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## **A Revolution through Evolution**

A Review of *The First Farmers of Europe: An Evolutionary Perspective* by Stephen Shennan (Cambridge University Press, 2018)

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### **Introduction**

Adding to his major body of work on cultural evolution, quantitative archaeology, and Neolithic Europe, Stephen Shennan offers a concise yet richly detailed overview of the emergence and spread of agriculture across Europe using a multifaceted perspective informed by diverse archaeological approaches. *The First Farmers of Europe: An Evolutionary Perspective* draws from life history theory to argue that agriculture emerged from an increasing dependence on a broadening diet of plant resources that promoted sedentism and reproductive success; as a result, farming spread across Europe when exploiting new territories and passing agricultural knowledge through generations further maximized reproductive success. Shennan supports this approach by systematically tracking agriculture, with its associated demographic, economic, ecological, and cultural patterns of change, from the earliest agricultural communities in south-west Asia to its ultimate emergence in the British Isles.

Recognizing the diversity of human experiences surrounding the adoption of agriculture between different geographic regions, time periods, and packages of domesticates, Shennan focuses on the European continent, which itself presents a massive cumulative breadth of archaeological scholarship. Shennan synthesizes decades of archaeological research and debates—integrating palaeodemography, zooarchaeology, palaeobotany, palaeoclimatology, ancient DNA, and material research—into a concise narrative that reads like a scientific history of Neolithic Europe. Starting from the Pleistocene–Holocene climate transition in south-west Asia, Shennan simultaneously follows population, ecological, and cultural patterns associated with farming as the practice moved westward and north across Europe.

In addition to making a thorough, diachronic case for evolutionary-demographic processes of Neolithization, *The First Farmers of Europe* also elegantly guides the reader through a vast array of past and present archaeological theory and scholarship. With the increasingly rapid pace of research emerging on

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the European Neolithic, Shennan briefs the reader on the current state of knowledge in archaeology and the historical scholarship that led to present interpretations. The result is an easily readable book that is on the pulse of current research and the state of present understanding of the Neolithic in Europe.

## ***The First Farmers of Europe***

*The First Farmers of Europe* consists of nine chapters and totals 253 pages including references and bibliography. The first chapter situates the reader in the theoretical foundations of evolutionary demography and life history theory. Shennan draws on these approaches as an explanatory mechanism to weave together the story of agriculture throughout the rest of the book. Each subsequent chapter represents a different spatial and temporal step in the adoption and spread of agriculture across Europe. These chapters can be synthesized into four distinct phases: 1) the origins of agriculture, 2) westward expansion, 3) stasis of farming communities in continental Europe, and 4) final westward expansion into western Europe. The book concludes with a synthesis that links his various lines of evidence concisely back to his life history framework.

## **Theoretical Foundations**

Shennan situates the emergence and spread of agriculture within an evolutionary framework informed by a life history approach that draws from evolutionary demography, human behavioral ecology, and cultural evolution.

Life history theory is a set of ideas centered on the ways through which natural selection affects how organisms allocate resources to different developmental and reproductive phases over the course of their lifetime. Thus, individual-level processes may be used to interpret larger-scale patterns in the population.

Shennan's application of a life history approach to archaeological data supports an under-utilized generational perspective to understand population and subsistence changes through time. There have been fewer applications of the life history approach in archaeological scholarship, which more commonly applies optimal foraging theory. While both are encompassed under the umbrella of human behavioral ecology, they operate on different timescales of equally important value. Optimal foraging theory concerns the costs and benefits of resource choices on a daily, seasonal, yearly, etc. basis whereas life history focuses on resource allocation on the scale of an individual lifespan.

