HOABINHIAN IN VIETNAM AND ECONOMIC ACTIVITIES FROM 20,000 TO 7,000 YEARS BP

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Abstract

This article studies the basic economic activities of Hoa Binh cultural inhabitants in the period of 20,000 to 7,000 years BP, including tool making, hunting, gathering, and primitive agriculture. The research results have identified a number of key economic characteristics of Hoa Binh cultural residents and evaluated the effectiveness of human methods of finding and gathering food under the fluctuations of the natural environment during the late Pleistocene to early Holocene in northern Vietnam. Little evidence directly related to cultivation and animal husbandry has been found at Hoa Binh cultural sites, so the issue of Hoa Binh agriculture is still a working hypothesis that needs to be studied further.

Keywords: Hoa Binh culture; Hoabinhian tradition; Hoabinhian-like; Hoabinhian technocomplex; Holocene; Post-Hoabinhian.
1. **THE HOABINHIAN - A REVIEW**

_Hoa Binh culture_ (Hoabinhian) is an archaeological culture from the Late Paleolithic to the Early Neolithic in Vietnam, dating from 20,000 to 7,000 BP (before the present). The economic activities of this period were of incipient socio-economic complexity – the first stage of humanity. The outstanding features of the Hoabinhian are foraging activities based on raw material supply (mainly stone, bamboo, and wooden tools), social ownership of the means of production and the products of labor, and a classless society where all members are equal as they work and enjoy life together.

In early 1932, a resolution acknowledging the term _Hoabinhian_ proposed by M. Colani was passed by a special committee set up by the First Congress of Prehistorians of the Far East in Hanoi (Prehistoria Asia Orientalis, 1932, pp. 11-12). The concept of Hoabinhian was introduced by M. Colani, based mainly on the morpho-technological criteria of stone tools. Typical cobble tools worked only on one face are the ovate axe, short axe, disc-shaped scraper, pestle, grinding stone, and bone tool. They are located in the sediments of limestone caves (karst) in the upstream region of northern Vietnam, which are filled with freshwater mollusk shells, animal bones, burial remains, and human remains. The Hoabinhian archaeological sites include three substages: Hoabinhian I - Paleolithic, Hoabinhian II - Mesolithic, and Hoabinhian III - Neolithic or Bacsonian (Colani, 1927, 1930).

In the 1960s, the Hoabinhian sites in Vietnam were researched again. In “Vietnam in primeval times” (Первобытное прошлое Вьетнама), Hoabinhian is characterized as occurring during the Mesolithic (Boriskovski, 1966) and being distributed in limestone caves in Hoa Binh and surrounding provinces with a culture layer containing freshwater mollusk shells. Tools were mainly made from pebbles. The main tools are sumatralith axes (both unifacial and bifacial), bifacial ovate hand axes, long axes, short axes, disc-shaped scrapers, scrapers made of cobbles with a flaked edge on one side, Bacsonian axes, grinding stones, pestles, grinding tables, bone tools, horns, and mussel shells (Boriskovski, 1966, pp. 85-90).

In the 1960s and 1970s, Hoabinhian sites were discovered in some Southeast Asian countries and southern China. Since then, the concept of the Hoabinhian has been expanded spatially to include mainland Southeast Asia, and its period is estimated to last from the late Pleistocene to the early Holocene (50,000–5,000 BP). New technical terms for _Hoa Binh culture_ were also introduced, such as Hoabinhian, Hoabinhians, Hoabinhian tradition, and Hoabinhian technocomplex (Gorman, 1971; Solheim, 1970, pp. 145-162, 1972, pp. 34-41). However, these terms were reviewed in 1992 by Southeast Asian archaeologists at a meeting in Hanoi. Finally, they agreed to use the first term _Hoabinhian_ introduced by M. Colani and defined its timespan as lasting from the late Pleistocene to the early Holocene (Hà, 1994, pp. 3-8).

Several aspects of the Hoabinhian have been summarized (Hoàng, 1989). Most Vietnamese archaeologists consider Hoabinhian culture to be the archaeological culture of a group of people residing in the limestone mountains of northern Vietnam. The stone
tools made by Hoabinhian residents have strong consistency and coherence in terms of tool working characteristics. Typical examples include the ovate axe, disc-shaped scraper, short axe, sumatralith tool, and edge-polished stone axe. Along with the stone tool collection are pestles, grinding tables, grinding stones, percussion stones, flakes, stones with holes in the middle, and bone and mollusk shell tools. Hoabinhian people mainly collected freshwater mollusks and hunted small and medium-sized animals. They may have known incipient agricultural activities (dating 20,000–7,000 BP). The Hoabinhian is classified in three stages: pre-Hoabinhian (20,000–11,000 BP), Typical Hoabinhian (11,000–9,000 BP), and Developed Hoabinhian (9,000–7,000 BP) (Nguyễn, 1984a, pp. 75–86, 1994, pp. 22–30, 2021, pp. 26–43). Archaeological sites more recent than 7,000 BP are collectively known as “post-Hoabinhian.” Archaeological sites outside the territory of Vietnam with unifacial cobble tools similar to those of the Hoa Binh culture are called “Hoabinhian-like.”

