

LegumeCHOICE – a participatory tool to fit multi-purpose legumes to appropriate niches in mixed crop-livestock farming systems

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A few values were also found in the Ecocrop database of the Food and Agriculture Organization: <http://ecocrop.fao.org/ecocrop/srv/en/home>

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Introduction

Plants belonging to the family Fabaceae (or Leguminosae) are characterized by their ability to form a symbiotic relationship with soil bacteria called rhizobia contained within root nodules which fix atmospheric nitrogen which can be used by the host plant (although not all legumes fix nitrogen). This nitrogen-fixing ability presents considerable benefits to plants growing in nitrogen-constrained environments and lends them various functions of potential benefit to humans who utilize them for various livelihood purposes.

Legumes as a plant family are diverse in structure ranging from herbaceous plants through to woody shrubs and trees. This diversity of form and function presents multiple opportunities for beneficial human use but also complexity in terms of how different legume species fit within different farming systems.

The science community, recognizing the potential benefits of increasing legume use in smallholder farming systems in Africa have been enthusiastic in their promotion of legumes among farmers but the reality on the ground is that legume uptake is much lower than expected. The reasons for this lack of legume uptake have been eloquently reviewed before (Sumberg 2002) and mainly relate to an inadequate understanding among legume promoters of the livelihood realities of the African smallholder farmer.

It is with this in mind that the LegumeCHOICE decision support approach is being developed. LegumeCHOICE offers a systematic framework for categorizing legume species, defining how they fulfil different livelihood functions and then matching appropriate legume types to widely varying farming contexts. The following narrative expands on a series of Concepts and Definitions before describing the logical flow of LegumeCHOICE activities that need to be applied to come up with promising legume options in a particular context.

Concepts and definitions

LegumeCHOICE is a participatory approach to making informed decisions, with farmers, about which legume types and species would be most appropriate to meet their livelihood needs. The simple concept underlying the tool is that different legume types fulfil different functions within farms and that by matching legume types with the functions demanded by farmers a sensible set of legume options can be tested and refined at farm level.

Legume types

Legume types can be classified as shown in Table 1

Table 1 – a simple classification of legume types

Type	Sub-type	Examples
Grain legume	Seasonal	Common bean (<i>Phaseolus vulgaris</i>) Faba bean (<i>Vicia faba</i>) Soybean (<i>Glycine max</i>)
	Perennial	Pigeon pea (<i>Cajanus cajan</i>)
Herbaceous legume	Seasonal/no-regrowth (harvest after one season, then need reseeded)	Velvet bean (<i>Mucuna pruriens</i>)
	Perennial/regrowth (ability to regrowth after seasonal harvesting)	Desmodium intortum
Tree legumes	Not-coppicing after repeated cuts	Albizia
	Coppicing after repeated cuts	Sesbania sesban Tephrosia (<i>Tephrosia vogelii</i>) Gliricidia Leucaena leucocephala Calliandra (<i>Calliandra calothyrsus</i>)

Legume functions

A series of functions of legumes can be described. These can be further characterized as seven primary functions and a series of secondary functions and services as laid out in Table 2.