In the life history approach, lifetime reproductive success is contingent on the successful raising and social placement of offspring. This result is achieving a balance between maximum birth rate and fitness of offspring that adapts to shifting external conditions. The way this translates in social terms is that

population growth broadly associated with a given culturally transmitted economic strategy is a measure of fitness and success. Building on the foundational works of Jean-Pierre Bocquet-Appel (2002, 2008, 2011) on the Neolithic demographic transition, Shennan sets out to argue that the emergence of farming corresponded with a positive shift in female energy availability. The increased caloric resources available from domesticated crops and animals, paired with decreased mobility due to sedentism, lowered the costs of reproduction such that it was advantageous to give birth to and raise more children, maximizing reproductive success. However, because the external conditions that favor a larger population may shift rapidly, continued reproductive success associated with agriculture then depends on the cultural transmission of farming strategies and domesticated animals and crops between generations. In applying this approach, *The First Farmers of Europe* seamlessly connects evolutionary demography with cultural evolution.

## **Origins of Agriculture**

Shennan begins his account of the emergence and spread of agriculture across Europe with the earliest origins of agriculture in south-west Asia during the Pleistocene–Holocene climatic transition. He gives readers a tour through the various interpretations of the origins of agriculture, reflecting on early hypotheses and how they have changed in light of new evidence through time. The chapter continues to discuss the emergence of cereal crops, the domestication of animals, and changes in population patterns from the Epipalaeolithic through the Early Neolithic. Shennan focuses particular attention on the diversity of the origins of agriculture across the Near East. Breaking down the region into the subregions of the southern Levant, northern Levant/upper Mesopotamia, and south-central Anatolia, he tracks the variation in subsistence, ecology, and population geographically as well as their non-uniform patterns of change through time.

Chapter 2 introduces a number of quantitative methods that are used throughout the following chapters for different phases of the spread of farming across Europe. Notably, Shennan draws on the work of Neil Roberts et al. (2017), who developed a method using summed calibrated radiocarbon probabilities to estimate regional population size. This approach builds on Shennan's earlier work (Shennan et al. 2013) and that of Timpson et al. (2014) and uses the intensity of human occupation/activity based on the number of radiocarbon dates obtained from several archaeological sites as a proxy for inferring the size and density of the population. Alternative approaches to estimating population size have been proposed in previous scholarship, which used age distributions of skeletal populations (Bocquet-Appel 2002; Guerrero et al. 2008) and estimates of site densities (Goring-Morris and Belfer-Cohen 2010) as proxies. While there have

been critiques of the approach of Roberts et al. (2017), the results appear to correspond to other contextual lines of evidence. When applied to the Neolithic transition in south-west Asia, the results fit an exponential curve of population growth over time. Periods that departed from the fitted exponential model were evaluated using methods implemented by Crema et al. (2016), who used simulated conditional summed probability distributions to calculate departures from the exponential curve. These departures reflect periods of greater population growth or decline than predicted. The resolution of this approach allows for population size to be effectively compared to other important concurrent processes, such as climate change.

In addition to his analysis of population size, Shennan interweaves the quantitative methods of various other archaeological subdisciplines to build his behavioral and ecological narrative of the Neolithic, including using 1) climate models for temperature and precipitation, 2) zooarchaeological profiles of hunted and domesticated fauna, and 3) palaeobotanical frequencies for wild and domesticated plants. Shennan's discussion of the southern Levant provides an example of how he integrates these various lines of data. The diminishing size of hunted fauna lends credence to the theory that sedentarization in the Late Epipalaeolithic corresponded with rising population levels. This population increase was further supported by the cultivation of cereals, which were more viable in the warm, wet, and stable climate of the early Pre-Pottery Neolithic A. A second population increase was made possible by artificially selected crops with larger seeds and higher yields as well as developments in storage technology and the emergence of new social institutions to support the growing population. This process was not uniform across the other regions discussed, highlighting the variation underlying Neolithization.

Shennan concludes by drawing attention to the importance of cultural changes in addition to the demographic and ecological trends. He argues that there must be social mechanisms that counter the tendency for groups to fission after certain population thresholds. The social and material contexts of the Neolithic are linked in the broader framework of the book through the cultural-evolutionary perspective on niche construction. This attention to the social contexts of ecological processes is a theme revisited repeatedly throughout the book.

