project component, outcome, output, and/or activity. The project did not include any gender targeted components, outcomes or outputs. The description of the project activities made it clear that a number of them, particularly at the pilot sites were to be participatory, following the principles of public participation set forth by GEF. The project document included the following paragraph.

“Women are involved in all aspects of invasive species from invasion pathways through to the implementation of management and control strategies. Women in Africa are particularly affected by invasive species during land preparation, crop production and the collection of firewood etc. During the PDF-B phase of the project, it was recognised that women were inadequately represented at all levels. Therefore during the inception phase of the project, country-specific mechanisms involving affirmative action will be established to ensure that women are involved in all aspects of the project including recruitment, representation on committees, training and consultancies, etc.”

The tables presented above indicate that while there may have been attempts made at affirmative action, the results have not been very successful. A survey on awareness in Uganda illustrates the difficulties (Gumisiriza & Beine, 2008). Out of 535 people interviewed, only 18.1% were female. The survey was administered by district administration field officers, to other field officers in the natural resources management, council and church leaders, and ‘lead/progressive’ and other farmers, and many of these categories are mainly males.

Gender informed monitoring and evaluation. There are no gender-specific project performance indicators in the monitoring and evaluation process. The tracking tool for Biodiversity Focal Area Strategic Priority Area 2, Mainstreaming biodiversity in production landscapes and sectors, does not include any gender related indicators, neither does the annual performance review include any assessment of gender mainstreaming efforts. Similarly the project mid-term review in 2007 made no assessment of gender issues in project implementation.

Budget allocated to gender activities. No financial resources are specifically allocated to gender-related activities in the budget. A gender specialist was part of the task team to assess the economic impact of the two priority invasive plants in Ethiopia.

6. Field study in Ethiopia

6.1 Introduction

A participatory rural appraisal was undertaken in Ethiopia to collect supplementary information on gender-related impacts, perceptions and management of the two priority species *Prosopis* and *Parthenium*. The field work was undertaken at the RBIPMA pilot sites.

6.2 *Prosopis* in Ethiopia

Prosopis juliflora was introduced to Amibara District of Afar Regional State in 1988, as a windbreak to protect citrus orchards, and for the general amelioration of the harsh environment in the area. *Prosopis* species are generally valued as a rehabilitation tool for degraded rangelands, shade, fodder (the pods are palatable for livestock and humans),

honey, charcoal, timber, fuel and several other resources. On the other hand introduced *Prosopis* species have become invasive in many countries. In Ethiopia, *P. juliflora* has invaded approximately 700,000 ha of fields, rangelands and protected areas. It is aggressively invading pastoral areas where it covers thousands of hectares in the Middle and Upper Awash Valley, and Eastern Harerge, destroying natural pasture, displacing native trees, forming impenetrable thickets and reducing grazing potential.

The pastoral economy is important and the dominant livelihood in the Afar region. Vegetation resources therefore form the basis on which pastoralists depend, with most of it confined to the flood plains of major rivers and streams. The extreme importance of riverine vegetation as a lifeline to livestock, especially during drought, is evidenced by the heavy concentration of livestock along river basins, swamps and other wetlands in the region. *Prosopis juliflora* is gradually out-competing the most critical forage and browse species in these areas. It has formed green impenetrable thickets with no undergrowth for extensive areas, leaving nothing except its pods for livestock feed. Livestock death associated with indigestion problems as a result of feeding on *P. juliflora* pods is increasingly being reported, and occurs when the animal's diet has too much *prosopis* and too little supplementary feeds such as grass.

In the Afar Regional State food production mainly occurs in the most fertile lands along major rivers, swamps and deltas. *Prosopis juliflora* invasion in these habitats is particularly severe and is already causing adverse impacts on agricultural production. It inhibits mechanization (the thorns puncture tyres), dense infestations block irrigation canals, and infestations lead to a significant diversion of resources towards clearing and weeding throughout the year. The need to spend more time and money managing *P. juliflora* species reduces the time available for other productive agricultural activities, subsequently affecting the farmers' financial situation. In some cases infestations have been so severe that farmers have abandoned their lands and homesteads.

Prosopis juliflora tends to invade low-lying areas first where it has a significant impact on water resources. It has a well developed taproot which enables it to source water from underground aquifers and as a result it has a negative impact on scarce underground water resources that are critical for the survival of local communities and their livestock. Studies have shown that *P. juliflora* trees have deep and extensive root systems that can easily reach water tables up to 18m or more below the soil surface. A mature *P. juliflora* tree can use about 40 -100 litres of water per day. Water use per hectare of dense stand is estimated at one million litres per year – enough to sustain 40,000 people per year according to the standard of 25 litres/person/day (Stoltz, 2001). Versveld *et al.* (1998) have shown that a dense infestation of the species uses about 2,800 m³/ha/yr more than the natural vegetation within the invaded areas.

Unpublished studies in invaded areas in Ethiopia have indicated a drastic reduction in the number of indigenous plant species. This also has implications for human health as most people in the Afar Regional State use medicinal plants to treat various ailments. In South Africa there were 41 dung beetle species in uninvaded areas compared to 34 in areas invaded with *Prosopis* species (Steenkamp and Chown, 1996). Local communities in Ethiopia have also indicated that a number of large mammal species have disappeared from areas invaded by *Prosopis* species. In South Africa bird diversity is far lower in invaded versus uninvaded areas with no raptors present in areas where *Prosopis* species are abundant (Dean *et al.*, 2002). Many factors could be responsible for this including

a change in vegetation structure and fewer insect species associated with *Prosopis* species in their introduced range, hence the lower number of insectivorous birds and other prey items in dense stands. The potential reduction in bird diversity has implications for bird tourism with many designated International Bird Areas (IBA's) in Ethiopia.

