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The social construction of weeds: different reactions to an emergent problem by farmers, officials and researchers

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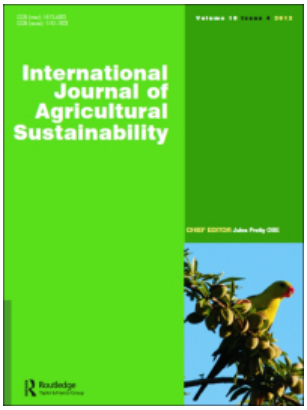

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Rapid population increase in southern Benin has changed the prevailing system of shifting cultivation into one of more permanent land use. New herbaceous weeds exacerbated rural poverty through crop failure, higher labour inputs, rising costs of production and reduced availability of suitable land. We investigated how different actors reacted to the emergence of weeds, in terms of the construction of knowledge, labour practices and technology development. Weeds have become an important cause of rural poverty. Farmers have actively engaged in technology development and new labour practices have emerged. Officials early on did report weed problems, especially where export crops were concerned. Researchers have not translated the new weed problem into a research priority until very recently, resulting in limited and inappropriate weed management technologies. The challenge of the research of which this study is part is to optimize weed management, by combining emergent indigenous weed management practices with scientific knowledge.

Keywords: Indigenous technologies, labour shortage, permanent land cultivation, population pressure, rural poverty, stakeholder diversity

Introduction

Weeds induce substantial crop losses and have an important impact on smallholders' revenue. Weed control is labour intensive. It can consume between 30 and 54 % of the total amount of labour used on an African farm, depending on the crop and the level of other available resources, and it takes about 280 hours of labour to weed one hectare twice (Okon & Amalu, 2003). In all, weed reduction is an important component of the quest to reduce rural poverty in Africa. However, formal science has made insufficient impact in addressing and solving weed-related problems.

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Weed-related problems raise interesting questions with respect to how different groups perceive and react to weeds. In this paper, we focus on farmers, (colonial) officers and agricultural researchers. At a more theoretical level, the paper discusses the issue how the weed problem became socially constructed (Berger & Luckman, 1966; Hacking, 1999) by different groups and what the consequences were and are for dealing with the problem. What makes weeds in Africa especially interesting from a constructivist point of view is that within living memory, the issue of weeds has undergone a transformation in African farming systems. Population pressure on land has led to a very rapid decline in fallow periods from sometimes more than 20 to four or five years (Mateete

et al., 1997; Vissoh *et al.*, 2004; Weber *et al.*, 1995). Where formerly weeding had to contend with re-growth of trees and shrubs, more permanent land use has given rise to the emergence of herbaceous weeds that sharply reduce yields and greatly increase the labour required to grow crops (Weber *et al.*, 1995). Weeds posed new problems that rural people had to cope with, and became a component of the vicious circle of poverty in small-scale farmers' production systems (Vissoh *et al.*, 2004). This transformation in the nature of weeds and weeding requires a concomitant transformation in the cognitive and social domains: naming weeds, inventing, testing and diffusing technologies, adapting farming practices and changing labour deployment and prices.

In this paper we describe the emergence of novel herbaceous weeds in selected farming systems in Benin. We focus on *Imperata cylindrica* (speargrass or Cogongrass, Alang Alang), a pioneer plant whose rhizomes rapidly invade arable fields and which is very difficult to eradicate; and on *Striga hermonthica* (witchweed), a parasitic plant that thrives in conditions of soil degradation and destroys cereal crops such as sorghum and maize. We also describe ways in which Benin farmers adapted to these weeds. The principal author has an emotional stake here. He grew up on a small family farm and spent many hours of back-breaking labour to weed his father's fields. We also trace how government authorities reacted to weed problems. Finally, we analyse the reaction of formal agricultural research to the emergence of weeds in Benin. But first we provide a quick overview of the attempts to define weeds and provide a short background to the social construction of reality.

The definition of weeds

The definition of a weed has always given rise to controversies, even among weed scientists. Not all people agree what a weed is or which plants are weeds. Scientists' most common definition is that a weed is a plant that grows where it is not desired (Reijntjes *et al.*, 1992; Van Rijn, 2000; Zimdahl, 1993). Weed control is not necessarily the eradication of unwanted plants but an activity aimed at decreasing or removing the interference. Farmers have learned to manage populations of weeds and to strike a balance between competition, soil protection and weeding costs (Oyen, 1995). Traditional farmers make a distinction between good weeds, which are often not even seen as weeds, and bad weeds. The definition of weed as 'a plant whose virtues have not yet been discovered' (Godinho, 1984; Zimdahl, 1993) connotes that it is humans who decide whether a plant is a weed or not, depending on context (time, space, socio-economic and cultural conditions), and the balance between the perceived negative and positive aspects of a plant. Weeds have, therefore, not only been considered as pests to be eradicated; some of them are also useful plants for medicinal purposes, soil fertility management, pest control, construction material, food for people and animals and various other purposes (Akobundu, 1987; Alcorn, 1995; Delabarre, 1977; Obatolu & Agboola, 1993; Okon & Amalu, 2003; Reijntjes *et al.*, 1992; Slaats, 1995; Van Rijn, 2000). There is no single 'objectively true' way to look at weeds. Instead, the multiple perspectives on weeds underscore the fact that humans depend on active social construction and learning to deal with important phenomena in their domain of existence. Only if one accepts the multiple realities that people construct, can one explain why one person's devastating weed may be another person's valuable plant.

