The Perception of Soil Quality of the Southeast Pampa of Argentina and Social Attitudes

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Abstract

It is essential to know how producers perceive soil quality, what indicators must be evaluated, and what similarities and differences exist between the producer and expert regard. There are multiple forms of knowledge, values, and practices in communities that could be recovered for incorporation into the design of soil management programs. The objectives of this work were to implement a pilot testing of a perception survey of soil quality with a test developed by the University of Wisconsin to determine the fit between the existing soil quality indicators -physical, chemical, biological- and the interpretation of producers, in Southeast Pampa Argentina (Azul, Balcarce and Tandil), and to know and understand the socio-economic indicators involved in the quality of the soil from the perspective of the group interaction of those same producers. The questionnaire is a tool of great application value to alert the farmers about soil health. Reformulation related to better comprehension of the questions and adequacy of the answers is necessary in some cases, and other issues could be incorporated to increase the obtained information. The value of producer as social actor, taking into account socio-economic aspects, showed that perception of soil quality introduces the cultural, social and personal context of the farmers. Producers perceive problems in a different way than experts, but are able to identify problems and solutions according to their expertise.

Key words: farmers' perception, soil quality, soil health scorecard

1. Introduction

During the '90s, the consolidation of a productivist agricultural development model in Argentina focused on the profitability of the foreign market, began to replace a highly diversified culture with large-scale monocultures and highly specialized goods, with application of new technological and scientific systems. Within the issue of natural resources, the discussion about the constant and permanent degradation in agricultural areas has become more remarkable with the increase of livestock traditionally surface being transformed into agricultural. Maintaining or improving soil quality is essential to sustain agricultural productivity and soil health.

The European Union proposed a definition, stating that soil quality is an account of the soil's ability to provide ecosystem and social services through its capacities to perform its functions under changing conditions (Toth *et al*, 1997).

The construction of an environmental rationality involves the formation of new knowledge and interdisciplinary knowledge integration (Leff, 1998). Capra (1998) states that the new view of reality is based on the understanding of the relationships and interactions and essential dependencies of all phenomena: physical, biological, psychological, social and cultural perspective that exceeds current disciplinary and conceptual boundaries.
A point of view to study the soil only from the perspective of the hard sciences, involves a biased, fragmented, and simplified examination of the reality. The anthropic environment demonstrates the value of social actor theory (Giménez Montiel, 2010).

In Nepal, Desbiez *et al* (2004) found that farmers' perceptions of soil fertility were more 'holistic' than those of researchers, as they included factors they felt influenced the soils and crop growth in their fields. The term 'field fitness' was proposed as it conveys farmers' perceptions more accurately than 'soil fertility' alone.

It is essential to know how producers perceive soil quality, what indicators must be evaluated, and what similarities and differences exist between the producer and expert regard. There are multiple forms of knowledge, values, and practices in communities that could be recovered for incorporation into the design of soil management programs. In this framework, it is possible to study the relationship between the mental representation of soil quality for different social actors, and how perceptions are linked to behaviors adopted for soil management.
García Álvarez (2006) stated that cognitive perception of a system is working properly when the symbols appropriately represent an aspect of the real world, and processing of information leads to a successful solution of the problems. Thus, perception studies represent an area of theoretical interest for cognitive modes of relationship between technology adoption and social representations (Campos & Santarelli, 2005), that could be applied to soil quality and applied management.

According to Bourdieu (1984) all social practice is the result of the dialectical relationship between the two states of the social: the external objective structures and internalized objective structures, which are based on the fact that social reality has an objective existence and simultaneously is an object of perception. The purpose of the application of soil health score card was to obtain a comprehensive view of the soil ecosystem, agricultural production, animal and human health and environmental production from the perception of farmers about soil system. Producers are closely linked to the resource and perceive the system as a unit, so their vision is very important for the experts.

In this way, the objectives of this work were to test a perception survey of soil quality (based on Wisconsin soil health score card Romig *et al*, 1994), to characterize socio-economic aspects of social actors, and determine the fit between the existing soil quality indicators and the interpretation of surveyed producers in Southeast Pampa Argentina (Azul, Balcarce and Tandil).