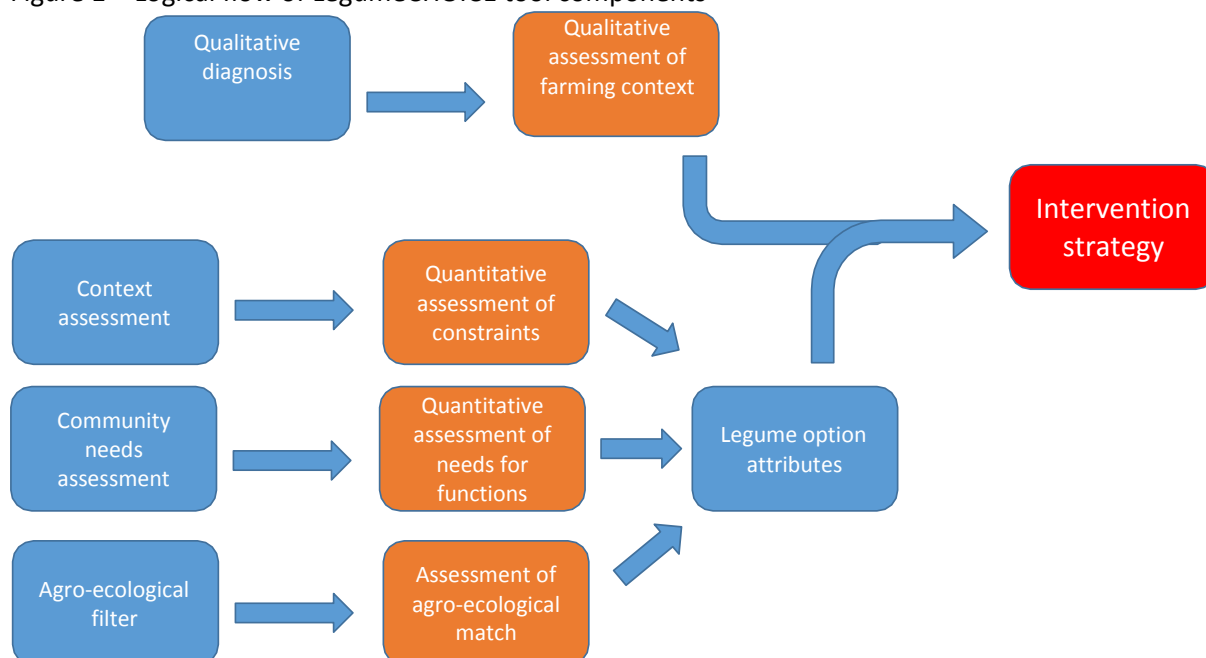
Table 2 – Functions of legumes

Functions	Primary function	Secondary function	Services
Food	X		
Livestock feed	X		
Income	X		
Erosion control	X		
Soil fertility	X		
Fuel	X		
Staking (e.g. for beans)		X	
Moisture retention		X	
Shading		X	
Beekeeping		X	
Fence/field boundaries		X	
Poles (e.g. construction)		X	
Biological control (push-pull)		X	
Pest and weed control (break crops)		X	
Wind breaking		X	
Medicinal properties		X	
Carbon sequestration			X
Biodiversity			X
Improved N cycling			X

Logical flow of LegumeCHOICE

LegumeCHOICE is an approach for understanding the needs of local communities for the various functions offered by multi-purpose legumes and then using an inventory of legume options to find those that supply the required functions. It consists of a series of components as shown in Figure 1.

Figure 1 – Logical flow of LegumeCHOICE tool components



The tool is thus composed of five key components:

1. Qualitative diagnosis
2. Context assessment
3. Community needs assessment
4. Agro-ecological filter
5. Legume option attributes

The logic of the tools is as follows.

The Qualitative Diagnosis is a simple checklist of questions designed to construct a broad overview of the farming context focusing in particular on those elements of relevance to legume use.

The Context Assessment goes deeper by specifically considering a series of key constraints to legume use and assigning a score to each key constraint for the particular context or community being studied.

The third component, the Community Needs Assessment involves a series of participatory exercises with a community to gather an understanding of their needs in relation to what legumes might offer. Each of a series of “legume functions” is given a score representing the extent to which a particular community demands a given function.

The fourth component is an agro-ecological filter that scores legume options according to their suitability to the agro-ecological conditions (altitude, rainfall, soil quality etc) of the target site.

The final component is a long list of legume options each pre-scored by experts on (1) their sensitivity to the various legume use constraints (from the Context Assessment) (2) how well they supply various pre-defined legume functions (from the Community Needs Assessment) and (3) their agro-ecological requirements.

The scores in legume option list are compared against (1), (2) and (3) to give an overall score for each legume option on their suitability for the given context in relation to use constraints, legume function supply and agro-ecological match.

The main output from LegumeCHOICE is a brief report describing the overall farming context, presenting scored constraints, scored functions and a short list of promising legume options for the target community which takes into account both constraints and opportunities.

In the following sections the methodology for application of the various LegumeCHOICE components is outlined.

Applying LegumeCHOICE

LegumeCHOICE is designed to be a rapid approach to identifying promising legume interventions based on community dialogue and expert knowledge. The following are the suggested steps and timelines for application of the approach

Preparation meeting (2 hrs): This should be arranged several days before application of the tool itself. The purpose is to introduce the approach to village elders and local officials as well as developing a list of farmers who will be involved in subsequent discussions. Dates for the community discussions should also be agreed.

Conduct small expert meeting with local officials (district experts, extension agents, community leaders, farmer representatives). Aim is to establish 3 distinguishable types of farmers – this is a fairly rough and ready method of typing farmers but is good enough for the present purpose.