6.3 Parthenium in Ethiopia

Parthenium hysterophorus is a low annual shrub native to the sub-tropical areas of South America. Under favourable conditions it can germinate, mature and set seed in 28 days. A single plant can reach a height of 2 m and can produce up to 28,000 seeds (achenes) (Navie et al., 1996), which are spread by vehicles, machinery, animals, contaminated pasture and crop seed, stock feed and water. The weed can affect crop production, animal husbandry, human health and biodiversity. Few other weeds have such a wide ranging and serious impact. It has been introduced and become invasive in many parts of Africa, India, Israel, Nepal, Taiwan, and Australia. It is believed to have been introduced accidentally into Ethiopia through aid shipments in the 1980s (Murphy and Cheesman, 2006). The main pathway for spread in Ethiopia has been along main roads from Addis Ababa to Dire Dawa to the east (which passes through Boset) and to Mekele to the north. It has invaded more than 1 million ha in Ethiopia.

The impact of parthenium weed on livestock production is both direct and indirect. It affects grazing land, animal health, milk and meat quality as well as marketing of pasture seed and grain. Jayachandra (1971) reported that the weed can reduce pasture carrying capacity by up to 90%. According to McFadyen (1992) over 17,000 km² were infested by *P. hysterophorus* in Queensland, Australia, at that time, and that 45,000 cattle could have been marketed in the absence of the weed, with a net annual loss of revenue of AU\$ 5-17 million. Narasimhan et al. (1977) reported that while cattle and buffalo feed sparingly on *P. hysterophorus*, goats readily graze it. In artificial feeding tests, however, buffalo calves accepted the weed in various mixtures, and 11 out of 16 of the calves developed dermatitis and toxic symptoms and died within 8-30 days. The milk of cattle, buffalo and sheep that have ingested substantial quantities of the weed can also be tainted (Towers and Subba Rao, 1992).

Because parthenium weed is an extremely prolific seed producer, it has high potential to be an extremely aggressive colonizer of crops. In addition to exhibiting allelopathy (Rajan, 1973; Kanchan, 1975), *P. hysterophorus* directly affects crop production. Channappagoudar et al. (1990) in India, reported that the presence of *P. hysterophorus* reduced sorghum grain yield from 6.47 to 4.25 tons/hectare and decreased grain weight by 30%. *P. hysterophorus* has also been reported to act as an alternate host for insect pests and diseases, thus indirectly affecting crop production. In Ethiopia, if parthenium is left uncontrolled throughout the cropping season, sorghum yield losses can range between 40-97%, depending on the year and site (Tamado and Milberg 2004).

Human health risks from *P. hysterophorus* have been known for decades (Lonkar et al., 1974). These risks were comprehensively reviewed with emphasis on India and Australia (Towers and Subba Rao, 1992; McFadyen, 1995). After 1 to 10 years exposure to the weed, 10% to 20% of the population will develop severe allergic reactions which include hay fever, asthma or dermatitis and can be caused by dust and debris from the plant as well as pollen (McFadyen, 1995). Wiesner et al. (2007) recorded a range of effects of parthenium on human health in Ethiopia.

Because of its invasive capacity and allelopathic properties, parthenium weed has the potential to disrupt natural ecosystems. It has been reported to cause a total habitat change in native Australian grasslands, open woodlands, river banks and flood plains (McFadyen, 1992; Chippendale and Paneta, 1994). Similar invasions of *P. hysterophorus* have been observed more recently in Ethiopia where it has already reduced the available forage for wildlife. The weed is rapidly invading protected areas and is now present in the Awash National Park. This will increase pressure on existing grazers. Increased incursion of domestic livestock into the park (under the pressure of *P. juliflora* and *P. hysterophorus* invasion) would also result in overgrazing, facilitating *Parthenium* invasion resulting in a positive feedback process of ecosystem degradation and invasion.

6.4 Methodology

The aim of the rural appraisal was to gather first-hand information from women and men about the impacts (positive or negative) and management of the two species, from a gender perspective. We used a qualitative approach, based on discussions with groups of men and groups of women (Fig. 1), as well as individual discussions with key informants.

6.4.1 Study sites

The field work was undertaken in 2 districts or woredas, Amibara and Boset. Both these are districts in which the RBIPMA project is working. In each district, focus group discussions were held in 2 villages or kebeles.

Amibara District

Amibara is in Afar Regional State, located in the Middle Awash Basin (approximately 9° 17'N, 40° 22' E), about 268 km NE of the capital Addis Ababa (Fig. 2). The woreda has a semi-arid climate with a mean annual rainfall of c.600 mm falling between February and August. Temperatures vary between 10°C and 42°C. The natural vegetation in the district is acacia savannah. The best remaining example of this habitat is found in the Awash National Park which covers 827 km².

Pastoralism accounts for the major land use in the area with cattle, camels, goats and sheep being the dominant species. In addition there is seasonal cultivation of staple crops such as tef and sorghum and large state and privately owned farms growing cotton, citrus fruits, sesame and groundnuts under irrigation. The total population of the area is estimated to be 63,280 with a total land size of 3,994 km². There are 18 kebeles in the woreda with 39 Development Agents (12 women and 27 men). Since polygamy is common practice in the area it is very difficult to estimate the number of women headed households in the woreda.