2. Methodology

2.1. CSR: socioeconomic quick characterization

Ceballos (2007) presented the CSR: socioeconomic quick characterization. The purpose is to apply this to obtain information about the surveyed producers: age, education and scientific-technological information, values, attitudes and skills, years of employment in the agrarian occupation, legal form of land tenure- and their farms – length of the surfaces and range of surfaces, production strategies, and production orientations.

It is useful to know and understand the socio-economic indicators that interact with the assessment of soil quality from the perspective of group interaction of the producers, so a socioeconomic quick characterization was applied.

2.2. The survey

On the basis of University of Wisconsin questionnaire (Romig *et al*, 1994), partially modified, production information and relevant indicators of soil quality were collected from 76 producers and analyzed. It assesses a soil's health as a function of soil, plant, animal and water properties identified by farmers. The scorecard is a field tool to monitor and improve soil health based on field experience and a working knowledge of a soil. Indicators of soil quality survey were: presence / action of earthworms, soil erosion, ease of tillage, structure, color, wet, compaction, infiltration, drainage, water retention, decomposition of organic remains, fertility, tactile sensation, surface crust, surface coverage, hardness, odor, soil texture, aeration, biological activity, soil depth, organic matter content, and pH, contents of macro / micronutrients, presence of chemicals in water.

Following a suggestion of the pollsters it was added a question about an index of soil quality perceived by the producers.

The casual sample consisted of selecting fifteen producers of each locality, who were interviewed individually.

2.3. The focus group

The focus group technique is a focused discussion, organized for preliminary empirical evidence that is not usually accessible through individual interviews.

Key points were analyzed according to those around which producers have organized their business processes as socio-economic agents of production, in order to meet the guidelines that formed the operational logic related to the professional and business profile, family tradition, personal experience (Morgan & Krueger, 1997). As a technique used by this qualitative research type, the objective was to learn and understand the meanings of the perceptions that the producers gave to soil quality through dialogue, guided by a moderator.

2.4. Soils

From the point of view of geomorphology, Tandil, Azul and Balcarce, belong to the domain edaphic domain -2 (UNDP, 1989). The parent material of these soils is the loess, generally a thin layer resting on rock. In Tandil and Azul soils are shallower than in Balcarce. In Tandil Typic Hapludol predominates, and in Balcarce main soils are Typic Argiudol (shallow) and Lytic Hapludol. Azul is an area with Typic Argiudols (USDA-Soil Taxonomy, 1975).

3. Results and discussion

3.1. Of the 20 selected indicators, more than half are physical, biological and chemical properties, which facilitated the response by verifiable evidence. In a similar work, Tugel *et al.* (2001) reported that when producers faced the possibility of selecting indicators, first, tended to the physical ones, then selected the plants, the biological elements and finally the chemical indicators. The applied questionnaire contains some questions which are formulated in technical terms that result difficult in some cases for the farmers response (e.g., "erosion", "friable", "fragipan", "biological activity") that are outside the scope of understanding of 86% of respondents. Some terms needed clarification: "tactile feel" and "hardness", as they should be observed in dry and wet soil. The questions that aroused the interest of the respondents and that made them think were about "erosion", "plowing", "soil structure", "moist color", "compact", "infiltration", "drain", "water retention", "breakdown", "tactile feel", "surface crust", "hardness", "texture" and "soil depth". In "tillage" responses indicated no problems with tillage but no specific references to no-tillage. "Smell" surprised the farmers, with lack of answers; the response could be oriented to "smell of fresh soil". However, they also disagreed with the response options of "biological activity", "soil fertility", "decomposition", "drainage". The main items that led to an ambiguous response or inaccuracy were "presence of worms", "biological activity".

In "tactile sensation" (consistency), this property needs to be reformulated because in 47 % of cases was confused with "texture". In Balcarce they considered "infiltration" not limiting, but in Tandil and Azul almost all recognized problems. There was consensus among the producers of the three areas in terms of the slow "decomposition of organic waste" which is explained by weather conditions. Landscape forms in the Pampa area may suggest that the risk of "erosion" is low relative to other landscapes but also it can be assumed that no tillage practice maintains cover with vegetable remains. In Tandil concern for erosion was higher than in Balcarce and Azul, related to the slope of the landscape.

