



Review Article

Weed Management Systems Adopted For Natural Pastureland: Implication to Improve Yield and Health of the Pastureland in Ethiopia

Hailegabriel Ajema Desalegn

Department of Livestock Research, Ethiopian Institute of Agricultural Research, Holetta Agricultural Research Center, Holetta, Ethiopia

Email address:

Hailegabriel29@gmail.com

To cite this article:

Hailegabriel Ajema Desalegn. Weed Management Systems Adopted For Natural Pastureland: Implication to Improve Yield and Health of the Pastureland in Ethiopia. *International Journal of Animal Science and Technology*. Vol. 7, No. 4, 2023, pp. 48-56.

doi: 10.11648/j.ijast.20230704.11

Received: September 17, 2023; **Accepted:** October 4, 2023; **Published:** October 14, 2023

Abstract: Feed problem is the major among constraints hindering the full exploitation of Livestock sector in Ethiopia. This is due to decline of Pasture land productivity either in quantity or quality. To overcome these challenges exploring the methods of pasture management to increase production and productivity of the forages is essential. Nowadays many factors affect the productivity of the pastureland, among these unwanted plants or weeds are the main factors devastating the pastureland and reducing the quantity and quality of forage produced from the pasture especially in developing countries like Ethiopia. Although exceptions exist, most weeds struggle to compete with a dense stand of valuable forage species. To reduce the impact of weedy plants, pastures and hayfields should be maintained to encourage the strong growth of desired forage species. Maintaining proper pastureland management using controlled grazing practices; mowing at the proper timing and stage of maturity; allowing new seedlings to become well established before use; renovating pastures when needed are all examples of effective pasture management programs. To achieve long-term weed management, weeds must be targeted more precisely, and reliance on single treatments like pesticides or machines must be minimized as more integrated strategies are adopted. As long as farming or grazing is practiced, weeds will be a part of primary production. Effective weed management techniques are critical in light of the current emphasis on sustainable land use. The seemingly insurmountable problem is to establish a control choice that is effective, selective, and directs to quick, positive economic return from original input while conserving and improving local, regional, and global sustainability. So assessing the methods and ways to manage these problems and knowing the kind of weeds available in grassland of specific areas were the priority issues to be considered to overcome the consequences of these invasive weed species. This paper is aimed to present some management practices applied across the globe to overcome these challenges.

Keywords: Pastureland, Invasive, Weed, Weed Management

1. Introduction

Agriculture is the primary source of income for the majority of the world's people. In Ethiopia, livestock production is an important part of almost all agricultural activity [1]. The United Nations Food and Agriculture Organization (FAO) [2] forecasted a 34% rise in global population by 2050, raising serious worries about human lifestyles and food security. Sustainable agricultural production and productivity intensification is a reasonable strategy to meet societal and

environmental demand while producing enough food. Population growth, migration, labor shortages, decreasing land productivity, climate volatility, and food insecurity will continue to be challenges for developing countries in the years ahead [3]. Food and agricultural systems' sustainability is dependent on avoiding depleting natural resources; soils, in particular, have been deteriorated by intense crop production, complicating future food production in certain locations. To prevent further losses and improve the state of natural resources, further action is required.

Even though weed experts have a clear knowledge of the term, there is disagreement over universal definitions of weeds. The name 'weed' alone encapsulates the most basic concept of weed research [4]. A weed is a plant that emerged in a natural environment and, in response to imposed or natural surroundings, evolved, and continues to do so, as an interfering association with our crops and activities [4]. "Both an origin and a continual changing perspective" is provided by this term. A weed is defined as "a plant that forms populations capable of entering cultivated, substantially disturbed, or occupied by man ecosystems and potentially depressing or displacing resident plant populations that are purposely cultivated or are of ecological and/or aesthetic interest." Even if no one can agree on what a weed is, most people agree that it is undesirable [4]. Weeds are a major issue in food and feed production, and the use of herbicides in excess of what is necessary to manage them is a global concern for food security, human health, and environmental sustainability [5].

Weeds have an impact on pasture output and quality by displacing preferred grass species and filling in gaps. Weeds produce allelopathic chemicals that are poisonous to agricultural plants [6]. As a result of the disappearance of highly palatable and quality species, invasions of invasive weeds, and soil depletion, the quality of grazing land has deteriorated; and the indiscriminate continuous grazing and lack of control over communal grazing land requires due attention through improved management systems and community participation [7].

Weeds have an impact on the attractiveness of a pasture [8]. Dalmatian toadflax, diffuse knapweed, downy brome, and musk thistle are among the most invasive and harmful weeds in America [9]. The discovery of an abundant population of *J. plumose*, an invasive weed in South Africa [10], suggests that this species has a wider distribution than previously thought and has been neglected. The apical Pappas are well specialized to seed or spore dissemination, and the species has a lengthy beard that easily attaches to clothing, fur, and other surfaces, indicating that it has the potential to become invasive.

Despite few exceptions, most weeds find it difficult to compete with a populated stand of valuable forage species. Maintaining pastures and hayfields will help the targeted forage species develop strongly, which minimizes the influence of weedy plants. Maintaining proper soil pH and fertility levels; using controlled grazing practices; mowing at the proper timing and stage of maturity; allowing new seedlings to become well established before use; renovating pastures when needed are all examples of effective pasture management programs, according to (8).