Boset

Boset woreda is in the Oromia region of Ethiopia, about 125 km east of Addis Ababa (Fig. 2). It is situated at an altitude of 1700 m with a mean annual rainfall of 850 mm. The natural vegetation type is similar to found in the Amibara District although tree densities are much higher given the greater rainfall and lower evapotranspiration in this area.

Major crop enterprises that comprise 81 % of the total income source are maize, sorghum, haricot bean, wheat, barley, lentil, field pea, chick pea, rough pea and faba bean production. Livestock generates 18% of the income while petty trading comprises 1% in income generation. The total population of the woreda is 153,606. The number of women headed households is indicated to be 1,235. There are 42 kebeles and 92 Development Agents (17 women and 75 men). Unlike the Amibara area, the dominant religion is Christianity.



Figure 1. Women's and men's focus group discussions

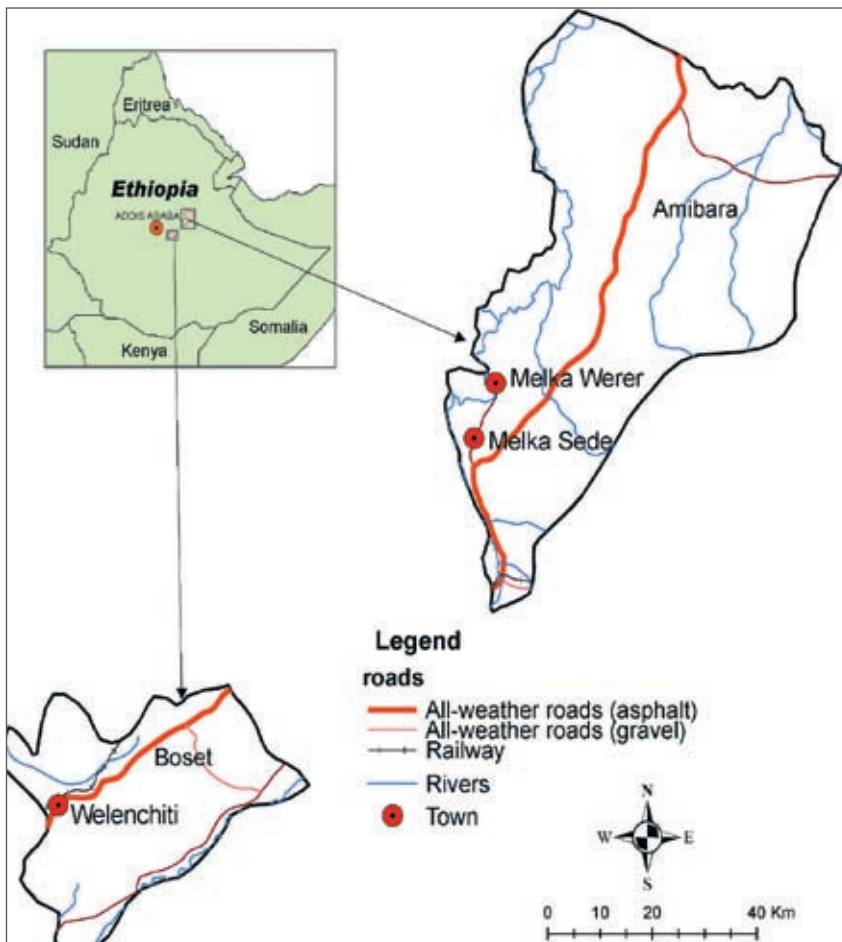


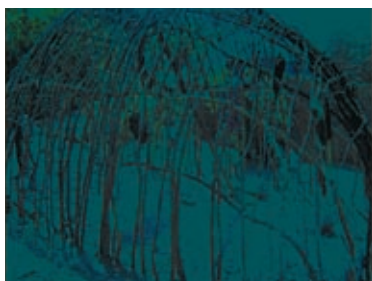
Figure 2. Location of the study sites (GIS office, Ethiopian Institute of Agricultural Research)

6.4.2 Focus group discussions and interviews

Information was collected in two kebeles in each district. Data were collected using participatory methods including key informant interview, focus group discussion, transect walk, trend analysis and pair wise ranking methods. Twenty five key informant interviews were conducted with local chiefs, Development Agents, head of women's affairs office at each study site, and staff of the relevant stakeholders' offices including Ministry of Agriculture and Rural Development, MoARD, Institute of Biodiversity Conservation, (IBC), Environmental Protection Authority (EPA), and Farm Africa (an NGO). Focus group discussions were conducted separately with a group of men only and a group of women only in each kebele (Table 6) (Figure 2). Discussions were based on a checklist (Annex 1).

Table 6. Focus group discussions

Kebele	Number of group members	
	Women	Men
Amibara woreda		
Halydegi	8	7
Bedulale	8	7
Boset woreda		
Tirebireti	5	9
Dengore Tiyo	7	7
Total	28	30

**Figure 2.** Afar traditional houses, which are constructed by women

6.5 Results

6.5.1 Livelihoods

In Amibara livelihoods are predominantly based on livestock production. Cattle, camels, goats and sheep are the dominant livestock species in the area. Women and men are both responsible for the production and management of the livestock sector, but key informants reported that Afar women are very strong in shouldering various different responsibilities. In addition to their domestic chores, they are responsible for constructing traditional houses, and also engage in the labour market to generate income to meet household needs. Both men and women reported that women are involved in collecting animal feed, fetching water, collecting fire wood and preparing food for the family. Women are also responsible for looking after calves, goats and sheep, often being assisted by children. In particular, collection of wood for constructing traditional houses is entirely the responsibility of women (Figure 2). Men are predominantly engaged in traveling with animals for grazing. Key informants indicated that Afar women are increasingly working as daily labourers on other private and state farms in the area.