- Set thresholds to distinguish 3 typologies
 - o Land area
 - o Livestock holding (especially oxen)
 - o (Fertilizer use)
 - o (Proportion of produce sold to market)
- For example high resource farmers could be those with >2 ha, 4 oxen or more and generally apply fertilizer at recommended rates
- Ask experts to identify 18 farmers falling into different types using above criteria
 - o 6 high resource farmers (aim for equal numbers of men and women)
 - o 6 medium resource farmers (aim for equal numbers of men and women)
 - o 6 low resource farmers (aim for equal numbers of men and women)

Day 1 – Introduction of the tool, Qualitative Diagnosis (Annex 1) and Context Assessment (Annex 2)

This should take a bit more than half a day and will allow farmers to return to other tasks later.

Once farmers have gathered the lead facilitator should introduce the LegumeCHOICE exercise, explain its purpose and introduce the facilitation team. Farmers should then be given an opportunity to introduce themselves (0.5 hr)

Then, facilitators should split the group into male and female groups each with a facilitator and note-taker. The Qualitative Diagnosis (Annex 1) should be conducted separately with each group (2 hr).

The group could then gather for lunch (1 hr)

After lunch farmers should be divided by typologies (3 groups). The Context Assessment (Annex 2) should be conducted separately for each typology group. There should be one facilitator per typology group who can also act as note-taker for this exercise (1.5 hr).

Day 2 – Community Needs Assessment (Annex 3) and wrap up

Farmers reconvene in the morning and a brief welcome and recap of Day 1 should start the day. Farmers are then split into male and female groups once more for two 1 hr exercises: Vision Mapping (Annex 3A) and Pairwise Ranking (Annex 3B). Each group should have a facilitator and note taker (2hrs)

The group could then gather for lunch (1 hr)

The final exercise is Participatory Matrix Scoring (Annex 3C) which should be conducted with the whole group of 18 farmers (2 hrs)

Once complete, farmers should be thanked and invited to a final reflection meeting some time in the future.

Data analysis and report and presentation preparation

Following collection of data using the LegumeCHOICE tool the data should be processed and form the basis for a. a presentation to feed back to farmers and b. a LegumeCHOICE report (Annex 5).

Findings of the Qualitative Diagnosis should be summarized as a narrative (or bullet points for presentation) noting any key differences in perspectives of men and women.

Follow up meeting (0.5 day): Presentation of results and discussion on intervention options

Once data has been processed the results should be presented back to farmers in the form of a powerpoint or flip charts. The top ranked legume options should be presented along with a justification for their choice based on the results of the LegumeCHOICE exercise. The ideas should be discussed, refined, validated with farmers to agree the outline of an action plan.

References

Sumberg, J. 2002. The logic of fodder legumes in Africa. *Food Policy* 27: 285-300.
[http://dx.doi.org/10.1016/S0306-9192\(02\)00019-2](http://dx.doi.org/10.1016/S0306-9192(02)00019-2)

Annex 1: Qualitative diagnosis methodology (focus group discussion)

This component provides a qualitative assessment of the farming system in relation to possible legume niches

Aims:

- To brainstorm and identify constraints for legume intensification, i.e. increased productivity and area of existing legume species
- To scope for niches for 'new' usage of legumes and introduction/adoption of 'new' legume types (species/varieties, for new uses; fodder, fuels, etc.)

Process:

The focus group discussion (FGD) is conducted separately for men and women and will last for around 2 hours. Use flip charts, stickers or cards for individual contributions. Document the meeting and think about using a translator (where needed). For each FGD one facilitator and one rapporteur/documenter is needed.

In selecting participants aim to have balanced participation between farm typologies.

Question Guide

What do we mean by "legume"? If possible, good to have one or two legume experts involved in facilitation (grain, herbaceous, tree)

- What do you understand by "legume"?
- What plants do you know that produce seed in pods?
- Facilitator to give a few local examples of different types of legumes: grain legumes, herbaceous legumes, tree legumes. Facilitator to prepare a few pictures in advance of FGD illustrating different types
- Ask focus group to list other examples in each category
- How do these plants affect soil fertility, yield of the following crop?
- How do plants do this?
- Facilitator to explain in simple terms the biology of nitrogen fixation – plants take fertilizer from the air – they supply themselves with fertilizer.

What benefits do legumes bring?

