Using Ethnobotany to Find the Demand for Weed Research in the Bolivian Andes

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Introduction

Asking tropical, smallholder farmers for their weed research demands is not as straightforward as it seems[1]. They may place exaggerated expectations on research ("How can we make *Spergula* disappear from our community?") Their ecological relationships with weeds are more complex that the researcher immediately grasps (some weeds are actually harvested, like hay, but many are not). Ethnobotany can help elicit demand for research in a culturally and ecologically sensitive way.

Folk Science of Weeds

Ethnobotany or folk botany[2] is the study of local knowledge of plants. Balick and Cox define ethnobotany simply as "the study of the relationships between plants and people (Balick & Cox 1996:3). Ethnobotany includes the study of local names and folk taxonomy of plants as well as the local knowledge of them.

Emic and etic. Anthropologists who document folk biology commonly distinguish between emic and etic concepts. Emic concepts are those of the people themselves. Etic

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[1] This research was supported by PROMMASEL (Sustainable Management of Weeds on Hillsides), a research project funded from February 1999 to March 2002 by the UK's Department for International Development (DFID). DFID finances research programmes with the purpose of alleviating poverty by generating and applying knowledge. This Project was funded through DFID's Crop Protection Programme (CPP). It is managed in the UK by the Natural Resources Institute and in Bolivia by the Universidad Mayor de San Simón (UMSS).

[2] Eugene Hunn (1977) distinguishes folk biology from ethnobiology, one being the study of nomenclature and taxonomy and the other the study of other kinds of knowledge. But separating the 2 is not particularly useful.

concepts are of outside researchers. “Weed” is an etic concept. The Quechua-speaking people of Cochabamba in the Central Andes of Bolivia have a concept they label “**qhura**[3],” which includes most herbaceous and grassy plants, whether weeds or not. Yet it is possible to study the emic knowledge of an etic concept, like weeds.

The Value of Ethnobotany

Ethnobotany is much more than the study of folk remedies made from plants. Local knowledge of weed control, soil conservation and other uses of weeds (forage, construction, even toys) can also be documented. Local knowledge is a serious, but relatively recent concern of development professionals, but anthropologists have been interested in folk knowledge since the early 20th century and have created formal tools for studying it since the 1960s and 70s (for an engaging and fairly recent review see Berlin 1992)[4]. Paul Sillitoe has argued that anthropological tools (of which ethnobotany is an obvious example) are well-suited to applied topics, e.g. agricultural development (Sillitoe 1998). In this case, Quechua farmers’ weed management was sophisticated, and ethnobotany was helped us identify subtle changes that could possibly be useful.

A Brief Geography of Cochabamba

The study area is in the Bolivian Andes, in the department of Cochabamba.

Rainfall: 400 to 600 mm of rainfall.
Elevation: 2,400 to over 4,000 meters.
Latitude: 17º to 18º South.

Rain falls from October through January, which limits crops to one season, unless there is irrigation. Farm communities tend to cluster around relatively flat pockets of irrigated land. The Andes are steep and dry here, and native plants include cactus, needle grass (*Stipa* spp.), acacias and mesquite (*Prosopis* spp.). The parent rock is sedimentary, especially sandstone, so soil fertility is uneven and crops respond to fertiliser. The dry, rugged terrain makes for low population density, and communities are easily 60 km from the city. Transportation is expensive and uncomfortable, in the back of trucks. People grow many species of food crops to avoid an over-dependence on the market. Still, all provincial towns have a weekly market and buyers come from the city of Cochabamba to sell such exotic items as soap and sardines and matches and to buy the potatoes and wheat and broad beans that feed the half million people in the city.

Method and Materials

Year 1, the crops’ perspective

Over 4 weeks in January, 2000, Jeff Bentley and Bolivian agronomist Silvio Nina interviewed farmers in 3 provinces of Cochabamba: Ayopaya, Tiraque, and Esteban Arce. We used a short, 2 page questionnaire, which was formal enough to guide the interview through the annual cropping cycle, but open-ended enough to illicit concepts that were meaningful to the farmer and novel to the interviewers (like weeding for mice, see discussion). The interview lasted 15-20 minutes per field. The authors interviewed the 34 farmers in 119 fields. A few of the interviews were in Spanish, but almost all were in Quechua, the native language of the area. Mr Nina is a native speaker of Quechua and Spanish and he did most of the talking while Bentley took notes.

