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Plant Agency and the Domestication of Prehistoric Korea

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[Abstract]

Agriculture has been primarily understood from an anthropocentric standpoint with humans being the agents of cultivation and plants the objects of cultivation. This paper regards plants as nonhuman agents in agricultural interactions and presents an alternative perspective by emphasizing that crops had an explicit agenda of making copies of themselves and migrated to new soils using humans as a vehicle for their movement. Rice, wheat, and barley are non-native plants that arrived at the Korean peninsula in prehistory. A number of changes are archaeologically visible since their arrival, such as expansion in site range, increase in community size, shortening of inter-village distances and sedentariness. These changes were immediately beneficial to the reproduction of these crops. This paper demonstrates that the development of prehistoric farming

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communities is better understood when the changes are envisioned from the plant's viewpoint and when a discussion on plant materiality is brought into the consideration.

1. Introduction

This article explores prehistoric agriculture from the plant's viewpoint and presents a plant-centered discussion of the early agricultural communities. The purpose of this work is to achieve a more complete understanding of the Chulmun/Mumun (or the Neolithic/Bronze) transition in prehistoric Korea by regarding crops as nonhuman agents with an intention as well as the capacity to engage, manipulate, and control humans. Agency is a topic that has been fervently debated in archaeology over the past decades, and the emphasis in discussion has shifted over time. The early debates focused on the individual's capacity to exert his or her political intention, while the recent discussion incorporated a broader theoretical consideration on historically situated agency, relationality, materiality, and the dialectic relations between structure and action (Robb 2010). Over the course of considerations on agency, it has become clear that human agents act in relation with other people and objects, and that the capacity of material things to act on people and on social relationship should be under closer scrutiny (Robb 2010). The dialogues and discussion on the concept of agency, initially aimed at "putting people back in the past," have now included attempts to consider nonhuman entities as agents in people-material relationships. The idea of humans as the sole players is being reconsidered, as the people are also affected by the entities they influence, frequently in mutually supportive relationships (Knappett and Malafouris 2010).

Archaeological discussion on material agency has featured a range of objects such as pots, ornaments and megaliths; plants have also been brought to the fore in the debate (Bausch 2012; Gosden 2005; Hodder 2012: Robb 2010; Van der Veen 2014). In archaeological studies of prehistoric agriculture, plants have been primarily regarded as passive objects to be nurtured, traded and consumed by the human agents for a variety of human purposes. The persistent tendency of anthropocentric view on plant cultivation is odd, however, as it often overlooks on what the plants want, namely to reproduce (Pollan 2001; Van der Veen 2014). Reproduction, the act of making copies of oneself, is the fundamental desire of all plants, and botanical research is full of examples that illustrate the strategies that plants have developed to fulfill this desire over the long evolutionary process. This leads one to assume that plant agency is a valid concept and to suspect that agency may not necessarily be the exclusive property of human individuals. Plants, like other organisms, have an agenda, as well as the ability to express their agenda. As a well-studied example, many prehistoric crops in East Asia were alien to the locus of their cultivation and had travelled long distances across the Eurasian continent with humans as a medium of their movement. Entering into a new soil, these plants had a clear and simple desire to reproduce and the desire was eventually fulfilled beyond anyone’s expectation with humans enabling it. The current discussion is an inquiry into the complex entanglements of plants and people from a non-anthropocentric viewpoint and, by assuming plant agency, attempts to explore how the plant’s objectives were achieved in the prehistoric society.

The excavation of Pyeonggeo-dong, a multi-period settlement in Jinju, South Korea, is presented as a case study to illustrate the capacity of plant agents to act upon humans. The transition from the Chulmun (ca. 8000-1500 BC) to the Mumun (ca. 1500-1 BC) period in Korea is characterized by changes in the food-procurement system, from one that relied on hunting, gathering and fishing in addition to millet cultivation, to one that relied on harvesting crops alien to the region including rice, wheat and barley. The argument made here is that many societal changes in the Mumun period are better understood when the changes are contextualized by referring to the intention and behaviors of the new crops. The newly arrived crops influenced the humans in the region and induced changes in settlements, social relationship and other realms of people’s daily life, not necessarily for the farmers but for the benefit of the plants themselves. The inauguration of agricultural communities was prompted by the actions of the plant agents, and both plants and humans were responsible for the establishment of the new farming communities. While the presented example focuses on a single site and a region, the arguments presented herein have a wider applicability across East Asia.