- What benefits to legumes bring? Why do you grow legumes? Facilitator to lead open discussion but to guide the conversation to include the following aspects (functions of legumes – the purpose of the discussion is to help introduce the concept of legume functions so that the scoring exercises that follow become easier)
- Unique benefits

- Food value?
- Fodder for livestock?
- Improved soil fertility?
- Other benefits
 - Income (from crops directly or from livestock fed on legumes)
 - Control of erosion (especially trees)
 - Quick growing trees for fuel

Legumes/legume systems and their use

- What legumes do you grow? Go around the group and list on flipchart. Add frequency when several people are growing the same thing.
- The facilitator can ask for specific species that he/she has seen during his/her field visits in the villages since people might not always know which plants/trees are legumes.
- Now group the legumes into legume types (done by facilitator but asking participants if they agree) using the following table. Use the six pre-defined legume types.

Type	Sub-type	Local examples
Grain legume	Seasonal	
	Perennial	
Herbaceous legume	Seasonal/no-regrowth (harvest after one season, then need reseeded)	
	Perennial/regrowth (ability to regrowth after seasonal harvesting)	
Tree legumes	Not-coppicing after repeated cuts	
	Coppicing after repeated cuts	

- What are the legumes being identified used for? Make a list on flipcharts and score them according to the most frequent uses.
- What are the main challenges with growing and managing legumes listed?

Legume productivity, what are the limiting factors?

What limits legume productivity in general and for different legume types? List the four main constraints to legume productivity in ranked order e.g. fungal diseases, other pests, hail damage/weather, lack of improved seeds, management issues, lack of or too little weeding, inappropriate fertilizers, “tired soils” due to continuous cropping (e.g. soil borne diseases, nematodes, soil fertility e.g. lack of P)

Area used for legume production – what are the limiting factors?

What stops you from expanding the area allocated to legume production? List the four main constraints to legume expansion in ranked order e.g. lack of land, lack of inputs, lack of labour, lack of market etc

Niches and opportunities

- Brainstorm and discuss existing and potential new niches for legumes on the farm (or outside the farm) and in the cropping year. Niches can be spatial or seasonal (e.g. intercropping, relay cropping, use of field margins, using existing stakes to grow climbers).
- Do you see any new uses for legumes on farm (e.g. fodder, fuel, nutrition)?
- Do you see any opportunities/niches for the market? For domestic and export market?
- If you were given the chance try some innovation related to legumes, what would it be? Ask this question in brainstorming mode: participants write individual suggestions on stickers/small papers and bring to the flip chart. List suggestions and discuss in the group and score your 3-top options using a vote or using beans as counters – each participant gets 10 beans and distributes among options.

Annex 2: Context assessment methodology

Method to assess context focusing on scoring a set of key context attributes

The purpose of the exercise is to come up with a series of scores from zero to four that indicate the strength of a series of generic constraints to legume production. The exercise is carried out with a group – the questions are asked and on the basis of the responses, the group is asked to come up with a score for each constraint. The facilitator also assigns a score based on his assessment. This exercise is conducted separately with the 3 typology groups and the average for each attribute is the rounded average of all 6 scores (3 typologies x 2 score types per attribute)

See Annex 5 for data collection sheet.

Annex 3: Community needs assessment methodology

Method to assess community needs for different legume functions

Steps

A. Vision mapping

Ask questions along following lines:

- What are your current livelihood strategies and how do you want that to change in the future?
 - What are main sources of income now (crops, livestock, business, pension etc)
 - How would you like that to change in 5 years' time?
- Which of the following is most appealing for the future?
 - Commercialization of existing operations – market orientation/intensification
 - Increased off farm employment/leaving agriculture
 - Diversification of existing farm operations
 - Expanding area

B. Pairwise ranking

- Instructions: this exercise is carried out as a group. The method for this exercise involves presenting all possible pairs of functions to participants and asking them to vote on which is more important. The exercise is conducted separately for men and women. The following pairwise ranking table is used (printable copy in Annex 6 B).