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[3] Quechua words are in **bold** and Spanish terms are in *italics*. Words and phrases that are blends of the 2 languages are in ***bold and italics***.
[4] For an excellent book on how to do ethnobotanical field research, see (Alexiades 1996).

While Nina and Bentley interviewed the farmer, other team members collected natural history data. Gregorio Gonzales and Juan Villarroel collected weed specimens for a botanical inventory. Salomón Pérez gathered abiotic information (degree of slope, exposure, soil type, irrigation structures, geomorphology etc.). Several farmers went with us, so we could visit a number of fields at once, without having to climb back down the mountain after every interview. The farmers who were not being interviewed for that particular field would usually listen to the interview, chat among themselves, or help Mr Pérez collect data. We paid farmers for their time.

The questions were calendar and activity based, e.g.:

Interviewer: What was the first task you did for these potatoes?
Farmer: I ploughed.
Interviewer: With what?
Farmer: An ox team.
Interviewer: When was that?
…
Interviewer: Then what did you do?
Farmer: I planted?
Interviewer: With what kind of seed?

Each interview went on like this, step by step, covering all major tasks, including weeding and harvest. When farmers volunteered long, complicated answers, we listened and wrote summaries of them. All of the quantitative data (botanical, abiotic and cultural) was entered into an Excel data base and Margaret Smith (NRI) analysed the numbers.

Year 2, the weeds' point of view

The first year (2000) we looked at ethnobotany from the crops' point of view (albeit through the farmers' eyes). The second year (2001) we looked at ethnobotany from the weeds' point of view (again through the farmers' eyes). In January, 2001, Silvio Nina, Jeff Bentley and Salomón Pérez spent 2 weeks in the same provinces, doing semi-structured interviews (not questionnaires) about knowledge and behaviour of weed species. We did as much of the interview as possible in the field. When it was raining we plucked a large set of weeds and took them somewhere dry (usually a barn or a farmhouse) and interviewed the farmer, usually in small groups of 2-4 people (see Table 1).

Table 1: Date and Place of Main Interviews

Date	***Place***	***Who was interviewed***
17-January	Piusilla, Ayopaya	Severino García, Angel Begamonte + others
18-January	San Andrés, Ayopaya	Angel Begamonte, Germán Alegre
19-January	San Andrés, Ayopaya	Cecilia Ruíz, Casiano Ruíz
22-January	Qulqi Qhuya, Tiraque	Francisco Molina, Juan Galindo
23-January	Payrumani, Tiraque	Federico Zelada, Ramiro Colque
24-January	Yunkataki, Esteban Arce	Vicenta Blanco
25-January	Uray Huerta, E. Arce	José Ugarte, Francisco Veizaga, + 2 others
26-January	Mayola, Esteban Arce	Mario López, Guillermo Osorio

Nina began by asking the farmer "which of these plants causes you the most anger[5]?" Species by species, in order of which one vexed the farmers the most, we documented the names of each plant, the damage it does, how it is controlled, its uses and other information. The interviews lasted 3 to 4 hours. Again, we paid people for their time; some were the same people we had interviewed the previous year. If we had not paid them in 2000, they would have avoided us in 2001. Salomón Pérez kept a specimen of each weed we discussed with farmers.

The second year's emphasis on each individual weed species was possible because by 2001 the team knew the weeds better. Salomón Pérez and other team members had spent much of the intervening year identifying weeds through literature and by consulting botanists. The ethnographic studies from year one and year 2 complimented each other.

Results, Year 1 (2000)

Number, Timing and Method of Weeding

The number of weedings per crop is shown in Table 2. Major crops are:

- Andean tubers (potatoes, oca, papa lisa, isaño)
- Maize
- Small grains (wheat, barley, oats and any other similar, European grain)
- Broad beans (broad beans)

Table 2: Number of Weedings and Crop Type

Crop	***No. of Weedings***	***Description***
Andean tubers	2-3	Usually 1 weeding with hoes, and 2 *aporques* (hilling-up, or furrowing) made with an ox plough or with a pointed hoe).
Maize	2-3	Usually 1 weeding with hoes, 1 *aporque*, with plough or pointed hoe, and 1 harvest of weeds with a sickle, late in the cycle (the weeds are then fed to oxen and other livestock).
Small grains	0-1	1 hand-pulling of tall weeds, especially *Brassica campestris*, both for eliminating weeds, their seeds, and for cattle forage. Unlike the other crops, which are planted in rows, small grains are broadcast, and farmers say that weeding with tools would damage the crop.
Broad beans	2	1 hoe weeding and 1 *aporque*, because the broad beans shade out weeds later in their cycle.

