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The widespread occurrence of Celtic field systems in the central part of the Netherlands

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ABSTRACT

The detailed elevation model based on airborne laser altimetry (AHN) proved to be a reliable tool to detect well-developed Celtic field systems, characteristic arable plots of the Iron Age. They were detected in the central part of the Netherlands, where only a limited number of Celtic field systems have been recognized in the past. Most of these previously detected systems were identified in the northern part of the Netherlands or in the southern part, but not in this zone. About 1200 ha of well-developed systems could be identified by AHN in the central part of the Netherlands, of which only 136 ha were registered as an archaeological monument. Another 335 ha of archaeologically identified Celtic field systems were not accepted or recognized by AHN, because they were morphologically less well-developed. Most of the around 1050 ha new discoveries occur in rough vegetations and forested areas, and can hardly be identified with previously used geodetic methods and aerial photography. Less well-developed or preserved systems were even more extensive and remnants were traced as fossil arable layers below plaggen soils or on lower slopes incorporated in mediaeval reclamations. The newly identified Celtic field systems, therefore, can be considered as remnants of much larger areas once covered with these arable plots. In the central part of the Netherlands, the estimated area once covered was at least around 4500 ha, more than enough to supply 10,000 people with cereals. Well-developed Celtic field systems started to develop in the late Iron Age with formation intensifying during the early Roman Period. The central part of the Netherlands is situated just north of the river Rhine, the former boundary of the Roman Empire, the Limes. The newly discovered extent of Celtic field systems will have influenced the interaction between different cultures on the border of the Roman Empire in the early Roman Period, about which very little is known. This perspective underscores the need for an integrated conservation policy and in-depth research through excavations in the near future.

1. Introduction

At the start of the 21st century the last sheets of the geomorphological map 1:50,000 of the Netherlands had to be completed. The areas to cover were situated in the central part of the Netherlands. At that time the Actual Height Model of the Netherlands (Rijkswaterstaat, 2000), a detailed elevation model of the whole country using airborne laser altimetry, had just become available. With this model, relief patterns could be studied in much more detail and coherence than before. Therefore, the AHN was used to study the relief of the Pleistocene deposits in the central part of the Netherlands. In the process of geomorphological mapping, substantial areas with small, more or less rectangular patterns were recognized. They consisted of individual plots, varying from 25 to 45 m in length and width, marked by raised boundaries, varying between 10 and 100 cm in height. They strongly resembled Celtic field systems, a characteristic kind of field systems common in the Iron Age, occurring throughout northwest Europe. These patterns were checked with archaeologically registered Celtic field systems with known location and occurrence. They were identical.

Most of the Celtic field systems in the Netherlands have been identified in the northern and southern parts of the country. In the past, Celtic field research mainly focussed on the Dutch northern province of Drenthe where open landscapes prevailed. Using air photography many Celtic field systems could be identified (Brongers, 1976). The AHN survey of the Pleistocene area in the central part of the Netherlands, however, showed that in this area a substantial surface was covered with Celtic field systems, mostly located in rough vegetations and forested areas. The AHN appeared to offer new opportunities to study Celtic field systems.

This study focussed on the identification and characteristics of Celtic field systems in the central part of the Netherlands, a relatively

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poorly known area in this respect. The data obtained using AHN is compared with that of archaeologically registered Celtic field systems in the same area. The distribution of the Celtic field systems in the landscape is analysed and compared with the soil types on which they occur. The information obtained enabled to estimate the probable importance of food production from Celtic field agriculture in this part of the Netherlands, just north of the river Rhine, before and in the early Roman Period, about which our knowledge is scant.

2. Celtic field systems in time

Celtic fields are characteristic field systems dating from the late Bronze Age to the Roman Age (ca. 1100 BC–AD 200). They are recognized by their shape, size and pattern. Celtic field systems consist of a large number of adjoining, small, more or less rectangular plots. The individual plots measure from about 20 to 45 m in length and width. These plots are generally bordered by low raised boundaries, which consist of either sandy material or accumulations of stones. The raised boundaries measure from several centimetres up to 1 m. Celtic field systems are found in the whole of northwest Europe, from Ireland in the west to Sweden and the Baltic states in the northeast (Klamm, 1993; Spek, 2004). In the sandy regions of the Netherlands, Germany, Denmark, Poland and the Baltic states, the raised boundaries generally consist of sand. High, sandy raised boundaries can be between 8 and 12 m wide (Spek et al., 2003; Harsema, 2005). In other countries where Celtic field systems are found, Ireland, Great Britain, and Sweden, rockier soils dominate and the boundaries of the plots generally are delineated by accumulated stones. The area covered by one Celtic field system may vary from a few to over 70 ha.