Constructivism and the social construction of knowledge

For the purposes of this article, it is necessary to briefly introduce constructivism, especially because it is not a perspective that is common among agricultural scientists. Constructivism views knowledge as 'constructed', because it does not project the outside world on the brain. Instead, humans actively construct knowledge depending on social experience, learning, convention, culture, etc. Constructivism has given rise to science wars (Hacking, 1999) as philosophers and scientists with different metaphysical and epistemological persuasions bitterly fought each other about the nature of knowledge and truth. Our interest in social constructivism derives from our conviction that understanding the ways in which different groups constructed (knowledge of) weeds and on the basis thereof constructed weed management practices,

helps us to understand the mismatch between technologies proposed by formal science and farmers. Phrased differently: the science arena in which weeds are investigated lies outside the farmers' arena where weeds are experienced. Understanding this mismatch could then contribute to designing together with farmers novel ways of weed management practices that are acceptable to farmers and work under their conditions.

Hacking (1999) identified three main issues ('sticking points') on social construction, *viz.* contingency, nominalism and explanations of stability. The *contingency* thesis implies that a successful science did not have to develop the way it did, but could have taken a very different route. As we will make clear in this paper, the contingency thesis makes sense in weed science. Weed science could have developed differently, depending on its relative focus on the soils in which weeds thrive (weeds as a problem of soil fertility), on the plants and their interactions with crops (yield decline through weeds) or on the way humans manage such plants (weeding as a basic concept in weed science). However, that conclusion should not be construed as a general claim that our knowledge of the world is only determined by how people perceive it and frame it in terms of language, experience, and needs (the issue of *nominalism* versus realism); in other words, the claim that weeds only exist in the minds of farmers, weed scientists and others. Such a version would ultimately entail the claim that weeds exist because (and since) weed scientists claimed their existence and nuisance. We do not subscribe to that view. Not every construction can be effectively and justifiably deconstructed. Adaptive social construction has the very purpose of arriving at effective action in a predictable environment. The effective farming systems that African farmers have, over time, developed stand as testimony to this process (Röling, 2003).

Hacking's third sticking point refers to internal versus external explanations of *stability*. As this paper will also show, perception and knowledge of weeds by the different groups have their own histories. Weed perception and management by farmers changed due to agricultural intensification leading to the emergence of novel weeds. Weed perception and technology development by scientists and government officials also changed due to a shift in attention from export to subsistence crops, to the emergence of new weeds, and to the increasing awareness of weeding as a human practice.

Methodologies

Study area and the villages

An in-depth study was carried out in the villages of Damè-Wogon (District of Bonou), located in the Ouémé valley, and in Somè (District of Za-Kpota), situated on the Abomey plateau. Both villages are located in the southern agro-ecological zone of Benin. Land pressure is higher in Somè than in Damè-Wogon as population density in Za-Kpota district is nearly twice that of Bonou district. The land tenure system in both villages is based on inheritance, which means in the traditional setting that sons gain control over the land when their father dies. Other forms of land acquisition include borrowing, while in Somè renting, and in Damè-Wogon sharecropping and pledging have emerged as new ways of gaining access to land. In recent times distress sales of land have also taken place. Data collected during an earlier diagnostic study (Vissoh *et al.*, 2004) were complemented by novel information to give a more complete picture of how farmers perceive weeds.

Data collection

This article reports on work that is part of a larger study that includes experiments with farmers to test and adapt weed management technologies in accordance with farmers' socio-economic realities (Vissoh, 2006). Many of the technologies tested comprise indigenous technologies. These technologies are part of our analysis of the social construction of weeds by farmers. Additional data were collected, using a combination of methods, comprising:

(1) Archival research at the *Archive Nationale* and *Bibliothèque Nationale* at Porto-Novo, the political capital of Benin.
(2) Literature review of agricultural research activities and findings through published and unpublished articles, annual reports, and workshop proceedings of national and international research institutes (INRAB, University of Abomey-Calavi, IITA, IFDC and various NGOs).

(3) A semi-structured questionnaire was used to collect socio-economic characteristics of farmers, the prevailing land tenure systems in the study area, labour use, etc. The questionnaire was administered to 50 randomly chosen respondents (seven women and 43 men in Damè-Wogon; 14 women and 36 men in Somè).
(4) Qualitative data were collected through focus group discussions, participant observation, informal and semi-structured interviews of groups and key informants. Focus group discussions were held with different categories of farmers. The groups included elderly, middle-aged and young, male and female farmers.
(5) Informal discussions were held with weed researchers and extensionists about their concept of weeds and about the responsiveness of agricultural research to emerging weed problems so as to crosscheck information gathered from the literature and farmers.