Equipment

Team of oxen (*yunta*). Traditionally used with a wooden ard plough. Since the early 1980s often replaced by a small, metal plough, introduced by the Swiss-funded CIFEMA Project.

Hoe (*azadón*). A commercially-available, steel hoe blade, fixed to a home-made wooden handle.

[5] "Ima qhura ancha rabiachisunki?"

Triangular or pointed hoe (**chujchuka**). The blade is a long, metal triangle, hafted onto a wooden handle.

Crop Rotation

Rotation fulfils many purposes in Andean farming systems, one of which is to control weeds. The basic rotation is something like this (with one crop per year):

Fallow→potatoes→other tubers→maize and/or broad beans→small grains→fallow (up to 10 years)

There are many variations on this rotation, some involving only 2 or 3 crops. Other options include:

Fallow→potatoes→small grains→fallow
(for extensive crops on large, dry fields)

potatoes→broad beans→potatoes→broad beans
(for intensive gardening with irrigation)

potatoes→small grains (in the same year)→maize & broad beans (same field)→potatoes
(3 plantings every 2 years, with irrigation)

There are still other types[6], but the above rotations are the main ones. The main constraints to rotation are:

- Fallow is common.
- Most rotations start with potatoes.
- Small grains (or sometimes, broad beans) usually end the cycle.
- Small grains always end the cycle if there is a fallow.
- In more intensive systems, small grains may be eliminated or moved to the middle of the cycle, in order to fit 2 crops (potatoes and small grains) into one year. These systems are heavily weeded and ploughed.

Potatoes start the cycle because they are usually the only crop that is fertilised, or at least the only one that is heavily fertilised. Other crops (e.g. tubers, maize) use nutrients banked during the potato crop.

When we asked farmers why they ended the cycle with small grains, they said it was because grains improved the soil, or fed the soil for potatoes. But farmers frequently said things like “not even oats can eliminate X weed” which suggested that farmers were aware that small grains out-compete weeds. When I explicitly asked some of the farmers if they ended a cycle with small grains in order to eliminate weeds, they said yes. However, it also seems that farmers plant small grains on the fourth year of crop rotation because by the fourth year the field has become depleted of nutrients, and weed infested, and small grains withstand these conditions better than other crops. Much of the grain crop is harvested with the straw and fed weeds-and-all to livestock.

[6] Terrazas et al. (1998) list 295 observed rotations in highland Bolivia. This very large number is made possible by counting every minor variation as a different rotation (e.g. classifying a cycle ending in wheat as different from one ending in barley). We do not dispute their data, but find it more useful to lump rotations into a smaller number of functional equivalents.

Land Preparation

Options. Farmers' first option for ploughing is generally with an ox team. In Sacabamba, Esteban Arce, there is a large, flat plain that can be ploughed with tractors, but machinery is not an option on most of Cochabamba's farms. In fact, many fields are too steep even for oxen. Farmers told of ox teams rolling head over heals off of some slopes. Many mountainsides must be worked entirely by **chujchukas** and other hand tools.

Effect of previous crop. Andean valley farmers pay close attention to the sequence of crop rotation. Land that is cropped without a fallow is called **qallpa**. When farmers plant crops following potatoes (that is, when they plant in **papa qallpa**) they usually do not plough the soil, but sow directly into earth, already heavily worked during the potato harvest.

Menus of Weed Control Types

Decision making. When we asked farmers to describe how they decided to weed, they often looked at us as though we were idiots, because the answer was so obvious to them. They occasionally volunteered the information that they were waiting for the soil to dry more before doing the next *aporque* (1999-2000 was a wet year). They said they wanted to work the soil when it was neither muddy nor very dry, but simply moist (a condition they described with the word **phiri**). They weed and ridge less in dry years, because they are fully aware that this dries the soil. Farmers said they decided to weed when there was "a lot" (**ashka**) of weeds, or "when weeds appear" (**qhura rikhuxtin**). See Table 3.

