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Farming From its Origin to Tomorrow

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Farming is a recent activity in the history of the human race. Our species separated from chimpanzees more than six million years ago, and the people of 200,000 years ago were little different in appearance from the people of today. The population was tiny, with perhaps 10,000 people, and all were hunter-gatherers, spending most of their time catching or collecting food, and not having the ability to store or transport amounts that would be useful to maintain them through famines, or even from one year to the next. The period about 10,000 years ago, at the end of the geological Pleistocene epoch and the Paleolithic stone-age was marked by a period of global transition. The changes experienced included alterations in the climate as the last glaciations finished, the extinction of many larger animal species, and appearance of different forms of vegetation cover with open woodlands being replaced by forests or grasslands.

This period was also marked by the people changing their lifestyle from hunter-gatherer to farming, with the new activity emerging at different places throughout the world over a relatively short period: Southeast Asia, China, the Middle East and Southern Europe, and Central America (Fig. 1). Why should these separate groups of people have adopted the new lifestyle, involving changes to diet, new governance to organize planting, harvest and storage of crops, and new roles for the men, women and children? Many of the possibilities sound remarkably similar to the challenges faced by humans today: over-exploitation of wild species, climate change, habitat destruction, increasing populations needing more resources, and perhaps the desire to spend less time working to win food.

It is remarkable that all the major crops and animals that we eat today were domesticated right at the dawn of the agriculture – the cereals including wheat, rice, barley, maize, the peas and beans, root crops and fruits, as well as sheep, pigs and cows. Then, as now, fewer than twenty crop plants produced the vast majority of all the food eaten by people. About 60% of the calories we eat have always come from seeds (Fig 2), the part of the plant which could be collected, stored and propagated most easily, although there is no 'rule' as to which part of a plant is the storage structure and chosen

. 1 Farming as
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ears. Here, teff
agrostis tef) is being
nted following a
lock plough. Both
crop and the animal
similar to those first
nesticated.

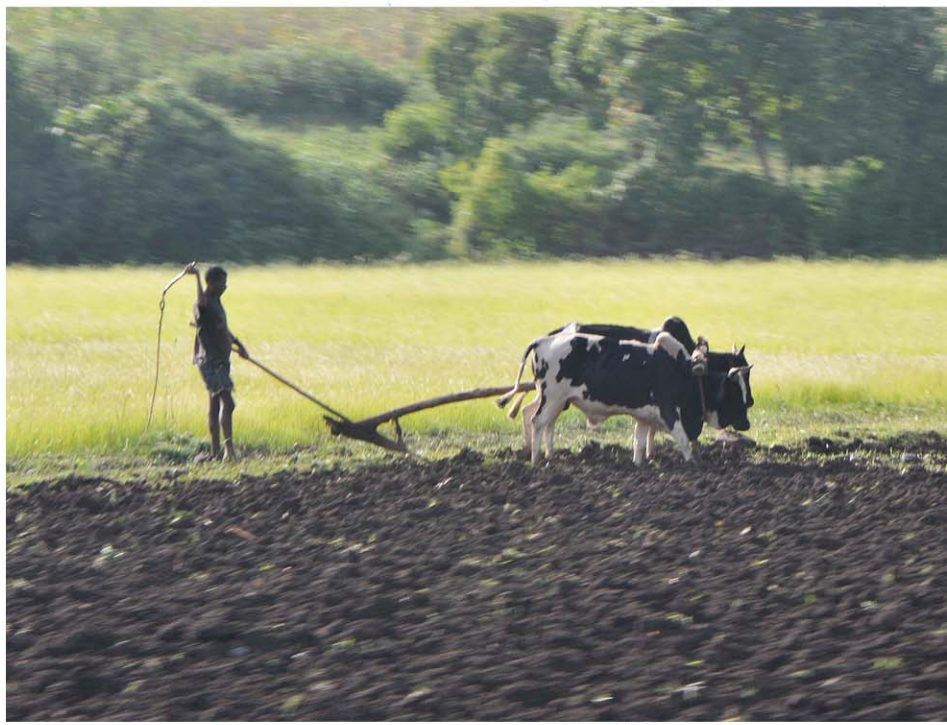


Fig. 2 The head or ear of teff. This grass produces small grains that are a staple food in parts of Africa. Unlike its wild relatives, the seeds are not dispersed easily, so the crop can be collected and threshed.

for cultivation. Different parts of the seed are eaten in peas and cereals, while fruits are very diverse, and other crops are grown for their tubers, roots, leaves or even stems (Fig. 3).

The crops planted and harvested by people right from the start differed from their wild relatives by a group of characters known as the "domestication syndrome". This group of characters makes the crop largely dependent on humans for reproduction and growth, but at the same time makes its planting, cultivation and harvest productive and worthwhile. The characters include lack of seed dispersal (so seeds stay attached together and to the plant), seeds which freely germinated when planted, larger seeds, fruits or roots that are harvested (also called gigantism), often combined with less production of non-edible parts of the plant.