Data analysis

Data analysis focused on understanding how population pressure led to changes in land use systems, on the causes and consequences of the emergence of weeds, on the impact of weed emergence on labour and its cost, and finally on crop yields and livelihoods. We analysed farmers' names for weeds. We also attempted to understand positive functions of weeds, as well as farmers' adoption of recommended science-based weed management practices. Finally, we analysed the social dimensions of weeds as a new component of the vicious circle of rural poverty.

Emergence of weeds and farmers' reactions

Elderly farmers acknowledge that in the past, when land and labour were plentiful, weeds were not a problem. Family labour was abundant. Children did not go to school and were available for weeding. Long fallow periods of more than ten years generally succeeded periods of three to four years of cultivation. The recent increase in population density has resulted in a rapid reduction of fallow periods and a breakdown in farm size from one generation to the other in such a way that the present generation is experiencing acute land shortage. For instance Ahossi's grandfather owned 6 ha. When he died, his plot was divided equally among his five wives to be given to their sons according to the tradition. Ahossi's father then inherited 1.2 ha, which he distributed to his five sons who each inherited 0.24 ha. Having ten sons, each of them will inherit 0.024 ha when he dies.

Land scarcity and farming history

The breakdown of farm size in both villages is alarming, particularly in Somè. The survey revealed that on average, 70% and 78% of the farmers own less than three hectares respectively in Damè-Wogon, and in Somè (data not shown). Land shortage is so critical in Somè that the majority of young people do not have access to land for farming. As an example, Koutika, a young man of about 25 years old, is a landless farmer. He was compelled to borrow a plot of 0.12 ha from his relatives to enable his wife to grow maize. He was forced to migrate to the Department of the *Collines* where he worked as a labourer. He is a driver and during periods when farm activities are relaxed, he usually returns to drive a taxi or ride a taxi-motorbike whenever he manages to obtain access to a vehicle. Five years ago, he travelled to Abidjan (Côte d'Ivoire) in search of employment but he was forced to come back because of the political crisis in that country.

In these conditions, land is continuously cultivated. For instance, Animanonvo, a farmer in Somè village, has been cultivating his land for 40 years. The land was fallowed when he spent about seven years in Côte d'Ivoire. When he came back in about 1975, he grew cotton and maize for three years. Thereafter he abandoned cotton because he got into debt and grew maize, sorghum, groundnut and cowpea. *Striga hermonthica* was discovered 20 years ago and presently the plot is no longer suitable for maize cultivation. He used to crop the local variety of cowpea Sèwécoun, which became infested with *Striga gesnerioides*. The interference by both *Striga* species is so severe that sorghum and cowpea cannot be produced anymore. For ten years he has allowed this land to be used for scientific experiments related to *Striga* spp. management. During the last three years, the land has been used for participatory development of *Striga*

management technology within the framework of the Convergence of Sciences Project.

In Damè-Wogon, farmers crop both the plateau and the valley offering them more opportunities than in Somè. However, speargrass has invaded most of plots cropped continuously. Cowpea varieties are used to suppress speargrass.

Farmers' perceptions of weeds

There is no uniform conception of weed among farmers. In Damè-Wogon, the local term for weed is *Gbégnlancan*, which expresses the more harmful aspects of weeds as plants that compete with crops, impoverish the soil, harbour insect pests, and of which their management is laborious and costly. In Somè, in the local language *Fon*, weeds are called *Gbé* or *Gbéhan*, which is any plant that has not been sown but has emerged spontaneously in the field.

The local name for *Imperata cylindrica* is *Sê, Enon Sè Doaa* meaning that whatever you do, it does not move. In other words, speargrass is difficult to eradicate. According to farmers speargrass has become a real constraint to agricultural production during the last 20 years. Similarly, the local name of *Striga* spp. in *Fon* is *Do* which means death because it inevitably kills the cereal and cowpea. In traditional societies in Africa, death is usually attributed to witches; therefore *Do* refers to witch as well.[1]

Harmful and beneficial aspects of weed species

Farmers rank weeds using the following criteria: degree of harmfulness, number of required weedings, and investment in weeding (Tables 1–3). Weeds that are marked with three asterisks are those that are highly detrimental to crop yields (Table 1). On the plateau, *Imperata cylindrica, Striga* spp., *Commelina* spp and *Cyperus* spp., are very harmful. In Somè, farmers stated that *Striga* spp. are more harmful and more difficult to control than *Imperata cylindrica*. In the valley, *Oryza longistaminata, Leersia hexandra*, and *Ipomoea aquatica* are considered the most troublesome weeds.

Farmers also consider that most weeds have beneficial aspects. Table 1 presents various positive functions of some weeds. Some are used either as construction materials and/or traditional medicine or provide income (e.g. *Imperata cylindrica*); others are used as vegetables, as animal feed or as soil fertility indicators. Speargrass straw was used as roofing material but nowadays the use of iron sheets is a matter of prestige. Speargrass does not last as long as iron sheets, but thatched houses are cooler and thus more comfortable than those with iron sheets, especially during dry seasons. The demand for bundles of dried speargrass in rural areas and in towns has enabled the development of a substantial trade in that weed. Some farmers have developed the sale of speargrass into an alternative to farming and have succeeded in making a decent living out of it. *Striga* species do not occur in Damè-Wogon. In Somè, farmers do not perceive beneficial uses for *Striga*. However, *Striga* is used as insect repellent, herbal medicine and indigo blue dye in northern Ghana (Lagoke & Hoevers, 1992), while in northern Benin it is used as medicine to cure cattle's colics, as indigo blue dye and as a cure for children with retarded growth (Egbers, 1990; G. Gbèhounou & A. Youehouénou, pers. comm.).