2. Plants, Domesticated and Domesticating

In most archaeological studies of agriculture, plants are regarded as a food item, and plant cultivation as an activity of food production. This idea is advocated particularly in studies searching for the “origins” of agriculture. For instance, researchers have attempted to explain agricultural origins in terms of population-resource imbalances with the idea that a worsening food shortage caused people to artificially produce food (Binford 1968; Cohen 1977). The viewpoint that equates plants with food persists, and the transition from foraging to farming is presented as a shift from the collection to the production of "food." This persistent view of regarding cultivated plants as food is understandable since many, if not all, cultivated plants are eventually consumed as food. It is worth noting, however, that people rarely want *food as an undifferentiated entity*. But rather, food is referred to in the context of *a particular type of food*. People's desire for food tends to be very specific. In other words, farmers want a particular plant (and animal) species to reproduce successfully rather than simply have any edible material multiply. This observation is of importance since different plants have different evolutionary trajectories and are not alike in their optimal growth conditions, physical properties, and behaviors. People therefore have to change themselves, and adjust their own actions to align with the particular plants they have available and want to use.

The moment when people decided to contribute to the growth of their favorite plants was the time when people started to work towards fulfilling a plant's agenda. Reproduction is the ultimate goal of all plants, and a few plants have also successfully aligned their own goals with the way people think of them, thus employing people for their purposes. This transfer presumably happened multiple times across the globe from time immemorial but there is not always evidence to prove this. Argument has been made that agriculture should be seen as a type of mutual interaction among plants, animals and non-organic substances, and as an outcome of the evolutionary process that started long before the Holocene period (Blumer 1996; Ingold 1993; Rindos 1984). Seen from the plant perspective, humans in the Holocene have proven to be an effective collaborator by helping to reproduce, nurture and spread their offspring. Using humans as a means of transportation and reproduction, many wild plants multiplied and grew beyond the well-defined natural boundaries.

As plants have had to change their own genetic and physical make-up in order to adapt to human labor for their own purposes, an evolutionary process known as domestication has been at play. Plants have become increasingly dependent on humans for their reproduction, and this has created plants with new traits that include shape and function. The domesticated plants show similar characteristics even across different species. The new plants tend to germinate and bear fruit synchronously; have large seeds, fruits and other utilized organs; produce a smaller number of fruit; lose bitterness and toxic substances; lose their mechanical means of protection; have increased in starch, sugar and oil content, but decreased in protein content; lose their natural means of seed dispersal; and retain their mature seed or fruit on the plant body (Harlan 1992; Schwanitz 1996; Warwick and Stewart 2005). The increases in seed-size and the loss of natural means of seed dispersal have been commonly discussed in archaeology, partly because these changes are observable from the archaeobotanical remains (Crawford and Shen 1998; Fuller et al. 2007; Liu et al. 2007; Thompson 1996). The two changes mentioned above are advantageous to farmers since they provide immobile and larger food crops.

Seen from a perspective, humans have also changed as they have become part of a new relationship, and some of these changes have been *biological*. The consumption of domesticated plants has incurred changes in the chemical composition of people’s body, as shown by stable isotope analyses for such as ^{15}N and ^{13}C content (Vogel and Van der Merwe

1977). The reliance on soft-textured and carbohydrate-rich cereals has decreased the infant mortality; it has also promoted the rapid growth of the newborn and young, along with hastening the age of first maturation and shortening the period of breastfeeding. There have also been changes to the female fecundity due to these dietary source changes (Hillman 1989; Pennington 1992). A cereals diet has induced craniofacial alteration towards a smaller face, and has contributed to a decline in dental health with a high degree of dental caries, ante mortem tooth loss, tooth crowding and malocclusion (Larsen 1995). The nutritional conditions and physical labors unique to the farming societies have caused a decline in stature, loss of cortical bone thickness, pervasiveness of other bone-related diseases such as osteoarthritis, osteophytosis, and spondylolysis (Larsen 1995). The strenuous manual activities of grinding cereal grains into flour with mortars and pestles damage bone-protecting cartilage, and can cause elbow osteoarthritis. The biological changes in the foraging/farming transition have induced humans to rely more on cultivated plants for their survival and reproduction.

Some changes are *behavioral*. People start to behave differently as they help new plants to grow. Instead of walking long distances, people decided to ambulate less, spending more time on raising immobile plants. People in virtually all societal levels nurture and are emotionally attached to certain plants, but the behaviors in the remote past have not been easily deduced (Hastorf 1998). Some plants nonetheless have pushed people beyond a threshold and have created archaeological vestiges. For instance, people in farming communities transform the surrounding landscape towards promoting the growth of particular plants. The examples include the large-scale land modifications such as the construction of agricultural fields, terraces and irrigation canals in addition to the smaller and routine activities of plowing, watering, weeding and fertilizing with manure. People transform the land into a particular territory, which may be collectively or privately owned. The cultivated plants also lead people to seek new knowledge regarding soil, water, weather and celestial body movements, and to schedule ritual performances and social events in accordance with the crop growing cycles (Zaro and Lohse 2005). The plants bring new rhythms and tempos of activity into the society.