2. ECONOMIC ACTIVITIES OF HOABINHIAN PEOPLE

2.1. Crafting tools

Crafting tools was an important economic activity for the Hoabinhian people. The Hoabinhian artifacts include stone tools, bone tools, mollusk shells, and pottery. Stone tools account for a substantial proportion compared with bone tools, mollusks, and pottery. An inventory of 65 Hoabinhian sites indicates that 30,120 artifacts were found, including 28,000 stone objects, 250 bones, horns, mollusk shells, and 1,800 pottery sherds.

Hoabinhian residents used cobbles from local rivers and streams to make tools. The raw cobbles are porphyrite, andesite, rhyolite, basalt, and sometimes quartz or quartzite. They are eroded by water and usually have a flattened oval shape. Hoabinhian people knew how to choose suitable materials for each type of tool (Nguyễn & Nguyễn, 2009). The technique of crafting stone tools, called flaking, involves removing the cortex from the cobble surface while keeping its core to form a tool. Some tools are bifacially flaked and others are unifacially flaked. Besides the flaking technique, the ancient residents also adopted another approach by splitting cobbles in half and using the separated pieces to create tools. In the assemblage of Hoabinhian sites, the number of cobbles crafted using the flaking technique is equivalent to that crafted using the splitting method. Hoabinhian people also used the technique of cutting oval tools horizontally to create short axes with flat, semi-oval tips. The knapping technique was less prevalent among the Hoabinhian people than among the members of the Bac Son culture. Flake marks found at some Hoabinhian sites were possibly made by later Neolithic inhabitants and do not characterize the Hoabinhian (Hoàng, 1977, p. 22). Flaked tools were shapeless and rare in the Hoa Binh culture. In contrast, cobbles were the absolute majority, with some typical types being axes in almond, triangle, round, and oval shapes, short axes, and long axes with cut tips made from unimpaired or split cobbles and mainly crafted unifacially.

An inventory of 4,461 pebble tools from 20 Hoabinhian sites in Vietnam includes 125 hand axes (2.9%), 421 tools made from unimpaired pebbles (9.4%), and 3,915 flaked pebble tools (87.7%). Among the 924 Hoabinhian pebble tools obtained from Xom Trai
Cave are 148 bifacial (16%) and 776 unifacial stone tools (84%). Of the same 924 tools found, 425 were made from split cobbles (46.18%), and 509 were made from unimpaired cobbles (53.82%) (Nguyễn, 1984b, p. 36).

Another study recorded a few bone, horn, and mussel shell artifacts at Hoabinhian sites (Đặng, 1984, pp. 56-61). The 253 artifacts found at 35 sites include bone axes, chisels, points, and scrapers. Most of the bone tools are well-honed, and some have markings. From 50 Hoabinhian sites, 1,800 pottery pieces of late residents were found, mainly in the upper layer. Some raw pottery sherds are of residents of the late Hoabinhian (Phạm, 1984, pp. 62-65).

The data show that toolmaking was an important economic activity for Hoabinhian residents, reflecting their technical level, aesthetic thinking, and compatibility with the landscape and environment. In Hoabinhian caves, there are a large number of raw implements, grinding stones, and cortex removed during the toolmaking process, indicating that the stone tools were made in the caves. These caves did not play the role of an “atelier” but rather were residential crafting spaces because the Hoabinhian sites are far apart. The stone tools share similar characteristics, but they have distinctive local features (Nguyễn, 1993, pp. 1-13).

Hoabinhian inhabitants were usually distributed in groups; each group inhabited about ten sites, occupying several valleys with similar archaeological sites and artifacts. Each group has a site with a thick cultural layer that formed in the early stage and had a longer residence time than the surrounding sites (Nguyễn, 2022; Nguyễn et al., 2016). This is possibly the “primitive village” from which the surrounding communities formed with the same bloodline. Each site here was self-sufficient and served as a toolmaking place and “residential village.” The sites are located far apart. However, they still have some similarities, resulting from the “cross-valley” or “inter-village” relationship of a community of Hoabinhian people.

2.2. **Hunting and Gathering**

Another important economic activity for Hoabinhian residents was hunting and gathering to meet their daily needs. This aspect can be tackled based on studies of the flora and fauna remains found during archaeological excavations. Many mollusk shells, along with animal bones, crab claws, turtle shells, and nuts, are often obtained at Hoabinhian sites. With scientific methods, particularly pollen analysis, it is possible to draw inferences regarding the paleoclimate, environment, vegetation composition, and domestication of plants and animals.