Technology development by farmers

With the invasion of speargrass, farmers in Damè-Wogon, first used to excavate the rhizomes with a special hoe. They realized later that this time, energy, and resource consuming practice reduces arable farm size. They then tested a less stressful strategy, which consists of planting creeping or semi-erect but leafy cowpea varieties after land preparation to suppress speargrass and to improve soil nitrogen and organic matter.

As for *Striga* species, farmers in Somè adapted their planting date of cereals (maize and sorghum) and cowpea to escape from severe infestation. They have also learnt to adapt the crop mix to the soil fertility status and the level of infestation, so that severely infested degraded plots around the homesteads are usually cropped with sorghum, which is somewhat more tolerant than maize. The transplanting of sorghum initially was not used for *Striga* management but it was used to fill gaps in planted rows. But farmers soon noticed that plants transplanted from nurseries in the fertile soil close

Table 1 Weeds in the different agro-ecological zones

Weed species	***Topo-sequence***	***Farmers' perception***	
		Level of harmfulness	***Use***
Imperata cylindrica	Plateau	***	Construction material
			Source of income
			Rhizomes are used in traditional medicine
Striga spp.	Plateau	***	Not yet identified
Cyperus spp.	Plateau, valley	***	Nuts are use in traditional medicine
Commelina benghalensis	Plateau, valley	***	Flowers are used in traditional medicine
			Leaves are animal feed
Panicum maximum	Plateau, valley	**	Soil fertility indicator
			Animal feed
Andropogon gayanus	Plateau, valley	**	Soil fertility indicator
			Animal feed
Tridax procumbens	Plateau	**	Animal feed
Dactyloctenium aegyptium	Plateau	**	Not yet identified
Pennisetum spp.	Plateau	**	Soil fertility indicator
Boerhavia diffusa	Plateau	**	Not yet identified
Centrosema pubescens	Plateau	**	Soil fertility indicator
Leersia hexandra	Valley	***	Not yet identified
Oryza longistaminata	Valley	***	Roofing material in the valley
Hygrophila auriculata	Valley	***	Not yet identified
Ipomoea aquatica	Valley	***	Animal feed
Ageratum conyzoides	Valley	*	Vegetable
Justicia anselliana	Valley	*	Vegetable
Echinochloa pyramidalis	Valley	*	Maintain soil moisture
Acroceras zizanioides	Valley	—	Maintains moisture
			Suppresses weed
			Improves soil fertility

Source: Field interviews March 2005.
***: very harmful, **: harmful, *: fairly harmful; —: not harmful.

to the houses tended to withstand *Striga* in an infested plot. In this way, farmers discover solutions to problems even if they do not know how it works.

Weeds as a component of the rural poverty cycle

Farmers of the learning groups formed after the diagnostic study in each village (Vissoh *et al.*, 2004) analysed causes and consequences of weeds. The analysis is depicted in Figure 1. The root cause of weed invasion is population growth, which has resulted in a substantial reduction of farm size and in soil mining. Out-migration of people in response to land shortage, and the modern practice of sending children to school have both had a negative impact on the availability of labour for agricultural activities. Labour scarcity, in turn, has led to an increase in labour costs, to a reduction in the number of weedings,

Table 2 Cost and amount of labour relative to land preparation and weeding of different types of weeds in Damè-Wogon

Weed species	Round of weeding	Labour (day ha^{-1})		Cost (F CFA ha^{-1})	
		Ploughing	Weeding	Ploughing	Weeding
Imperata cylindrica	3	125	125	125,000	262,500
Cyperus spp.	2	25	25	12,500	20,000
Commelina benghalensis	2	25	25	12,500	20,000
Oryza longistaminata	2	25	25	25,000	20,000
Panicum maximum	2	13	13	25,000	20,000
Centrosema pubescens	2	25	13	12,500	20,000
Andropogon gayanus	2	13	13	12,500	20,000
Andropogon gayanus	2	13	13	12,500	20,000
Cyperus sphacelatus	2	125	125	125,000	262,500

Source: Field interviews March 2005.

and consequently to substantial crop losses. Farmers lack the financial resources to invest in weeding or run up debts. Thus weeds force them into a vicious cycle of poverty.

The concomitant food shortfall that results from inadequate weeding threatens food self-sufficiency, and renders poor people vulnerable to diverse illnesses including malaria, tuberculosis and AIDS/HIV, which further reduce already scarce labour. Poor farmers who are incapable of providing the household with proper care and schooling are forced to entrust their children to people who promise to educate them. This phenomenon is usually referred to as *vidomègon*. In return, household heads receive a modest amount of money and the promise to benefit from the dividend of their children's work. Such *selling of children* again reduces the labour force available for weeding. Usually these children are ill-treated once they are in the towns or sent abroad (Côte d'Ivoire and Nigeria). The poorer the villages, the more child-trafficking increases and the more acute labour scarcity becomes. This strategy of escaping from poverty is more common in Somè than in Damè-Wogon. Sometimes, when farmers are completely desperate, they have been known to commit suicide.