Pair	Function considered more important
food vs. feed	
food vs. soil fertility	
food vs. income	
food vs. erosion control	
food vs. fuel	
feed vs. soil fertility	
feed vs. income	
feed vs. erosion control	
feed vs. fuel	
soil fertility vs. income	
soil fertility vs. erosion control	
soil fertility vs. fuel	
income vs. erosion control	
income vs. fuel	
erosion control vs. fuel	

C. Participatory matrix scoring

- Instructions: Purpose of the exercise is to assess what individual farmers of different gender and typology would look for in any new intervention involving legumes. This is a separate approach to establishing/validating community aspirations on legume functions. This helps to triangulate the results of the previous exercise. Farmers are given 20 beans/seeds and asked to allocate them according to the importance of the various functions for their future aspirations. Farmers fill the pre-prepared score sheet (printable copy in Annex 6) individually and facilitator photographs each sheet or records the data in pre-prepared data sheet. The data from this exercise produces an overall community score for each legume function but also allows variation according to type and gender to be assessed. Facilitator can consider entering the data in real time and producing a graph displaying relative importance of different functions.

Annex 4: Structure for LegumeCHOICE report

1. Introduction
2. Farmer selection process and farmer list by typology
3. Qualitative Diagnosis results and reflections
4. Context assessment results and reflections
5. Vision Mapping results
6. Community needs assessment results
7. Legume Options Results
8. Preliminary ideas for top 3 legume interventions with justification drawing from LegumeCHOICE results

Annex 5: data sheets

A. Context Assessment data sheet (print 3 copies)

Community name:	Typology (circle one) low medium high				Date:
Attributes and questions	Responses				Attribute score
1. Land					
a. What proportion (%) of land is used for subsistence (staple cereals)? <i>Please tick</i>	1-25% <input type="checkbox"/>	26-50% <input type="checkbox"/>	51-75% <input type="checkbox"/>	76-100 % <input type="checkbox"/>	How scarce is land?
b. How much for cash crops? <i>Please tick</i>	1-25% <input type="checkbox"/>	26-50% <input type="checkbox"/>	51-75% <input type="checkbox"/>	76-100 % <input type="checkbox"/>	Farmers' score <input type="text"/>
c. What proportion of land is put to fallow? <i>Please tick</i>	1-25% <input type="checkbox"/>	26-50% <input type="checkbox"/>	51-75% <input type="checkbox"/>	76-100 % <input type="checkbox"/>	Expert's score <input type="text"/>
d. What proportion of your land is cultivated? <i>Please tick</i>	1-25% <input type="checkbox"/>	26-50% <input type="checkbox"/>	51-75% <input type="checkbox"/>	76-100 % <input type="checkbox"/>	
2. Labour					
How easy is it to hire casual labour as and when required? <i>Please tick</i>	a. Easy <input type="checkbox"/> b. Usually possible <input type="checkbox"/> c. Very difficult <input type="checkbox"/>				How scarce is labour?
Are labour costs affordable? <i>Please tick</i>	a. Easily affordable <input type="checkbox"/> b. Moderately affordable <input type="checkbox"/> c. Extremely expensive <input type="checkbox"/>				Farmers' score <input type="text"/>
What is the peak cost for labour?	Local currency <input type="text"/>		Amount <input type="text"/>		
What is the cost to lease a hectare of land?	Local currency <input type="text"/>		Amount <input type="text"/>		Expert's score <input type="text"/>
What is the ratio? (<i>Labour cost: cost of leasing land</i>)	<input type="text"/>				
3. Seed supply					
Are there private seed suppliers in the local market? y/n					How difficult to access seed?
Does the extension system supply legume seed? y/n					Farmers' score <input type="text"/>
If seed is available, is it affordable? y/n					Expert's score <input type="text"/>
Have you bought legume seed in the last 12 months? y/n					
Do you save seed from last year's harvest and is the seed of good quality? y/n					
4. Material input delivery - e.g. urea, concentrate feeds, plastic sheeting, implements, forage seeds					
How often do you visit the local agro-dealer Is	a. Every week <input type="checkbox"/> b. Around once per month <input type="checkbox"/> c. Once every three months <input type="checkbox"/> d. Never <input type="checkbox"/>				How difficult is it to access inputs?
How often in the last year have you accessed any of the following : concentrate feeds, plastic sheeting, implements, forage seeds	a. Every week <input type="checkbox"/> b. Around once per month <input type="checkbox"/> c. Once every three months <input type="checkbox"/> d. Never <input type="checkbox"/>				Farmers' score <input type="text"/>
					Expert's score <input type="text"/>

