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# Sustainable Agriculture: A Study on Farmers' Perceptions and Practices Regarding Nutrient Management and Limiting Losses

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This paper presents the findings of a scientific project focused on reducing nutrient losses from farms by promoting more sustainable fertilizer application methods. It is a case study that examines specific aspects of farm management, with a focus on sustainable agriculture and its tools. The primary goal of the study was to analyze and assess farmers' knowledge of the fertilization process and its various aspects, as well as their implementation of sustainable agricultural practices. The research highlights the significance of nutrient management for sustainable farming and also examines the relationship between farmers' opinions and their actions. A key issue addressed in the study was the adoption of sustainable farm management practices and measures to limit nutrient leaching into groundwater.

Twenty-eight farmers from two regions in Poland were interviewed for this case study to understand their perceptions. The farmers generally felt that their farming activities had become more sustainable over time, and they demonstrated a basic understanding of sustainable agriculture. However, many still had a poor grasp of nutrient flows and balances on their farms. Their knowledge was based on general concepts rather than specific information gained from academic or vocational courses. While they recognized that new or low-cost measures could make their management more sustainable and pro-environmental, there is still a need for wider adoption of these practices.

**Keywords:** farmers, fertilizers, nutrients, sustainable agriculture

## Introduction

Agriculture has a significant impact on the national economy, the environment, and climate change. Farming and animal husbandry are crucial for food production, and in Poland, the ongoing specialization in agriculture affects the structure and economy of the entire society. Over time, the desire to increase income and competition has led to larger farm units and higher livestock densities. Farms with intensive animal production tend to have the highest nutrient losses. International agreements and directives, such as the Helsinki Convention and Directive 2000/60/EC, emphasize the need to reduce nutrient losses and improve nutrient management to ensure agricultural sustainability and address climate change.

Historically, agriculture catered to a local market, but it has now taken on an international role. Polish farmers face international competition due to increased efficiency and mechanization. They also have to deal with resource management and environmental issues, which necessitates an improved farm management training system. For example, nutrient leaching from agriculture can cause eutrophication, and greenhouse gas emissions from animals contribute to global warming.

The Food and Agriculture Organization (FAO) defines sustainable agriculture as "production which fulfils food security, environmental protection, and economic and social needs in rural areas". This is a complex task that involves human activities like farm

management and agricultural policies, as well as independent factors such as climate, soil type, and gas emissions from animals.

The purpose of sustainable agriculture is to protect and conserve natural resources. Some resources, like soil nutrients, may become depleted, while others, like groundwater, can be contaminated. More sustainable agricultural practices are emerging to protect resources, especially since resources like phosphorus are expected to be depleted later this century. Due to market and social demands, farm managers are expected to provide good quality food while also protecting the environment, including water and air quality, soil properties, and ecosystems. Farmers face the difficult challenge of balancing social and economic goals without harming the environment. This is particularly hard when economic results depend on using natural resources.

Various research projects have explored ways to implement sustainable agricultural development. One such project in Poland and Sweden was the "Self-evaluation and risk analysis by farmers concerning losses of nutrients and low cost remedial measures" pilot project, conducted from 2013 to 2016. This paper analyzes farmers' perceptions of their practices' environmental impact and their willingness to adopt methods to improve sustainability. The specific goal was to analyze the development of more sustainable nutrient use on farms. Some results of the case study were based on the initial investigation of the 28 subjects.

## Materials and Methods

The empirical studies for this paper were derived from a pilot project conducted by several institutions, including Stockholm University and the Institute of Technology and Life Sciences, in two Polish provinces: Mazowieckie and Pomorskie, between 2013 and 2016. The farmers were introduced to the farm-gate nutrient balance concept, a method for assessing nitrogen leaching risk based on farming practices. They also participated in farm walks with agricultural advisors and were given soil surveys and subsidized seeds.