To achieve long-term weed management, weeds must be targeted more precisely, and reliance on single treatments like pesticides or machines must be minimized as more integrated strategies are adopted [11]. As long as farming or grazing is practiced, weeds will be a part of primary production. Cost-effective weed management techniques are critical in light of the current emphasis on sustainable land use. The seemingly insurmountable problem is to establish a control choice that is effective, selective, and directs to quick, positive

economic return from original input while conserving and improving local, regional, and global sustainability [11]. Improved weed management in pastures requires an understanding of weed floristic composition and phytosociology. There is a scarcity of information about weed species that grow in pastures in the Central Highlands, particularly around Holetta. As a result, it is critical to search for and develop information to assist farmers and stakeholders in controlling weeds for livestock farming communities who are dependent on pastureland.

2. Materials and Methods

2.1. Rationale

This paper is reviewed to create strong awareness on the management of the current issue concerning pasture weeds management in Ethiopia and across the world which is negatively affecting pasture land productivity and as a result livestock production sustainability in general. If not given attention this invasion of weeds on Ethiopian grazing land will be the worst devastating threat to Livestock sector in the country. So this paper is intended to create awareness for Livestock keepers, Experts, Researchers and all stakeholders in this field of expertise.

2.2. Data Collection

In addition to some author knowledge and worries raised in this review paper, 41 articles with titles related to Pastureland weed management, productivity and future opportunities were accessed across different websites including Google, Scopus, Elsevier and Research for Life databases to prepare and write this review paper on this an interesting topic.

3. Results

3.1. Natural Pasture Condition of Ethiopia

At the national level, the share of natural grazing pasture as a cattle feed resource has recently decreased to around 57 percent [12] from an earlier level of 90% [13]. This may be due to elevation, rainfall, soil, and cropping intensity each all affect the quantity and quality of natural pasture. Grazing pastures are being converted to arable land due to the rapid population expansion and increasing need for food. As a result, they are now only found on marginal ground, such as hilltops, swamps, and other of little importance regions. This is especially true in Ethiopia's mixed-farming highlands and mid-altitudes. According to information gathered from feed owners in rural parts of Ethiopia, green forage (pasture grass) is the most significant type of feed (54.54 percent), followed by agricultural leftovers (31.13 percent). Hay and by-products have also been employed as animal feed, with 7.35 and 2.03 percent of total feed, respectively. A substantial proportion of improved feed was utilized as animal feed (only 0.57 percent), and other feed was also used throughout the country, accounting for around 4.37 percent [14].

3.2. Natural Pasture Productivity

According to rough estimates there is between 61 and 65 million hectares of pasture and browsing land [15], but this number is constantly changing as a result of cropping and growing populations. Aside from changes in time and environment, estimates of productivity also fluctuate due to variations in rainfall, soil type, and cropping intensity. Natural pasture yields were formerly estimated to be 1 DM tone/hectare in the lowlands, 3 DM tone/hectare in the highlands and mid-altitude on well-drained soils, and 4–6 DM tone/hectare in seasonally flooded productive areas [15].

Natural pasture production for the lowlands was formerly estimated at 1 DM ton/hectare, 3 DM tone/hectares for the highlands and mid-altitude on easily depleted soils, and 4-6 DM tone/hectares for fertile areas that experience seasonal flooding [1]. For the lowland and highland, MoA estimated 0.56 and 1.5 DM tone/hectare, respectively [16]. Savannah grassland and humid temperate pasture, two very productive cereal/livestock zones, produced 2 and 2.5 tons ha/year, as well, with regard to another yield estimate for various highland zones [17].

3.3. Major Weeds in Ethiopian Pasturelands and Their Management Efforts

The (*Parthenium hysterophorus* L.) weed is an invasive alien plant with no known mechanism of introduction. It was firstly discovered in Ethiopia in 1968. Since then, it has been rapidly colonizing disturbed sites, having a devastating impact on pastures, croplands, and woods by outcompeting native species, and has become a major environmental problem. It has been discovered in Ethiopia's north, east, and southern regions. In both urban and rural locations, it is fast growing. Initially confined to railway lines, roadsides, and non-cropped areas, the weed has swiftly colonized pasturelands and farmed regions in Ethiopia [18].

In India, (*parthenium hysterophorus* L.) weed causes a 90% loss in forage yield in grasslands [19]. *Parthenium hysterophorus* L. is more abundant on roadsides and grasslands in Australia, owing to continuous road verge disturbance and in natural grasslands where overgrazing has occurred, as in Ethiopia [20], but it is not an issue in crop fields, owing to good crop field management [21]. Because of its prolific growth, fast dissemination, and generation of poisonous allelochemicals, this weed species has presented major concerns to crop output, natural biodiversity, animal and human health in many introduced ranges [22, 23].

After an invasion, Invasive alien plant species use a variety of control tactics, including mechanical, chemical, biological,

and fire. The manual uprooting of trees is a rather typical control approach used in Ethiopia.

Table 1. Families in Eastern Africa with four or more invasive weed species
Source: [24].