The data show that mollusk shells were often piled up in Hoa Binh cultural caves. Some caves are 3 to 4 m high, such as Boi Cave, Trong Cave, Con Moong Cave, Xom Trai Cave, and Cho Cave. Ancient Hoabinhian residents collected land snails (*Cyclophorus*), freshwater snails (*Antimelania*), mussels (*Plychorhynclus*), and freshwater mussels (*Lanceolaria, Oxynaia*) as food (Hoàng, 1984, pp. 132-135). Within each of these categories, there are many different species. In the group of freshwater mussels, the red-
rimmed melania (*Melanoides tuberculata*) accounts for the most substantial proportion (Matthews, 1966; Yi et al., 2008). Many snails were crushed to remove the intestines easily. The land snails (*Cyclophorus fulguratus*, *C. siamensis*, and *C. speciosus*) are also exceptionally rich in species and were predominant in the caves (Reynolds, 1990). Moreover, they account for different proportions depending on the location.

Hoa Binh archaeological sites are classified as kitchen middens. The term *kitchen midden* was first used in 1848 to refer to the shell midden consisting of oysters and clams distributed along the coast of Jutland, Denmark. In Vietnam, from 1909 to 1924, H. Mansuy and M. Colani excavated the remains of kitchen middens in some Bac Son caves in Lang Son Province (Mansuy & Colani, 1925). Then, from 1926 to 1927, M. Colani excavated a series of Hoabinhian sites in Hoa Binh, Ninh Binh, Thanh Hoa, and Quang Binh Provinces (Colani, 1927) and established a system of Hoabinhian kitchen middens. In 1932, E. Patte excavated a heap of freshwater mussel shells at the Da But site, Vinh Loc district (Thanh Hoa Province) and named it the Da But shell midden (Bùi, 1987; Patte, 1932, 1965). From 1930 to 1931, M. Colani excavated shell middens around the Giat bridge in the Quynh Luu district of Nghe An Province. Later, 21 such shell middens were discovered along the Nghe An coast and named the Quynh Van kitchen midden system (Hoàng, 1966; Nguyễn, 1998). The kitchen midden formation in Hoabinhian caves differs from those along the northeast coast of peninsular Malaysia and from other kitchen middens found in Vietnam.

Kitchen middens in Hoabinhian caves were formed in association with human habitation. Terrestrial and freshwater mollusks were brought back to caves as food. Their shells, collectively known as secondary or discarded items, were dumped in residential areas and became stratified. These kitchen middens are related to the shell-bearing habitation site, one of five types of kitchen middens classified by Widmer while studying this type of archaeological site (Widmer, 1989).

Among the Hoabinhian kitchen middens, some shell middens were left almost intact, such as Boi Cave and Trong Cave (Ninh Binh Province), and some were left with mollusk shells crushed and compacted, such as Moi Cave and Ong Hay Rock-shelter (Ninh Binh Province). There are also caves bearing characteristics of both types, such as Con Moong Cave (Thanh Hoa Province), whose formation differs from others.

Caves with layers of unimpaired shells, such as Boi Cave and Trong Cave (Ninh Binh Province), often have shells loosely stacked on each other, with very little soil alternating. The shell layer at the cave entrance is usually thick but thinner inward, possibly due to the movement of shells when people pour them on the ground. There is almost no trace of force on the surface, where the unimpaired shells lie. In the stratigraphy of Boi Cave, the boundary between these shell sediments is unclear. However, unimpaired shells in the upper layer of the stratigraphy and near the mouth of the cave often contain more soil, rock sediments, and calcareous clay particles than the lower level, possibly due to the post-depositional movement of fine sediments downward or differences in the active periods of the site. Often, layers of unimpaired shells indicate a reduction in human
habitation and food availability, indicating that the deposition rate may have been very rapid (Nguyễn, 2016; Rabett et al., 2011).

Layers of crushed shells are found in Moi Cave and Ong Hay Rock-shelter. The broken shells are mixed with silt, clay, and archaeological remains. The animal remains in these places are solidified by calcite that was possibly deposited by rainwater flowing through the rock crevices and carrying it into the kitchen midden. The phenomenon of shells being crushed and compacted, as in Ong Hay Rock-shelter or Moi Cave (Ninh Binh Province), is explained by the fact that the shells there were processed by fire or buried in heated limestone. At high temperatures, the shells are fragile and easily broken. In addition, these shells were scattered on the residential floor and trampled on by humans, resulting in the shells being crushed and tightly embedded. Particularly in the lower layers of 1 to 2 m at Ong Hay Rock-shelter, the shells are finely crushed and compacted, while the upper layers contain mainly whole shells. This phenomenon can be explained by the fact that the cave floor was low in the early stages while the cave ceiling was still high, so people poured mollusk shells to level the floor. People often trampled on the stone tools, flakes, animal bones, and coal ash. However, in the upper cultural layer, the distance from the shell floor to the ceiling is short, so people rarely entered the caves and eventually moved outside. Therefore, the shells in the upper layer are mainly intact (Nguyễn, 2016).

