Agroecosystem Health Cards: a practical tool for sustainable management of grasslands

Iker Mijangos, Isabel Albizu, Mikel Anza, Iker Martin, Sorkunde Mendarte, Lur Epelde and Carlos Garbisu

Department of Ecology and Natural Resources. Neiker, Basque Institute for Research and Agricultural Development, Spain, www.neiker.net

Contact email: imijangos@neiker.net

Keywords: Ecosystem services, biodiversity, biological indicators, grazing, soil quality.

Introduction

The traditional grazing activity carried out for centuries in mountainous areas of the Basque Country (Northern Atlantic Spain) facilitated the presence of different extensive pasture habitats, such as those included in the Gorbeia Natural Park and surrounding valleys (43° 02'N, 2° 49'W). Currently, these pastures are highly valued due to the ecosystem services they provide. In this context, one of the main objectives of the LIFE-SOILMONTANA project (ref. LIFE 10 NAT/ES/579) is to develop a practical tool that allows grassland managers (farmers, scientists and authorities) to auto-evaluate the suitability of alternative agronomic practices in relation to the conservation of these ecosystem services through the conservation of their biodiversity, especially soil biodiversity.

Methods

The Agroecosystem Health Cards (AHC) consist of handbooks that provide straightforward, practical explanations on how to assess the health of grassland ecosystems, through the analysis of a variety of aboveground (plant) and belowground (soil) indicators. Besides, they allow us to know the impact of any perturbance (*e.g.* agricultural practices) on these agro-ecosystems health.

To these aims, AHC specify what indicators of agro-ecosystem health can be measured, how to do so properly, what each indicator means, and include reference values considered as "good", "average" and "bad" for both mountainous and valley grasslands. These parameters or indicators were separated into two different categories, "basic" and "advanced", which lead respectively to a basic or an advanced health diagnose, depending on the interests or possibilities of each user (land managers, scientists, farmers, public in general).

Results

Figure 1 shows the list of "basic" indicators that can be measured (both aboveground and belowground) and interpreted without any previous or special training or qualification, simply by reading the handbook and using easy homemade instruments. It allows non-experts to diagnose and monitor the health of their grasslands.

25.