In Boset, as in many other parts of the country, women, men and children (boys and girls) share responsibilities in agricultural production, in both crop and livestock enterprises. Women and children are involved in agricultural activities such as land preparation (gulgualo), hand weeding, cultivation using a hoe, harvesting, transporting, preparing the threshing ground, threshing, cleaning and storing. With regard to livestock production, women are involved in feeding, barn cleaning, and milking. Men are often involved in plowing the land, sowing, harvesting, and to some extent in weeding. The key informants and focus groups indicated that although women contribute much labour, they still lag behind men in decision making power. The women headed households meet their labour requirements by using family labour, by arranging events to use community labour, and by hiring in labour. It is also common among the female headed households to rent out their land.

6.5.2 General perceptions of the two plant species

Almost all the informants involved in the interviews and discussion were very familiar with the two species. Pastoralists of Amibara woreda indicated that prosopis was introduced by a white man during the Dergue regime in the 1980s, along the irrigation areas. Local elders were consulted prior to its introduction. They were told that prosopis has a number of merits that can benefit the community and the environment; it can grow under conditions of water stress, it is evergreen, and can be used as animal feed. The community was convinced and started planting seedlings around the irrigation development area. However, they are now of the opinion that it has invaded them and is out of control. They emphasized that it is of no significant benefit to the native pastoralists. The informants believe that its multifaceted harmful effects outweigh the benefits derived from it. In particular, it is a major threat to their livestock, the basis of their livelihood.

Informants in Boset indicated that parthenium was also introduced during the Dergue regime, but accidentally with food aid. It initially appeared along the main highways and railway tracks. It gradually spread and infested farm lands, becoming one of the most dangerous weeds posing serious problems in their area. All the interviewed individuals in the two woredas considered the two plant species as highly invasive and harmful that need to be eradicated. They believe that they threaten crops and livestock productivity, livestock and human health, biodiversity, and overall livelihood of the community.

At one kebele in each woreda, focus groups were invited to identify the main problems they face, as a way of gauging the overall importance of the two invasive weeds. Tables 6, 7, 8 and 9 show the results of pairwise ranking of the priority problems conducted by men and women in Bedulale and Tirebireti kebeles. Cell entries in the table show whether the problem in the row or column heading was considered more severe (column heading abbreviations are as indicated in the row headings). The score for each problem is the number of such pairwise comparisons in which the problem (by row) was considered the more severe.

Table 7. Pairwise ranking of priority problems by men in Bedulale kebele

Problem	P	L	A	G	Ph	I	C	F	Score	Rank
Prosopis (P)	-	P	P	P	P	P	P	P	7	1
Decreasing livestock population (L)		-	A	G	L	L	L	L	4	4
Animal disease (A)			-	G	A	A	A	A	5	3
Grazing land/feed (G)				-	G	G	G	G	6	2
Parthenium (Ph)					-	I	C	F	0	8
Irrigation (I)						-	I	I	3	5
Construction materials (C)							-	C	2	6
Fuel wood (F)								-	1	7

Table 8. Pairwise ranking of priority problems by women in Bedulale kebele

Problems	P	F	W	H	T	C	Score	Rank
Prosopis (P)	-	P	P	P	P	P	5	1
Animal feed (F)		-	F	H	F	F	3	3
Drinking water (W)			-	H	W	W	2	4
Health service (H)				-	H	H	4	2
Transport (T)					-	C	0	6
Construction material (C)						-	1	5

Table 9. Pairwise ranking of priority problems by men in Tirebireti kebele

Problem	P	S	Dr	C	A	I	Df	Dw	Score	Rank
Parthenium & other weeds (P)	-	P	Dr	P	P	I	Df	Dw	3	5
Soil erosion (SE)		-	Dr	S	A	I	Df	Dw	1	7
Drought (DR)			-	Dr	Dr	I	Df	Dr	5	3=
Crop pests (CP)				-	A	I	Df	Dw	0	7
Animal feed (AF)					-	I	Df	Dw	2	6
Irrigation water (IW)						-	I	Dw	6	1=
Deforestation (DF)							-	Dw	5	3=
Drinking water (DW)								-	6	1=

Table 10. Pairwise ranking of priority problems by women in Tirebireti kebele

Problem	P	T	R	W	F	Score	Rank
Parthenium (P)	-	P	R	W	F	1	4
Technology for food processing (T)		-	R	W	F	0	5
Erratic rainfall (R)			-	R	F	3	2
Shortage of drinking water (W)				-	F	2	3
Flood (F)					-	4	1

In Bedulale women and men cited some similar and some different problems, but both groups identified *Prosopis* as the most important problem. This might have been contributed to in part by the group knowing that the study was in relation to invasive weed problems. However, *Parthenium* was not cited by the women as a problem, and the men placed it last of their 8 problems. This suggests that *Prosopis* is indeed perceived as a major problem by both men and women. Several of the problems listed are ones that *prosopis* interacts with; for example it can exacerbate problems of shortage of grazing land.

In Tirebireti kebele, both groups listed *Parthenium* amongst their priority problems, and both placed it around midway down the list, 4th in the case of women, 5th in the men's group. Most of the problems having greater importance than *Parthenium* were to do with water; too much, too little, for drinking and irrigation. As expected, *Parthenium* was therefore more of a problem where crop production rather than livestock is the main livelihood.

6.5.3. Impacts

Boxes 9 and 10 list the various impacts (both positive and negative) that were reported.