Additionally, many changes that people go through with the newly induced plants are *social*. The changes under this category have been most intensively discussed in archaeology. The new plants change people's worldview and the way people define themselves. Cultivated plants tend to grow together, and the crops densely filling the agricultural fields can feed more people per given land area than the wild plants sparsely scattered across the landscape. As such, the new plants restructure human societies towards ones with denser populations and sedentary communities; with these changes, there frequently is surplus food and wealth, along with specialized labors and a social hierarchy. Food surplus incurred by the cultivated plants supports the emergence of social elites, who are not directly involved in food production but preside over rituals and monopolize decision making. The cultivated plants also encourage inequality between the sexes (Diamond 1987). Once established, social hierarchy in turn promotes the reproduction of particular plants, which are mobilized towards the center and are placed under the leadership's control. In this regard, the social elites and crops mutually benefit from each other, while the majority of the human population have to bear an increased workload for propagating the crops and thus enabling the reproduction of those particular plants.

In short, the cultivators and the cultivated plants are interdependent, and both have to transform themselves for their relationships to prosper. People and plants domesticated each other (Van der Veen 2014). Even people in a pre-agricultural society affected and altered their plants by harvesting, nurturing, removing, and transporting them. There are many archaeological examples of foragers who favored certain plants, relocated the plants nearer to their villages, and put them under intensive care, while dispensing with less favored plants (Hastorf 1998). People's power over the plant world grew even larger in agricultural societies.

Plants played their part in transforming the human world. People moved around and relocated themselves in relation to plants, and considered their surroundings barren if they could not find the plants they wanted. The plants enticed people with their fruits and grains, which the people were willing to purchase at the expense of their health, labor, and freedom. They motivated people to create a larger workforce by providing calories and nutrition, and lured the people to return periodically or become sedentary from the provided stability with storable food. Social hierarchy and alliance was maintained by providing foods, spices and symbolic items. All these social changes were then transcribed into producing more of these plants.

The details of behavioral and societal changes that result from people's engagement with new plants are determined in great part by the nature of each plant. Each plant species brings its own habit, temper, and personality as they engage with humans. They behave differently from each other just like humans are different from other animals helping in pollination and seed dispersal. Farmers have to adjust their own actions and worldview in accordance with the plants they cultivate. The plants determine how farmers build their society and interact with their fellow human beings. In this regard, it is important to scrutinize what the newly arrived plants were in order to understand how they influenced the social domain.

3. Crops in Korean Prehistory: What were they and what did they want?

3.1. Oaks

Pollen research indicates that oaks (*Quercus*) proliferated across the Korean peninsula with the beginning of the Holocene period (Choi 1998). The oaks produce acorn, which is nutritious and rich in carbohydrate and fat. The acorn was an important food for squirrels, wild boars and deer, as well as for humans during the Chulmun period. Unlike the crops that came later, oaks do not rely on humans for their reproduction. Oaks primarily use squirrels for seed dispersal, which move acorns away from the parent trees and, beyond their original intention of caching them for future use, end up planting some portion of them in suitable locations for germination (Janzen 1971). Acorns therefore should be large enough to attract squirrels but small enough for them to carry. Oaks compete with each other for sunlight, water and nutrients, and produce more acorns when they are spaced apart. Although oaks are independent of humans for their growth, they nonetheless engage and affect people. The scattered distribution of oak wood induces the foraging communities to disperse across the landscape. People start to use stone mortars and pestles to process hard nuts. They make clay vessels and dig underground pits to hold water and make acorns edible by leaching out the bitter tannins. These behaviors characterized the Chulmun period (Kim et al. 2015; Korean Archaeological Society 2012).

3.2. Millets

Two species of millets — foxtail millet (*Setaria italica*) and broomcorn millet (*Panicum miliaceum*) — started to grow in the Korean peninsula no later than 4000 BC. Foxtail millet is known to have evolved from bristle grass (*Setaria viridis*), which is widely distributed across Eurasia, whereas the wild ancestor of broomcorn millet remains unclear (Hunt et al. 2008; Zohary and Hopf 2000). These millets were first cultivated in northern China and then migrated to the Korean peninsula. Yang et al. (2012) argued that, based on starch grain analysis, millet cultivation started in China as early as ca. 8000 BC. Zhao (2011) reports the carbonized foxtail and broomcorn millet grains of ca. 6000 BC recovered from several sites along the Yellow River in northeastern China. Two millets successfully moved across the landscape towards Korea, as the carbonized remains from Xinglonggou (ca. 5600 BC) in the upper Liao River region indicate. The millet remains have been found from many Korean Chulmun sites of ca. 4000 BC and the later periods (Kim et al. 2015).

Foxtail and broomcorn millets are adaptable to a wide range of habits and grow on hill slopes as well as on plains. Millets require only a small amount of water and are tolerant of a dry climate, unpredictable rainfall and sandy soils, although the addition of water and fertilizer facilitates growth (Weber and Fuller 2008; Weber et al. 2010). Millets bear ripe fruit in a very short period of less than 90 days after sowing (USDA 2016). The cultivation of foxtail and broomcorn millets do not necessarily demand a high population density and labor input, and even blends into a nomadic way of life (Frachetti et al. 2010; Lightfoot et al. 2015). Millets can be independent of human activity and sometimes escape from cultivated fields and locate themselves in other habitats with lesser human intervention. Foxtail millet is known to be still inter-fertile with their wild progenitor (Zohary and Hopf 2000). The millet grains are yet as nutritious as other cereals and can be easily stored for a long period (Weber and Fuller 2008).