Celtic field systems formed a new development in the agricultural history of northwest Europe, starting in the late Bronze Age. Before that time, until ca. 1100 BC, shifting cultivation was practised, whereby every few years new fields were reclaimed from the forest by slashing and burning trees and their undergrowth to grow crops. Prehistoric farmers focussed on soils light enough to be tilled by means of hand-held digging sticks, the sandy soils. These soils tend to have a low fertility. Consequently, fields were soon deserted and new ones reclaimed. At the end of the Bronze Age, however, farmers remained in one area. They reclaimed a number of small rectangular plots, a Celtic field system, of which only a part was used at the same time. The dimensions of the individual plots, about 30 × 30 m, are thought to represent the surface that could be cleared in 1 day. Likewise, the size of these is believed to have enabled ploughing and sowing in 1 day (Brinkkemper, 1993; Van Wijngaarden-Bakker and Brinkkemper, 2005). When the soil was exhausted, the used plots were abandoned to recover and a different part of the plots within the Celtic field system was cleared and tilled. The farmers lived in farmsteads built on one of the plots and barnsteds were usually present in adjoining ones. After a few decades, generally coinciding with the reclamation of a new group of plots alongside existing ones, new farmsteads were built on another location in the same Celtic field system. Cattle were held, also on the plots. They provided the draught-power for ploughing and their dung served for manuring of the plots (Gebhart, 1982; Spek et al., 2003). The abandoned plots became covered with vegetation, including shrubs and small trees. When reclaimed again, the vegetation was burned and waste material accumulated on the edges of the plots resulting in raised boundaries (Spek et al., 2003). After every fallow period more materials accumulated and distinct ridges separating the individual plots developed. Celtic field systems with well-developed and relatively high, raised boundaries are thought to have formed during the later stages of the Celtic field cultivation, viz. the late Iron Age up to the Roman Period (250 BC–AD 200). This can either be the result of (1) continuous clearing and accumulation on the edges during prolonged periods or (2) a more intensive agricultural system with an intentional raising of the walls with material from the surroundings, in which mainly the ridges were intensively cultivated and manured (Zimmerman, 1976; Behre, 2000; Spek et al., 2003; Harsema, 2005). Due to repeated burning of the vegetation, Celtic field systems often contain hardly any pollen nor botanical macro-remains and the reconstruction of grown crops is limited (Spek et al., 2003; Spek, 2004; unpublished data main author). Botanical macro-remains of grown crops, however, can be encountered in settlements, grain storage pits or offering pits and in some cases may be related to neighbouring Celtic field systems. Only in a few studies in the central part of the Netherlands (Buurman, 1986; Vermeeren, 1991; Van Zeist, 1968/1970) and comparable nearby locations (Bakels, 1998; Kooistra, 2008) cereals grown in these ancient field systems have been detected. They include *Panicum miliaceum*, *Hordeum vulgare*, *Triticum dicoccum*, *Triticum spelta* and *Avena sativa*.

In the Roman Period agricultural practices changed considerably, due to improved implements and intensified manuring. At the start of the Middle Ages more fertile land was reclaimed. Celtic field systems became abandoned and were incorporated into larger field plots or buried below a plaggen layer.

3. Identification of Celtic field systems in the past

Celtic field systems, together with burial mounds and megalithic tombs, are considered the best visible relicts of the archaeological heritage in the landscape in the Netherlands. Burial mounds, due to the possible presence of gifts, and the appealing megalithic tombs got most attention. Nevertheless much research has been focussed on Celtic field systems, due to their conspicuous relief pattern. Klamm (1993) and Spek et al. (2003) have given excellent reviews of Celtic field research in northwest Europe.

Celtic field systems were first recognized as a particular type of ancient field systems during excavations in the first part of the previous century. The position and configuration of individual plots were commonly registered using various geodetic methods (viz. Van Giffen, 1928; Nielsen and Clemmensen, 1995). Due to their conspicuous relief in open, flat or rolling landscapes they belonged to the first archaeological features studied using aerial photography (Crawford, 1923). Thereafter, several air photo surveys of Celtic field systems were executed (Brongers, 1976; Zimmerman, 1976; Olesen, 1983). Brongers (1976), e.g., identified 95 possible Celtic field systems in the province of Drenthe. Field investigations using relief properties and soil profile characteristics of these locations resulted in 83 proper Celtic field systems and 12 uncertain systems (Spek et al., 2003). Even after modern reclamation activities, Celtic field systems commonly remain visible in aerial photographs, due to the difference in humus content between the plots and the base of the raised boundaries (Spek, 2004; Harsema, 2005). However, when the surface of the land is obscured, viz. in woodlands, aerial photographs were of limited use and thorough field surveys were needed to determine the presence and location of Celtic field systems (Jankuhn, 1956/57; Koster, 1970; Nielsen, 1984).

4. New identification method of Celtic field systems

At the start of the 21st century the Actual Height Model of the Netherlands (AHN), a detailed elevation model of the whole country based on airborne laser altimetry, became available. Laser scanners are hardly hampered by vegetation compared to aerial photographs or satellite images and better register the elevation of the solid ground. To eliminate the small remaining reflections of vegetation on the raw data, different filter techniques were developed to compensate for different types of vegetation structures. The resulting data is representative for the elevation of the solid ground. The elevation levels of the entire Netherlands were mapped with