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The history and future of agricultural experiments

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ABSTRACT

An agricultural experiment is usually associated with a scientific method for testing certain agricultural phenomena. A central point in the work of Paul Richards is that experimentation is at the heart of agricultural practice. The reason why agricultural experiments are something different for farmers and agronomists is not their capacity to experiment as such but the embedding of experiments in a specific ecological, material and institutional environment. Using a historical perspective, changes are examined in the organization of agricultural experiments focusing on the Netherlands and colonial Indonesia during the first half of the 20th century and the international agricultural research institutes for the period thereafter. The results show a gradual shift in the role of experiments in the connection between science and practice. Initially, the link was considered to be established through various forms of experiments, rooted in an integrated social and technical understanding of agronomy. Gradually, this turned into a connection primarily established through various forms of communication. Recent work of Richards incorporates ideas that address key issues emerging from the history of agricultural experiments, dealing with an integrated social and technical understanding of agriculture.

1. Introduction

What is an agricultural experiment? Within the agricultural sciences the answer to this question will vary among disciplines. The common features are a treatment, a hypothesized process or causal mechanisms to be tested. Living creatures or parts thereof are usually the object of an experiment. Today, each branch of the agricultural sciences will have its manual or guidelines for experimentation, depending on the object of the experiment, the place where the experiment is done, the treatment or process that is tested and the methods used. The connection between agricultural experiments and agricultural science seems obvious. However, at the beginning of the 20th century, agricultural scientists were very much in doubt about the validity of the commonly used experimental approach. In recent years, anthropologists like Richards and others claim that many of the basic agricultural activities carried out by farmers are experimental in nature as well. Based on anthropological fieldwork among rice farmers in Sierra Leone, Richards in particular emphasized how farmers deal with the agro-ecological conditions as a performance. In farming practice, experimentation is a crucial act to improve farming results in subsequent seasons [1,2]. At first glance, the experiments by farmers look completely different from the scientific experiments performed on controlled experimental plots, often in climate-conditioned greenhouses. Experiments by (African) farmers and scientists seem as distinct as (Western) scientific knowledge and (non-Western) indigenous knowledge [3]. However, Richards has pointed out that the principles of farmer experiments are basically the same as the principles of scientific experiments [2,4]. For him, claims about fundamental distinctions between the cognitive processes underlying experiments of African farmers and knowledge production in (Western) science carry an "implicit notion of intellectual apartheid". What makes agricultural experiments something different for farmers and agronomists is therefore not the capacity to experiment as such but the embedding of experiments in a specific ecological, material and institutional environment.

This paper puts different environments of experimentation and the linkages between them in a historical perspective. Experts dealing with agricultural experiments were most of the time worried about both the scientific validity of their experiments and the connection with farming practice. Throughout the years the growth of research activities as well as the changes in experimental capacity transformed the nature of the connection between scientific experiments and on-farm experimentation. In later work, Richards offered concrete suggestions for new ways of establishing a connection between farmer experiments and scientific experiments. What is argued here is that his ideas about reconnecting farmer experiments with scientific experiments fit with the historical trajectory of agricultural experiments and therefore have a broader relevance than the focus on West African rice cultivation might suggest. The

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historical trajectory of agricultural experiments is characterized by a growing distance between farmer experiments and scientific experiments. In other words, establishing the connection between science-based experimentation and agriculture became more complex in terms of methodology and organization. This resulted in a weakening of the link between the scientific experiment and the experimental nature of farming. Agricultural advisors or extension officers are crucial actors in bringing science and practice together. The changes in agricultural science also affected the relation between research and extension. The historical development of agricultural extension, as presented here, suggests that extension work moved from an agronomic orientation towards a more sociological and psychological orientation. This may explain why in recent decades attempts to bridge the gap between scientific experiments and farming practice are usually framed in behavioural and communicative terms.