5. Knowledge and skills			
How often to you meet with a knowledgeable extension worker	a. Every week <input type="checkbox"/> b. Around once per month <input type="checkbox"/> c. Once every three months <input type="checkbox"/> d. Never <input type="checkbox"/>	Are available knowledge and skills a key constraint? Farmers' score <input type="text"/> Expert's score <input type="text"/>	
What proportion of the PRA group have completed primary schooling?	1-25% <input type="text"/> 26-50% <input type="text"/>	51-75% <input type="text"/> 76-100 % <input type="text"/>	Expert's score <input type="text"/>
What proportion of the PRA group have completed secondary schooling?	1-25% <input type="text"/> 26-50% <input type="text"/>	51-75% <input type="text"/> 76-100 % <input type="text"/>	
6. Water			
Is irrigation available in the area? y/n		Is water for agriculture in short supply?	
What percentage of households have access to irrigation? _____%		Farmers' score <input type="text"/> Expert's score <input type="text"/>	
7. Markets			
How long does it take to reach the local market?	a. <30 minutes <input type="checkbox"/> b. 30 minutes to 1 hour <input type="checkbox"/> c. 1 hour to 2 hours <input type="checkbox"/> d. More than 2 hours <input type="checkbox"/>	Are markets for agricultural products readily accessible?	
How often do you visit the local market?	a. Every day <input type="checkbox"/> b. Once or twice a week <input type="checkbox"/> c. Less than once per week <input type="checkbox"/> d. Once per month or less <input type="checkbox"/>	Farmers' score <input type="text"/> Expert's score <input type="text"/>	

B. Pairwise ranking (print 2 copies)

Community name:	Date:	Gender of group (circle) Male Female
Pair		Problem considered more important
food vs. feed		
food vs. soil fertility		
food vs. income		
food vs. erosion control		
food vs. fuel		
feed vs. soil fertility		
feed vs. income		
feed vs. erosion control		
feed vs. fuel		
soil fertility vs. income		
soil fertility vs. erosion control		
soil fertility vs. fuel		
income vs. erosion control		
income vs. fuel		
erosion control vs. fuel		

C. Participatory Matrix Scoring – farmer data sheet (print at least 20 copies – 1 per farmer)

Farmer name _____ Gender M/F Village/location _____ Date _____

Food	Feed	Soil fertility
Erosion control	Income	Fuel

D. Participatory Matrix Scoring – summary data sheet (print 1 copy)

Community name				Date						
			Functions							
#	Farmer name	Gender	Typology	Food	Feed	Soil Fertility	Income	Erosion control	Fuel	Total (must add to 20)
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
Total Rank										

Annex 6 – Instructions for using the LegumeCHOICE excel data sheet

The LegumeCHOICE spreadsheet has a number of data entry tabs as follows:

- Context scores
- Pairwise ranking
- Participatory matrix scoring
- Agro-ecological filter

The final tab called “Legume option scores” contains a list of 50 legume options each scored for a range of attributes.

To use the spreadsheet each Data Entry Tab must be completed using information from the LegumeCHOICE exercise as follows:

Context scores

Fill the yellow and green columns using data from the Context Assessment data sheet (Annex 5.A). The average scores in the orange cells are automatically transcribed into the Legume Option Scores sheet.

Pairwise ranking

Using data from the Pairwise Ranking exercise (Annex 5.B) fill the green cells using the drop down options for both the men’s and the women’s groups. These data are used to generate the spider graphs on the same tab and are also used to calculate Legume Option Ranks. They are a useful triangulation for the Participatory Matrix Scoring exercise.

Participatory matrix scoring

Using data from the Participatory Matrix Scoring exercise (Annex 5.C) fill the coloured cells for each respondent overwriting the existing data with your own. These data are used to generate the spider graphs on the same tab and are also used to calculate Legume Option Ranks. They are a useful triangulation for the Pairwise Ranking exercise.

Agro-ecological filter

Using your own knowledge of the field site fill the green cells with representative data. These data are used to assess agro-ecological suitability of the field site for different legume options in the Legume Option Scores sheet.

Legume Option Scores

This is where the suitability of a range of different legume options is calculated using data from the data entry tabs and pre-filled attributes of each legume option. Scroll right across the sheets to see the “heat maps” of which legume options score well on each criterion (green is good, red is bad). Also see the global scores for each section plus a list of ranks. The top ranks are highlighted in blue. At the extreme right edge of the spreadsheet is a summary of ranks so you can quickly visualize which legume options do well on various elements of the scoring system.