The case of a cultural layer where there is an interweaving between the layers of land snails and freshwater snails or between the layers of unimpaired shells and crushed ones, such as at Con Moong Cave, is said to be a seasonal process of mollusk exploitation (Phạm et al., 2022). Around July and August every year, the Con Moong Cave area is usually in the rainy season. After a few days of rain, land snails (known as rock snails) proliferate and crawl out of the rock crevices to eat moss, so this is also the time when ancient residents collected them the most. Freshwater snails were also exploited in the rainy season because rivers and streams where mollusks reproduce are full of water. In the dry season, snail collecting activities have almost no desired results. Land snails were often grilled over the fire, wrapped in banana tree sheaths, or buried in limestone piles after being heated on the fire. The snail meat is cooked, and the shells are easily broken. On the other hand, freshwater snails were often collected and their flesh extracted as food. With this processing method, the shells were rarely damaged, despite the impact of human walking activities.

Hoabinhian residents were widely distributed, and each subregion collected different species of mollusks. In the mountainous areas of the Western Nghe An Province, in Tham Hoi and Chua caves, Hoabinhian people gathered several mollusks, such with three species of freshwater snails (Angulyagra polyzonata, Angulyagra boettgeri, and Antimelania costula), two species of land snails (Cyclophorus dodrans, Cyclophorus speciosus), and many species of freshwater mussels (Hyriopsis cumingii, Ptychorhynchus pfisteri, Lanprotula nodulosa, Lanprotula leai, Lanprotula gladiolus, Nodularia donglasiae, Oxynaia jourdyi, and Corbicula bocourti). In volcanic caves in the Central Highlands, there are freshwater snails (Sinotaia aeruginosa), freshwater mussels (Oxynaia micheloti), Asian clams (Corbicula fluminea), and land snails (Cyclophorus sp.)
(Lê et al., 2018; Nguyễn et al., 2017, 2018, 2019, 2020). These include two terrestrial species: Cyclophorus dodrans and Cyclophorus speciosus; the rest are mollusks living in freshwater, mountainous areas, and plateaus. Remarkably, the two species of land snail, Cyclophorus dodrans and Cyclophorus speciosus, and the long-bodied snail, Antimelania costula, are found only in mountainous and bordering areas. This species of long snail is only found in the Northwest and North Central mountains, while other snail species are distributed in the Northeast Region, the Red River Delta, and the North Central Coast (Vũ, 1972, pp. 103-105).

In the stratigraphy of Con Moong Cave (Thanh Hoa Province), there are small land snails with a round operculum (Cyclophorus fulguratus), land snails with narrow operculum (Camaena vayssierei), long-bodied land snails (Hybocystis crossei), and species of freshwater snails with a long body (Antimelania swinhoei, Antimelania siamensis, and Antimelania costula). Also found are clams (Bivalvia), species of freshwater mussels (Lanceolaria laevis, Lanceolaria grayi, Lanceolaria fruhstorferi, Oxynaia diespiter, Oxynaia sp., and Sinohyriopsis cumingii), and mountain crab (Ranguna sp.) (Đặng, 1977, pp. 18-19).

Mollusks contain all essential amino acids and fatty acids for the human body. However, the fat percentage is too small and poor in nutrition (Lubell, 2004, p. 8). Possibly, mollusk collecting was more popular than hunting mammals. It can be seen that this is a suitable food solution for the tropical monsoon climate of northern Vietnam.

Hunting animals was an essential economic activity for Hoabinhian residents. Animals hunted during this period include modern species still existing in Vietnam. They are gibbons (Hylobates sp.), monkeys (Macaca sp.), porcupines (Hystrix), squirrels (Sciuridae sp.), rats (Rattus sp.), wild boars (Sus sp.), bison (Bibos sp.), wild buffaloes (Bubalus), badgers (Artonyx collaris), Asian palm civets (Paradoxurus), and tigers (Pathera tigris). Some extinct or extremely rare species such as the ancient elephant (Palaeoxodon), rhinoceros (Rhinoceros sp.), orangutan (Pongo sp.), giant panda (Ailuropoda melanoleuca), and pygmy hog (Porcula sp.) were also hunted (Vũ, 1984, p. 126). Thousands of animal bones found in other Hoabinhian archaeological caves are those of wild animals typical of the ancient hot and humid tropical climate, with no trace of domesticated animals (Lê, 1984, pp. 136-141).