Box 9. Impacts of *Prosopis* reported

Negative impacts

- It has displaced a number of important indigenous trees and grass species (used as food, feed, medicine and construction material; see Table 7).
- It invades grazing land and prevents livestock from freely moving around and feeding on grasses.
- Pastoralists are forced to take their animals to distant places in search of grazing land. This can cause tribal conflict due to scarcity of grazing lands.
- Shortage of grazing lands and pasture has led to loss of animal and animal products.
- If animals are fed on un-dried pods or eat too many dried pods, without supplementing with grasses, it can kill them.

The thorn ("like a snake") wounds human beings and livestock, which can be fatal for camels. It causes serious injury to women's hands during fuel wood collection. It also damages goats' and cows' breasts.

- It favours tick expansion by helping ticks to survive during dry seasons.
- It harbours kurkuda (a pest similar to tick) and wild animals that threaten livestock and the pastoralist community.
- Has caused widespread malaria by harbouring the vector.
- It closes animal and vehicle roads and paths.
- It blocks water ways and aggravates flooding problems

Positive impacts/uses

- Used for charcoal and fuel wood. However, the local communities believe that charcoal production and use is not sustainable, and is predominantly practiced by settlers.
- It greens the area during dry season.
- It can reduce accumulation of salt (soil salinity).
- Pods can be used as animal feed by mixing with grasses.

Table 11. Indigenous trees reported to have been displaced in Amibara as a result of Prosopis invasion. Scientific names have not been determined.

Local Name	Traditional uses/purpose
Adayto	Human food and animal feed
Hedayto	Human food and animal feed
Keselto	Animal feed, charcoal
Angelita	Local medicine usually for flu
Gersdayto	Edible fruit
Maderto	Construction material , food and feed
Adado (also known as kontir)	Edible fruit
Geranto	Animal feed
Udayito	Food, feed and medicinal plant
Yeebto	Used for preparing local tea

Box 10. Impacts of Parthenium reported

Negative impacts

- Threatens grazing land (especially replaces grasses along the farm boarders and on road sides) causing loss of food, milk, income from animal products.
- It changes the taste and colour of milk (becomes bitter/distasteful and tainted),
- Causes allergy, such as itching eruption on human skin (if exposed during weeding)
- It affects crops productivity and causes yield reduction. The effect is worst on tef, followed by wheat, barley and sorghum. Some farmers have therefore switched from growing tef to sorghum.
- It raises weeding costs and labour requirement (it needs repeated weeding, even persists during and after harvest).
- It competes for women's time and hinders their participation in other development and social activities.
- It displaces other plant species.
- It exhausts the land/soil.
- When used like tissue paper, it creates wounds anal tumours.

Positive impacts/uses

- Some use it as fuel.
- Some use it to clean the homestead and threshing fields.
- Used as cushion materials on trucks and in tomato boxes.

- Some believe that it can reduce erosion on slopes or due to wind.
- It may control other weeds.
- Charcoal makers use it to cover the wood before they cover with soil.

May be used as compost (but the quality is yet to be assessed).

Both groups indicated that *prosopis* has adverse effects on men and women, but both indicated that it is the women who are often injured by *prosopis* thorns while collecting fuel wood. However, more important was that Afar women are responsible for collecting and using poles for constructing their houses. Because *prosopis* is considered of poor quality for use in house construction, and because it has displaced and reduced the availability of preferred species, women are obliged to collect and bring building materials from more distant areas. This increases the cost and risk of collecting the materials, and reduces the time available for other activities, including taking part in control.

Both men and women in Amibara felt that the reduction in availability of milk and butter caused by *prosopis* has greater impact on women and children. However, it was felt by both groups that men also suffer badly from *prosopis* invasion. Men are responsible for ensuring the cattle have good grazing, and just as the women have to go further afield in search of construction poles, so the men have to go further afield in search of grazing land. It was reported that this extension of the area used for grazing triggers conflict with neighbouring communities who are also having to search further afield. Conflict for natural resources can be caused by a number of factors, and the men separately identified grazing land as the next most important problem after *prosopis*, perhaps due to irregular rainfall. But invasive species such as *prosopis* are clearly another factor that can create competition for and thus conflict over natural resources, both directly and indirectly by exacerbating other problems.

In Boset informants also indicated that *Parthenium* is harmful for everybody, having an impact on crop and livestock production. As in Amibara, the effect of reduced availability of dairy products (milk, butter) was said to be more severely felt by women and children. Sale of dairy products is affected by the reduced production and by tainting resulting from cattle feeding on *parthenium*.

An important part of the impact of *parthenium* is through the additional work required to weed it from crop land. Women felt that they are responsible for much of the hand-weeding that is done, so are more affected by the allergic reactions that exposure to *parthenium* causes. However, men reported that unless it is uprooted when young, *parthenium* becomes too difficult for women to remove, and therefore the burden falls on them. They have noticed this because *parthenium* has displaced some other weeds that are easier to uproot.

6.5.4 Management

To assess further the gender-related impact of the two species, men's and women's groups were asked to identify who undertakes, and to what level, the different activities related to weed control and utilization (in the case of *prosopis*). Tables 8, 9, 10 and 11 show the results.