3.3. Legumes

The wild progenitors of soybean (*Glycine max* subsp. *max*) and red bean (*Vigna angularis* var. *angularis*), *G. max* subsp. *soja* and *V. angularis* var. *nipponensis*, respectively, are native to East Asia, and researchers have argued that the cultivation of these plants may have started as early as the Chulmun period in Korea (Ahn 2002; Lee 2013; Lee et al. 2011; Lee and Park 2006). Carbonized remains of these legumes were discovered from more than fifty Chulmun and Mumun sites across the Korean peninsula (Ahn 2008). Soybean and red bean were undoubtedly important economic plants in prehistory, and their importance may have increased even further in historic times.

Soybean and red bean grow in a diversity of environmental conditions and have relatively flexible sowing period and, in many aspects, are complementary to other cereals. Legumes are rich in protein and fat, and offer a balanced nutrition along with other carbohydrate-rich grains. They also help the reproduction of other crops by enriching the soil with nitrogen absorbed from the air. Legumes can thus be effectively cultivated in combination with other grain crops as a mean to improve soil fertility and to increase the overall crop yields. Cultivation of legumes could have been important not only for producing more food matter but also for improving farming systems, which was the case in pre-modern Korea.

3.4. Rice

Rice (*Oryza sative*) is radically different from millets and legumes. Rice originated from the Yangtze River region in southern China and arrived at the Korean soil approximately 2500 years after the millets, in the beginning of the Mumun period (Ahn 2010). Archaeological sites in Korea with carbonized rice grains count more than a hundred (Ahn 2008; Kim 2015). There are two subspecies of Asian rice, *japonica* and *indica*, and the remains from the Korean sites conform to *japonica* type, which are characterized by short and plump grains. The ancestors of cultivated rice include *Oryza rufipogon* and *O. nivara*, which are perennial and annual grasses that grow in shallow waters of tropical and subtropical regions (Zohary and Hopf 2000). As with its ancestors, the cultivated rice, especially the *japonica* type, requires high temperature, prolonged sunshine and an ample supply of water (Grist 1965).

In the temperate region such as Korea where rice would have been perceived as being in a sub-optical environment, the influence of rice on human behavior and social arena is profound. Most importantly, successful rice cultivation depends on the farmer's ability to utilize periodic rainfalls and manage paddy fields. It is not a matter of supplying sufficient water per se, but of controlling it. The water should be gently flowing, not stagnant, and an excessive supply of water may be harmful. The fields need to be drained several times over the course of the rice's life cycle when manured and fertilized, and be completely drained by the time of the harvest. The water should be equally distributed across the paddy fields, because the fields located distant from the water sources may receive less water and be less productive. Because rice's demand is very specific, the summer becomes an important season when long sunlight, high temperatures and abundant rainfalls convene. This is the busiest time of the year when the fields should be weeded, manured and fertilized, and the farmers have to be wary of pest and disease.

Rice tends to draw people together and tie them to the ground. All household members including children and elders contribute their labor to rice cultivation, and rice becomes a symbol of family and lineage identity (Ohnuki-Tierney 1993). Rice demands sophisticated irrigation and paddy fields, and the construction and management of the water facilities are carried out on a communal basis. Rice cultivation should be carefully organized in a community in order to guarantee a good harvest. Rice requires a large workgroup and the need for a collaborative labor force on a seasonal basis is essential. Researchers have noted that a sophisticated water-management system is required to secure rice production and that rice cultivation tends to create a large cooperative workgroup and a communal and/or centralized social organization (Bray 1986; Fuller and Qin 2009). Although all crops would naturally mobilize human labor, rice tends to intensify it. Rice cultivation requires people to work harmoniously while supporting some hierarchical social orders. The aggregation of people in farming villages was advantageous for reproduction of rice.

3.5. Wheat and barley

Wheat (*Triticum aestivum*) and barley (*Hordeum vulgare*) originated from the Near East and traveled the longest distance among the crops to reach the Korean peninsula. Carbonized wheat and barley grains dating to the second millennium BC have been found at multiple sites across northern China (D'Alpoim Guedes et al. 2015; Flad et al. 2010). Some uncertainty remains with the earliest wheat remains of Korea. It is conventional to think that wheat and barley cultivation started in the Mumun period. However, the recent discovery of carbonized wheat grains and the accelerator mass spectrometry dating obtained directly from the grains suggest that cultivation may have started in the Chulmun period (Han et al. 2014). The evidence of wheat and barley cultivation for the Chulmun period is yet meager, while there are more than fifty Mumun-period sites that have yielded carbonized wheat and barley remains (Ahn 2008; Kim 2013).