The need for "fertilizer use" was marked in Tandil and Azul, but in Balcarce, fertility showed a better score and it is associated with a large phosphorus fertilization tradition. In Balcarce "compaction" was not important, in the other locations there was major concern of producers about its presence. The indicator "soil depth" was considered a key feature in soil quality.

Marenya *et al* (2008) also stated that researchers can benefit from understanding the local knowledge and perceptions of agricultural resource managers, resulting of particular interest to know whether farmers' perceptions of resource conditions and the returns to proposed responses to resource deficiencies diverge from those suggested by scientific measurements. They observed that farmers' perceptions of soil fertility on their plots are largely determined by observed crop yields, and farmers' perceptions on the impacts of fertilizer on yields vary rather closely with estimated returns to fertilizer application.

The index of "soil quality" provided by the producers was 60/100 points for Tandil, 66/100 in Balcarce and 66.5/100 for Azul Differences accompanied the measured differences in physical crop yield. According to these ratings, the producers do not perceive soil quality as a priority issue within the production system. Although they were concerned about their conservation for future generations, the soybean crop was the best productive output.
To summarize, it was detected that the producers marked some flaws in some questionnaire designed in the U.S. The existence of mismatches between the design of the questionnaire and the perception of producers (irrelevance and lack of questions that addressed issues that were of significant agronomic value) was found. Also there is a trend towards simplification of answers and time saving. To increase the information gathered the questionnaire other issues are proposed: soil analysis (including frequency), fertilizer use (type, dose, time, frequency of application), date of incorporation of fertilizer or tillage, use of technology in precision agriculture, technical advice. In this regard, it should be noted that the producer is closer to the perception of phenomena (experiential processes of construction of reality) that the conceptualization of the same, whereas the researcher treats directly with concepts (abstractions, symbols). As new complex forms of knowledge arise, experts are devoted exclusively to his areas of expertise, perhaps moving away from the pragmatic needs of everyday life as they face the development of conceptual mechanisms (Berger & Luckmann, 1997). The appropriate scientific vocabulary for conceptual issues, essential for easy communication among scientists, however, is not accessible for the average producer. Nevertheless the questionnaire is a tool of great application value to alert the farmers about soil health.

3.2. Socio-economic indicators in the perception of soil quality

3.2.1. The farms

Generally, farmers with productive units less than 100 ha, rent the fields, losing control of the management, with tenants that make non sustainable practices as unnecessary tillage and monoculture. The rents are invested in urban lots purchase or non-productive activities. In this scheme is very difficult to reconcile the different requirements that have to do with an economic return, system sustainability and corporate stability in the medium and long term (Romagnoli, 2006). In this study, farms of 200-500 ha were 53% in Azul; farms of 50-200 ha represented 25 % in Tandil and in 29,6% in Balcarce . The most extensive farms (500-1500 ha) stand for 24% in Tandil, 17% en Balcarce and 7% in Azul.

Mixed production system prevailed: the cattle area was 25 % and agriculture 70% (in average: corn 20 %, soybeans 30 %, wheat / soybean 20 %). Average yields for the last three years were: wheat: 38 qq ha^{-1}, maize: 88 qq ha^{-1}, soybean (1^{st}): **early sowed?** 38 qq ha^{-1}, soybean (2^{nd}): 20 qq ha^{-1}.

3.2.2. The farmers

The average age of farmers was 46 years old. The age group of 40-50 years was the most represented, followed by the 30-40 years. They presented an average time of 17 years in productive activity, and resided in cities near farms. Producers who were between 37 and 39 years were those who felt more compromise on preserving soil quality; holding this argument from their own experiences in activity. In contrast, more than 50 years farmers were more attracted to prioritize faster economic benefits of exploitation. The traditional producer, that for at least two generations was dedicated to this activity, integrating family businesses, almost always aims to stay in, and leave to their successors a sustainable production. Most of the farmers owned the land (81% in Tandil, 73% in Balcarce and 67% in Azul), and had more than a production unit.

With reference to educational level, most had complete or incomplete secondary education, and in Balcarce and Tandil almost all the producers had university degrees.

