Integrating (and reconciling) traditional and precision tools to optimize soil and nutrient management

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TECNOAGRO
TECNOLOGIA AGROPECUARIA

Outline

- Are we understanding the adoption technology process?
- Are traditional and PA technologies complementary?
- Are AgTech´s adding real value to farmers?
- Thoughts about how to integrate traditional and modern technologies to improve crop fertilization

The complexity of technological adoption:

we often see the tree rather than the forest…

Are associated traditional and innovative Ag technologies?

Journal of Environmental Quality SPECIAL SECTION
IMPROVING NITROGEN USE EFFICIENCY IN CROP AND LIVESTOCK PRODUCTION SYSTEMS

Adoption of Nitrogen-Efficient Technologies by U.S. Corn Farmers

Catharine Weber and Laura McCann*

Abstract

Anthropogenically introduced nitrogen (N) has compromised environmental quality, but it is an essential element for crop production, particularly corn production. Increasing N use efficiency by adopting eco-innovations such as N soil testing, plant tissue testing, and N transformation inhibitors can ameliorate this problem. Data from the 2010 USDA Agricultural Resource Management Survey of corn producers was used to examine the factors affecting adoption of these practices. Twenty-one percent of the 1840 corn farmers had adopted N soil testing, 3% had adopted plant tissue testing, and 10% had adopted N inhibitors. A multivariate probit regression found significant results for each category of explanatory variable that was examined. Among the findings was the importance of information source for N recommendations. Farmers who did not obtain external recommendations were less likely to adopt all three practices than farmers who received recommendations from a crop consultant. Those who received recommendations from fertilizer dealers were less likely to adopt N soil testing and plant tissue testing. All regions were more likely to adopt N soil testing than the Midwest, and warmer regions were less likely to adopt N transformation inhibitors. Those who adopted conservation tillage were more likely to adopt plant tissue testing and N inhibitors, and those who received conservation payments were more likely to adopt N soil testing and plant tissue testing. Adoption of conservation tillage was also associated with the adoption of several other technologies. Implications for research and educational programs are discussed.

In the past few decades, there has been growing concern regarding the effect of increasing amounts of agricultural chemical inputs on the environment (Galloway et al., 2004). Anthropogenically introduced nitrogen (N) has compromised water quality and biological diversity and threatens human health around the world (Robertson and Vitousek, 2009; Galloway et al., 2004). Nitrate-N is highly mobile in water (Mitsch et al., 1999). Nitrogen can enter surface water via runoff during rain events. Areas that have shallow groundwater that is used for human consumption can be at risk of nitrate pollution from agriculture due to leaching. Once nitrates pollute groundwater, they must be removed before consumption (Ribaudo et al., 2011). The USEPA has set the maximum contaminant level at 10 mg L^{-1} in the United States for drinking water (USEPA, 2010). This means that minimizing N loss at the farm level becomes crucial in combating nonpoint-source pollution (Vitousek et al., 1997), especially because agriculture is the main source of N nonpoint-source pollution (Ribaudo et al., 2011).

Changes to the global N cycle can involve redistribution of natural reactive N sources (manure) or use of N forms generated by industrial fixation. The growing reactive N imbalance has increased the need for greater N use efficiency (NUE) (Galloway et al., 2004; Robertson and Vitousek, 2009; Vitousek et al., 1997), which is defined as the quantitative measure of grain produced per unit of fertilizer applied (Cassman and Vyn, 2011). Nitrogen fertilizer loss varies by chemical form, application method, soils, climatic variations, and agroecosystem—all of which influence ammonia volatilization, nitrification, leaching, runoff, and denitrification (Chen et al., 2008). This directly links environmental quality to N fertilizer management by farmers. Decisions on farm-level application methods, timing, and additional technology adoption ultimately affect agricultural production's impact on water quality and farmer profitability. Understanding the motivations and constraints of farmers is thus critical to addressing the environmental impacts of N.

In the United States, corn/maize is the most widely planted crop and receives the highest N application rates per acre

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Assigned to Associate Editor Jim Pease.

Abbreviations: ARMS, USDA Agricultural Resource Management Survey; BMP, best management practice; NRCS, Natural Resource Conservation Service; NUE, nitrogen use efficiency; VIF, variance inflation factor.