The material for this paper is a selection of key events, decisions and circumstances in the history of agricultural science that resulted in the establishment of various forms of agricultural experiments, its connections and disconnections. Like in most of Richards' work, examples and case material relate to rice cultivation. Rather than looking at West Africa, the historical developments in agricultural science presented here primarily relate to the case of the Netherlands. The involvement of Dutch scientists in agricultural experiments, applied to a variety of crops including rice, started in the early 20th century when besides the booming agricultural sector in the Netherlands, the Dutch built up much of their agronomic expertise in the Netherlands Indies. In the colonies, cash crops formed the dominant economic part of agriculture, although much effort went into stabilizing the food situation for which agricultural science was considered a necessary input. After the independence of Indonesia in the 1940s, Dutch agronomists continued to be active in rice cultivation, partly in the remaining Dutch South American colony Suriname and partly in the emerging international research institutes and expert networks spreading out over the globe. The continuing involvement of Dutch agronomists in research on tropical crops like rice illustrates how agricultural science has become an activity relatively independent of immediate linkage to constituent farmers. This is not to say that agricultural science has entirely lost its connection with practice but to make clear how the commonalities between scientific experimentation and farmer experimentation have become obscured and received less attention. Combining the history of agricultural experiments with the work of Richards provides some interesting perspectives for the future of agricultural science and the role of experimentation in creating effective linkages between science and practice.

There are few studies that examine agricultural experiments as performed by agronomists or other agricultural scientists. The social science literature on scientific experiments more generally is much larger and this paper therefore first addresses some of the central features emerging from that literature and how this applies to experiments in agricultural science. In the following sections historical information is mobilized to show what developments resulted in the displacement of agricultural experiments from the farmer's field to various other environments. The case of rice is of particular interest because initiatives to set up experiments for rice improvement were taken by administrators of the colonial government who were concerned about the food situation on Java, Indonesia. During the late 1880s and 1890s, district officers located in different parts of this island were instructed to set up experiments with various cultivation methods to demonstrate to the local farmers how to grow rice more efficiently. These administrators had no training in agriculture, no experience with rice cultivation and, with few exceptions, never took it very seriously. Initially, when agricultural experts entered the scene there was little commitment to engage in rice farming. However, once agricultural advisors were appointed with a mandate to perform on-farm experiments things started moving. Prompted by the advance in statistical inference calculation, the design and validity of the experiments became a controversial issue. It will be shown how a particular solution established by the late 1920s, resulted in a hierarchy of experiments held together by the bureaucracy of the agricultural research organization. In the decades that followed, a variety of factors resulted in an increasing differentiation of agricultural experiments. This differentiation had an impact on most agricultural research and extension services across the world and is still the dominant mode of operation today. The last section discusses some of the shortcomings of the current mode of agricultural experimentation. It is shown how recent work of Richards offers some suggestions for alternative ways of setting up experiments and how agricultural experimentation might be organized differently.

2. Agricultural experiments in the social science literature

Many forms of experiments can be classified as an agricultural experiment. Rather than making a list of all the appearances of agricultural experiments, the social science literature, in particular the history and sociology of science, is used to highlight some of the common features and processes related to experimentation. In several studies the theory and practice of scientific experiments are examined. The overall message is that historically and socially determined factors play an important role in establishing what counts as a scientific experiment. The common association between experiments and laboratories, for example, is a feature of present-day science that is very different from the situation in the past. A common feature of all forms of experiment, in past and present, is demonstration. More specifically, there is a close connection between what experiments try to demonstrate and the public they want to convince with the demonstration.

Examining the activities of Royal Society Fellows in 17th century England, the historian and sociologist of science Steven Shapin [5] showed that most experiments were conducted in private houses. Other possible locations were a coffeehouse or the royal palace. More than a geographical space and material setting, these locations were demarcated by social regulations. "[A]ccess to most experimental venues (and especially those located in private residences) was obtained in a highly informal manner, through the tacit system of recognitions, rights, and expectations that operated in the wider society of gentlemen." [5: 389]. The location where experiments were done varied with the audience called in to be convinced as witness. A similar point emerges from Bruno Latour's study of the discovery of an anthrax vaccine by the microbiologist Louis Pasteur. Not the discovery as such but the process of convincing veterinarians and livestock farmers, Latour argues, is what made Pasteur a great scientist. To accomplish this, Pasteur organized 'staged demonstrations' at the countryside in which he managed to replicate what he did in the laboratory [6].

Besides management of the audience, the objects and findings resulting from scientific experiments require alignment with the material environment outside the scientific experimental setting. The social studies on the role of laboratories in science make clear how relocation of a laboratory experiment in a real situation requires both physical and social adjustment in order to make clear that what works in the laboratory also works in society. Success in science implies optimized mobility of experimental results between the protected environment of a laboratory and the messy world outside [7,8]. In particular for scientific fields that work on technical applications in a certain domain of society, careful adjustments of what works in a scientific experiment and what works in society is required. In other words, for experiments on new tech-