Wheat and barley have a novel seasonal rhythm. Unlike most other crops that are sown in the spring and harvested in the fall, wheat and barley maintain a unique life cycle of being sown in the fall and harvested in the late spring. There are some varieties that are sown in the early spring and harvested in the late summer, but such scheduling is rather an exception. Wheat and barley are not simply tolerant of cool temperatures but have also evolved to make use of it, as cold temperatures in winter suppress the activities of weeds and insects harmful to their growth. In Korea, wheat and barley planted in the fall soon germinate and develop into young plants, remain dormant during the winter, and resume growth in the early spring to mature by the late spring. A hot and humid climate is detrimental to these crops, as it would cause disease and root problems, although an adequate supply of moisture is important during the growing season.

Compared with rice, wheat and barley bring people together and to the farming grounds for different reasons and at different times of year. The total amount of required labor for wheat and barley cultivation could be less than that of rice. Yet farmers should continue caring for the crops throughout the winter season. The unique and traditional method of nurturing wheat and barley in East Asia has been to apply mechanical stress by periodically treading seedlings during the winter (Kim 1985; Lida 2014; National Folk Museum of Korea 1997, 1998). This is called *mil balki* (for wheat) and *bori balki* (for barley) in Korean, and *mugifumi* in Japanese. This activity prevents spindly growth, strengthens and spreads roots, shortens plant height, increases tiller number and spike length, and eventually leads to a better yield (Lida 2014). Freezing is also prevented by lodging roots in the soil, which rise from the ground with the development of frost pillars (Lida 2014). As to when and how often to tread the ground, it is determined every year depending on weather and growth conditions. Typically, treading is performed every ten days and neighbors are convened for this work (National Folk Museum of Korea 1998). Wheat and barley demand farmers to adjust their schedule for the winter, which was previously saved not for plant cultivation but for hunting and shellfish collecting during the Chulmun period.

3.6. Influence of these crops

Every crop brings its own temperament and character in its relationship with people, and people have to accordingly adjust their behaviors and lifeways. Millets only minimally demand people to aggregate and work on the ground. They nonetheless expect people to settle down and cultivate their next generation, and offer storable foodstuffs in exchange. Rice wants people to work harder, especially on hot summer days, and to secure an adequate supply of water. To have a paddy densely filled with rice, people should similarly aggregate and work harmoniously as a community. Rice also induces people to cultivate their own leaders. Wheat and barley bring their own seasonal rhythms. They have farmers continue farming throughout the winter. All these plants are agents that have actively played their parts in the new plant-people interaction.

4. Pyeonggeo-dong: an Overview

The social and behavioral changes that occurred with plant agency are illustrated using the case of Pyeonggeo-dong as reference. Pyeonggeo-dong is a multi-period site located in the Namgang River basin, Jinju (Fig. 1). The excavation in 2005-2010 of approximately 0.27 km^2 revealed that the site contained the remains of Paleolithic (-8000 BC), Chulmun (8000-1500 BC), and Mumun (1500-1 BC) periods, as well as those of the later historical periods (Gyeongnam Development Institute 2011, 2012). The primary interest of this paper is the Chulmun and Mumun periods, during which communities emerged and developed that were dependent on cultivated plants. The archaeological features of the Chulmun period include 10 pit houses and 27 hearths, whereas those of the Mumun period include 70 pit houses, 33 dolmen and stone cist burials, and remains of wet and dry agricultural fields (Gyeongnam Development Institute

2011, 2012; Jeong et al. 2012; Mun et al. 2012). The region along the Namgang River has been intensively excavated in the late 1990s and early 2000s. There are many prehistoric sites in the vicinity, and some of them are multiple-period sites occupied during the Chulmun and Mumun periods (Gyeongnam Development Institute 2011).

Fig. 1. Aerial view of Pyeonggeo-dong

Pyeonggeo-dong and multiple sites along the Namgang River have been the subject of archaeobotanical research (Crawford and Lee 2003; Lee 2011). The previous studies show that, during the Chulmun period, acorns (*Quercus*) were collected, and broomcorn millet, foxtail millet and legumes (*Glycine* and *Vigna*) were cultivated. Wild plants recovered from the Chulmun period include kiwi (*Actinidia*), grape (*Vitis*), sesame

(*Perilla/Molsa*), goosefoot (*Chenopodium*), and knotweed (*Polygonum*). The subsequent Mumun period witnessed the arrival of new crops, most importantly rice, wheat and barley, while broomcorn and foxtail millets and legumes continued to grow. The Chulmun and Mumun people were both agricultural, but some differences are noted. The Chulmun focused on a rather small range of crops, primarily broomcorn and foxtail millets whereas those of the Mumun period relied on a diversity of crops, newly incorporating the crops from southern China and the Near East. The cultivation of new crops caused behavioral and societal changes, which were directly beneficial to the reproduction of these crops.