## **Westward Expansion**

Chapters 3 through 5 follow the first expansion of agricultural subsistence westward from south-west Europe into Cyprus, across Anatolia, into the Aegean, and through the Balkans into central Europe. Chapter 3 begins with the perplexing case of the Late Pleistocene and Early Holocene occupation of Cyprus and the importation of domesticates and agricultural practices to the island. Before the

western expansion of farming into Anatolia in the eighth millennium BC, humans from the Levantine coast undertook difficult maritime journeys to occupy Cyprus with domesticated (as well as wild) plants and animals in tow. While the early date and seafaring component of the Cypriot Neolithic is presented as exceptional, it nicely sets the stage for discussing how the farming way of life—and the accompanying plants, animals, and knowledge—followed populations as they moved and occupied new areas in similar ways through time.

As the question of population movement and replacement grows to dominate the story of agricultural expansion, Shennan adds two major empirical approaches to his quantitative toolkit in the form of 1) a “wave of advance” model and 2) whole-genome ancient DNA (aDNA) analysis.

The “wave of advance” model is an equation commonly applied in the field of mathematics that estimates the speed of spatial dispersal in response to population expansion and has a long history of use—and criticism for its sometimes generalizing approach—in archaeology. Notably, Ammerman and Cavalli-Sforza (1973) first applied this model to the spread of agriculture using ethnographic proxies to predict past processes. Shennan argues for strengthening the model with quantitative archaeological data, particularly radiocarbon analysis. He models the dispersal wave from his previously discussed radiocarbon analysis methods, using earliest arrival dates of farming and summed calibrated radiocarbon probabilities for speed of the wave front and population growth rate parameters.

Ancient DNA analysis further builds on the study of population movement and offers the opportunity to further clarify who the migrating groups were, how they interacted with indigenous groups, and whether they brought their ways of life—in this case, agricultural systems—with them. The use of whole-genome aDNA is of particular importance because it derives from the cell nucleus, where DNA is the combination of maternal and paternal lines of inheritance, and therefore more closely represents a broader population. This stands in contrast to mitochondrial and Y-chromosomal DNA, which originate from either the maternal (mtDNA) or paternal line (Y). Nodding to the complex, highly specialized, and rapidly evolving research into the interpretation of aDNA, Shennan admits a lack of expertise in this field in the preface, but effectively weaves the current scholarship into his social and demographic narrative. While the other methods are sure to continue to make important contributions to the archaeological scholarship, the reader is left with the impression that aDNA analysis has made, and will continue to make, remarkable discoveries for the population histories of the Neolithic.

The combination of these approaches, in addition to the previous lines of evidence, allows Shennan to cohesively demonstrate the directionality and pace of movement while also addressing who participated in the movement and whether

they imported their lifeways where they went. The synthesis of approaches demonstrates that farming spread from the Aegean and western Anatolia into mainland Greece and the Balkans, as well as that westward expansion across the Mediterranean and central Europe occurred rapidly and at the hands of pioneering farming groups, with relatively little influence from indigenous foraging inhabitants. Shennan thus hinges the demographic expansion and population growth on the advantageous traits of the agricultural economy, which would have promoted the reproductive success of the early generations of pioneering farmers in Europe. Yet the short-lived population boom once these groups were settled in Europe forces the question of whether agriculture maintained its reproductive advantages when populations crashed after 7000 BP. To answer this, Shennan reconnects with his central life history approach. While this subject is hotly debated, he reflects on how the possible influencing factors of a limited range of ecological conditions for farming in central Europe, coupled with increasing population size, may have affected the cost-benefit ratio in reproductive decision making. As populations grew and increased in density, particularly evidenced in the Linearbandkeramik (LBK) culture of central Europe, the scalar stress on resources created inequalities and competition within groups. The increasing boundedness of individual families' reproductive decisions with one another in these dense settlements would have set the stage for intergroup competition and conflict. This is reflected in the growing number of potentially defensive enclosures around settlements, increased violence, and increasingly disconnected material exchange networks, which certainly lends multiple lines of evidence to his point.