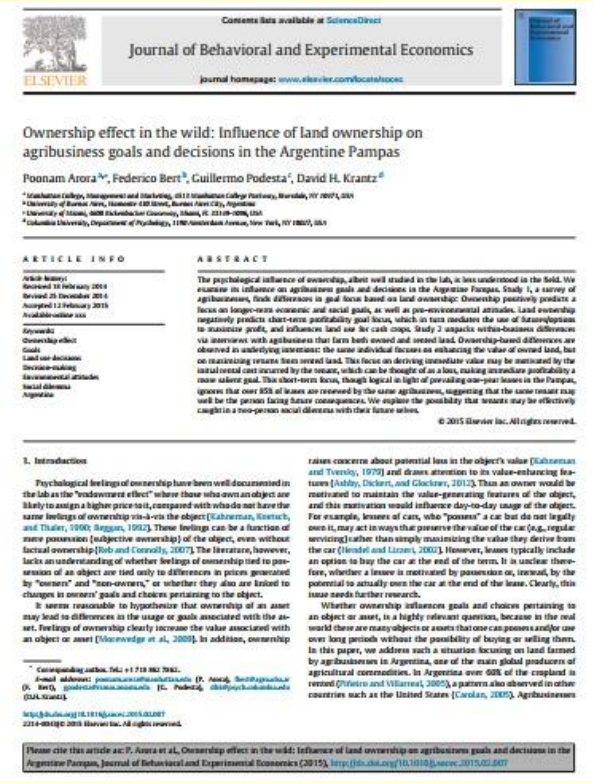
Table 3. Multivariate regression correlation coefficient results.

Dependent variable correlation combinations	
NSoilTest.PlantTishTest	0.50**
PlantTishTest.NHib	0.18†
NSoilTest.NHib	0.06

** Significant at the 0.01 probability level.

† Significant at the 0.1 probability level.

Influence of land ownership on argentine farmers technological adoption



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Ownership effect in the wild: Influence of land ownership on agribusiness goals and decisions in the Argentine Pampas

Poonam Arora [a,*], Federico Bert [b], Guillermo Podesta [c], David H. Krantz [d]

ARTICLE INFO

ABSTRACT

The psychological influence of ownership, albeit well studied in the lab, is less understood in the field. We examine its influence on agribusiness goals and decisions in the Argentine Pampas. Study 1, a survey of agribusinesses, finds differences in goal focus based on land ownership: Ownership positively predicts a focus on longer-term economic and social goals, as well as pro-environmental attitudes. Land ownership negatively predicts short-term profitability goal focus, which in turn mediates the use of futures/options to maximize profit, and influences land use for cash crops. Study 2 unpacks within-business differences via interviews with agribusiness that farm both owned and rented land. Ownership-based differences are observed in underlying intentions: the same individual focuses on enhancing the value of owned land, but on maximizing returns from rented land. This focus on deriving immediate value may be motivated by the initial rental cost incurred by the tenant, which can be thought of as a loss, making immediate profitability a more salient goal. This short-term focus, though logical in light of prevailing one-year leases in the Pampas, ignores that over 85% of leases are renewed by the same agribusiness, suggesting that the same tenant may well be the person facing future consequences. We explore the possibility that tenants may be effectively caught in a neo-person social dilemma with their future selves.

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1. Introduction

Psychological feelings of ownership have been well documented in the lab as the "endowment effect" where those who own an object are likely to assign a higher price to it, compared with who do not have the same feelings of ownership vis-à-vis the object (Kahneman, Knetsch, and Thaler, 1990; Reggars, 1992). These feelings can be a function of mere possession (subjective ownership) of the object, even without factual ownership (Rob and Connolly, 2007). The literature, however, lacks an understanding of whether feelings of ownership tied to possession of an object are tied only to differences in prices generated by "owners" and "non-owners," or whether they also are linked to changes in owners' goals and choices pertaining to the object.