Twenty-eight farmers were interviewed both before (2013) and after (2015) to identify changes in their activities and perceptions. The subjects were chosen to represent a range of farms, from 13 ha to 150 ha of arable land, and included crop, husbandry, and mixed farms. All subjects worked with agricultural advisors. The farmers were from different age groups and educational backgrounds. According to the most recent Agricultural Census, most Polish farmers have a basic vocational education, while 40% have a secondary or higher education. In this study group, 68% of the farmers ran large farms (exceeding 45 hectares), and 60% had not attended an agricultural college or university.

The study group was primarily composed of farmers with extensive farm management experience, with an average age of 45. Most had expanded their farms since Poland joined the EU and had largely mechanized their operations. They had also invested in new buildings and manure handling equipment.

## Tools for Sustainable Nutrient Management on Farms

At the farm level, nutrient management is a crucial part of sustainable agriculture because it impacts farm results as well as soil and water conditions. Achieving balanced and sustainable management of organic and mineral fertilizers is a significant challenge. A number of tools have been developed to help farm managers improve their nutrient management and prevent losses, often based on an analysis of nutrient flow on the farm. Nutrient flow analyses can show if there is a need to improve the efficiency of certain nutrients. The balance is typically calculated for nitrogen (N), phosphorus (P), and potassium (K), including inputs, stores on the farm, and outputs.

Nutrient surpluses or deficits can be used as indicators of a farm's environmental impact. The farm-gate balance, derived from a nutrient flow analysis, is one tool for sustainable agriculture. Another important tool is a fertilization plan, which specifies the optimal dosages of mineral fertilizer and manure for each crop based on its nutritional needs

and soil fertility. A complementary tool is a calculation model that assesses the risk of nitrogen leaching from individual fields based on farming practices.

## Results

### Farmers' Attitudes Towards Sustainable Nutrient Management on a Farm

At the beginning of the study, farmers were questioned about their fertilizing practices and knowledge, specifically regarding the Nitrates Directive, nutrient content differences between cow and pig manure, and nitrogen and phosphorus behavior in soil. All farmers stated they had complied with the EU Nitrate Directive's requirements for maximum nitrogen dosages, confirming that they had not exceeded the limit of 170 kg per year.

Regarding their knowledge of manure nutrient content, 53% of farmers believed there were significant differences between cow and pig manure. Most farmers (86%) correctly identified that nitrogen was more mobile in soil than phosphorus, and that phosphorus tended to accumulate in the soil. A majority of farmers (68%) understood that nitrogen should be applied in precise dosages to prevent it from being lost to the atmosphere or leaching into watercourses. Nine farmers (32%) noted that nitrogen was more mobile in sandy soil and that these losses could be reduced by using catch crops.

The study evaluated several tools for sustainable fertilization, including soil surveys, identifying nitrogen leaching "hotspots," the farm-gate balance, and fertilization plans. The soil survey was considered the most important and useful tool by all 28 farmers interviewed. Only four farmers (14%) had conducted a soil survey for the first time as a result of the project.

While all respondents had a basic understanding of a fertilization plan, not all knew the details well enough to apply it themselves. Only 16 farmers (57%) reported creating and using a plan on their own. Half of the farmers (14) found the farm-walk, a process of walking the farm with an advisor to identify potential leaching hotspots, to be a source of new and useful information. However, nearly 40% of the farmers reported that the farm-walk did not provide any new information, stating they were already familiar with their property and had the necessary knowledge.

The farm-gate nutrient balance (FGB) was a new tool for all farmers at the start of the project. By the second round of interviews, over 80% could recall details of the FGB, although their knowledge of how to use it was not yet well-established. As a result of the FGB recommendations, six farmers (21%) changed their practices, such as adopting non-tillage systems or reducing mineral fertilizer applications.

Overall, the farmers' attitudes and willingness to use these tools were ranked as follows: 1) soil surveys, 2) fertilization plans, 3) hotspot identification, and 4) farm-gate balances. Younger, more educated farmers were generally more positive about the project's tools, while older or less-educated farmers were less enthusiastic. Farmers with larger farms also showed more interest, likely because these farms were their primary source of income.

