

Detecting long-term valley fill evolution and rice paddy land use: Ageoarcheological investigation of the Baeksuk valley and the Bronze Age settlement, South Korea



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ABSTRACT

This study investigates paleoenvironmental changes over time and ancient land use related to agriculture at the Bronze Age settlement of Baeksuk, Cheonan, South Korea. Geoarcheological analytic methods including soil micromorphological, physical and multi-element analyses were employed to examine the alluvial valley fill between hills occupied by a large-scale Bronze Age settlement with abundant crop remains including rice, but which was scarcely inhabited in later periods. The location of the cultivation fields remains as yet undetermined despite a full excavation. This research reveals that there were four phases in the build-up of the valley fill from wetland to periodically dry wetland and, eventually, to the present day rice paddy, forming a cumelic A horizon. In particular, the lower buried horizon may have served as the earliest location for growing rice with surface disturbance noted by textural pedofeature formation, while the upper part of the soil profile exhibits features typical of paddy soil with high iron and manganese accumulations. The analyses of the valley soil profile suggest plausible interactions between human agricultural activities and environment through rice paddy cultivation.

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1. Introduction

1.1. Earliest paddy rice agriculture in Korea

The onset of rice agriculture in the Korean peninsula is closely related to the spread of Bronze Age culture (c. 1500–300 BC). The Korean Bronze Age is divided into two phases, the Early Bronze Age (EBA) between the 15th and 8th centuries BC and the Late Bronze Age (LBA) from the 9th to 3rd centuries BC. The EBA in Korea is crucial as it is believed to be a burgeoning period of agriculture including rice cultivation (Ahn, 2010). EBA culture originated in northeastern China, which then expanded southward (Gong, 2012; Nelson, 1993), creating regional variations in terms of house layout, interior facility and pottery type. Abundant archeobotanical remains including millet, rice, wheat, barley and legumes demonstrate the extensive agricultural practices of that time. In particular, the high ubiquity of rice remains in Bronze Age houses indicates that this crop became a common staple (Kim, 2015). However, rice agriculture was implemented later in the Three-Kingdoms period (c. 300–700 AD) along with iron tools, animal power, and advanced irrigation techniques. This is postulated from the rarity of rice remains at the archeological sites in the following Proto-Three

Kingdoms (c. 0–300 AD) period after the Bronze Age due to either environmental deterioration or other causes hindering rice growth. With this archeological context, rice has been a focus of attention due to its physiology as a semi-aquatic plant distinguished from other crops in that it prefers warmer and flooded environments. This is not an economically suitable food resource as it requires intensive labor and therefore has a high cost of production. Indeed there are many issues regarding the modes of early rice agriculture in the Korean peninsula which remain unresolved from the ecological perspective with a question of ancient land use patterns, beyond the simple adoption of technology.

Considering the ecological conditions required for rice, the suggestion of a diffusion route from the north ignited long-enduring debates on the type of rice agriculture being practiced (Ahn, 2010; Cho, 2008). From the present day climatic conditions, in the North Korea region and the northeast part of South Korea, which is the core area for the diffusion route of EBA culture, paddy rice had long been highly restricted due to low temperatures and aridity, where c. 1300 mm is the minimum annual precipitation required for rice cultivation (Moormann and van Breemen, 1978). In the Korean peninsula, the annual precipitation at Pyeongyang, where EBA rice remains were discovered (Kim, 2014) equals 911 mm. In the middle, southern and southeastern parts of South Korea rainfall totals 1200–1500 mm, 1000–1800 mm, and 1000–1300 mm, respectively (Korea Meteorological Administration, 2016). Thus, alternative explanations such as slash and burn agriculture and dry rice farming rather than paddy rice cultivation have been

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suggested as ways for early immigrants to grow rice in the northern part of the Korean peninsula. This conjecture has been opposed by the suggestion that the commencement of dry rice farming would likely require physiological amendment to the dry landrace. This is more plausibly regarded as a later advancement of dry rice farming with imported new rice varieties and advanced agricultural techniques from Han China being used (Ahn, 2010; Cho, 2008).

The common siting of EBA settlements on hill-tops with relatively clay-rich soils raises the question whether rice paddy was used as the earliest mode of rice agriculture (Ahn, 2010). It clearly contrasts to the siting of LBA settlements which favored low-lying hills suitable for rice paddy rice, and which yielded many preserved paddy fields and irrigation facilities. Such excavation contexts may have obliterated the agrarian landscape of EBA, especially that associated with rice agriculture. Furthermore, no paleo-environmental studies are available with which to test the proposition that paddy rice was an initial mode of rice agriculture, and no targeted research question has been systematically carried out to address this problem.

It is noteworthy that there is a growing awareness of the need to develop new methodological tools to investigate ancient landscapes apart from excavation, archeobotanical and pollen analyses, and the investigation of stone tool assemblages (Cho, 2008) in an attempt to resolve this long-debated archeological question. One way to reconstruct

anthropogenic landscapes associated with agricultural practice is to understand paleo-environmental change associated with individual settlements and any potential effects on the agricultural system. This is where targeted geoarcheological studies are key.