It seems reasonable to hypothesize that ownership of an asset may lead to differences in the usage or goals associated with the asset. Feelings of ownership clearly increase the value associated with an object or asset (Morewedge et al., 2009). In addition, ownership raises concerns about potential loss in the object's value (Kahneman and Tversky, 1979) and draws attention to its value-enhancing features (Ashby, Dickert, and Glöckner, 2012). Thus an owner would be motivated to maintain the value-generating features of the object, and this motivation would influence day-to-day usage of the object. For example, lessees of cars, who "possess" a car but do not legally own it, may act in ways that preserve the value of the car (e.g., regular servicing) rather than simply maximizing the value they derive from the car (Hendel and Lizzeri, 2002). However, leases typically include an option to buy the car at the end of the term. It is unclear therefore, whether a lessee is motivated by possession or, instead, by the potential to actually own the car at the end of the lease. Clearly, this issue needs further research.

Whether ownership influences goals and choices pertaining to an object or asset, is a highly relevant question, because in the real world there are many objects or assets that one can possess and/or use over long periods without the possibility of buying or selling them. In this paper, we address such a situation focusing on land farmed by agribusinesses in Argentina, one of the main global producers of agricultural commodities. In Argentina over 60% of the cropland is rented (Piñeiro and Villarreal, 2005), a pattern also observed in other countries such as the United States (Carolan, 2005). Agribusinesses

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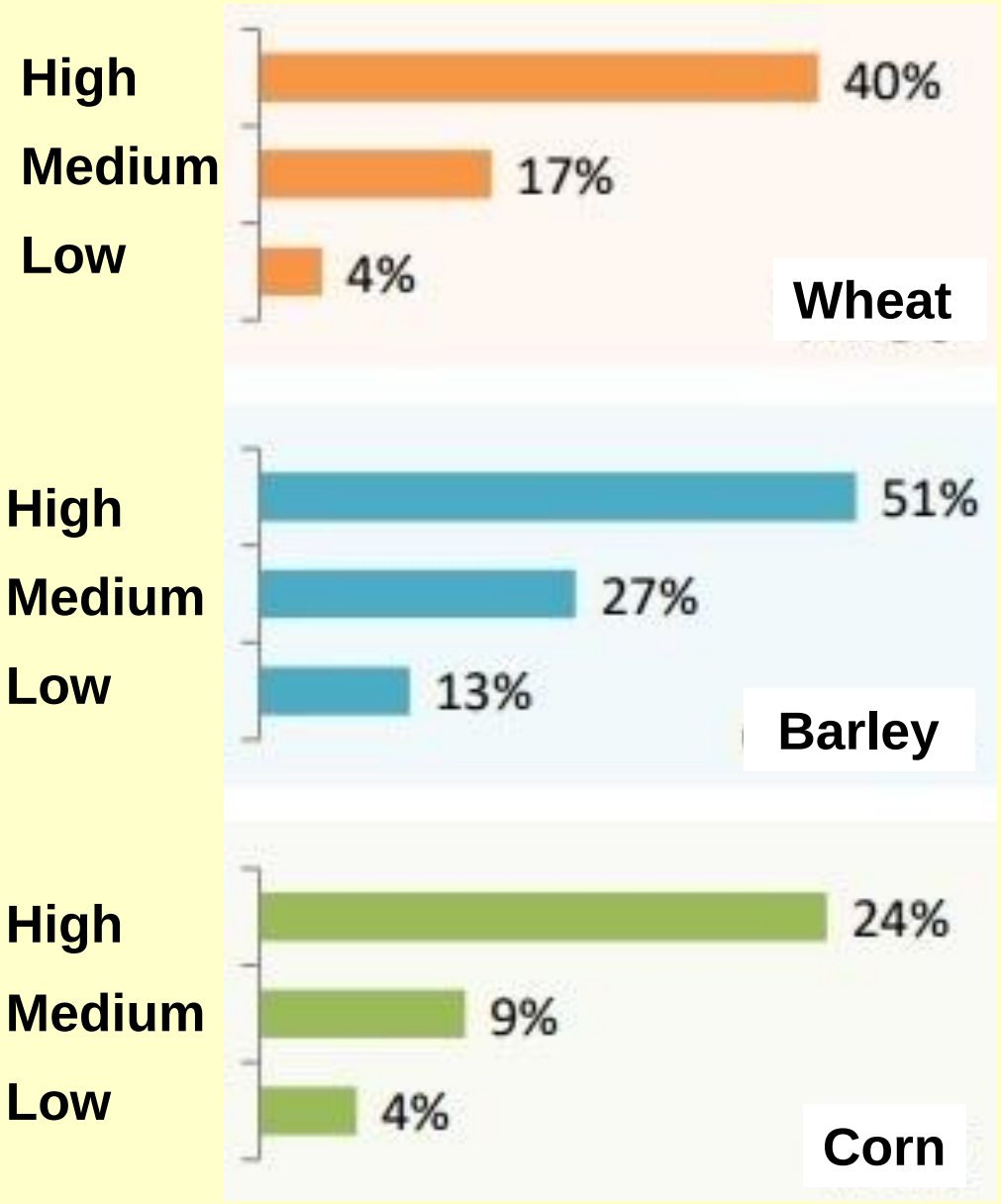
	Percent of mentions where underlying goal was land maintenance	Percent of mentions where underlying goal was profit maximization
Owned land	84%	18%
Rented land	16%	82%