Families	No. of invasive weed species	Percentage (%)
Fabaceae	27	16
Asteraceae	17	10
Solanaceae	13	8
Cactaceae	9	5
Apocynaceae	6	4
Convolvulaceae	6	4
Commelinaceae	5	3
Passifloraceae	5	3
Verbenaceae	5	3
Agavaceae	4	2
Crassulaceae	4	2
Euphorbiaceae	4	2
Meliaceae	4	2
Myrtaceae	4	2

Parthenium hysterophorus

Parthenium. hysterophorus weed control in Ethiopia, like other weeds, is fully dependent on cultural and labor-intensive activities including tillage, manual weeding, mowing, hoeing, and slashing [25].

Prosopis juliflora

Mechanical control of *prosopis juliflora*, is labor-intensive and costly, and is only economically viable for high-value fields. To regulate coppicing, *Prosopis* plants should be trimmed at 10 cm for immature trees and 40 cm for large trees or shrubs, according to the mechanical control method. It can also be used to simply control the expansion of the species, as community mobilization is ineffective in eradicating it. The best management alternatives for *Prosopis juliflora* include utilization (e.g., fuel wood, construction, and charcoal manufacturing, and feeding cattle by crushing pods) [25].

Eichhornia crassipes

A few options for controlling *Eichhornia crassipes* include mechanical, chemical, and biological methods, as well as fire after water drainage [25].

Lantana camara

Mechanical, chemical, and biological methods of controlling *Lantana camara* have had mixed results. *Lantana camara* is difficult to control because if slashed and left alone, it will coppice and form deeper thickets. *Lantana camara* can also be eradicated by utilization management. *Lantana camara* inaction can be stifled by harvesting the plant's biomass before it sets seeds. An integrated management style is the greatest alternative for management [25].

Table 2. The weed species that have had a major impact on Ethiopia's native vegetation with brief notes on habitat types invaded and impacts [24].

Families and Taxonomy	Growth pattern and invading nature	Type of habitat invaded	Adverse outcomes
<i>Partheniumhysterophorus</i> <i>L. (Asteraceae)</i>	Herb	Sav, Gra, Tra, Rs, Hab, Ara, Pl, Ws, Wc	Capable of restricting natural vegetation and allopathic. Adversely impacts the productivity of rangelands, and a significant majority of those who come into contact with it experience serious allergic reactions (dermatitis, hay fever, and asthma), as well as cattle and wildlife.

Families and Taxonomy	Growth pattern and invading nature	Type of habitat invaded	Adverse outcomes
<i>Xanthiumstrumarium</i> L.(<i>Asteraceae</i>)	Herb	Sav, Tra, Rs, Ar, Ws, Wc	Develops substantial stands quickly, displacing other plant species. toxic to livestock and deadly if consumed.
<i>Opuntiastricta</i> (Haw.) Haw. (<i>Cactaceae</i>)	Succulenttree orshrub	Sav, Rs, Hab, Pl, Ws, Wc, Dr, Ro	Decreases access to grazing and water supplies as well as animal carrying capacities. It results in illnesses, harm, and cattle mortality when consumed.
<i>Bryophyllumdelagoense</i> (Eckl. & Zeyh.) Druce (<i>Crassulaceae</i>)	Succulentherb	Sav, Tra, Rs, Ha, Pl, Ws, Wc	Creates dense monotypic stands, which displace native plant species. Toxic to livestock and humans and probably also to wildlife.
<i>Acaciamearnsii</i> DeWild (<i>Fabaceae</i>)	Treeorshrub	For, Gra, Tra, Rs, Hab, Pl, Ws, Wc	Diminishes native biodiversity and rangeland productivity by displacing natural vegetation. Decreases runoff of surface water. Boosts soil nitrogen levels while changing the nutrient cycle in the soil.
<i>Acaciasaligna</i> Wendl (<i>Fabaceae</i>)	Treeorshrub	Sav, Tra, Rs, Pl, Ws	Forms dense, impenetrable thickets, which displace native species and prevent their regeneration. Reduces surface water runoff. Increases soil nitrogen levels, altering soil nutrient cycling.
<i>Caesalpiniaadecapetala</i> (Roth) Alston (<i>Fabaceae</i>)	Climber	For, Sav, TR, Rs, Hab, Pl, Pl, Ws, Wc	Climbs over vegetation, creating dense, impenetrable thickets that are harmful to both wildlife and plants. Grows into the woodland and forest canopies, resulting in canopy collapse. Hinders forest management efforts and poses a fire risk. Decreases the capacity to transport cattle and restricts the movement of both livestock and people. Animals in general, livestock, and people can get hurt by the thick spines on the stems.
<i>Leucaenaaleucocephala</i> (Lam.) deWit (<i>Fabaceae</i>)	Treeorshrub	Sav, Tra, Rs, Hab, Pl, Ws, Wc	Forms large monocultures, displacing native plant and animal species. Invasions alter secondary succession processes and render areas unusable and inaccessible.
<i>Mimosadiplotricha</i> Sauvalle (<i>Fabaceae</i>)	Treeorshrub	For, Sav, Gra Tra, Rs, Hab, Pl, Arp, Pl, Ws, Wc	Suppresses other plants, blocking light for species that need it, and limiting their normal regrowth. Moving cattle and wildlife may be prevented or hindered by dense stands. It is poisonous to both sheep and pigs, according to the evidence.
<i>Mimosapigra</i> L.(<i>Fabaceae</i>)	Treeorshrub	Sav, Tra, Rs, Hab, Arp, Pl, Ws, Wc, W	Dense infestations can eliminate native plant and animal species, and lead to steep declines in the abundance of others. Hampers fishing activities, and blocks access to water bodies.
<i>Prosopisjuliflora</i> (Sw.) DC. (<i>Fabaceae</i>)	Treeorshrub	Sav, Tra, Rs, Hab, Arp, Pl, W, Wc	Decreases the ability to graze, wipes out a large number of species from invading ecosystems, and depletes groundwater supplies. Despite certain advantages like edible pods and firewood, the total net economic contribution is negative and is expected to get worse as the species spreads.
<i>Azadirachtaindica</i> A. Juss.(<i>Meliaceae</i>)	Tree or Shrub	For, Sav, Tra, Rs, Hab, Pl, Pl, Ws	Forms dense stands, especially in coastal areas, displacing native plant species. Alters habitats, leading to reductions in the abundance of small mammals.
<i>Psidiumguajava</i> L.(<i>Myrtaceae</i>)	Treeorshrub	For, Sav, Tra, Rs, Hab, Pl, Pl, Ws, Wc	Establishes dense stands, displacing native plant and animal species. Allopathic, impacting negatively on some crop species. Can be invasive in secondary forests.
<i>Daturastramonium</i> L. (<i>Solanaceae</i>)	Herb	Sav, Gra, Tra, Rs, Hab, Ar, Pl, Ws	Competes aggressively with native plants and crops, forming dense monospecific stands. Toxic to people and animals.
<i>Lantanacamara</i> L.(<i>Verbenaceae</i>)	Tree or Shrub	For, Sav, Gra, Tra, Rr, Hab, Pl, Ar, Pl, Ws, Wc	Displaces natural vegetation, impacting negatively on biodiversity. Toxic to livestock, causing animal deaths, reduced productivity, and loss of pasture.
<i>Cryptostegiagrandiflora</i> Roxb. ex R. Br (<i>Apocynaceae</i>)	Treeorshrub	Sav, Tra, Pl, W, Dr	Climbs into trees, burying native flora and causing canopy collapse, to the disadvantage of native plant and animal species. Dense invasions can limit cattle carrying capabilities by as much as 100%. Plants are harmful to humans and animals.
<i>Hyptissuaveolens</i> (L.) Poit. (<i>Lamiaceae</i>)	Herb	Sav, Tra, Rs, Hab, Arp, Pl, Ws	Forms dense stands, to the detriment of native fauna and flora. Regarded as one of the worst weeds in the world.