5. Plant-altered Landscape

The arrival of new crops caused space competition among the crops and demanded people to pay efforts to reclaim new lands. The geographical features of Pyeonggeo-dong consist of river, natural levees, floodplain, and hills (Fig. 1). The floodplain stretches from the natural levees in the south and meets the hill slopes in the north. Typical of a riverine environment, the levees are higher than the floodplain and are composed of relatively heavy and coarse sediments, whereas smaller and lighter sediments were deposited across the floodplain. The levees of Pyeonggeo-dong were well drained, and as the site excavators noted, the location would have been suitable for residence and dry-field farming (Gyeongnam Development Institute 2011). Concerning floodplains, these are rather flat and low-lying, and contain finer and clayey sediments. The floodplains retain more moisture than the natural levees due to their low altitude and the inundation caused by periodic precipitation and groundwater activities. This makes the floodplains a suitable location for wet paddies, while they would have been less preferred for human residence.

The pit houses and hearths of the Chulmun period are all located on natural levees. The dry fields for millet cultivation are also assumed to have been located on or near the levees, although evidence for Chulmun-period dry fields has not been found. It remains unknown how or even whether the floodplain was utilized during the Chulmun period because archaeological remains are absent for this period and for this location. The change in land-use pattern is clearly noticeable in the subsequent Mumun period, during which dry and wet paddy fields were respectively constructed in the natural levees and the floodplains (Fig. 2). Pit houses continued to be built on the levees during the Mumun period. The levees were the central location for the villages during the Chulmun and the Mumun periods, while the site range expanded in the latter period as the land previously abandoned or low-utilized were newly incorporated into the agricultural lifeways.

The cultivation of new land and the expansion in the site range are closely related to the arrival of non-native plants, especially rice. Seen from the perspective of rice that newly reached the area, the natural levees would not have been an attractive space because this location contained sandy and dry sediments and were already being used by others, i.e., millets, legumes, and humans. Rice would do better in the floodplain, which was vast, flat and unpopulated, consisted of fine sediments, and allowed for an easy supply of water with low altitude and periodic flooding. The colonization of new land was achieved with the ability of rice to engage with humans and to mobilize human labors to construct paddy systems.

The people of Pyeonggeo-dong were under the influence of this new relationship as indicated by the remains of wet paddy fields.

Fig. 2. Excavation of Mumun-period dry field (up) and wet paddy field (down) of Pyeonggeo-dong (photos courtesy of Minjung Ko)

The new plant-human interactions determined the way people engaged with the lithic materials. Neither metallic agricultural tools nor draft animals were available during the Mumun period. The only metallic objects were bronze daggers and mirrors, which were prestige items and would have been extremely rare. Dog was the only domesticated animal in this period. This implies that all agricultural and earth works had to be done manually using stone and wooden tools. In Pyeonggeo-dong, the 10 Chulmun-period houses (404 m^2 in total) and the 74 Mumun-period houses (3102 m^2 in total) respectively contained 42 and 962 stone tools. That is, an area of 10 m^2 of the Chulmun houses contained one stone tool whereas it was three in the Mumun houses. The Mumun houses not only had more stone tools but also had more diverse ones. In addition to mortar, pestle and arrowhead of the previous era, the Mumun stone assemblages contained axe, shovel, adze and knife, which enabled people to exert a greater control over the landscape (Gyeongnam Development Institute 2011, 2012). The desire of the plants to colonize a new land affected the people-stone relationship and intensified the anthropogenic disturbance of the riverine environment.

6. Collaboration

The important change seen with the advent of rice is that the number of pit houses increased in Pyeonggeo-dong and that the region witnessed a burgeoning of new villages along the river. In Pyeonggeo-dong, the house numbers increased from 10 to 74 between the Chulmun and Mumun periods. This suggests an intensified social aggregation in the later period, although not all houses would have been contemporaneous. The total area covered by the houses also expanded 7.7 times from 404 m^2 to 3102 m^2. This change was accompanied by an increase in the number of villages across the region. Twelve Mumun sites have so far been discovered along the Namgang River whereas there are only four known Chulmun sites (Fig. 3). The number of pit houses across the region multiplied 19 times from 33 from the Chulmun period to 627 from the Mumun period. The overall settlement pattern suggests that there were more people and villages across the region, and that more work forces could be assembled when needed during the Mumun period. These occasions would have included, but were not limited to, rice farming events.

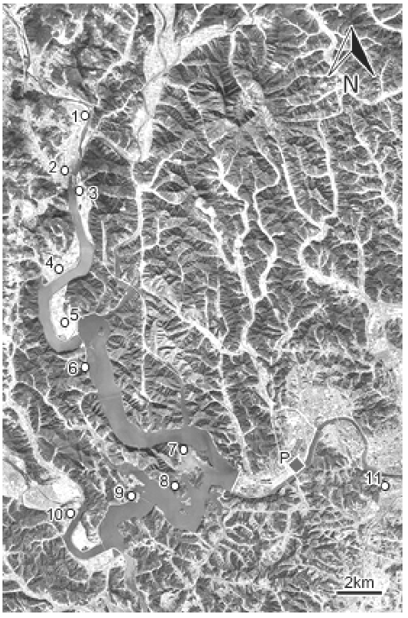

Fig. 3. The Chulmun and Mumun period sites along the Namgang River; P. Pyeonggeo-dong, 1. Gangru-ri, 2. Sawol-ri, 3. Mukgok-ri, 4. Soman-ri, 5. Daepyeong-ri, 6. Sangchon-ri, 7. Daechon, 8. Gwigok-dong, 9. Naechon-ri, 10. Bonchon-ri, 11. Gaho-dong; All sites have the Mumun houses, and Pyeonggeo-dong and # 4, 5, 6 sites also have the Chulmun houses.