Table 3: Menu of Control Options and Field or Weed Types

Control type	***Field or weed type***	***Reason***
Weeding with a hoe	Andean tubers, maize or broad beans, especially early in the season.	To eliminate weeds quickly, to clear the ground before *aporque* (hilling or ridging) with an ox plough.
Aporque with an ox plough	On flat or moderately sloping fields, especially if the field is not too small.	To dry the soil and manage soil-born diseases, and weeds, but especially to pile soil over tubers, which keeps them from surfacing and helps prevent wind lodging.
Aporque with a pointed hoe	On small or steep fields of Andean tubers, maize and broad bean.	For the same reasons as above, but is more labour-intensive. Used on fields too small or steep for an ox team.
Hand pulling	Tall weeds, especially *B. campestris* in fields of small grain.	Eliminate weeds, keep them from producing seeds and provide fodder.
Cutting weeds with sickle	Mature weeds, late in the cycle, especially in maize fields.	Prevent rodent damage and provide fodder in the hungry season.

Results, Year 2 (2001)

Names for Weeds

Farmers have names for most of the weeds in their fields, especially if the weeds are pests or, paradoxically, if they are useful.

Criteria of importance. Campesinos judge plants to be important if they are crop pests. Farmers describe weeds with the verb ***molestay*** (from the Spanish *molestar*, "to bother.")

Molestan—it bothers (i.e. a serious weed).

Mana molestanchu—it does not bother (i.e. not a very worrisome weed).

Farmers said that of the perhaps 30-40 plants in a typical field, only 3 or 4 really bothered the crop. *Brassica campestris*, *Bidens trinervia*, *Pennisetum clandestinum*, *Viguiera lanceolata*, *Rumex acetosella* and *Spergula arvensis* were the major, serious weeds (see Annex A).

Criteria of use. Fodder was by far the most important use mentioned by farmers, who showed a deep knowledge of weeds as forage. They knew which livestock species ate which plant, at which stage in its life cycle and whether the animal could eat the plant in the field or whether it could only eat the plant if the farmers harvested it and fed it to the animal. Farmers were also aware of whether or not livestock found the plants palatable, or merely ate them out of hunger, when there was nothing else. Other uses, such as medicine or toys were a distant third criteria for importance of a plant.

Damage and Control

Infuriating weeds. Campesinos describe a serious weed by saying that it makes one furious (***rabiachin***). Characteristics of an infuriating weed, in order of importance are: 1) abundant and 2) difficult to control. Most of the infuriating weeds have some uses, but farmers still regard them on the whole as negative. **Ch'iki** (*Pennisetum clandestinum*) is such extremely good fodder that farmers give it a kind of begrudged appreciation, yet it is still infuriating in a field.

Plant pests of the human body. Some weeds, like **ch'uqi ch'api** (*Xantium spinosum*), are not very abundant, but campesinos consider them infuriating because they are thorny. Farmers complain about it because livestock will not eat it, and because the weed jabs people's hands as they work.

Control: It comes out in the weeding. Farmers speak of weeds that are easy to control as "**qhurana lluqsin**" (*sale en la carpida*—it comes out in the weeding). That is, the weed is controlled by the regular operations of hoeing and cultivating and does not require any special treatment. This contrasts with other weeds that for some reason, usually architecture, demand a special control: e.g. *nabo* (*Brassica campestris*) grows low to the ground when it is young, which makes it hard to remove from a field of cereals. Farmers must wait until *nabo* grows its flower stalk, then hand pull it, taking care to do so before the seeds set, because the mature seed heads shatter when the plant is pulled. Farmers are fully aware of the relationship between the weed and its seeds.

Use

The weed scientists on this study wanted to take useful weeds into account when designing control strategies. But it turned out that almost all weeds had some sort of use. However, only a few weeds were required by farmers in large volumes, which is especially true of weeds used as fodder. Another bulk use would be the occasional, but dramatic use as a famine food. Most of the other uses of weeds are as specialty items: medicine, playthings etc. that use only small amounts of the plants.

Fodder. As land supply decreases, the weeds become more important as fodder (see Table 4).

Table 4: The greater the land pressure, the more weeds are used as fodder

Province	*Land supply*	*Weed use as fodder*	*Explanation*
Ayopaya	Abundant (much fallow land, some pastures and much irrigation)	Low	Farmers pasture livestock on weeds in fallow land. When campesinos are cultivating with oxen, far from the village, they may use a few armloads of recently cut weeds as fodder for the ox team, but otherwise make little use of weeds as fodder.
Tiraque	Less abundant (less fallow land, some pastures, some irrigation)	Medium	Campesinos harvest weeds, and haul them home in **q'ipis** (cloth bundles) for animals.
Esteban Arce	Scarce (little fallow land, degraded pastures, no irrigation in some crop areas)	High	People often haul weeds in **q'ipis** to feed to livestock. Farmers also wash weeds for livestock and haul weeds on donkeys to feed to other animals.