Influence of land ownership on agribusiness goals and decisions in the Argentine Pampas. P. Arora et al. (2015). Journal of Behavioral and Experimental Economics

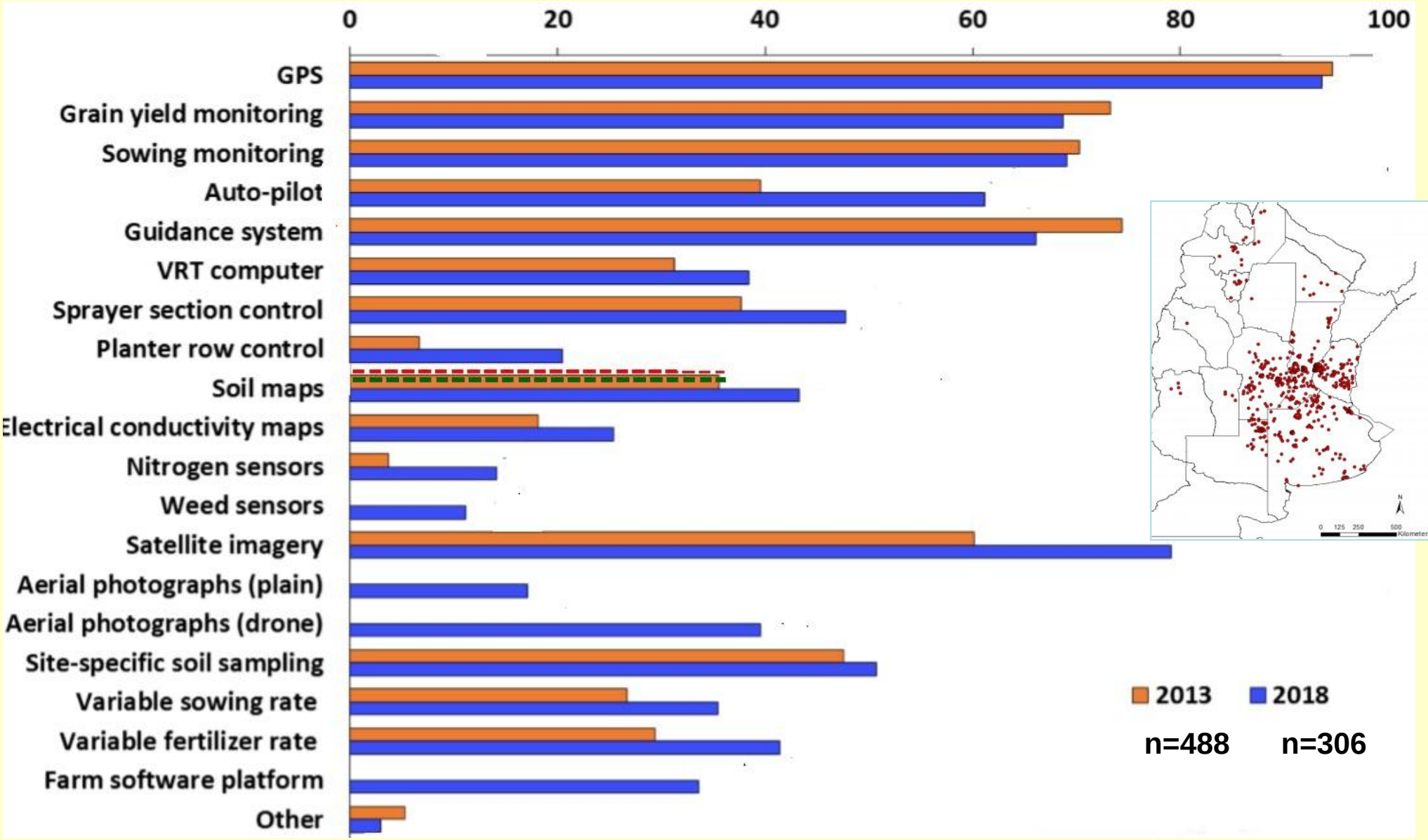
Soil sampling by technological level in cereal crops