The Hoabinhian residential area was large, so the animals in the subregions were not the same. For example, in the northwest region, Hoabinhian residents hunted gibbons (Hylobates sp.), monkeys (Macaca mulatta), porcupines (Hystrix), squirrels (Sciuridae), rats (Rattus sp.), elephants (Elephas sp.), rhinoceroses (Rhinoceros), pygmy hogs (Sus scrofa, Porcula salvania), sambar deer (Rusa unicolor), muntjac (Muntiacus muntjak), deer (Cervus sp.), chevrotains (Tragulus), wild water buffaloes (Bubalus bubalis), bison (Bibos sp.), mountain goats (Capricornis sumatraensis), Asian black bears (Ursus thibetanus), jackals (Cuon sp.), greater hog badgers (Arctonyx collaris), Asian palm civets (Paradoxurus hermaphroditus), tigers (Panthera tigris) and cats (Felis sp.) (Vũ, 1984, pp. 127-128). Along the North Central Coast, in Con Moong Cave (Thanh Hoa Province), animals caught by ancient residents included rhesus monkeys (Macaca
Canidae), squirrels (Sciuridae), rats (Rattus sp.), dogs (Canidae), greater hog badgers (Arctonyx collaris), Asian palm civets (Paradoxurus hermaphroditus), rhinoceroses (Rhinoceros sp.), wild boars (Sus scrofa), deer (Cervus sp.), sambar deer (Rusa unicolor), muntjacs (Muntiacus muntjak), bovids (Bovidae), Sumatran serows (Capricornis sumatraensis), grey geese (Anser), heavy, ground-dwelling birds (Phasianidae), pheasants (Lophura sp.), softshell turtles (Trionyx sp.), and small tortoises (Testudo sp.) (Vũ, 1977, pp. 15-17).

Hoabinhian people collected vegetables, fruits, crustaceans, insects, and bird eggs. Around Xom Trai Cave (Hoa Binh Province), up to 30 species of wild plants belong to 16 families whose fruits are edible. Only ten species have been found in this cave site, of which seven species have been identified from burned seeds (charcoal) used as food and left behind in the cave. These include gnetum (Gnetum montanum), various species of canarium (Canarium sp., Canarium tonkinense), taraw palm (Livistona cochinchinensis), Indian gooseberry (Phyllanthus emblica), and woodland elaeocarpus (Elaeocarpus sylvestris) (Nguyễn & Vũ, 1987, pp. 32-34).

Species of canarium were exploited by Hoabinhian people in the early stages as their seeds are found in Xom Trai Cave, Con Moong Cave (dating to 10,500–8,000 BP), Cang Cave (11,000–10,000 BP), and Dieu Rock-shelter (9,000–7,000 BP) (Nguyễn, 2013). Canarium is a genus of about 100 species of trees growing in limestone mountains, indicating a tropical monsoon climate. People in the mountainous areas of Vietnam still exploit canarium, the fruit of which is edible, and the resin is used to make candles for lighting.

The Hoabinhian people hunted and gathered in the tropical monsoon climate. The results of pollen analysis in the early stage of the Holocene in the north show that plants of this period were heat-loving, broad-leaved, and mixed with dry and cold-loving pointed-leaved plants. This period had a tropical monsoon climate, alternating from hot-dry to hot-humid (Nguyễn, 2005).

The analysis of magnetic susceptibility at some Hoabinhian sites, such as Con Moong Cave (Thanh Hoa Province), Cho Cave (Hoa Binh Province), Ong Hay Rock-shelter, Moi Cave, and Thung Binh Cave (Ninh Binh Province), indicates that the paleoclimatology of northern Vietnam from 20,000 to 7,000 BP alternated between hot, cold, and cool phases, especially a period of heavy rainfall from 11,400 to 8,800 BP and a sudden cold period (Younger Dryas) at 11,400 years BP (Lưu et al., 2009, pp. 410-417). Since 10,000 BP, northern Vietnam has had cycles of hot-humid and cold-dry or hot-dry and hot-humid alternately, as shown by analysis of the pollen from borehole ND-1 by the Red River. Different periods had different climate features: 9,950 to 9,310 BP was hot and humid; 9,310 to 8,850 BP was cold and dry; 8,850 to 8,640 BP had a sediment interruption; 8,640 to 6,340 BP was hot and dry; 6,340 to 4,530 BP was hot and humid; 4,530 to 3,340 BP was cold and humid; 3,340 to 2,100 BP was hot and dry; 2,100 to 1,720 BP was cold and humid, and from 1,720 BP to the present is hot and humid (Li et al., 2006).
Heavy rain, increased humidity, and expanded rainforest are reasons for the fast growth of land snails (*Cyclophorus* sp.), freshwater snails (*Antimelania costula*), and bivalves. Heavy rain, a cold climate, and developed tropical rainforest are the reasons why most Hoabinhian residents in Vietnam and Southeast Asia in the early Holocene period moved into caves and limestone valleys (Nguyễn, 2016, pp. 64-73). In addition, sea-level rise is also an issue that needs to be further studied and discussed to determine whether this was a significant reason for Hoabinhian residents to withdraw into caves.

Many species of animals are found in Hoabinhian sites. However, there are only a few individuals in each species, reflecting the characteristics of a complex ecosystem where the diversity index is high. In 1969, D. R. Harris divided the agroecosystem into two types: generalized and specialized ecosystems. The generalized ecosystem is one in which plant and animal species are diverse, the number of individuals of each species is relatively small, and the diversity index of the ecosystem is high. In contrast, the specialized ecosystem is characterized by having few species, but a vast number of individuals in each species, such that the diversity index is low (Harris, 1969).