BASIC Health Diagnosis

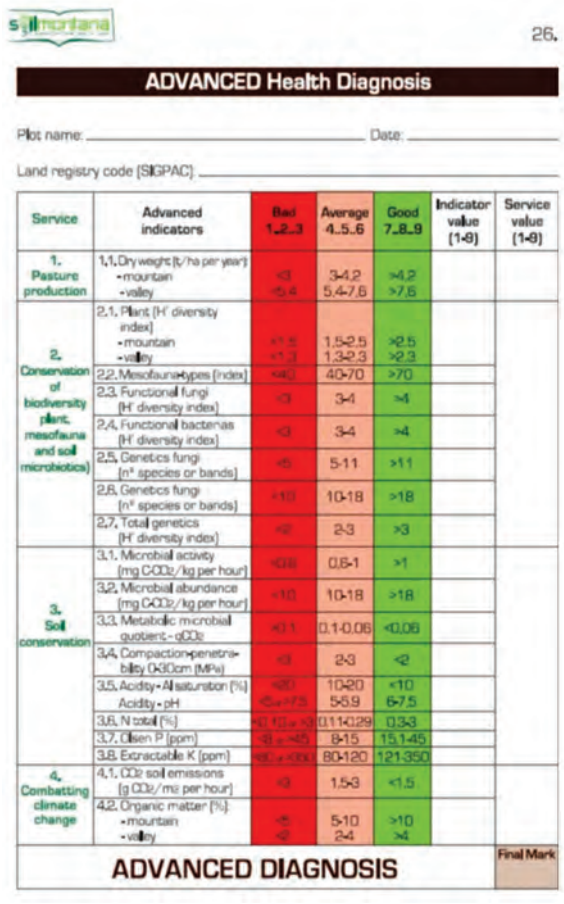
Plot name: _____ Date: _____

Land registry code (SIGPAC): _____

Service	Basic indicators	Bad 1_2_3	Average 4_5_6	Good 7_8_9	Indicator value (1-9)	Service value (1-9)
1. Pasture production	1.1. Fresh weight (kg/m² per year): - mountain - valley	<0.8 <2	0.8-1.1 2-2.8	>1.1 >2.8		
	1.2. Animal rejection (%)	>25	5-25	<5		
2. Conservation of biodiversity (plant and animal)	2.1. Plant species (nº) - mountain - valley	<15 <15	16-30 16-25	>30 >25		
	2.2. Plant strata (nº)	1	2	3		
	2.3. Types of macrofauna (nº)	<3	3-6	>6		
	2.4. Invasive species (animal/plant) (nº)	>1	1	0		
3. Soil conservation	3.1. Worms (nº/m²)	<16	17-64	>65		
	3.2. Compaction-penetrability (cm)	<3	3-15	>15		
	3.2'. Compaction-root depth (cm)	<15	15-30	>30		
	3.3. Erosion risk (% bare soil)	>15	5-15	<5		
	3.4. Infiltration capacity (min)	<30	10-30	<10		
	3.5. Plant colour	pale	patchy	dark		
4. Combatting climate change	4.1. Root abundance	low	average	high		
	4.2. Soil colour	light	average	dark		
BASIC DIAGNOSIS						Final Mark

Figure 1. The Agroecosystem Health Card for basic diagnosis of the grassland.

Figure 2 shows the list of "advanced" indicators, which require more sophisticated equipment and previous training and qualification. NEIKER (www.neiker.net contact: imijangos@neiker.net) has the infrastructure and expertise to determine and interpret these "advanced" indicators, in order to achieve a more comprehensive assessment of agroecosystem health.



26.

ADVANCED Health Diagnosis

Plot name: _____ Date: _____

Land registry code (SIGPAC): _____

Service	Advanced indicators	Bad 1_2_3	Average 4_5_6	Good 7_8_9	Indicator value (1-9)	Service value (1-9)
1. Pasture production	1.1. Dry weight (t/ha per year) - mountain - valley	<3 <5.4	3-4.2 5.4-7.6	>4.2 >7.6		
2. Conservation of biodiversity plant, mesofauna and soil microbiotics)	2.1. Plant (H' diversity index) - mountain - valley	<1.5 <1.3	1.5-2.5 1.3-2.3	>2.5 >2.3		
	2.2. Mesofauna-types (Index)	<40	40-70	>70		
	2.3. Functional fungi (H' diversity index)	<3	3-4	>4		
	2.4. Functional bacterias (H' diversity index)	<3	3-4	>4		
	2.5. Genetics fungi (n° species or bands)	<5	5-11	>11		
	2.6. Genetics fungi (n° species or bands)	<10	10-18	>18		
	2.7. Total genetics (H' diversity index)	<2	2-3	>3		
3. Soil conservation	3.1. Microbial activity (mg CO2/kg per hour)	<0.6	0.6-1	>1		
	3.2. Microbial abundance (mg CO2/kg per hour)	<10	10-18	>18		
	3.3. Metabolic microbial quotient - qCO2	>0.1	0.1-0.06	<0.06		
	3.4. Compaction-penetrability 0-30cm (MPa)	<1	2-3	<2		
	3.5. Acidity - Al saturation (%) Acidity - pH	<20 <5 or >7.5	10-20 5-5.9	<10 6-7.5		
	3.6. N total (%)	<0.1 or >3	0.11-0.29	0.3-3		
	3.7. Olsen P (ppm)	<8 or >45	8-15	15.1-45		
	3.8. Extractable K (ppm)	<80 or >300	80-120	121-350		
4. Combatting climate change	4.1. CO2 soil emissions (g CO2/m2 per hour)	>3	1.5-3	<1.5		
	4.2. Organic matter (%) - mountain - valley	<5 <2	5-10 2-4	>10 >4		
ADVANCED DIAGNOSIS						Final Mark

Figure 2. The Agroecosystem Health Card for advanced diagnosis of the grassland.

These AHC are being used to evaluate the impact on agroecosystem health of different agronomic practices usually carried out in Gorbeia Natural Park and surrounding grasslands, and are serving to sensitize-promote practices that conserve both socioeconomic (crop productivity) and environmental (soil and biodiversity conservation, global change mitigation) ecosystem services. The full AHC handbook (methodologies for each analysis, *etc*) can be downloaded free of charge from the website of the project (www.soilmontana.com), where early results and advances of the project are also shown.