Source: Bolsa de Cereales de Buenos Aires, ReTAA

Precision Agriculture tools and AgTech´s are disruptive technologies or well-done marketing proposals?

Recent trends in PA adoption in Argentina: challenges for near future



Melchiori & García (2018)

Some AgTechs available in Argentina

DATA MANAGEMENT

auravant

geo agro by TEK

Arc GIS ESRI — ArcView GIS

MI LOTE

Frontec TECNOLOGÍAS AEROESPACIALES

garageagro

AGP AGRICULTURA DE DATOS

Quantum GIS

SEPA

Google Earth Pro

VRT

Precision Planting

WEEDit SPOT ON SPRAYING

WeedSeeker Selective Spot Spray System

CROP PROTECTION AND MONITORING

SIMA

Lares Consultoría general de cultivos

Yara CheckIT

AGROAPP

SprayGuru

IMAGERY AND INFORMATION

GeoINTA

LAND VIEWER

USGS science for a changing world EarthExplorer

CLIMATE

BoosterAgro

LOGISTCS

Caminos Rurales.ar by FADA

IRRIGATION

AgroRobots

HydroBio

kilimo

Source: AAPRESID

Are Ag Tech´s adding value to farmers?

✓ Most Ag Techs are focus on monitoring

✓ Wide range of value propositions, more advanced Ag Techs in the market are those providing solutions for specific problems

✓ Constraints for setting Ag Techs companies due to local regulations and cost and delays to establish new companies

✓ Positioning from the offer, adjusting business plant to local cultural and socio-economic features rather than from a well-shaped demand

✓ Developments are limited by scaling considering diverse soil and climate types, farmer idiosyncrasies, farmers´s geographical dispersion, etc.