When For: Forest, Sav: Savanna, Gra: grass, Tra: Transformed, Rs: Road side, Hab: around habitation, Pl: Plantation, Arp: Arable/plowed land course, W: Wetland, Dr: Dry land, K: kloof/ravine, Rok: Rockysite.

3.4. Poisonous Plants

When allowing livestock to graze on weed-infested pasture, be aware of the potential for harmful plant exposure. The quantity and accessibility of the plant, its stage of development, the season, and the type of animal are all factors that affect a poisonous plant's tendency to poison animals [8]. However, to kill an animal, most potentially deadly plants (but

not all plants) must be taken in big enough quantities. Anti-quality variables have a significant impact on animal output in range and pasture lands.

Anti-quality components of forages are essentially any element in forage that prevents grazing animals from reaching their full potential for growth and reproduction. Bloat, mineral problems, nitrate toxicity, poisonings from plant poisons such as glycosides or alkaloids, neurological

effects, photosensitization, and illnesses connected with microbes and insects are all common side effects of anti-quality factors. Anti-quality features include lignin, tannins, thorns, and plant spatial patterns, all of which limit intake or digestibility [26]. Normal grazing livestock do not consume many hazardous plants, however plant composition can change after spraying. Some plants may become more edible as a result of this. For at least three weeks following spraying, do not graze pastures known to have dangerous plants [27].

3.5. Impact of Weeds on Animal Productivity and Pasture Yield

Many ranges and pastures have been grazed by domestic cattle for many years, and the plant composition has shifted dramatically from the original ecosystems. They have an influence on the livestock sector by diminishing fodder supply and quality, interfering with grazing, poisoning animals, raising management and production expenses, and lowering land value [28].

Weeds have a big impact on animal productivity. For example, weeds like prevalent cocklebur, prevalent ragweed, and tall ironweed are deliberately grazed to more extent than edible species like crabgrass because they are uncomfortable to animals or do not provide an adequate diet [8]. Reduced weight gain and deficiency disorders develop, which can lead to reproductive inefficiency and lower animal product quality. Sharp seeds and thorns can injure the feet, eyes, and other tissues, making bacterial diseases easier to spread and lowering the quality of animal goods [29]. Undesirable plant communities have a negative impact on the grazing capability of south-western Uganda rangelands [30]. *Eragrostis plana* is a kind of *Eragrostis*. *Nees*, also known as South African love grass, is a C4 perennial grass that reproduces through seeds. It is a warm-season perennial grass that is non-native to Brazil and has become a severe issue on pasture lands throughout Southern South America [31].