Labour shortage as a major constraint to weed management

In traditional farming, hand weeding is the most widespread weed management strategy. It is performed either by family members, hired labour or mutual support of self-help groups (*Adjolu*). Hand

Table 3 Cost and amount of labour relative to land preparation and weeding of different types of weeds in Somè

Weed species	Rounds of weeding	Labour (day ha^{-1})		Cost (F CFA ha^{-1})	
		Land preparation	Weeding	Land preparation	Weeding
Tridax procumbens	2	13	13	12,500	20,000
Panicum maximum	2	13	13	17,500	20,000
Cyperus spp.	2	13	13	12,500	20,000
Dactyloctenium aegyptium		13	13	12,500	20,000
Pennisetum polystachion	2	25	13	12,500	20,000
Pennisetum spp.	2	25	13	12,500	20,000
Imperata cylindrica	3	125	125	112,500	187,500
Striga spp	3	13	13	12,500	30,000

Source: Field interviews March 2005.

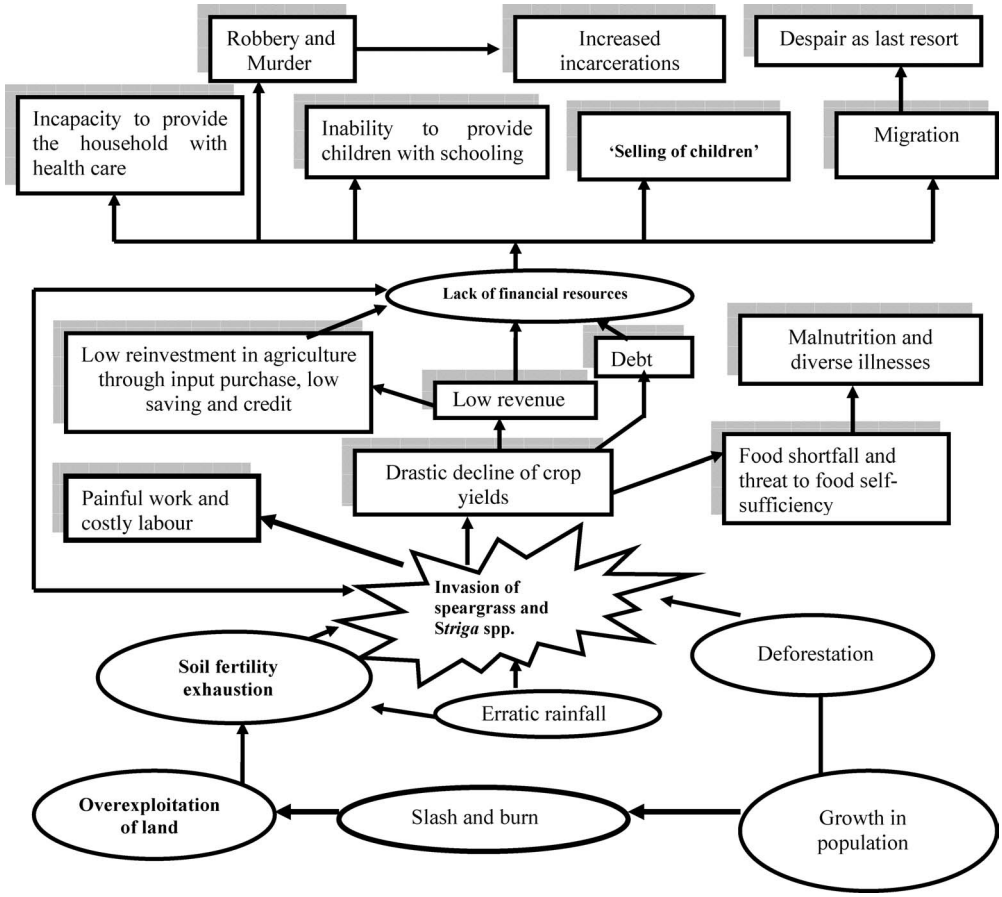

Figure 1 Farmers' perception of causes and consequences of speargrass and *Striga* problems (weed problem tree as explained by the experimental groups of farmers in Damè-Wogon and Somè).

weeding is a stressful and tedious farm activity. With it, physical and psychological suffering enters the discourse of weeds. With the establishment of the National Society for Rural Development[2] (SONADER) in 1968, hired labour was sought for the instalment of the state oil palm plantations. This has led to a rise in weeding costs. The introduction of cash crops resulted in disintegration of the traditional social organization and rising labour costs. In the 1970s, ridging 400 m^2 cost 100 FCFA.[3] Nowadays, labour for that area costs 1000 FCFA, 800 FCFA and 600 FCFA for land clearing, land preparation, and weeding respectively. Similarly, in the past, in Somè, farmers were organized in self-help groups that performed activities on members' farms. The monetary remuneration of labour was introduced with the introduction of cotton in the 1950s. Labour cost has risen from 1 FCFA in the past to 50 FCFA presently for preparing a ridge of 20 m length.