Rice production would have supported more population, but the aggregation of people was also a prerequisite for rice production. Researchers have highlighted the importance of collaborative works in rice cultivation, the need of which tends to be seasonally acute (Bray 1986; Kim 1985; Reed 1979; Ohnuki-Tierney 1993). Kim (1985) notes that, in the rural Korea before industrialization, labor for rice cultivation was assembled either through a large-scale and centralized labor mobilization, called *dure*, or through a small-scale and personal labor exchange, called *pumasi*. For the *dure*, people from one or multiple villages were summoned and directed to work. The *dure* represents a centralized social system because there is a leader who supervises the works and the participation in the communal works is to a certain extent mandatory with social pressure. The *pumasi*, on the other hand, is a private labor exchange among equals, mostly relatives and neighbors, at the times of high labor demand. It is generally agreed that the *dure* and *pumasi* have a long history and the primitive forms of such activities have existed since prehistory with the beginning of rice cultivation (Kim 1985).

Although all crops draw people together and mobilize their labor to some degree, rice tends to intensify these processes. Archaeological investigation of the Chulmun-period sites across the southern part of the Korean peninsula shows that the site numbers increased and some large sites appeared around 4000 BC, possibly with the beginning of millet cultivation (Kim et al. 2015). Compared with rice, the force of labor mobilization for millets was not strong. Millets mature within a relatively short span, and with minimal human labor and with little landscape modification. These plants only minimally lead people to aggregate and work collaboratively. Most Chulmun sites were small in scale with only a few houses and the distances between the sites were long. Furthermore, the number of inland sites sharply decreased towards the end of the Chulmun period (Ahn et al. 2015; Kim et al. 2015). Millets almost failed to use humans for their purposes when the late phases of the Chulmun period are concerned. Compared to the millets, rice should be seen as a plant that more forcefully led to mobilization of the human labor force. Rice created agricultural communities devoted to its reproduction and gave them a new identity. The Pyeonggeo-dong settlement in the Chulmun/Mumun transition reflects this change.

7. Seasonality and Mobility

The winter cereals such as wheat and barley add an offbeat rhythm to the seasonal agricultural cycles. Winter would have been a slack period for farmers without these plants. The winter cereals allowed the farmers to rotate crops and increase food amount in a limited space, provided that the farmers were willing to adjust their yearly schedule. Wheat and barley are less laborious to cultivate because of the low insect and weed activities, and there is no need for irrigation during the winter. However, they need to be protected, manured and nurtured throughout the winter in order to guarantee a good harvest. Treading wheat and barley seedlings was an important winter activity in the absence of mechanical equipment. Wheat and barley fields should also be manured during the winter. These activities are more effective with larger groups of people and lead to communal work that periodically convenes multiple families and neighbors (National Folk Museum of Korea 1997, 1998). Admittedly, it is difficult to know whether prehistoric people practiced the same cultivation methods as those in the modern era. It is nonetheless certain that these plants would have done better when people stayed with them during the winter. The storage of nuts, millets, legumes, and rice already made people less mobile and build year-round sedentary villages. The cultivation of wheat and barley strengthened this trend.

The introduction of a new seasonal rhythm can be inferred with the change in the pattern of shell middens along the southern coast. The Mumun period witnessed the discontinued or decreased utilization of littoral resources, accompanied by the disappearance of shell middens. There are more than 60 Chulmun-period shell middens located within 100 km of Pyeonggeo-dong, whereas there is virtually none for the Mumun period

(Fig. 4). The dominant shell species was the Pacific oyster (*Crassostrea gigas*), typically collected between the late fall and early spring. People may have shunned collecting littoral resources due to a number of ecological and social reasons, which should be further investigated. The lack of the shell middens in the Mumun period nevertheless shows that the coastal region was no longer the place where a large number of people aggregated in the winter. The disappearance of shell middens on the coast and the concurrent emergence of large inland settlements were consonant with the new rhythms of wheat and barley.