Table 12. Men's views of the gender division of labour concerning Prosopis control and utilisation, Halydegi kebele. (Table shows level of involvement in activity: |||=high, ||=moderate, |=low)

Activity	Men	Women	Boys	Girls	Remarks
1. Prosopis control					
• Cutting					Women cut small ones
• Uprooting					Women are mainly responsible for uprooting and removing small seedlings
• Burning					
• Carrying					
2. Utilisation					
Charcoal making					It is done by few settlers
• Production					
• Marketing					
• Access to income					
• Control of income					
Pod collection					Students/children collect the pods to prevent widespread dissemination.
Fuel wood					
• Cutting/collecting					
• Marketing					
• Using the wood					
• Control of income					
Crafts					Uncommon activity
• Production					
• Marketing					
• Access to income					
• Control of income					
Construction material					Is of poor quality and rarely used for house construction
• Cutting/collecting					
• Marketing					
• Using the wood					
• Control of income					

Table 13. Women's views of the gender division of labour concerning Prosopis control and utilisation, Halydegi kebele. (Table shows level of involvement in activity: |||=high, ||=moderate, |=low)

Activity	Men	Women	Boys	Girls	Remarks
1. Prosopis control					
• Cutting					
• Uprooting					
• Burning					
• Carrying					
2. Utilisation					
Charcoal making					
• Production					Women couldn't respond to this. They said that charcoal making is not traditional practice
• Marketing					
• Access to income					
• Control of income					
Pod collection					Students/children collect the pods to prevent widespread dissemination.
Fuel wood					
• Cutting/collecting					
• Marketing					Not traditional activity
• Using the wood					
• Control of income					
Crafts					Not common
• Production					
• Marketing					
• Access to income					
• Control of income					
Construction material					
• Cutting/collecting					
• Marketing					
• Using the wood					
• Control of income					

Table 14. Men's views of the gender division of labour concerning Parthenium control and utilisation, Dengore Tiyo kebele. (Table shows level of involvement in activity: |||=high, ||=moderate, |=low)

Activity	Men	Women	Boys	Girls	Remarks
Maize weeding					
1 st weeding					
2 nd weeding (oxen)					
3 rd weeding					Light; done with sickle
Tef weeding					
1 st Weeding					
2 nd Weeding					
Haricot bean weeding					
1 st Weeding					Done with hoe
2 nd Weeding					
Herbicide application					
Weeding road side					
Weeding homestead					
Carrying out of the field					
Burning the weeds					They burn in the field

Table 15. Women's views of the gender division of labour concerning *Parthenium* control and utilisation, Dengore Tiyo kebele. (Table shows level of involvement in activity: |||=high, ||=moderate, |=low)

Activity	Men	Women	Boys	Girls	Remarks
Maize weeding					
1 st weeding					
2 nd weeding (oxen)					
3 rd weeding					Depends on level of infestation
Tef weeding					
1 st weeding					Usually herbicide is used to control weeds in tef production
2 nd weeding					
Haricot bean weeding					
1 st weeding					Usually beans are weeded only once
2 nd weeding					
Herbicide application					Women prepare materials, tools and water etc
Weeding roadside					Usually done as a campaign
Weeding homestead					
Carrying out of the field					
Burning the weeds					

For control of *prosopis*, Tables 8 and 9 show that men and women had similar general perceptions regarding roles and responsibilities. The only difference was in relation to uprooting the weeds, which men believe is mainly undertaken by them, women only having sufficient strength for the small seedlings. However, men and women agreed that during clearing operations, cutting is predominantly undertaken by the men, burning is a joint activity, and carrying away the debris is mainly done by the women.

It was noted by key informants that recently in Afar women have begun taking a more active role in clearing of *prosopis*. Women's groups have cleared *prosopis* and started planting crops such as onions, and local development agents and the RBIPMA project pilot site coordinator confirmed that Afar women are increasingly taking a part in *prosopis* control and display greater commitment than men do.

Views were divergent regarding utilization of *propopis*. Women said they were unable to provide information on charcoal production and marketing as it is not a traditional practice, though the men indicated that apart from the production, it was a male dominated enterprise. Cutting and using *prosopis* as fuelwood were agreed by both genders to be activities undertaken mainly by women, which explains the view that it is women who are most often wounded by the thorns. However, the men also said they are involved in marketing *prosopis* as fuelwood, and controlling the derived income, while the women again said this was not a traditional activity. It thus appears that the promotion of *prosopis* charcoal production may be of more interest to the men than the women.

Men and women were in agreement that collecting and using poles for construction is the overwhelming responsibility of the women. Thus as noted above, anything that affects the availability or quality of pole wood will have a much greater impact on women than on men.

The views on division of labour regarding parthenium control suggest that men have the impression they do as much or more work than women in all areas except weeding in the homestead. The women, on the other hand, were more modest in their assessment of the amount of work involved for most of the different activities, but partly because in some instances it appears they felt that the questions were not entirely appropriate. The most obvious difference in views was regarding the first weeding in maize, where men and women both felt it was more or less entirely their responsibility. This may arise because young parthenium plants can be uprooted by women but men feel that once the plants are older, women have inadequate strength.

Both men and women indicated that children are involved in a number of weeding activities, albeit usually at a low level. Thus parthenium invasion can be expected to have a negative impact on children, and if they are coming into contact with the weed from an early age, the prolonged exposure over many years could increase the likelihood that they develop an allergic response. In Boset school children and women's groups have been taking active part in controlling parthenium.

6.5.5 Participation of women in development

Key informants indicated that traditionally women have been extremely disadvantaged in Ethiopia, particularly in regard to decision making. For example, it was uncommon for Afar women to attend public fora at which community decisions were made concerning, *inter alia*, natural resource management issues such as invasive species. Women's active participation has been hindered by domestic commitments and other factors, so men are the dominant group at such fora, and decisions reflect their perceptions and interests.

However, it was also reported that in recent years there has been a significant improvement regarding women's participation and position in the community. Part of this is through women organizing into groups, and in Boset, for example, a number of female 'model farmers' are appearing. In 2009, of the 33 farmers receiving a prize from the woreda, 10 were female farmers.