Aiming to interrogate and understand the complex and long-term interplay between humans, knowing their agricultural activities and environment is crucial. This approach is manifested in the concept of cultural 'soilscape' in which physical, biological and chemical effects of human activities are encoded in the soil record (Wells, 2006). The Baeksuk site study reported on below aims to do this by examining the interlinked evidence between human occupation, the soil/sediment record of the associated valley fills and rice agriculture in the Korean Bronze Age period. This article is a modified and improved discussion of the preliminary report on the geoarcheological investigation of the Baeksuk valley (French and Lee, 2009).

1.2. Characteristics of paddy soils

Paddysoil is a soil altered by paddy rice cultivation which requires a flooded field except for few varieties and cultivation schemes using some kind of irrigation to enhance the soil moisture regime (Moormann and van Breemen, 1978). Thus, paddy soil is a type of anthrosol often exhibiting a reduced matrix and oxidized

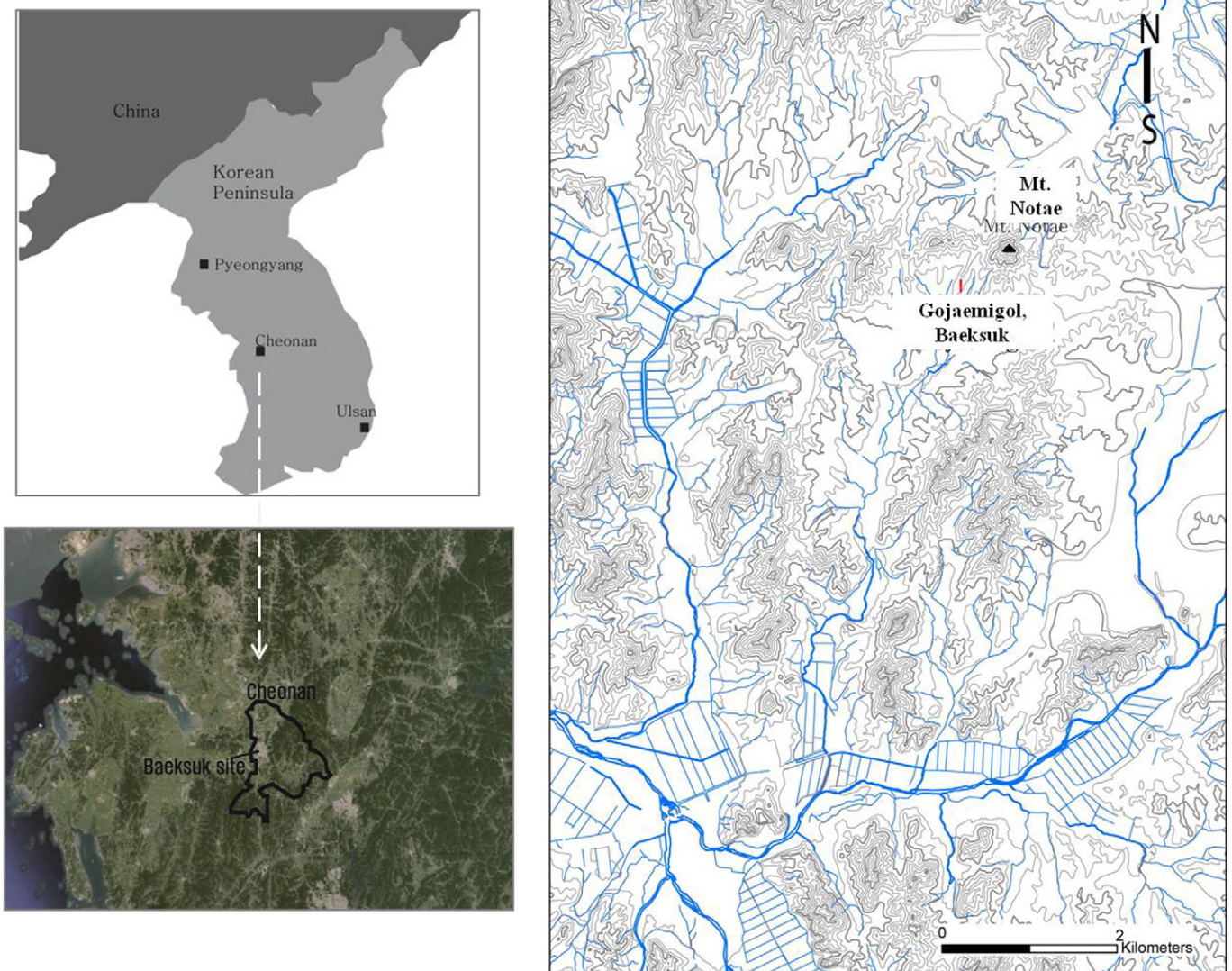


Fig. 1. Location of Baeksuk site.

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