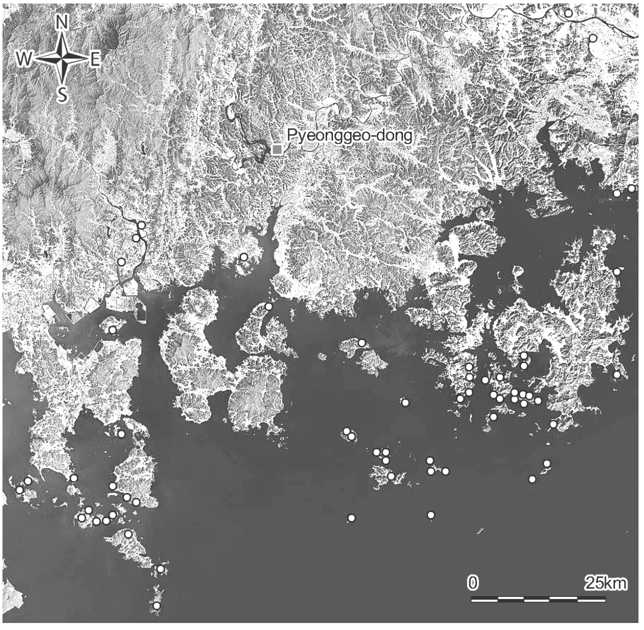

Fig. 4. The Chulmun-period shell middens along the southern coast; see Korea Cultural Property Investigation and Research Institute Association (2010) for the details of each shell midden.

8. Discussion and Conclusion

This article offers an alternative understanding of plant cultivation and the start of farming in prehistory. The commonplace stance is to regard cultivation as something that we, humans, have done to objects that include plants. The question is whether it is possible to understand plant cultivation as something that plants may have done to us, and to see agricultural communities as an achievement not only of humans but also of plants. This alternative understanding is possible when plants are seen as an agent, and not as a food resource or an immobile component in the natural environment. The new perspective begins by acknowledging that plants have a desire for reproduction and mingling with humans in a web of relationships to fulfill their desire. Many plants that thrived and outcompeted other species in Korean history have originated from distant locations. Rice, wheat and barley are noteworthy, while numerous other plants, for instance, sorghum, tea tree, potato, chili pepper and tobacco, can be listed in the later history. These plants moved out of their original habitats, as humans themselves once did out of Africa, and colonized new lands using humans as a medium of interaction with the material world. Agriculture was an accomplishment for them as much as it was for humans.

The excavation of Pyeonggeo-dong shows how plant agency shaped the early farmers and the farming communities. All plants changed people in one way or another. Oak trees provided acorns and made people less mobile. Oak trees were yet fairly independent of humans for their reproduction. Millets and legumes offered edible seeds, and in exchange required humans to prepare fields and to remove competing weeds. They also contributed to the formation of rudimentary farming villages. Yet stronger influences are perceived for rice, wheat and barley. Rice required water, and its steady supply necessitated people working communally and collaboratively. Rice also provided grains, which were deemed palatable and even precious, and in turn required people to aggregate, make communities with a strong ethos of harmony, and accept hierarchical social relationships. The winter cereals of wheat and barley brought in unique tempos and rhythms and made farmers work on the ground at a year-round basis. All these plants played their roles in creating new farmers and agricultural communities.

In summary, the prehistoric farming communities should be seen as an outcome of the interplay among plant, human, and material agency. People may have decided to start plant cultivation for a variety of reasons such food shortage or demand for delicacy. Whatever these reasons were, they could satisfy their need only by engaging with plants, which came with their own temperaments, predispositions and characteristics. People therefore had to adjust their body, behavior and life styles in the way required by the new relationships with the plants they cultivated. People sometimes had to endure high population densities, unbalanced diet, malnourishment, and hierarchical social structure, which may not have been advantageous to them but enabled more efficient means of reproduction for the plants. This paper deliberately focused on a few crops in Korean prehistory and on the rather limited subjects of landscape modification, community building, seasonality, and mobility. It is hoped that future research incorporates a broader range of plants and delves deeper into their relationships with humans.

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초 록

식물 작용주체와 선사시대 한반도의 순화 과정

김 민 구*

농경에 대한 기존의 고고학적 논의는 인간 중심적인 관점에서 이루어졌으며, 인간을 주체로 식물을 객체로 보았다. 본 논문은 식물 역시 인간이나 다른 동물과 함께 작용주체라는 점을 논한다. 인간과 마찬가지로 식물 역시 번식이라는 욕망을 가지고 있고 이 욕망을 충족시키기 위해 다양한 방법을 사용한다. 쌀, 밀, 보리는 외래식물이며 선사시대에 한반도에 도래하였다. 이 식물들이 도래한 후에 선사 문화는 급격하게 변화하였는데, 대표적인 변화로 유적의 확장, 공동체 규모의 증대, 유적간 거리의 감소, 강화된 정주성 등을 들 수 있다. 이러한 일련의 변화는 새롭게 도래한 외래식물의 번식이라는 목표를 효율적으로 이루기 위한 것이다. 본 논문은 선사시대 농경 공동체의 형성이란 인문적 변화를 식물의 관점에서 새롭게 이해할 필요가 있음을 보이고, 선사 농경에 관한 고고학적 논의에서 식물의 물질성을 적극적으로 고려하여야 함을 강조한다.

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