Most plants in the tropical monsoon environment thrive in the rainy season. This season is for seed and tuber production and nutrient storage, the richest and most diverse food sources for humans and animals. But in the dry season, many plants have shorter life spans; the food source for humans and animals is less abundant, so humans largely depended on low-altitude plants, such as sugar palms, yams, bamboo shoots, vegetables, and mushrooms. They are easy to exploit except for some high-quality carbohydrates and nutritious plants such as yams. They are obtained from deep underground, causing difficulties for residents of this period.

In the rainy season, the plants grow strong, so the herbivores gain more body weight. Many carnivores come to hunt where there are many herbivores such as deer, buffaloes, and cows. Tropical animals often gather in herds in the rainy season, and in the dry season, they migrate to wetter forest areas in limestone valleys, where there are creeks or small streams as a water source. Hunters took advantage of this habit to carry out effective hunting.

Hoabinhian residents lived in caves, but all livelihood activities occurred in limestone valleys, forcing them to move to adjacent valleys to obtain food, collectively known as sources. In a complex ecosystem, many species of animals and plants were not collected, and the number of each collected species was insignificant. Hence, resource exploitation was of the broad-spectrum form or the generalized exploitative pattern, exploiting many species but only a few of each species, as C. Gorman stated (Gorman, 1971).

The hunting and gathering activities of Hoabinhian residents also depended on seasonality. At the beginning of spring, most tropical plants are mobilizing nutrients to re-grow, and nutrients are metabolized, so food quality is low. As summer begins, food becomes more abundant, especially protein-rich vegetables. But when fall comes, plants store nutrients in tubers and seeds, often reaching their highest levels. In winter, plants
grow less. Plants with short growth cycles probably died by this time. Late winter and early spring are the times of greatest food scarcity.

From such observations, it is a common belief that Hoabinhian residents gathered food more often than hunted, and the plant-based diet played a major role in human nutrition. Many mollusk shells and very few animal bones are found in Hoa Binh caves. The fat content in mollusks and animals is not high, so plants are the alternative. Most Hoabinhian residents had severe tooth wear. One of the reasons is their preference for a plant-based diet over a meat-based one (Nguyễn, 1992, pp. 5-12).

Exploiting the complex ecosystem caused Hoabinhian residents to move often in search of food. However, the distances traveled were short, so they could search for food sources and return to their caves on the same day. The average distance between Hoabinhian caves in Cuc Phuong National Park is 5 to 6 kilometers. It is possibly the radius in which residents commuted (Nguyễn, 1983, pp. 8-21).

Most plant-based food sources in tropical forests are available year-round, but the highest quality food for humans is only available during certain times and seasons. Therefore, hunter-gatherers must have a general and profound knowledge of sources in each season. They must draw on many generations of experience, organize specialized groups for gathering and hunting, assign tasks based on sex, age, and experience in hunting and gathering activities, and explore locations with a high chance of obtaining specific food sources.

Regarding the way of hunting, gathering, and food processing activities by Hoabinhian residents, there is a remarkable feature: the complete set of bone remains of an animal is rarely encountered except for some small animals. This is presumably because large animals were hunted collectively, and the prey was divided among the participating members, so each cave had partial animal remains. Documents of some ethnic minorities in Vietnam show that the hunting of large animals, such as tigers, bears, buffaloes, cows, and wild boars, is collective, and that of small animals, such as monkeys, gibbons, hedgehogs, squirrels, chickens, and mice is handled by individuals. The leaders of the hunt are often given animal horns, fangs, or claws as tokens of honor. People of the Hoa Binh culture in Dang Cave, Moc Long Cave, and some other caves were buried with the fangs of tigers, bears, and wild boars, indicating a high probability that animal fangs symbolized human strength and victory.

The gathering of some small animals, such as reptiles, insects, young birds, crabs, fish, clams, and snails, occurred regularly and seasonally. The insect-gathering activities of some ethnic groups in the mountainous area of Son La are carried out simply nowadays. People light torches at night and place pots of water under them. Eventually, insects such as locusts, grasshoppers, and butterflies fall into the water. They are then taken out, roasted in a hot pan, and served as a dish.

Many wild plants, such as sugar palms and yams in the limestone areas of northern Vietnam, provided starch and are still exploited by residents. This type of plant has a large
body containing much fresh starch. The Muong, Dao, and Xa collect them as a starch source for cooking and brewing yeast to make wine. Ethnographic documents on the Xa and Thai people in the mountainous areas of Vietnam show that there are nine types of plants yielding starchy tubers and fruits, about 50 types of forest herbs, and 40 types of edible bamboo shoots, wood ears, and mushrooms (Đặng, 1970, pp. 90-91). These types of plants were probably exploited by Hoabinhian people for daily meals.

2.3. Incipient agricultural activity

An argument exists over whether agriculture arose in Hoa Binh culture about 10,000 years ago. At the Hoa Binh sites in Spirit Cave (Thailand), domesticated trees have been found, such as the butter tree (Madhuca), canarium (Canarium), tropical almond (Terminalia), candlenut tree (Aleurites), black pepper (Piper), areca palm (Areca), and legumes, such as gourds (Lagenaria), cucumbers (Cucumis), and water caltrops (Trapa), and some other species, such as Chinese hackberry (Celtis), lotus (Nelumbium), sponge gourd (Luffa), and bitter melon (Mormordica). Exploiting forest fruits and caring for plants to meet human needs are said to be signs of incipient agriculture and plant domestication (Gorman, 1969, pp. 671-673).