✓ AgTech´s much lower development than FinTechs

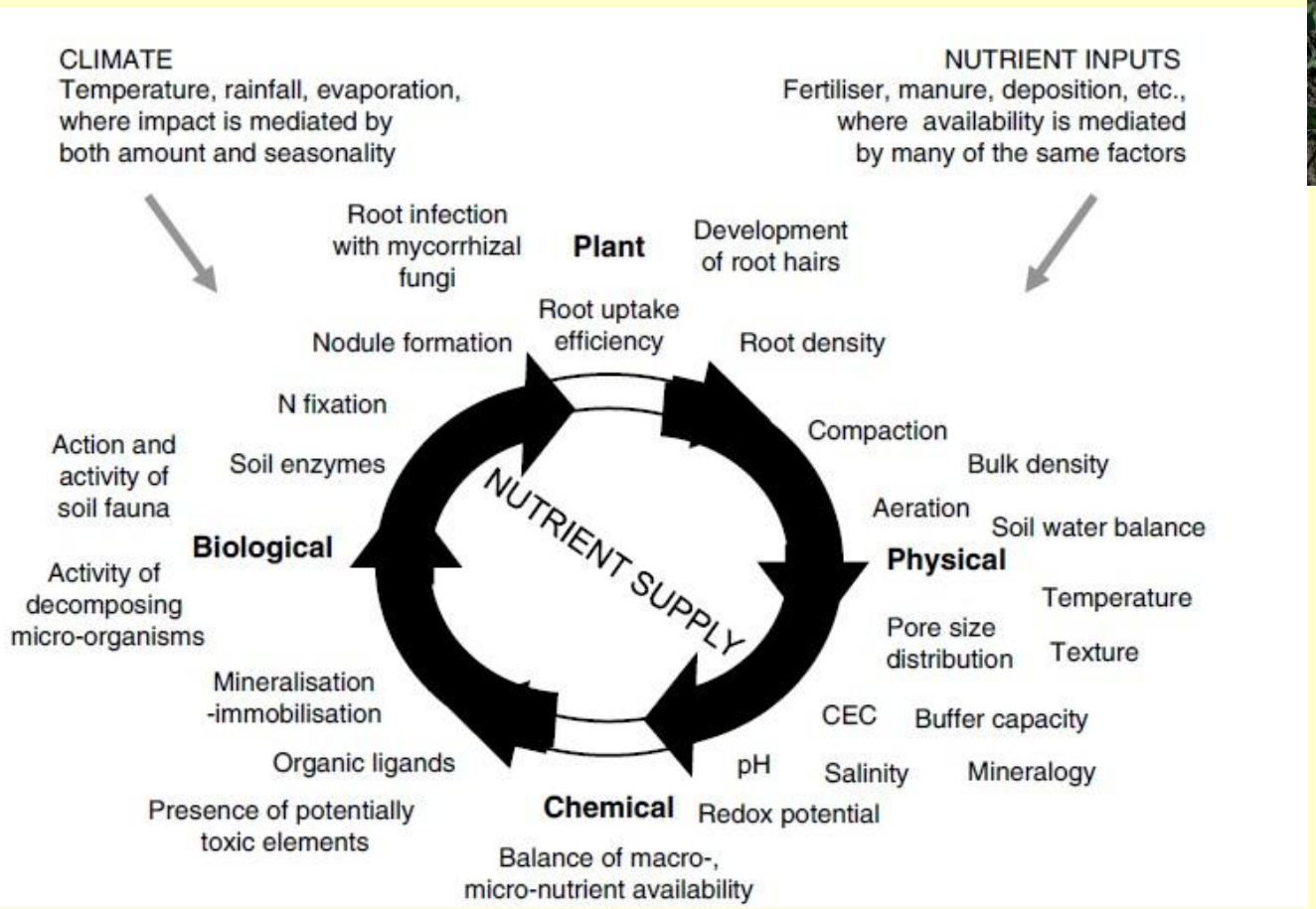
How to choose the accurate AgTech?. An example of a web-based tool being use in Argentina