## Discussion

Farmers' knowledge and awareness of environmental issues have a clear impact on the environment. The study found that farmers often took an intuitive approach to sustainable nutrient management, rather than having a detailed scientific understanding. Many older farmers (under 50 years old, 32%) relied on their extensive experience and knowledge gained from informal channels and exchanges with other farmers and advisors.

Younger farmers, on the other hand, were more focused on short-term profits but were willing to adopt new practices if they expected positive results. They primarily gained knowledge from agricultural schools or universities and supplemented it with information from the internet or training.

The farmers generally understood the importance of sustainable agriculture in reducing the use of chemical fertilizers, driven mainly by high prices and the need to comply with EU regulations to receive economic benefits. Their practices were often based on their

own experiences, and their observations were generally in line with the concept of sustainable agriculture.

The study demonstrated that farmers have changed their perceptions due to external pressures, such as building manure pads or investing in modern machinery, often with the support of financial aid from EU programs. These changes have led to more efficient and sustainable farm management practices, such as reducing leakage into water and using less chemical fertilizer.

The project highlighted that low-cost tools and measures can be adopted to improve sustainable farm management and nutrient use. Farmers recognized that these tools can lead to similar production results with a reduced environmental impact by helping them apply less mineral fertilizer with greater precision. However, some farmers noted that their knowledge base was insufficient to implement new pro-environmental measures on their own.

## Conclusion

Farmers manage many aspects of their business while facing uncontrollable external factors such as weather, market changes, and legal regulations. The challenge of environmental sustainability adds a new layer to their planning and daily activities. External factors, like the availability of funds and agricultural policies, significantly impact the implementation of pro-environmental practices and the achievement of sustainable agriculture goals.

The study concluded that project interventions using tools like nutrient balances and nitrogen leaching risk assessments were well-received, but more training is needed for a full understanding. The lack of readily available data for farmers and advisors means that the full effect of these tools will be a long-term process requiring more training and studies.

Advisors should focus not only on their clients' short-term goals but also on long-term sustainable development objectives. It is crucial to emphasize to farmers that their management activities impact not just their farms but also groundwater and surface water on a larger scale. Sustainable agriculture requires a system-wide thinking approach from both farmers and advisory institutions. There is a need for agencies and farmers to set coherent, common goals to reduce losses, improve effectiveness, and promote nutrient recycling.

## References

1. Beegle D.B., Carton O.T., Baily J.B. 2000. Nutrient Management planning: justification, theory, practice. Journal of Environmental Quality. No 29 p. 77-79.
2. Convention on the Protection of the Marine Environment of The Baltic Sea Area 1992. Helsinki Commission Baltic Marine Environment Protection Commission, HEL-COM, Finland pp. 43.
3. Cordell D., White S. 2011. Peak phosphorus: Clarifying the Key issues of a vigorous debate about long-term phosphorus security. Sustainability. No 3(10) p. 2027 – 2049.
4. Council Directive 91/676/EEC concerning the protection of Waters against pollution caused by nitrates from agricultural sources.
5. Cymerman R. 1994. Gospodarka zrównoważona (ekorozwój) na obszarach wiejskich. W: Doradztwo w ekorozwoju obszarów wiejskich [Balanced economy (sustainable development) in rural areas. In: Advisory in sustainable development of rural areas]. Szczecin. Wydaw. Druk p. 11-36.
6. Deumlich D., Mioduszewski W., Kośmit A. 1999. Analysis of nutrients entering rivers with surface flow in the Odra catchment. Journal of Water and Land Development. No 3 p. 33-45.
7. Directive 2000/60/EC of the European Parliament and of The Council establishing a framework for Community Action in the field of water policy.
8. Drangert J.-O., Kiełbasa B. 2015. Analysis of advisors' Collaboration with farmers. Report 1. Final report of Questionnaire study.