Several weed species have high dry matter digestibility during their early vegetative stages of growth, comparable to seeded forage species. The amount of crude protein available to cattle is also sufficient, but digestibility and crude protein diminish as weeds mature, as they do with many cultivated forage grasses [8].

4. Pastureland Weed Management Methods

4.1. Scouting

It aids in the definition of the problem's scope and allows for the timely implementation of the best management practices. It's crucial to know what species are present, how many weeds there are, and where they're located. Weeds that are dominant as well as unusual or perennial weeds must be taken into account [32]. The first step in weed control is to correctly identify weeds.

4.2. Mechanical Control

Hand-pulling, hoeing, tilling, mowing, grubbing, chaining, and bulldozing are some of the mechanical techniques used to control rangeland weeds. These methods can also be used to suppress tiny infestations or weeds on the outskirts of a larger infestation [28]. Weed control via cutting is a common practice. It has the potential to suppress seed production, deplete carbohydrate reserves, and benefit attractive perennial grasses. In pastures, it is one of the most commonly utilized weed control strategies [33]. Cutting a pasture improves its appearance, momentarily increases forage output, and, if done correctly, prevents weeds from seeding. On broadleaf weeds, mowing is more successful than grass mowing, and on annual weeds, mowing is more effective than perennial weeds [32]. Cutting or mowing alone will not control big weeds with extensive root systems, which is one of the disadvantages of weed control. Mowing also misses prostrate-growing weeds including crabgrass, spurge, and match weed. Mowing can also disperse vegetative plant stems, allowing plants (such as prickly pear) to take root elsewhere. If mowing is done after seeding, seeds might build on the mowing equipment and move to neighboring pastures, exacerbating the weed problem.

4.3. Biological Control

To protect weed growth, biotic agents (plants, herbivores, insects, nematodes, and phytopathogens) are used. Biological control is still in its early stages, although tremendous progress is being made, particularly against alien plants. The tobacco mild green mosaic tobamovirus (TMGMV) and the pest *Gratiana boliviana*, both employed to control TSA, are two good examples. TMGMV is a virus that may be sprayed on existing TSA plants to control them, while the beetle is generally employed for suppression [32]. The majority of biological control agents rarely achieve complete weed control, although they do tend to keep weed populations under control. Furthermore, biological control agents are rarely fast-acting, which means they take time to suppress a weed population.

Biologically based weed control agents include bio herbicides, which are substances generated from microbes such as fungi, bacteria, viruses, or protozoa; or phytotoxic plant residues, extracts, or single compounds originating from other plant species [4]. Every agricultural pest has at least one natural adversary that helps to control its population. Rather than employing man-made chemicals, bio herbicides make use of naturally occurring foes. This is significant since biological control agents often have far fewer and milder environmental effects than manufactured pesticides [4].

4.4. Chemical Control

Herbicides kill weeds by interfering with plant growth mechanisms. Herbicides should be chosen depending on the forage species grown, the presence of weed species, the cost, and the convenience of application. The technique of application as well as the environmental impact should be

examined [32]. Herbicides harm plants by interfering with a physiological mechanism that is necessary for their survival. For many herbicides, this is accomplished by the herbicide binding to a single protein [4]. It's critical to pick the right herbicide and apply it at the right rate. Low treatment rates will not provide consistent weed control, while high spray rates may harm the forage or just kill the aboveground portion of perennial weeds. In order to be cost-effective, herbicides must also be administered at the proper time.

Herbicides are currently the most frequent method of controlling broadleaf weeds and invasive winter annual grasses. Indaziflam, a new herbicide for invasive plant management in non-crop areas, is a cellulose-biosynthesis inhibitor capable of providing residual invasive winter annual grass control for most invasive and problematic weeds in America, such as Dalmatian toadflax, diffuse knapweed, downy brome, and musk thistle, for up to three years after treatment [9].

4.5. Integrated Weed Management

To manage weeds, integrated weed management employs all approaches, including physical, chemical, biological, and ecological, in a system-based approach. Overlapping or connecting the four methods of weed management is one technique to have a better knowledge of integrated weed management: Chemical weed management is dominated by synthetic herbicides, but there are also "natural" (eubiotic) herbicides; physical weed management is mechanical techniques like as hoeing and tillage, as well as thermal techniques such as flame weeding. To suppress weeds, biological weed management uses an understanding of plant biology, such as germination; ecological weed management employs species interactions, such as some pasture fodder species, weed competition, and allelopathy [31].

4.6. Grassland Cropping as Weed Management Tools

To diversify farming systems and improve overall land productivity, this cropping system combines species with complementary growth periods [34]. Pasture cropping reduced total weed density and the number of weed species by a significant amount. Pasture cropping can be regarded as a valid weed management method [34]. Anything that makes the crop more competitive against weeds is classified as a cultural practice that contributes to weed management. These measures include properly preparing the seedbed, planting at the optimum planting date, fertilizing properly, planting at higher densities, using the correct seeding rate, selecting high-quality weed-free crop seed, and selecting adapted species and varieties for the region during the establishment year. Perennial grasses, on the whole, are more competitive against weeds than legumes. At the time of sowing, make sure the seedbed is free of living weeds. Tillage or a burndown herbicide can be used to create a weed-free seedbed. It is critical that emergent forage species do not have to compete for limited nutrients in the early weeks of their establishment. Furthermore, newly emergent

plants may hold insects or viruses that could harm immature, vulnerable forage crops [6].