www.agtech.org.ar

Aapresid Agtech

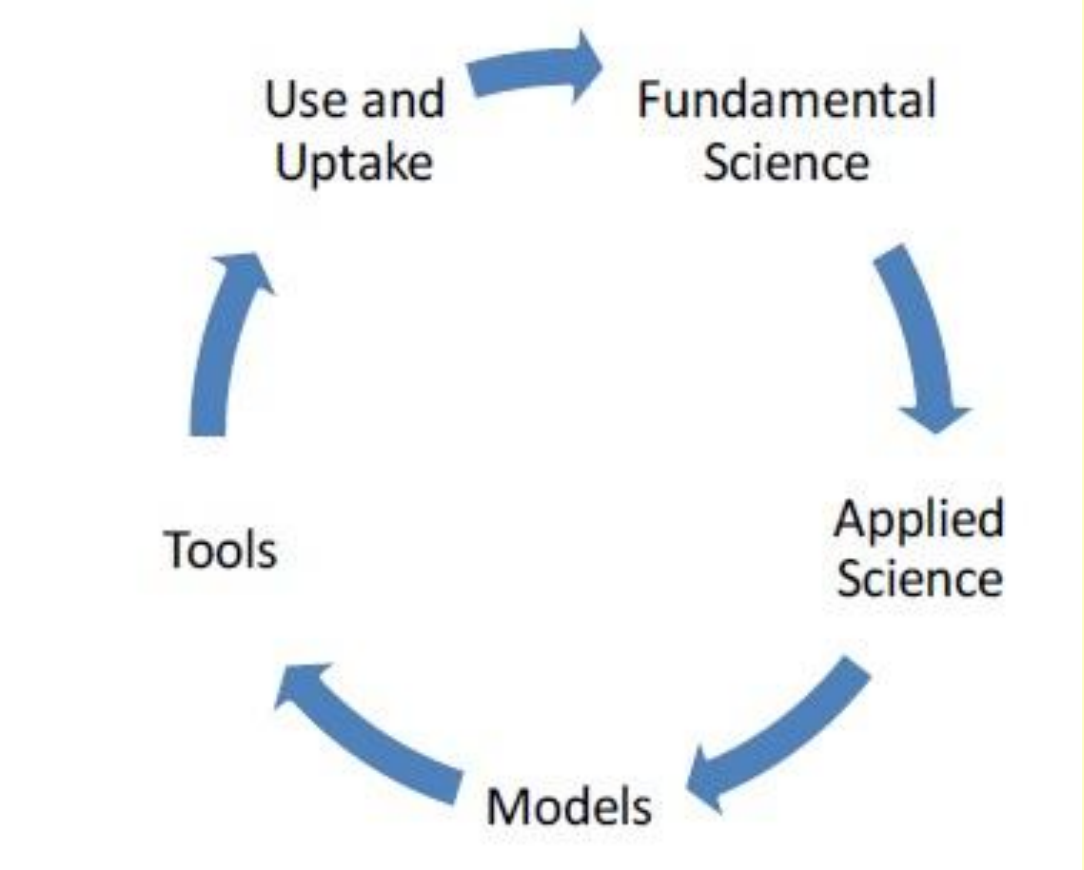
Some thoughts about how to integrate available technological tools to improve crop nutrient management

Integrating traditional and PA tools to optimize nutrient management



Adapted from Stockdale et al. (2013)

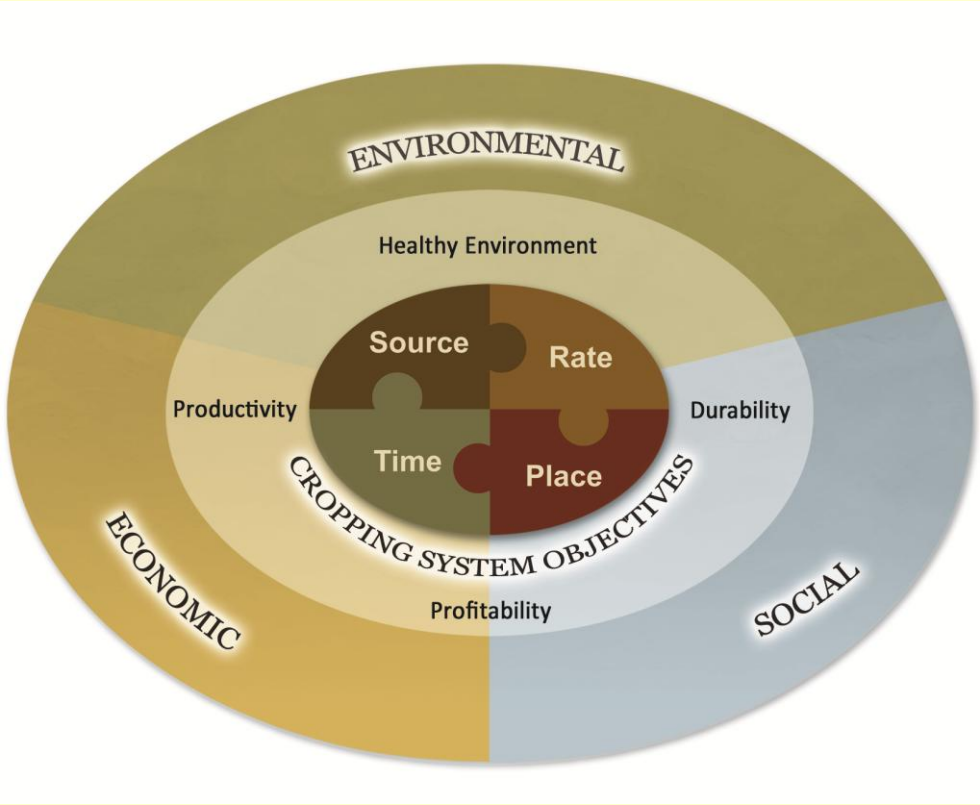
We should talk more about gaps in technology adoption!!!