Farmers pay close attention to which plants animals eat. People distinguish between the plants eaten by sheep, cattle, burros etc. They also distinguish between plants that are removed from fields as fodder, and between plants that are only eaten when they grow in pasture or fallow land.

Farmers said that many species are used as fodder only on fallow lands: in cropland the same weeds are simply hoed up and left to rot (**ismupun**). Brassica that is hand pulled from cereals is fed to livestock, and *garrotilla* is tolerated in some fields and harvested and even stored as fodder (see Anderson *et al*. 2001:20), but most weeds in farmers' fields are weeded out and not used as fodder (see Annex A for a description by each species of weed). When we pressed farmers to explain the uses of weeds, they replied that any crop is much more valuable than the weeds in it, and that few farmers allow a field to get weedy in order to harvest the weeds.

Food. Amaranth and *Chenopodium album* may be eaten as greens a few times a year. Some people use a few other plants as spices or in sauces, but weeds are not a major, staple part of the diet in Cochabamba.

Construction material. Farmers use **sunch'u** (*Viguiera lanceolata*) for building **pirwas**[7]. Viguiera grows tall and woody, especially on field edges. Farmers harvest some of the dried, hollow stalks and tie them together to make the **pirwas**.

[7] Basket-like granaries, about a meter tall and about a meter across. Used mainly for maize.

Toys. Several times, the farmers smiled as they talked about their childhood, when they made flutes from **kina kina**, or played carnival with streamers of *pajarillo*. Campesino children often go to the fields with their parents, and play there while the adults work. Campesino children have few store-bought toys. People who play with weeds as children grow up to know them in a more intimate, immediate way than people exposed to plants through formal education.

Medicine

Disclaimer: Do Not Eat or Drink Weed Concoctions

We include this discussion of ethno-pharmacy only for research purposes. The reader should not interpret the following text, nor the uses listed in Annex A as an endorsement to try them. Some wild plants can be quite toxic, and toxicity varies by dosage, place of origin of the plant etc. Many of the diseases that campesinos treat with weeds are folk diseases, without exact counterparts in modern medicine. Do not casually try weeds as pharmaceuticals.

Cochabamba's folk pharmacology may have once been fairly extensive, but it is being eroded. For some species, farmers recall that such-and-such a weed once had a medical use, but they no longer know what it was. When campesinos discuss forage, they are unequivocal. They speak with clear intellectual authority about which species are palatable, which species eat it and which part of the plant they will eat and when. It is often the first thing farmers mention about a plant. This is not the case with knowledge about medicinal plants. People hesitate to respond. They hedge their statements by admitting that the knowledge is hearsay and that they have not really tried the remedy themselves. In a few cases, people described a first-hand account with a medicinal plant.

Local Knowledge

Habitat. Most communities distinguish 2 kinds of land "up and down" (*arriba y abajo*; **patapi urapi**). Farmers frequently describe where a plant grows in these terms. Farmers also know if a plant is more common in fields or field edges or pastures, and can describe for example, that an **uqa uqa** plant grows better in a ploughed field than in fallow. In other words, local people are quite aware of the habitat of each species.

Deep knowledge. The farmers know much about certain topics, like architecture of the plant, habitat, life cycle. E.g. farmers in Ayopaya gave us a detailed description of there is more *Paspalum repens* in oca than in potatoes because birds eat the seeds of the weed when it grows in potatoes, then defecate the seed in the same fields, which are planted in oca the following year. Farmers are a bit less familiar with the species growing in the hard soil on the field edges. Still, farmers have a name and know uses for most of these species. This study only (or mostly) discusses weeds: annual plants that grow in cultivated fields. Besides the weeds, there are species in field edges, in pastures, along roadsides, along rivers, in fallow land and wild lands. These make up a huge ethno-flora, which is beyond the scope of this paper.

Manure. Many species arrived in Piusilla (Ayopaya) with manure from the Valley of Cochabamba. The people are fully aware that they are planting weeds with manure. But farmers are not very concerned about them.