## **Stasis of Farming Communities in Continental Europe**

Chapter 6 takes a hiatus from the cross-continental movement of farming communities and focuses primarily on how these now-established communities occupied or reoccupied areas where farming was already established in central and western Europe. Shennan unexpectedly rejects a long-standing hypothesis that the thousand-year period of stasis in agricultural expansion during the seventh millennium BP was the result of resistance by indigenous hunter-gatherer groups. Instead he argues for the adoption of farming by indigenous hunter-gatherers. For much of central Europe, farming populations decline or remain stable. By 6300 BP, there was settlement expansion and local communities began extensive, rather than intensive, exploitation of the less agriculturally productive areas outside of resource-dense patches. In lieu of DNA evidence, evidence for wild and domesticated resources paired with indigenous ceramic styles may in fact point toward the adoption of agricultural practices by foraging populations as well. However, Shennan faces limitations in the application of his framework to detailing agricultural production and adapted farming practices due to conflicting evidence

from pollen and macrobotanical data. Such conflict emphasizes that archaeological data does not always provide satisfactory conclusions, but areas to be further developed.

This chapter also reflects on the unusual and exciting synergy in western France, supported by aDNA evidence for the confluence of farming communities descended from the initial central European and the Mediterranean streams of farming expansion from the Aegean and western Anatolia. The region of Brittany during the seventh millennium BP remains unique within contemporary Europe due to archaeological evidence for a population boom paired with an abundance of exotic imports and massive monumental features. Shennan raises the possibility that the mixture of disparate agricultural populations resulted in the concentration of power and the consolidation of access to diverse economic resources, reflected in the exceptional material repertoires of these groups. Consequently, he highlights the importance of aDNA studies beyond grand population movements for understanding the material repercussions of more localized interactions.

## **The Northern Frontier of Agricultural Expansion**

Chapters 7 and 8 follow the second wave of westward and northern expansion after 6100 BP that established farming in Scandinavia and the British Isles. These chapters are particularly satisfying in that they present patterns of expansion that mirror the first farming expansion into Europe millennia earlier. Summed calibrated radiocarbon probabilities, “wave of advance” models, and genetic evidence all point toward a rapid migration of populations from mainland Europe and a subsequent population boom. Similarly, these populations brought their agricultural systems and knowledge with them. Both regions also experienced a rapid decline in population followed by the adoption of new cultural and agricultural practices. The ties between these chapters and the beginning of the book are a testament to the renewed importance of long-term historical perspectives in archaeology. With the backing of a multitude of empirical and quantitative lines of evidence, the long view of human demographic, ecological, and social history presents a critical opportunity to effectively test models of human cultural evolution in ways that may not be possible over short time frames.

## **Conclusion**

With the advancement of scientific technologies and computational methodologies that support quantitative archaeological research and the increasingly accessible nature of archaeological data, our understanding of the cultural evolution of the European Neolithic has been progressing at a rapid pace. Since the publication of *The First Farmers of Europe*, numerous groundbreaking research papers have been



published on processes of Neolithization in the continent. For example, Brace et al.'s (2019) aDNA study sparked headlines in the scientific community and beyond. This paper demonstrated population replacement in Neolithic Britain by continental Europeans, attributing the origins of agriculture in Britain to new arrivals. It is not difficult to imagine that the state of the field will change drastically within years rather than over decades. This is not to say that *The First Farmers of Europe* will rapidly lose relevance. On the contrary, this book takes the strategic and critical opportunity to digest the state of archaeological scholarship on European Neolithization. Particularly for archaeological researchers whose regional or temporal scope may not be the European Neolithic, or scholars and students of cultural evolution, this book distills a vast array of established and cutting-edge research for the region, setting the stage on which new research can build. With luck, Shennan's focus on Europe will lead to the development of similar cultural-evolutionary syntheses for other global contexts in the future.

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