We need to improve the effectiveness of extension and communication strategies !!

Grublen, 2003. Technology and Global Change. Cambridge University Press

The "4R" conceptual model integrates traditional and precision agriculture concepts!!



IPNI-net/4R

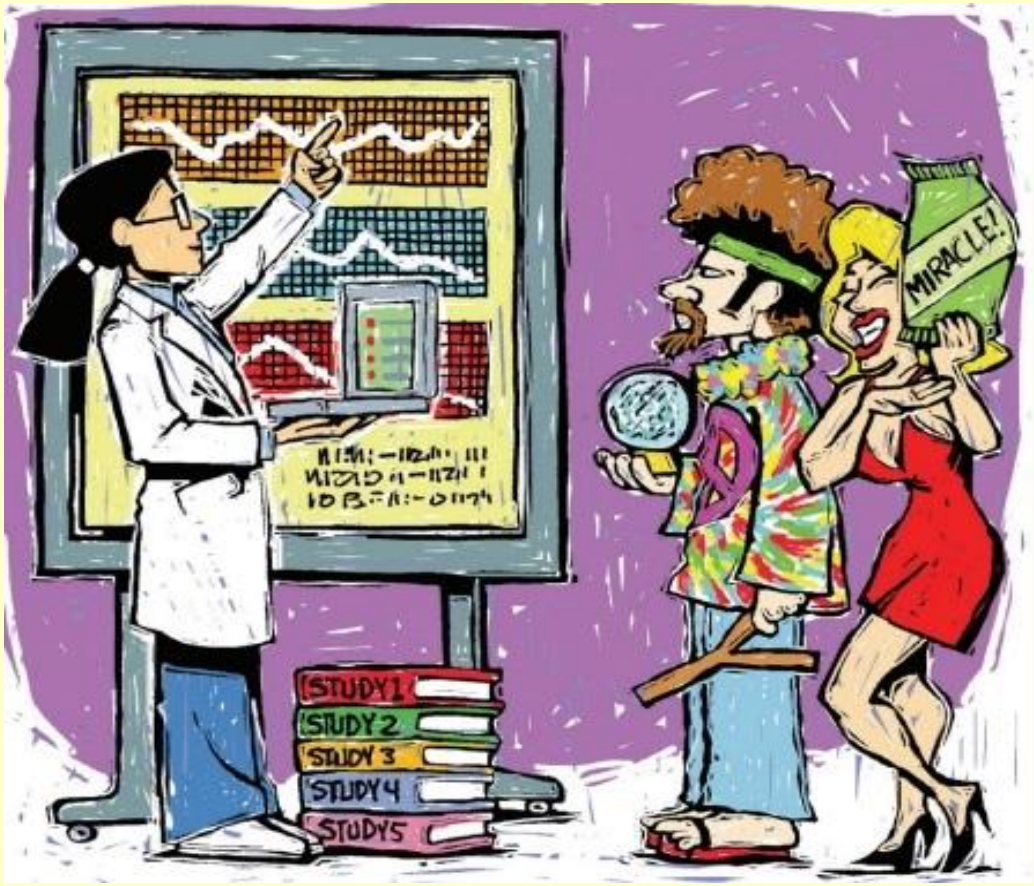


Imagen tomada de R. Norton (IPNI New Zealand, 2013)

Summing up…..

✓ Technological adoption process is complex; more efforts should be done for a better understanding of how farmers decide and use emerging technologies (e.g. sequence adoption process)

✓ Adoption of traditional technologies (e.g. soil testing) and PA tools are often associated (sequential technological adoption)

✓ Emerging digital technologies (i.e. AgTech´s) offered in the marketplace have been growing sharply in Argentina and worldwide

✓ Recent studies focus on the argentine AgTech´s offer shows that only few AgTech´s are adding real value to farmers (e.g. yield improvement; optimizing farming operations, etc.)

✓ The integration of “traditional” and “modern” should be based on scientific evidence and technological experience (e.g. 4R model)

Thank you very much for your attention!