A resilient system**.** Weeds in Cochabamba are part of a resilient farming system that has withstood many shocks. Some weeds, old ones, seem to have disappeared, or lost population, perhaps out of competition with other, new weeds (see Annex A: **ch'iñi**

ch'iwa and *Spergula arvensis*). Many of the major plants in the system have only been there for a few years. *Rumex acetosella*, *Pennisetum clandestinum* and *Spergula arvesnsis* are not only some of the most damaging weeds, but some of the newest (and *Cynodon dactylon* is now arriving). Yet people are coping with these aggressive new weeds. The Cochabamba weed system is dynamic, but control is fairly thorough, because farmers invest much hand labour in it, but especially because of the deep knowledge campesinos have of weeds, which allows them to adjust rapidly and successfully to change.

Discussion and Conclusion

Discussion

Farmers use many weed species for forage. Of the 72 weed species we discussed with farmers, 55 (76%) are used for fodder. But most of these fodder weeds are only eaten by livestock while being pastured in fallowed fields. Farmers fewer species (at least 10) to carry home to animals.

But even so they are still weeds. Even weeds that are good fodder are still regarded by farmers as noxious when the weed is in a cultivated field. It vexes the farmer (***rabiachin***) and has to be controlled.

Cochabamba farmers use a lot of hand labour to control weeds. For potatoes, farmers typically plough, hill up twice (cutting weeds by hand before they do so, to make it easier for the ox team to move through the field). Each crop has a different weeding strategy, but in general crops are intensely weeded.

Concepts of control. Farmers have clear, logical, emic concepts for weed control. For instance, farmers say that the weeds that are controlled by the normal labours (ploughing, hoeing and cultivation) "come out with the weeding" (*salen en la carpida*, **qhurana lluqsin**).

Serious weeds. Farmers think of weeds that do not "come out with the weeding" as serious problems, in part because people have to do special tasks to kill them. For example, *nabo* in grains must be pulled out by hand.

Hilling-up is not just for weed control. Farmers carry out one or usually 2 *aporques* in potatoes and other root crops for several reasons: to regulate soil moisture and to help manage soil-borne diseases. Farmers also explained that hilling up the soil helps the crop tubers to develop properly.

Herbicides would not be useful. Farmers would still need do the *aporque*, even if herbicides controlled the weeds. In fact, even when there are hardly any weeds, as happens sometimes at 4,000 meters above sea level, farmers still hill up the soil around the crop, for the reasons mentioned in the previous paragraph.

Weeding for mice. Weeding is not always what it seems. In one community (Piusilla) farmers described a weeding they called ***masida***: a light weeding with a sickle of climbing weeds in mature maize. The purpose is not weed control *per se*, but to cut the weeds that mice use to climb to the maturing ears, and to feed the weeds to oxen.

Deep knowledge. Farmers have a deep knowledge of weeds, even though many of the most vexing species are recent introductions. In other words, it is a cliché to say that local knowledge has been handed down from the ancestors. Certainly much of it has, but not all of it. Even when a community has only a few decades of experience with a weed, they know a great deal about it. This is because farmers' own observations, during their own lifetimes, allow them to understand much about organisms like weeds, which are easy to observe with the naked eye, and because the weeds are an important part of local culture, so farmers take the time to observe them and think about them (Bentley & González 2001).

Conclusions

As a result of this ethnobotanical study, weed researchers realised that farming in Cochabamba demanded weed control based on cropping system, e.g. rotation or fallow species. Existing weed control was thorough and was done with hand tools and animal-drawn implements. It fulfilled many functions that could not be provided by herbicides. There were various uses of weeds, e.g. fodder, especially at the critical ploughing time, especially in communities with little land. In spite of the uses of weeds, farmers still complained that some species were difficult to control.

In response, weed scientists designed and planted trials (in farmers' fields) of improved rotation crops. Scientists suggested trials of wheat intercropped with vetch, to improve weed control in the cereals (Espinoza, Webb & Sims 2000).

Because of the importance of cultural weed control, weed scientists worked with mechanical engineers to design animal-drawn machinery to control weeds and save labour.

Demand-led research. The study of ethnobotany allows researchers to inventory farmer knowledge of weeds and local control strategies. This can be used to inform weed researchers about the demands of the community, accounting for the complexity of human ecology. Simply asking farmers to list their demands are unlikely to yield similar results.

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