Key informants also indicated that local culture, mind-set and society's attitude towards women is one of the major impediments to including women in community-based management of invasive species. Many women lack the education, experience and confidence to participate, so the situation is self-sustaining.

In the context of the RBIPMA project, attempts have been made to encourage and facilitate women to attend community activities, for example by ensuring at least as many women as men are invited to field days, awareness campaigns etc. It has been noted that women who head households are more likely to attend such community activities than those from male-headed households, as it is a common practice among married women to be represented by their husband, so that they can continue with other domestic responsibilities. The project has in some instances therefore worked specifically with women's groups, to get round this barrier to involvement of women.

6.6 Conclusions

The study showed that both women and men are very much aware of the invasive characteristics of the two plant species, their modes of dissemination and their negative effects on their livelihood, health and biodiversity. They concluded that both plant species are harmful and therefore support efforts to eradicate them. Although *Prosopis* has some uses/benefits, the respondents underscored that its harmful effects outweigh these uses, so utilisation as a method of control that is often promoted (Geesing *et al.*, 2004) would not be appropriate. This corresponds with the findings by Mwangi and Swallow (2005, 2008) whose study on *Prosopis* in the Baringo area of Kenya showed that although there were significant economic benefits from the use of the tree, due to its negative impacts there was still overwhelming support for its eradication or control.

While such generalizations are appealing, it must be noted that the impacts of an invasive species are not the same in all situations. Even within a small area, some individuals may be experiencing a net economic benefit, while others are suffering major loss, emphasizing that the costs of invasive species impacts are complex. This study has shown that an important part of this complexity is gender. For all the reasons summarized in section 2, perceptions, experiences and views on the impact and management of invasive species are sometimes very different between the genders. Thus the study here provides specific examples of why a gender perspective is important in addressing invasive species problems.

In Ethiopia, women generally have low status, which manifests as a lack of decision making opportunities, low asset ownership, large workload at home and on the farm, low employment in the formal sector and low wages (Cherinet and Mulugeta, 2003). Thus taking a gendered perspective on invasive species management will not be easy in such a country. However, Cherinet and Mulugeta (2003) also note that policy documents, including environmental policy, are gender-sensitive. As noted by our key informants, the challenge is putting the policy into practice. For example, although both Ayele (2007) and Wegari (2008) conducted MSc projects on the impact of *Parthenium* in Ethiopia, neither made any gender disaggregated conclusions. The RBIPMA project has had some modest successes in attempting to put gender considerations into practice, and this short study provides further evidence of the importance of including gender in invasive species prevention and management programmes.

7. Discussion

7.1 Why is invasive species research, policy and practice gender-blind?

From this review, it is clear that much of the research and implementation on invasive species prevention and management has been gender-blind. There are a number of reasons why this might be the case.

First, the problem of invasive species has been approached particularly from a technical point of view. The subject of biological invasions is not new, but it was originally of interest as an ecological process; Elton's (1958) seminal work was titled "The ecology of invasions by animals and plants". In the last two decades the issue of invasive species has been placed firmly on the global environmental agenda, characterized by its inclusion in the CBD, but again its significance is from a biological perspective, and as a leading cause

of biodiversity loss. Driven by scientists, the invasive species agenda has often had a predominantly technical viewpoint. However, the social impacts of invasive species are now being given greater consideration, which should include gender dimensions.

The aspect of invasive species in which gender has probably received most attention is integrated pest management. However, it is noted that originally IPM was seen as a technological solution to a technical problem (the resurgence and creation of pest problems by over-use of chemical pesticides). Only when IPM became more socially focused, through the farmer field school approach in Asian rice, were gender and other socio-cultural issues addressed.

Second, the lack of research on gender-related impacts of invasive species reflects in part the general lack of data on invasive species impacts, particularly in developing countries. The best economic impact data are from developed countries, for example Pimentel et al. (2001), although there is debate about the validity of even those data. Part of the reason for scarcity of impact data in developing countries is because of practical difficulties, though this affects calculation of overall economic impacts rather than data disaggregated by gender for particular invasive species. There appears to be something of a "catch-22" situation: governments will not allocate funds to invasive species work unless they are convinced of the impacts, but without funding it is difficult to collect data.

Third, although it is nearly 25 years since the end of the UN's decade of women, it is only relatively recently that many organizations have begun to review the extent to which policies are put into practice. The recent review by GEF (2008) of its gender mainstreaming activities shows that there is still much to be done. So in the general climate of more words than action on gender issues, it is perhaps not surprising that gender has been given little attention in a specific area such as invasive species.

7.2 What are the key issues?

From the limited information that is available, it is clear that there can be very marked gender differences in how invasive species affect livelihoods. This applies to both the negative impacts, which can occur in a wide variety of ways, but also in the benefits that come from using invasive species.

Gender related impacts of invasive species arise out of the gender differences that are found in other natural resource management contexts; differences in ownership and access to assets and resources; division of labour; access to education, knowledge and information; decision making norms and practices. Together these mean that the immediate effects of species invasions can be experienced in different ways by men and women.

Negative impacts of invasive species are often multiple, interact, and lead to a series of other negative impacts. At the immediate level, invasive species can increase the time taken to perform tasks, reduce the efficiency or effectiveness of natural resource management and agricultural tasks, and result in reduced food production or quality. Direct effects on health can occur aside from invasive diseases themselves.