Archaeological finds give us a good impression of these early crops. Over the subsequent millennia, the crops of this early period have been improved, but no major new crops have been introduced. By the middle ages, there are books showing the appearance of crops at these early periods (Fig. 4).

Where is agriculture today? In the last 50 years, the global population has increased from 3 billion to 6.9 billion, a 2.3-fold change. In the same period, the production of crops has seen an increase of 2.9 times. This has meant better nutrition on average, with the number of seriously

Fig. 3 A market showing the diverse parts of plants that are eaten including leaves, stems, fruits, roots, tubers, bulbs and seeds.

undernourished people changing remarkably little and declining in Asia and South America. However, the number of overnourished and fat people has shown a large increase in the period, accompanied by changes in diet. As well as the increased consumption of meat, milk and eggs (with the animals eating some of the increase in production), plants grown for cooking oils, fats and margarines have shown fivefold increase in production in the period.

Another important social change was seen for the first time in 2008, when more than 50% of the world's population became urban, buying food that was transported from the countryside from a declining proportion of farmers or agricultural labourers.

As in any industry, it is important for food production not to lead to wastage, and postharvest loss is still a major challenge. In many parts of the world, as much as half of the food that is harvested is not eaten, whether it rots (Fig. 5) or is destroyed by insects or rats. All the resources and time for land preparation, watering, fertilizing, harvesting and packaging

have been put into the crop at this stage. As well as the challenges from needing to produce more food, there are also environmental challenges associated with its production.

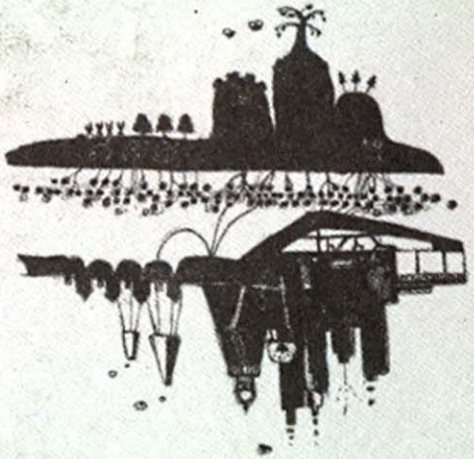
While farmers have in general been good stewards of the land, some practices have been unsustainable, including use of more land, overproduction and weed control allowing erosion (Fig. 6), use of heavy metal fungicides and in much of the world exploitation of water or irrigation. As discussed above, domestication happened 10,000 years ago, but many additional changes in our crops have been seen in less than a lifetime: it is now rare to find table grapes with seeds, eggplants or aubergines no longer need covering with salt for a day to remove bitter tastes before cooking, sweet and red grapefruit don't need sugar. The needs from consumers for more food that is safer, tastier and more nutritious will continue to increase; while farmers will look for plants which grow healthily and easily, while giving high and predictable yields with low inputs from fertilizers, crop protection chemicals and water. Growing the large amounts of food needed by the increasing population will always have a major impact on the diversity, and replace wild plants with cultivated crops, but this can be minimized. The diversity of genes present within crops, their wild relatives and more remote species can be used systematically for breeding of new varieties, continuing the selection and improvement carried out by mankind since the origins of agriculture (Fig. 7).

Fig. 4 Harvesting cabbages in the middle ages. This picture comes from The Tacuinum Sanitatis, a richly illustrated volume that gives a window on late medieval life and the cultivation of plants. The cabbages being harvested could feature on our plates today, although most varieties would now have leaves even more tightly together in a head. The Brassica vegetables cabbage, cauliflower, Brussels sprouts and broccoli are all the same species of plant, and the different forms are the result of selection by people. The Tacuinum is a 14th century translation of an 11th-century Arabic manuscript known as Taqwim al-Sihha bi al-Ashab al-Sitta, produced in northern Italy. Source: http://commons.wikimedia.org/wiki/File:Tacuinum_Sanitatis-cabbage_harvest.jpg

Fig. 5 Wastage of food: a problem facing many countries. After all the effort, land, and costs from ploughing, watering, harvesting and packaging, wastage of food before it can be eaten has huge economic and environmental costs.

Fig. 6 Environmental degradation from the middle ages. Many parts of the limestone pavements of the Burren area in Ireland were covered by soil and forests thousands of years ago. Exploitation over hundreds of years for fuel and feeding animals has eroded the area back to the underlying rock. Now though, the rare rock forms are important habitats for many plants and they are being carefully maintained.

Fig. 7 The diversity within a crop. There is enormous variation in many crops, seen here in bananas and plantains, where in the West we can only find the single banana variety Cavendish. The diversity extends beyond colour, size and flavour, and these varieties also differ in their resistance to disease, yields and efficiency of water usage. The range of diversity within crops and their wild relatives can be exploited for making new and improved crop varieties.



If you start taking the cobblestones out of the street, people will pass by and ask you what you are doing. When you tell them, "Sous les pavés, le jardin!", they will begin dismantling the streets with you. A critical mass of antipode gardeners will emerge – the polis will begin to fall and new configurations will rise, take root.

BENEATH THE PAVEMENT: A GARDEN