4.7. Grazing Animals as Weed Control Agents

Grazing animals are used by farmers to reduce weeds. In order for grazing animals to be beneficial for weed control, they must be available for use and able to be gated onto or off an area to modify grazing pressure. In rangeland, proper grazing management can help to reduce the spread of noxious weeds and efficiently manage them. There are three grazing strategies for managing weeds [35]: moderate grazing levels to minimize physiological impact on native plants and reduce soil disturbance; prolonged grazing to counteract cattle's natural dietary habits, resulting in equivalent effects on all forage species, like weeds; and multispecies foraging to more evenly distribute the impact of livestock grazing among both preferred and unfavorable species. The natural grazing preferences of several cattle types are utilized in multispecies grazing [36]. In every scenario, it's critical to choose the best grazer for the purpose [28].

If grazing animals are to be used as weed control instruments in any agricultural system, they must be available [37]. Grazing animals used properly to control weeds could help increase the value and productivity of the world's 3213 million ha of permanent pasture [38]. Farmers in Australia utilize high grazing at specific times of the year to swiftly graze pasture down to reduce weeds [39]. This approach was deemed successful by 39.9% of respondents, partially successful by 50.3 percent, and failed by 5.2 percent. The lack of success was attributed to selective grazing by the cattle selected; difficult to control weeds; seasonal conditions made the practice difficult to implement; and the sort of stock used was improper for the objective. A significant perennial plant in terms of agronomy is broad-leaved dock (*Rumex obtusifolius* L., Polygonaceae), which lowers pasture yields and feed quality [33]. Non-chemical dock control methods are often restricted to frequent pulling and pruning, and grazing animals normally avoid it.

Intensive time-controlled grazing, as an alternative to moderate grazing pressure, will reduce grazers' capacity to avoid less appetizing noxious weed species. Cattle may be forced to graze less desirable species, such as noxious weeds, due to high stocking rates. This should result in a more balanced competitive relationship between native and nonindigenous species, as well as a more homogeneous mix of range plant species [35]. A management approach often used in other countries is intensive grazing for a few days on a rotational basis [28].

Although grazing animals can be employed to reduce weeds in a variety of conditions, controlled animal grazing is especially effective in pastures. Controlling weed populations nearing an economic threshold necessitates predictable control strategies that are tightly tied to the biology of the weeds and their competitive connection with the crop or pasture. Long-term weed population control must be prioritized, which necessitates knowledge of seed dormancy, longevity, and germination [37].

Plots grazed by sheep showed much less gaps in the sward than mowed plots, according to [33] report on sheep grazing versus cutting effect on *Rumex obtusifolius* weed. In grazed plots, legume cover was much lower and grass cover was significantly higher than in mowed plots; non-leguminous herb cover was unaltered by either cutting or grazing. The density of swards and the contribution of legumes and grasses to the grassland community are influenced by grazing.

4.8. Suppressive Plants as Weed Management Tool

Parthenium hysterophorus L. is listed in several countries as one of the most troublesome invasive grassland weeds. It has the potential to reduce pasture and livestock output, as well as natural community biodiversity and human and animal health [40]. Sowing suppressive pasture plants in parthenium weed-infested grasslands has shown promise in improving management efficacy. However, the capacity of such species to reduce weed development under grazing conditions must be verified. Purple pigeon grass, buffel grass, and butterfly pea legume, according to [40], inhibited parthenium weed development by more than 50% under low and moderate simulated grazing pressures, while also producing moderate to high amounts of fodder biomass (up to 5.07 t ha⁻¹ per year). Under low simulated grazing pressure, native species Kangaroo grass and bull Mitchell grass both reduced the parthenium weed's development by more than 50%, although they only generated low to moderate levels of biomass, 1.83 t ha⁻¹ and 2.7 t ha⁻¹ per year, respectively.

The four pasture species (purple pigeon grass, buffel grass, butterfly pea, and Kangaroo grass) suppressed the weed's growth more effectively under low and moderate (25 and 50 percent) simulated grazing pressures due to their rapid height attainment, tillering or branching, and biomass production [41]. Weeds are generally thought to represent a threat to biodiversity, however interactions between native and exotic species in grasslands are poorly understood, and reported results vary depending on the study's spatial scale, factors controlled for, and response variables studied.

5. Conclusion

Maintaining healthy, productive pastures reduces the danger of weed infestation. Healthy pastures are the product of good pasture management strategies such as appropriate fertilization, insect control, and controlled grazing. Unfortunately, weeds can be found in pastures, and the loss of forage production that results can be very costly. The most cost-effective and environmentally friendly method to pasture weed management is an integrated weed management plan that combines prevention, detection, and control. Weed invasions are less likely to affect forage plants that are healthy and well-established. As a result, manage desirable forage species to make them as weed-resistant as possible. Because forage plants are scarce and the soil is disturbed regularly, the areas near gates, water troughs, feed bunks, bedding grounds, highways, and fence lines should be the first to receive attention. Weeds frequently establish themselves in these

areas first, making it much easier for them to spread out to grazing land. Future regulations should be effective, there should be significant local support, and the government's commitments to eradication and replacement seems well founded.