Nowadays, labour cost for weeding is determined by the following criteria: (1) invasion of perennial weeds (*Imperata, Cyperus*), (2) soil texture and workability, (3) presence of stumps and (4) abundance of annual weeds. Labourers are not paid per man-day, but based on the time spent in the field. Labourers work for four hours (from 7 AM to 11 AM). Tables 2 and 3 present current labour prices per weed species and farm operation in Damè-Wogon and Somè, respectively. Weeding is more expensive than land preparation for the most troublesome weeds such as *Imperata cylindrica* and *Cyperus* spp. This is due to the fact that weeding is less attractive than land preparation, because it consumes more time, is more tedious and stressful. People willing to perform weeding

take advantage of this circumstance and demand higher prices plus food and drink. Sometimes labourers go to other farmers because they offer better prices for the job even if they had been appointed and their food had been cooked.

Speargrass requires the highest amount of financial investment, but these costs are higher in Damè-Wogon than in Somè. This difference is due to the fact that in Somè farmers prepare land and weed superficially and do not remove speargrass rhizomes.

Gender division of labour

We examined how gender affects the reaction to weeds emergence by analysing the division of labour. Land insecurity prevents women, who do not inherit land but have access to it according to traditional arrangements, from adopting soil and weed management technologies. Moreover, although women have access to land through their husbands, they are often given more exhausted and highly weed-infested land. Women usually help their husband in his field, which delays weeding their own field. Therefore, women suffer more than men from weed problems.

An investigation carried out on labour organization and allocation within households reveals that men, women and children are involved in land clearing, land preparation and weeding (Table 4). The difference lies in the time spent to perform these different farm activities. Women spend more time than men and children's labour is essential. The same observations concerning women and weeds were made in the humid forest zone of Cameroon (IITA, 1995). Because they perform the bulk of weeding activities, women should be involved in the development of weed management strategies.

History of the recognition of weeds as a problem by the authorities

Agricultural constraints during the pre-colonial era: 1800–1905

Archival research showed that the pre-colonial era was essentially characterized by subsistence agriculture whereby large production units called *tatas* (large households composed of many families) were responsible for producing the bulk of food. Traditional rulers who headed these production units shared the produce among their people after sending the tribute payment to the king. Apart from cash crops, such as oil palm, coconut and tobacco, which were introduced by the king of Danxomè,[4] Ghezo (1818–1858), food crops were prioritized, especially after the famine of 1847–1848 caused by a prolonged drought. The major agricultural problems mentioned were weed management and bush fires in oil palm plantations. No weed species were reported. Food crop cultivation was compulsory and the planting of oil palm was subject to strict regulation. According to colonial administration reports, herbaceous weeds were not a constraint in food crop production, although they were in tree plantations. These industrial crops were newly introduced and local farmers therefore lacked knowledge of their ecology. Abandoned plantations were highly susceptible to fire during the dry season due to severe weed infestation.

Agricultural constraints during the colonial era: 1906–1960

After King Béhanzin had been captured and the revolt of the Bariba people had been suppressed, the French colony imposed an agricultural policy that prioritized

Table 4 Division of labour for speargrass management among farm operations according to gender and age in Damè-Wogon

Activities	*Level of involvement*		
	Men	*Women*	*Children*
	Time spent (hours ha^{-1})	*Time spent (hours ha^{-1})*	*Time spent (hours ha^{-1})*
Land clearing	62.5–100	62.5–112.5	2.5–112.5
Ploughing	400	800	300–800
Weeding	600	800–1000	500–1000

Source: Field interviews 2005.

cash crops to the detriment of food crops. The agricultural sector was organized in marketing chains or commodity networks including agricultural research, credit and extension (Savariau, 1906).

Research stations were initially managed by the French administration. French research institutes (e.g. *Office de la Recherche Scientifique et Technique dans les Territoires d'Outre-Mer*, ORSTOM) took over their management and more research stations were created. These included research stations on oil palm located at Pobè and on coconut situated at Sèmè created in 1922 by ORSTOM. In 1930, the experimental farm established at Ina (run by the *Institut Français de Recherches Agricoles Tropicales et de Cultures Vivrières*, IRAT) was created and specialized in animal traction and the pre-multiplication of seeds. The *Institut de Recherche du Coton et des Textiles Exotiques* (IRCT) for cotton and other textiles was created in 1947 (INRAB, 2005).

The research agenda emphasized yield improvement, and priority was given to varietal breeding, which extensionists could recommend to farmers. Other socio-economic and cultural aspects were overlooked. The general agricultural constraints included climatic constraints, difficulties in managing the indigenous Societies of Providence[5] (*Société Indigène de Prévoyance*: SIP), and distrust by farmers towards the technical packages introduced by the colonialists.

Speargrass invasion was cited as a major constraint for the first time in 1936. Weed management in coffee plantations was reported in 1945. A general report mentioned that 'weed infestation in the coffee plantations was of concern in a number of centres despite all efforts made. Some farmers were very careless and seemed completely reluctant to heed the extensionists' advice' (Anonymous, 1949). The report also revealed that the number of weed-infested coffee plantations was smaller than the number of plantations that were frequently weeded. Specifically, 25% of the plantations were completely abandoned, 10% were neglected but regularly harvested, while 65% of the plantations were weeded well. In November 1954, the use of cover crops (*Pueraria javanica, Calopogonium mucunoides* and *Centrosema plumieri*) to restore soil fertility of oil palm plantations and of arable fields for food production was suggested. These cover crops would have helped control weeds in these plantations. Hand weeding was still the main weed control method during that period.