3.2.3. Education and information and the corporate culture

The age group between 37 and 44 were highly educated participants that consult technical publications. Also, were those that gave more importance to be able to have more respect for scientific-technological aspects that define the quality of the soil, rather than appeal to historical experience. It is reflected upon the values, attitudes and skills. The explanations grounded in the cultural value of conserving soil with arguments to usufruct land as part of an investment strategy, are associated with those producers from the educated sector. Medium producers have different attitudes, they didn´t accept immediately no-till, they were more critical and argued to keep crop or livestock rotations to preserve the ground. The focus groups agreed with the importance of innovation, through the attitude of farmers towards change and technological measures that affected favorably the soil situation.

As for the skills, focus groups felt that they were "knowing how to implement the practice of no-till", "the interest is to manage well the land and conservate organic matter", "seek new management alternatives", “implement measure systems for soils, plants, weeds, rainfall, humidity”. They argued that the management of soil quality tended to be more efficient when the full extent of the exploited land was located on the same site or block (greater dispersion less control).

In assessing the quality of soils, producers considered as highly significant the interaction between climate, topography of the fields and the type of soil.

The contributions of producers went beyond the traditional concept of management as an indicator of soil quality, in a modern and inclusive perspective referred to the importance of corporate governance. In this regard, they noted the changes that no-tillage system in the organization of production and labors, use of technology, and interconnection with other links in the agri-food chain, produced more requests for the staff.

In a global economy based on the competitive advantages, the availability of information and automation of production and administrative processes is highlighted.

Furthermore, the required management and inputs demanded new qualified professional outsourced or employed by the same production units.

According to Wirzba (2003), in USA there has been a massive and unprecedented migration of farmers to urban centers, and the farmers have become a statistically irrelevant group. In Argentine Pampa, in productive lands where the study was performed, there is a migration of young professionals with their families to the farms or to nearby cities, that generates local economy reactivation and an increase of educational and cultural centers.

3.3. Soil quality and perception of contingencies

In general, producers are inclined to disregard the inherent risks due to human perception of contingencies, but agreed to decrease the probability of earning less, reducing operating risk shocks of extreme events (Bartholomé *et al*., 2004).

3.4. Soil quality and "sojización"

The tillage system combined with the genetically modified soybean had enabled the reduction of tasks and a considerable decrease in implementation costs. Also, appreciable yields had led to achieve better profit margins, higher than other crops, encouraging the planting of this oilseed, giving it a more important role in rotations. But also participants recognized a significant increase in yield of soybeans as effect of rotation with corn (wheat - soybean and corn - soybean). They raised the need to regulate the mode of crop rotation to have more carbon in the soil and therefore primordial organic matter - element soil nutrient and essential principle of plants.

3.5. Soil quality and agrochemicals

No-tillage as production paradigm is based on the predominance of agrochemicals above agronomic character issues (most linked to the crops), determines the need for the use of these inputs achieve system success. They identified two critical points: obviously, the economic aspects, and the type of land tenure. Producers expressed “the importance of the use of agrochemicals”, however, they marked the negative effects of the system on the environment, primarily on workers handling herbicides, more relevant for them that aspects that affect streams, wildlife, etc.

3.6. The profit

A great weight indicator was the evaluation of profit margin on costs, where the central idea expressed was "every producer thinks in terms of costs and returns“ Thus, to be acceptable to most producers, a new practice that protects soil quality must promise reduced costs or substantial increases in performance. Both the level and safety in agricultural product prices encouraged producers to increase their soybean production. What they wanted was producing a substantial margin between the costs of the various inputs and services and the value of their products in the market. Among producers, the variables defining soil quality were articulated and played subordinate to other aspects involved in making decisions from the business logic.

While participants recognized the importance of soil conservation measures associated with Argentina's economic policy towards the agro, in economic terms, for most producers prevailed detrimental policy such as agricultural retention and high taxes that affected the entire production process and marketing strategies.

4. Conclusions

The questionnaire is a tool of great application value to alert the farmers about soil health and should have a continuous implementation and derivation to other productive zones. Reformulation related to better comprehension of the questions and adequacy of the answers to choose a score is necessary in some cases. Other issues could be incorporated to increase the information gathered by the questionnaire.