The indirect effects of invasive species are harder to assess, but in general they are likely to be similar to those caused by other factors that interfere with natural resource

management and agriculture, and depend on the social context as much as the original constraint. For example, if a woman has to spend more time collecting water, leaving less time for other activities, whether that is caused by an invasive species or lack of rain is not significant when the knock-on effects are considered. Thus when looking at the gender dimension of invasive species impacts it is most instructive to focus on the direct impacts as we have attempted to do in this paper.

Our review also found reports showing that there can be immediate economic benefits of invasive species, and that these can segregate by gender. This emphasizes the need for gender to be taken into account when evaluating both the costs and benefits of a prevention or management strategy. Decision making and policy regarding invasive species that are also beneficial is often confused in Africa, in part because inadequate information is available. Disaggregating information by gender may complicate the issue further, but should be done as a matter of efficiency and effectiveness, as well as equity.

Prevention and control strategies and programmes also have gender dimension that should be taken into account, again in terms of how the costs and benefits separate out, and in terms of the effectiveness of implementation. Integrated Pest Management, when promoted in gender-sensitive ways, has shown that gender mainstreaming is possible, and can yield the expected benefits.

7.3 What should be done?

There is already a substantial and expanding body of literature on how gender can be mainstreamed in natural resource management, agriculture and other sectors (for example: European Commission, 2004; FAO, 2005; Fong & Bhushan, 1996; Hunt, 2004; Joekes *et al.*, 1996; Lilja & Dixon, 2008; UNDP, 2001; World Bank, FAO & IFAD, 2009). Application of these approaches should translate into changes that relate to invasive species as well as to many other issues. Of more interest here are the actions that could be taken specifically in regards to invasive species and gender.

The issue of gender in invasive species prevention and management needs a 'champion', and given its influential position, we suggest that this role could be taken on by the Global Invasive Species Programme GISP. This study represent a first step in that direction, but the development of awareness materials, toolkits and case studies along the lines of those already produced, but with a special focus on gender, would provide a much needed impetus to the topic.

At the project level, the RBIPMA project has an opportunity during its final year to strengthen its activities and outputs in this area. Several data sets have gender as a variable, but the data have not been analysed with respect to gender, so this could be done relatively easily. Ongoing activities in consultation with communities, the provision of training, and the development of awareness raising materials could all aim to include more women, and more explicitly take gender into consideration.

The few good studies that have been found where data on invasive species impacts and benefits have been disaggregated by gender suggest that it would be worth undertaking more such studies, for a range of different invasives. Again this is something GISP could coordinate, building on their earlier case studies of economic impact.

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Annex 1. Key informant and Focus Group Discussion Checklists

Checklist to guide FGD and key informant interviews (local community)

1. General information about the respondents

- Women/Men group, woreda/kebele, occupation, position in the household, etc,

2. Information on invasive species and their impacts on men and women?

2.1. Knowledge and perception of women/men farmers about invasive species

- Do you know parthenium or prosopis?
- When and how was it introduced into the area?

2.2. Perception of women and men about impacts of invasive species

- Negative impacts of prosopis/parthenium?
- What are the differential impacts on men and women, and how? Ecological, physical, economical, social including health
- Any positive impact/benefit of invasive species for men and women?
- Any conflicting interest of men and women regarding the management or control of invasive species? Do they think that it is necessary to make efforts to prevent/manage invasive species?
- What changes have occurred to individuals' way of life as a result of the invasion?
- How does the group view these changes (positively or negatively)?
- Are men & women willing to take part in the control and management of Prosopis?
- Would any body expect to lose out or to gain if the plant species was totally eradicated? Who? How?

3. Information on RBIPMA project

- Are you aware of the RBIPMA project? If yes, how did you know about it, what does it do?
- Do both men and women participate in the activities of RBIPMA project? If not, why? If yes, what activities?
- Who are the project beneficiaries, men or women? Why?
- How can its beneficial effect for women be enhanced?

4. How to enhance role of women in the management of invasive species?

- Who should be responsible for the prevention/management of invasive species? Why?
- What factors do limit women's role in the management of invasive species? How to overcome this?
- Suggestion for future intervention?

5. Gender role in prosopis control, associated activities, and benefits

	M	F	B	G	Remark
1. Prosopis control					
• Cutting					
• Uprooting					
• Burning					
• Carrying					
• Paying for labourers					
• Support for and willingness to control					
2. Benefits					
Charcoal making					
• Who makes					
• Role in sale					
• Access to income from charcoal					
• Control over income from charcoal					
Fuel wood					
• Who cuts/collects					
• Who sells					
• Who uses the wood					
• Who controls the income					
Crafts					
• Who makes					
• Role in sale					
• Access to income					
• Control over income					
Construction material					
• Who cuts					
• Who sells					
• Who uses the material					
• Who controls the income					
Feed					
• Who collects					
• Who benefits most					

5. Gender role analysis in parthenium control

Role in control and impact	M	F	B	G	Remark
• Weeding farm land					
• 1 st weeding					
• 2 nd weeding					
• 3 rd weeding					
• Herbicide application					
• Weeding roadside and homestead					
• Carrying out of the field					
• Burning the weeds					
• Paying for labourers					
• Paying for pesticide					
• Support for and willingness to control					

6. Trend line analysis of:

- Availability of grazing land
- Livestock population
- Availability of indigenous trees
- Availability of fuel wood
- Availability of construction materials
- Distance to grazing places
- Expansion of prosopis
- Crop yield
- Expansion of parthenium
- Time required for weeding
- Use of herbicide
- Availability of grazing land

7. Pair-wise ranking (to prioritize problems)

Major problems that affect productivity

- Shortage of fuel wood
- Shortage of animal feed
- Shortage of construction materials
- Shortage of drinking water

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