There are instances when taking direct action to control weeds is the best option. Following are some examples of these scenarios:

- 1) Before populations become well-established, weeds that are new to a farm or property and small in number should be controlled with a shovel, herbicide, or other appropriate approach.
- 2) Toxic plants can result in unacceptably high livestock losses. Control activities should be implemented in grazing areas that are small and accessible. In critical circumstances, fencing may be necessary, but if plants are widespread and scarce, pesticides or shovels are effective tools. Poisonous plants are often the first to emerge in the spring. Delay bringing animals into these areas until sufficient pasture is available, and then don't overgraze.
- 3) Some perennial weeds are unaffected by vigorous forage plants. For these species, herbicides, mechanical removal, and tillage are standard control measures, but consider grazing various livestock, such as goats or sheep, which may provide effective control.
- 4) Herbicides or tillage may be the best management option if weeds have become so numerous and the forage species have become so thin that the land is unprofitable. This should only be done when absolutely required.

Conflict of Interest

The author declared that there is no conflict of interest and all scientific findings raised in this review were fully acknowledged.

Acknowledgments

I express my gratitude for the assistance in conducting scientific research review to the Department of Livestock Research, Holetta Agricultural Research Centre and Ada'a Berga Sub-centre.

References

- [1] Kebede, G., & Assefa, G. (2017). Review on Major Feed Resources in Ethiopia: Conditions, Challenges and Opportunities Farming System Dynamism in Ethiopia View project. November. <https://doi.org/10.14662/ARJASR2017.013>
- [2] FAO (2016) How to feed the world in 2050. Food and Agriculture Organisation, Rome www.fao.org/fileadmin/templates/wsfs/docs/paper/How_to_Feed_the_World_in_2050.pdf. Accessed 23 January 2019
- [3] Sims, B., Corsi, S., Gbehounou, G., Kienzie, J., Taguchi, M., & Friedrich, T. (2018). Sustainable Weed Management for Conservation Agriculture: Options for Smallholder Farmers. 1–20. <https://doi.org/10.3390/agriculture8080000>