Agricultural constraints of the post-colonial era

The political change to independence that occurred in 1960 also resulted in a shift in the agricultural sector. The state priorities were to achieve food self-sufficiency, increase crop production, to expand export cash crops in order to provide foreign currency, and to produce raw materials required by the state industries. From 1960 to 1972, policy priorities in agriculture were still directed towards export crops. Lack of chemical fertilizers and beetle *(Oryctes* spp.) damage were major constraints to cotton and oil palm respectively. There were no specific weed control experiments in maize cropping at the Niaouli research station (IRAT, 1974). The Marxist-Leninist era started in 1972. The new leaders declared agriculture to be the basis of development and industry the motor of the economy. This view brought about changes resulting in the creation of new research units, still with a mandate on export crops. Research activities in coffee and cocoa were launched again. In Benin, the laboratory of crop protection, which comprises weed management, was only created in 1975. In 1977, so as to better coordinate research activities, the Benin Government decided to take charge of research stations and experiment centres, which had been run by the French institutes until that time.

From 1977 to 1987, the major agricultural constraints included low and unpredictable rainfall, the decline in soil organic matter due to intensified land use, land shortage, insect pests, diseases, and grain-eating birds. During that period, research programmes emphasized breeding of high yielding, early-maturing and drought-resistant varieties, fertilizer application, crop husbandry, and crop protection. Weed problems were not a priority.

Response of formal agricultural research

The reaction of scientists to farmers' emerging weed problem

From Table 5, it can be noted that researchers overlooked weeds, compared to other production

Table 5 Research and development responsiveness to the articulation of weed problems: number of items where the topic is mentioned (1906–1997)

Period (years)	*Striga spp.*	*Imperata cylindrica*	*Commelina benghalensis*	*Cyperus rotundus*	*Chromolaena odorata*	*Weed in general*	*Aquatic weed*	*Forestry and agro-forestry*	*Soil fertility and water management*	*Animal rearing and fishery*	*Post-harvest technology*	*Institutional development*
1906–1947												149
1948									30	20		
1967								3	65	245	546	
1971		1							56		675	106
1974				1				5	46			
1977						1		6	49	206		
1979						2		4	55			
1981						2		2	60	349	1607	207
1984						3		5	65			
1985	3					3		5	108			
1986		1						10	159			
1987	2				1	5		8				
1988	2					2		11	154			
1989	6					4		5				
1990		1						15	176	457	905	52
1991	2	1			1	4		13	155			
1992			1			5		18	100			
1993	4		2		2	3	4	13	167			
1994	8	2	2			1	1	20	109			
1995	8							18	76			
1997–2001	10	1						68	30	189	509	60
Total of subjects	43	07	05	01	04	35	05	229	1660	1496	4242	574
Relative importance of each theme (%)	0.52	0.08	0.06	0.01	0.05	0.42	0.06	2.76	20.00	18.02	51.10	6.91
	1.17%							98.78%				

Source: INRAB, 1997.

constraints. Only 1% of research topics were related to weeds, compared to 20% to soil fertility and water management, and 18% and 51% to animal rearing and fisheries, and post-harvest technologies, respectively. Until 1981, there were no weed scientists in Benin. The *Faculté des Sciences Agronomiques* of the University of Abomey-Calavi trained the first weed scientist in 1982. International research centres such as ICRISAT, SAFGRAD, IITA, IFDC, etc. were also beginning to become concerned with developing weed management technologies for resource-poor farmers either directly or through soil fertility management (Akobundu, 1993; Ba, 1983; Carsky *et al.*, 2000; IITA, 1986, 1998; Musselman & Parker, 1983; Reneaud, 1983; SP-IPM, 2003; Weber *et al.*, 1995).

Weed science emerged, not because weeds were considered important in the food crop systems, but because the government embarked on rice production, and a student was asked to study weed–rice competition (Ahissou, 1982). It was around 1985 that researchers started paying attention to weeds. Weed scientists were trained to better manage *Commelina benghalensis*, which causes substantial yield losses in cotton (Ahanchédé, 1994), and *Striga* spp. in cereal-based cropping systems (Gbèhounou, 1992, 1998). Researchers' contribution to *Striga* control includes the development of resistant cultivars, the use of N-fertilizer, and rotation with trap crops. Breeding for resistance and tolerance has been the major thrust and sources of tolerance have been identified (Kim, 1988; Kim & Akintunde, 1989). Resistant sorghum varieties have been developed by ICRISAT and for cowpea by IITA/SAFGRAD. IITA scientists developed screening and selection techniques for *Striga* resistance (IITA, 1983). IITA-improved early maturing erect cowpea varieties, one with resistance to *S. gesnerioides*, and transplanting of seedlings (for sorghum and millet) were also recommended to farmers (Gbèhounou *et al.*, 2004; IITA, 1993, 1998; INRAB, 2000, 2002). Several legumes were evaluated together with maize for their combined effect on reducing the *Striga* seed bank in the soil in comparison with fallowing. Soybean and a fodder legume (*Aeschynomene histrix*) were found to reduce *S. hermonthica* seed levels in the soil (Berner *et al.*, 1995).