However, direct archaeological evidence for incipient agricultural production by Hoa Binh inhabitants in Vietnam is unclear. The hypothesis that agriculture originated in Hoa Binh culture is based on the premise that agriculture arose when hunter-gatherers became permanent residents, specialized in herb extraction, and accumulated a rich trove of knowledge about plant growth cycles. These criteria are related to the inhabitants of Hoa Binh culture, where there is a thick cultural layer, with long-term human settlement, long-term exploitation of plant resources around the residence, the opportunity to select beneficial mutations over many generations of wild or semi-domesticated plants, and the premise for the transition from foraging to domestication (Hà, 1980, pp. 4-10).

Another opinion is that Hoabinhian agriculture arose later in the Developed Hoabinhian (9,000–7,000 BP). This hypothesis is based on the studies of Hoabinhian sites in Cuc Phuong National Park. The number of Hoabinhian sites increased during this period, indicating a rise in population and a decrease in hunting and gathering resources. The balance between human demand and natural supply was disrupted, especially with the appearance of the edge-polished stone axe, corded ware pottery, legumes, and cucurbits (Nguyễn, 1983, pp. 8-21).

Some assume that the Flandrian transgression of the sea in the late Pleistocene shrunk the living environment of Hoabinhian people while an increase in population occurred, forcing residents to leave the mountains and occupy the limestone valleys. The Hoabinhian people had to adjust their lifestyles by adapting to farming and animal husbandry to survive in the karst valleys (Trần, 1986, pp. 1-6).

The pollen analysis of Hoabinhian sites, such as Bung, Khoai, Con Moong, Tham Khuong, and Xom Trai caves, shows that among 40 species of pollen in the Holocene epoch, pollens of the legume family (Leguminosae), goosefoot family (Chenopodiaceae),
and madder family (Rubiaceae) account for the highest proportion. Most plants from the goosefoot (Chenopodiaceae) and Myricaceae families in the valleys settled by Hoa Binh inhabitants are edible. They were often distributed in and around caves. The Hoabinhian people might have used the fruit of these plants as food. Later, their seeds germinated and were consciously cared for by the Hoabinhian people. In these locations, species such as gnetum (Gnetum montanum), canarium (Canarium sp., Canarium tonkinense), taraw palm (Livistona cochinichinensis), Indian gooseberry (Phyllanthus emblica), brindle berry (Garcinia multiflora), woodland elaeocarpus (Elaeocarpus sylvestris), and tea (Thea) are also found. Gnetum was used as food, seed-under-leaf (Phyllanthus) as spice, and tea as a stimulant, suggesting plant domestication by Hoabinhian residents.

Some researchers believe that tuber production preceded seed production in Southeast Asia. The first stage of plant domestication is asexual reproduction. Plants producing annual bulbs or perennials (multi-year) increase their yield gradually over time. Plants that reproduce asexually are often less affected by the weather and easier to care for than plants that reproduce sexually, nor do they need carefully prepared soil. These plants can live symbiotically with grass or other plants, tolerate shade, and are less susceptible to insect damage. It is easier to grow tubers than seed plants, and the ability to harvest is also higher, with a low chance of losing crops.

There are many types of edible tuber plants in Southeast Asia, such as taro, which belongs to the Araceae family, and yams, which belong to the brown tuber family (Dioscoreaceae). These are very popular in Vietnam, especially in the Hoabinhian distribution area. Among them, purple yam (Dioscorea alata) and lesser yam (Dioscorea esculenta) are the most significant. Some researchers have suggested that some yam species grown as tubers in Southeast Asia may have descended from two wild species: Dioscorea hamiltonii, distributed in East India and Burma, and Dioscorea persimilis, distributed in Indochina. Dioscorea persimilis is abundant in the forests of northern Vietnam and is the object of regular exploitation by mountain-dwelling people today. Some other species of the Dioscoreaceae family, such as Indian three-leaved yam (D. hispida), karsata (D. glabra), five-leaf yam (D. pierrei), and yam with rough bark (D. brevipetiolata), are adapted to terrestrial environments, similar to the forests surrounding Hoabinhian caves today.

Some ethnic groups in the mountainous regions of Vietnam habitually take care of wild plants for the following year’s harvest by clearing the surrounding weeds so that the plants can grow quickly. Many people even “save seeds” or replant a part of a wild tuber or stem at its obtained location to mark the place where they will return to harvest next year. Perhaps this is the most primitive form of agriculture used by the Hoabinhian people. This process is repeated and gradually becomes conscious planting. In addition to tubers, the Hoa Binh people also cultivated legumes, fruit trees, and root crops adapted to wet or flooded areas, such as water taro, Indian taro, and eddoe. This type of farming is reminiscent of horticulture, in which various plants are intercropped on a patch of land.