- [4] Rana, S. S., & Rana, M. C. (2016). Principles and Practices of Weed Management. 176062.
- [5] Schuster, M. Z., Lustosa, S. B. C., Pelissari, A., Harrison, S. K., Sulc, R. M., Deiss, L., Lang, C. R., de Faccio Carvalho, P. C., Gazziero, D. L. P., & de Moraes, A. (2019). Optimizing forage allowance for productivity and weed management in integrated crop-livestock systems. *Agronomy for Sustainable Development*, 39 (2). <https://doi.org/10.1007/s13593-019-0564-4>
- [6] Curran, W. S. (2009). Weed Management in Pasture Systems. 62.
- [7] Kassahun, G. (2021). Management and utilization practices of natural pasture in Western Ethiopia. *International Journal of Agricultural Science and Food Technology*, 7, 147–153. <https://doi.org/10.17352/2455-815x.000102>
- [8] Green, J. D. (2015). Weed Management in Grass Pastures, Hayfields, and Other Farmstead Sites.
- [9] Sebastian, D. J., Nissen, S. J., Sebastian, J. R., Meiman, P. J., & Beck, K. G. (2017). Pre-emergence Control of Nine Invasive Weeds with Aminocyclopyrachlor, Aminopyralid, and Indaziflam. *Invasive Plant Science and Management*, 10 (1), 99–109. <https://doi.org/10.1017/inp.2017.7>
- [10] Sylvester, S. P., Soreng, R. J., Sylvester, M. D. P. V., Mapaura, A., & Clark, V. R. (2021). New records of alien and potentially invasive grass (Poaceae) species for southern Africa. *Bothalia*, 51 (2), 1–9. <https://doi.org/10.38201/btha.abc.v51.i2.1>
- [11] Schaffner, Urs, Müller-Schärer, Heinz Lüscher and Andreas Lüscher. 2022. Integrated weed management in grasslands. Switzerland. Chapter taken from: Kudsk, P. (ed.), *Advances in integrated weed management*, Burleigh Dodds Science Publishing, Cambridge, UK, 2021, (ISBN: 978 1 78676 745 5; www.bdsublishing.com) <http://dx.doi.org/10.19103/AS.2021.0098.15>
- [12] CSA (Central Statistical Agency). 2013. Statistical Abstract. 120p.
- [13] Alemayehu M. 1985. GrassLand Ecology Study. MoA, Animal and Fishery Resource Development Department. Addis Ababa. Ethiopia.
- [14] CSA (Central statistical agency), (2021). Federal Democratic Republic of Ethiopia Central Statistical Agency Agricultural Sample Survey 2020 / 21 report on livestock and livestock characteristics. II (February).
- [15] Alemayehu M. 1998. The Borana and the 1991-92 Drought: Rangeland and Livestock Resource Study. Institute for Sustainable Development (ISD), Addis Ababa, Ethiopia.
- [16] MoA. (1984). Livestock Sector Review (LSR). Annexe volume 1, Ministry of Agriculture. Addis Ababa. Ethiopia.
- [17] MoA. (1989). Agroforestry Potential and Research needs, Addis Ababa. Ethiopia.
- [18] Nigatu, L., & Sharma, J. J. (2013). Parthenium weed invasion and biodiversity loss in Ethiopia: a literature review. *African Crop Science Conference Proceedings*, 11, 377–381.
- [19] Nath, R. 1988. *Parthenium hysterophorus* L. - a general account. *Agricultural Review*. 9: 171-179.
- [20] Tessema, T., Rupschus, C., Wiesner, M., Rezene, F., Firehun, Y., Ulrichs, C., & Büttner, C. (2011). Parthenium Weed (*Parthenium hysterophorus* L.) Research in Ethiopia: Impacts on Food Production, Plant Biodiversity and Human Health. *Ethiopian Journal of Agricultural Sciences*, 21 (1–2), 128-150–150.
- [21] Adkins, S. W., S. C. Navie, G. C. Gerham, and R. E. McFadyen 1997. Parthenium weed in Australia: research underway at co-operative research centre for tropical pest management. In: Mahadevappa, M and Patil, V. C. (eds), *Proceedings of the 1st International Conference on Parthenium Management*, 6-8 October 1997, University of Agricultural Sciences, Dahrwad, India, pp. 63-69.
- [22] Kohli, R. K., Batish, D. R., Singh, H. P. (2006). Status, invasiveness and environmental threats of three tropical American invasive weeds (*Parthenium hysterophorus* L., *Ageratum conyzoides* L., *Lantana camara* L.) in India. *Biol Invasions* 8, 1501–1510 <https://doi.org/10.1007/s10530-005-5842-1>
- [23] Asresie Hassan, Lisanework Nigatu & Sharma, J. J. 2008. Impact of Parthenium on herbaceous vegetation and soil seed Bank Flora in Sorghum Fields in North- Eastern Ethiopia. *Ethiopian Journal of Weed Management* 2, 1-11.
- [24] Witt, A., Beale, T., & van Wilgen, B. W. (2018). An assessment of the distribution and potential ecological impacts of invasive alien plant species in eastern Africa. *Transactions of the Royal Society of South Africa*, 73 (3), 217–236. <https://doi.org/10.1080/0035919X.2018.1529003>
- [25] Getachew Gebru Tegegn. Experiences on *Prosopis juliflora* management: The case of Afar Region, Ethiopia: Farm Africa; 2008. p. 1–35.
- [26] Launchbaugh, K. (2001). Anti quality factors in rangeland and pasture land forages. *Station Bulletin* 73, July.
- [27] Hulting, A. (2019). Small Pastures. March 2018.
- [28] DiTomaso, J. M. (2000). Invasive weeds in rangelands: Species, impacts, and management. *Weed Science*, 48 (2), 255–265. [https://doi.org/10.1614/0043-1745 \(2000\)048\[0255: iwirsi\] 2.0.co; 2](https://doi.org/10.1614/0043-1745 (2000)048[0255: iwirsi] 2.0.co; 2)
- [29] Edgar, J. A. (1992). Impact of weeds on animal productivity. 1, 140–144.
- [30] Byenkya, G. S. (2004). Impact of undesirable plant communities on the carrying.
- [31] Merfield, C. N. (2018). Integrated weed management in organic farming. In *Organic Farming: Global Perspectives and Methods*. Elsevier Inc. <https://doi.org/10.1016/B978-0-12-813272-2.00005-7>
- [32] Sellers, B. A., & Devkota, P. (2020). Weed Management in Pastures and Rangeland — 2020 1. 1–16.
- [33] Zaller, J. G. (2006). Sheep grazing vs. cutting : regeneration and soil nutrient exploitation of the grassland weed *Rumex obtusifolius*. 837–850. <https://doi.org/10.1007/s10526-005-5272-0>
- [34] Luna, I. M., & Dorado, J. (2020). Is Pasture Cropping a Valid Weed Management Tool ? 1–13.
- [35] Olson, B. E. 1999b. Grazing and weeds. Pages 85-96 in R. L. Sheley and J. K. Petroff, eds. *Biology and Management of Noxious Rangeland Weeds*. Corvallis, OR: Oregon State University Press.

- [36] Walker J. W. 1994. Multispecies grazing: the ecological advantage. Pages 52-64 in Sheep Res. J. Special Issue.
- [37] Popay, I. A. N., & Field, R. (1996). Review Grazing Animals as Weed Control Agents). 10, 217–231.
- [38] Riveros. F. 1993. Grasslands for our world. Proc. 10th. Grassl. Congo 17: 15-20.
- [39] Reeve, I. J., Kaine, G., Lees, J. W., & Barclay, E. (2000). Producer perceptions of pasture decline and grazing management. Australian Journal of Experimental Agriculture, 40 (2), 331–341. <https://doi.org/10.1071/EA98018>
- [40] Khan, N., George, D., Shabbir, A., & Adkins, S. W. (2019). Suppressive plants as weed management tool: Managing *Parthenium hysterophorus* under simulated grazing in Australian grasslands. Journal of Environmental Management, 247 (February), 224–233. <https://doi.org/10.1016/j.jenvman.2019.06.051>
- [41] Khan, N., O'Donnell, C., George, D., & Adkins, S. W. (2013). Suppressive ability of selected fodder plants on the growth of *Parthenium hysterophorus*. Weed Research, 53 (1), 61–68. <https://doi.org/10.1111/j.1365-3180.2012.00953.x>