The magnitude of the *Striga* problem led to institutional developments where scientists at the national, regional and international levels through networks and workshops engaged in collaborative action on the *Striga* threat to define research strategies and approaches (Kim, 1991; Lagoke *et al.*, 1994; SP-IPM, 2003). Researchers recommended the implementation of integrated systems of control comprising (1) the use of *Striga*-free planting material; (2) crop rotation with selected non-host cultivars efficacious in germinating *Striga* spp. seeds and (3) host-plant resistance, host-seed treatments, transplanting and biological control to reduce the amount of *Striga* seeds in the soils (Berner *et al.*, 2003; IITA, 1998; INRAB, 2001; Zoschke & Quadranti, 2002). However the majority of these research findings were only adopted to a limited extent by resource-poor farmers (IITA, 1993; Rao, 1985) because they did not fit in their socio-economic conditions.

Taking advantage of the introduction of cover crops (*Mucuna utilis*) in 1986 by researchers to ameliorate degraded soils, participating farmers drew researchers' attention to the effectiveness of legumes in suppressing speargrass (IITA, 1994; Versteeg & Koudokpon, 1990). This discovery by farmers triggered a nation-wide dissemination of green manure cover crops by researchers, development projects and NGOs (Buckles *et al.*, 1998; Carsky *et al.*, 2000; Vissoh *et al.*, 1997, 1998). The farmers' main reason for using *Mucuna* spp. was to suppress speargrass (Versteeg *et al.*, 1998). However, after about a decade of usage, farmers became disillusioned when they realized that the subsidized dissemination of legume cover crops had hidden the inherent constraints to their adoption (e.g. farmers cannot eat the seeds, the crop occupies scarce land, and requires a great deal of painful work to be removed). Despite the huge amount of initial funding provided by donors and the publicity given to it by researchers and developers, *Mucuna* use in Benin has strongly declined.

Herbicides (Round Up) were also recommended to farmers as an alternative to hand weeding, but their adoption was constrained by their unavailability, their prohibitive cost, and low food crop prices. Chemical control is only practised in cotton production in response to labour shortage.

Conclusion

This study has examined the responses of different actors to an important but historically underrated event: the emergence of herbaceous weeds as a result of reduced fallow periods and land scarcity under population pressure. Weeds have become a significant player in the vicious circle of rural poverty. The weed problem cannot be seen in isolation from increasing scarcity of labour and land. Unattractive food prices discourage small-scale farmers from investing in soil fertility and weed management. Consequently, soil mining and weed invasion mutually reinforce their impact on rural poverty.

The article has examined the social construction and response by three major actors to the emergent weed problem. Farmers, who have to live from the results of their labour on the land, were of course the first to suffer the consequences, especially women farmers. But rural people have also actively engaged in developing technologies to combat weeds. The other actors we looked at were the authorities in pre-colonial, colonial and post-independence periods. The examination of the records revealed that, while weed problems were reported quite early on, the focus was mainly on plantation and export crops that were important for revenue collection. The impacts of weeds on the rural population and on food crop production were generally ignored until very recently. Concomitant with official oversight of weeds, there was an almost total neglect of weeds by agricultural research until well into the 1980s. Even then, spending on weed research has been very limited. We can only speculate on the reasons for this finding. One major reason could be that science has systematically overlooked the importance of labour in weeding. It is all too common to read in a research paper that 'fields were weeded when necessary' without specifying who did the weeding and how much labour was involved. This oversight could also be related to gender bias because women are more engaged in weeding. Later on, when agricultural science did address issues of weed management, it was still partly blind to the constraints that farmers experience (costs of herbicides and fertilizers, time needed for weeding, the impossibility to use cover crops if that results in foregoing the harvest of an edible crop during a season, etc.).

Weeds are a key component of rural poverty in West Africa. Effective weed control methods should be a key concern for agricultural research that seeks to reduce rural poverty in West Africa. Our study reveals how little weed perceptions and weeding practices by small-scale farmers influenced the research and policy agenda of agricultural science and the government. Perhaps the key lesson from this study is that different conceptualizations (constructions) of weeds determined different practices of weed management and that a conceptual convergence is essential for designing more effective pathways of science in future.

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Notes

1. However, even though the Latin word *Striga* means witch, and the vernacular name of *Striga* species is witchweed, any connection in the scientific literature between *Striga* and witches is spurious, because the Latin name *Striga* was derived from strigosus, referring to the bristly nature of the stem.
2. SONADER was a state body in charge of oil palm (*Elaeis guineensis*) plantations.
3. 1 € = 650 FCFA.
4. Danxomè is the name of the Abomey kingdom, which has been changed to Dahomey (actual Republic of Benin) and attributed to the country after the independence by the French colony.
5. Indigenous Societies of Providence were the extension structures in charge of disseminating agricultural technologies during the colonial era.

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