Producers perceive problems in a different way than experts. Educational level is high, so they are able to identify problems and solutions according to their expertise.

The value of producer as social actor, taking into account socio-economic aspects showed that perception of soil quality introduces the cultural, social and personal context of the farmers.

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5. References

Bartolomé, M.; Caputo, M. G.; Celis, A.; Herzer, H.; Rodríguez, C. 2004. "El clima y otros factores de riesgo en la pampa argentina". En Realidad Económica. Buenos Aires. Nº 202, pp. 88-107.

Berger, P.; Luckmann, T. 1997. La construcción social de la realidad. Buenos Aires. Amorrortu.

Bertello, F. 2005. "La directa, con nuevos desafíos". Diario La Nación. Buenos Aires. 13 de agosto. [www.lanacion.com.ar/729507]

Bourdieu, P. 1984. *Homo Academicus*. Paris: Les Éditions de Minuit.

Capra, F. 1998. La trama de la vida. Una nueva percepción de los sistemas vivos. Editorial Anagrama. Barcelona. 197 pp.

Campos, M.; Santarelli, S. 2005. La percepción del paisaje y los vínculos con el lugar. Comunicación del Departamento de Geografía. Universidad Nacional del Sur.

Ceballos, M. C. Caracterización socioeconómica rápida del Parque Nacional Juan Bautista Pérez Rancier (Valle Nuevo). 2007. [www.gestiopolis.com/recursos6/Docs/Ger/4-manual-de-conservacion-de-recursos-naturales.htm]

Desbiez, A.; Matthews, R.; Tripathi, B.; Jones Arnaud, JE. 2004. Perceptions and assessment of soil fertility by farmers in the mid-hills of Nepal Agriculture, Ecosystems and Environment 103, 191-206.

García Álvarez, A. 2006. Ciencia o teleología. Los conceptos de calidad, funciones y salud del suelo. [www.argiropolis.com.ar/index.php]

Giménez Montiel, G. 2010. Para una teoría del actor en las ciencias sociales. Problemática de la relación entre estructura y "agency". En Cultura y representaciones sociales. Revista del Instituto de Investigaciones Sociales. V. 1, N° 1. Universidad Autónoma de México. México D.F. [www.journals.unam.mx]

Morgan, D.; Krueger, R. 1997. The Focus Group Kit. USA: Sage Publications Leff, E. 1998. Introducción a la teoría ambiental. Maestría GADU.UNC. Argentina. Pág. 32.

Marenya, P.; Barrett, CB and T. Gulick. 2008. Farmers' perceptions of soil fertility and fertilizer yield response in Kenya. Cornell University. August. [http://aem.cornell.edu/faculty_sites/cbb2/Papers/farmers%20perceptions]

PNUD ARG. 1989. Mapa de Suelos de la Provincia de Buenos Aires. SAGyP-INTA-Proyecto PNUD ARG/85/019.pag.544.

Romagnoli, J. 2006. IX Seminario Agrícola en el Norte, organizado por Aapresid. En Agricultura, Siembra Directa, Medio Ambiente [www.e-campo.com]. 10 de noviembre.

Romig, DE; Garlynd, MJ and R.F. Harris. 1996. Chapter: Farmer-Based Assessment of Soil Quality: A Soil Health Scorecard. In Methods for Assessing Soil Quality. p. 39–60.. Editor(s): Doran, John W.Jones, Alice J. SSSA Special Publication 49. Soil Science Society of America

Toth, G.; Stolbovoy, V. and Montanarella, 2007. Soil Quality and Sustainability Evaluation - An integrated approach to support soil-related policies of the European Union, EUR 22721 EN. 40 pp. Office for Official Publications of the European Communities, Luxembourg.

Tugel, AJ.; Seiter, S.; Friedman, D.; Davis, J.; Dick, RP.; McGrath, D. and Weil, RR. 2001. Locally led conservation activities: Developing a soil quality assessment tool. In "Sustaining the Global Farm" (Eds. Stott DE, Mohtar RH, Steinhardt GC) pp. 529-34 (USDA).

Wirzba N. 2003. The Essentials agrarian reader: the future of culture, community and the land. Shoemaker&Hoard. Avalon Publising Group Inc.pp.276.