Pollen analysis of 18 samples from Con Moong Cave indicates that herbaceous shrubs and woody plants were predominant, recorded around Con Moong Cave at the
time in an open space, possibly related to human luminescence activity in the Developed Hoa Binh (Nguyễn & Phạm, 2009, pp. 20-29). Hand axes appeared abundantly during this period. In Cultural Level III (top) of Con Moong Cave, the hand axe accounts for nearly 50% of artifacts and for 18% in Muoi Cave. Along with hand axes, the number of food processing tools such as pestles and grinding tables also spiked. Food processing tools account for 26 of the 39 stone tools found in Dang Cave and 46 of the 200 tools found in Con Moong Cave. The spike in the number of edge-polished stone axes, pestles, and grinding tables during this period may be related to incipient agricultural activity (Nguyễn, 1983, p. 19). The presence of edge-polished stone axes, pestles, and grinding tables confirms the economic orientation of polyculture in the valley areas, which produced fruit, tubers, and seeds. Moreover, taro and root crops were probably selected by the Hoabinhian and Bacsonian people to become the main food crop (Chữ, 1988, pp. 29-32).

Regarding animal domestication, several pig bones dating to 10,000 BP have been found in the mountains of Papua New Guinea, indicating the earliest animal domestication stage in Southeast Asia (Bulmer, 1975, p. 31). In Vietnam, the earliest stage of animal domestication was around 7,000 BP, as evidenced by dog, buffalo, and cow remains found in areas of the Da But culture (Patte, 1965; Vũ, 2003, pp. 80-87). However, livestock production has not been seen at other Hoabinhian sites.

3. CONCLUSION

(1) The Hoa Binh culture (Hoabinhian) is considered the culture of a community from the late Pleistocene to the early Holocene, from the Paleolithic to the Neolithic, and from hunting and gathering to incipient agriculture. Hoabinhian archaeological sites are mainly distributed in the limestone mountains (karst) of Hoa Binh and Thanh Hoa provinces, which are considered the original area of Hoabinhian culture. Hoa Binh culture is present in Vietnam and elsewhere in mainland Southeast Asia. Similar archaeological sites found outside this area are considered Hoabinhian-like.

(2) Toolmaking, hunting, gathering, and cultivating in Hoa Binh culture were carried out in various ways and bear clear local imprints. The Hoa Binh inhabitants in Vietnam made tools in limestone caves, and they hunted, gathered, and cultivated in the adjacent karst valleys. Hoabinhian tools changed little over time in material, technique, shape, and function. However, there are differences in the types of tools and in the hunting and gathering practices between the karst subregions.

The Hoabinhian people hunted and gathered in the limestone valleys of the tropical rainforest. They only exploited a portion of the flora and fauna during this time. Many species were exploited, but the number of exploited individuals of each species was limited. Thus, Hoabinhian residents’ means of living did not lead to the extinction of a particular species, and gathering was more favored than hunting.

Hoabinhian people gathered terrestrial and aquatic mollusks, crabs, fish, turtles, tortoises, vegetables, tubers, fruits, mushrooms, bamboo shoots, bird eggs, young birds, and insects to prepare meals. In particular, mollusks were the main Hoabinhian food source. Land and freshwater snails only peaked in number during the last two to three
months of the rainy season. It is easy to collect them, but the nutritional quality is not high, so people were forced to gather them in large numbers, and the shells filled up the caves as a kitchen midden.

There is not much evidence of agriculture in Hoa Binh culture. Most people believe that ten thousand years ago, Hoabinhian people knew how to plant bulbs for the next season. But in the Developed Hoabinhian (7,000–6,000 BP), there is a possibility that horticulture was born. Root crops, such as taro, fruit trees, cucurbits, and yams, may have been domesticated. Analysis of pollen from the Developed Hoabinhian indicates the presence of the legume family (Leguminoseae), the goosefoot family (Chenopodiaceae), the madder family (Rubiaceae), and seeds of gnetum (Gnetum montanum), taraw palm (Livistona cochinchinensis), brindle berry (Garcinia multiflora), woodland elaeocarpus (Elaeocarpus sylvestris), Indian gooseberry (Phyllanthus emblica), tea plant (Thea sp.), and canarium (Canarium nigrum, Canarium tonkinensis). These can be considered the first type of crops. They are associated with the appearance of farming tools, such as stone picks and hand axes, and food processing tools, such as pestles and grinding tables. These indicate a new farming practice, possibly primitive farming.

(3) In their existence and development, the Hoabinhian people contributed an outstanding cultural heritage regarding human compatibility with the harsh environmental changes after the last ice age, which is reflected in their habitation patterns, toolmaking morphology and techniques, and food acquisition strategies. This also broadens our view of the changes in structure, local landscape, and flora-fauna diversity associated with the Hoabinhian prehistoric socio-economy in Vietnam and Southeast Asia, with its typical tropical monsoon climate.

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