THE TRUE COST OF FOOD

A.

At an organic farming conference in Winnipeg, Canada, a woman in the audience stood up and said: "Organic foods are not going to become popular with mainstream consumers until they became quick, convenient, and cheap." The comment causes much thinking about the nature of our food system and about what we have done to try to make foods quick, convenient, and cheap for consumers.

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B.

At the 'farm level, our never-ending quest for cheap food is the root cause of the transformation of agriculture from a system of small, diversified, independently operated, family farms into a system of large-scale, industrialized, corporately controlled agribusinesses. The production technologies that supported specialization, mechanization, and ultimately, large-scale, contract production, were all developed to make agriculture more efficient — to make food cheaper for consumers. Millions of farmers have been forced off the land, those remaining are sacrificing their independence, and thousands of small farming communities have withered and died — all for the sake of cheap food. These were the consequences of progress, so we were told. The agricultural establishment has boasted loudly that ever fewer farmers have been able to feed a growing nation with an ever-decreasing share of consumer income spent for food.

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C.

Changes in the food system have brought considerable cost to the environment and human health. Such problems have been widely documented over recent decades, but it is only recently that efforts to put a monetary cost on them have begun to emerge. These costs are telling us something fundamentally important about the real costs of modern food and farming. A group of scientists at the University of Essex recently completed the first national study of the environmental and health impacts of modern farming. They looked at what are called "externalities"—the costs imposed by an activity that are borne by others. These costs are not part of the prices paid by producers or consumers. And when such externalities are not included in prices, they distort the market. They encourage activities that are costly to society even if the private benefits to farmers are substantial.

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D.

A heavy lorry that damages a bridge, or pollutes the atmosphere, externalizes some of its costs — and others pay for them. Similarly, a pesticide used to control a pest imposes costs on others if it leaks away from fields to contaminate drinking water. The types of externality encountered in the agricultural sector have four distinct features: 1) their costs are often neglected; 2) they often occur with a time lag; 3) they often damage groups whose interests are not represented; and 4) the identity of the producer of the externality is not always known.

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E.

The study sought to put a cost on these externalities in the UK. It concentrated on the negative side-effects of conventional agriculture—in particular the environmental and health costs. Two types of damage cost were estimated: 1) the treatment or prevention costs incurred to clean up the environment and restore human health to comply with legislation or to return these to an undamaged state and 2) the administration costs incurred by public agencies for monitoring environmental, food and health implications. It is conservatively estimated that the total costs are £ 2.34 billion for 1996 alone in the UK. Significant costs arise from contamination of drinking water with pesticides (£ 120 million per year), nitrate (£ 16 m), cryptosporidium (£ 23 m) and phosphate and soil (£ 55 m), from damage to wildlife, habitats, hedgerows and dry stone walls (£ 124 m), from emissions of gases (£ 1,113 m), from soil erosion and organic carbon losses (£ 96 m), and from food poisoning (£ 169 m).

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F.

Water is an interesting case. Twenty-five million kilograms of pesticides are used each year in farming--and some of these get into water. It costs water companies £ 120 million each year to remove pesticides — not completely, but to a level stipulated in law as acceptable . Water companies do not pay this cost — they pass it on to those who pay water bills. This represents a hidden subsidy to those who pollute. Some of the costs are straightforward to measure, others more difficult. How do we know about the effects of the greenhouse gases methane, nitrous oxide and carbon dioxide produced by farming? Economists have been able to put a£ /tonne cost on these gases based on agreed estimates about the effects of future climate change. The study has been very conservative, using lower estimates of costs. But still the costs are great.

Each of these costs should provoke questions about how they could be reduced or even removed. Where does this leave us in policy terms? Is it conceivable that we could evolve sustainable agriculture systems that maximize their production of positive externalities — goods that the public enjoys and is willing to pay for — as well as minimizing the environmental and health costs? The answer is clearly yes. We know enough about sustainable methods of farming to be confident. Sustainable farming has substantially lower negative externalities than conventional farming. We roughly estimate these to be no more than a third — perhaps £ 60 - £ 70 per hectare. Sustainable farming also has higher positive externalities — the other side of the equation.

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H.

Although it only represented around 3% of the total EU utilized agricultural area (UAA) in 2000, organic farming has in fact developed into one of the most dynamic agricultural sectors in the European Union. The organic farm sector grew by about 25% a year between 1993 and 1998 and, since 1998, is estimated to have grown by around 30% a year. Organic farming has to be understood as part of a sustainable farming system and a viable alternative to the more traditional approaches to agriculture. Since the EU rules on organic farming came into force in 1992, tens of thousands of farms have been converted to this system, as a result of increased consumer awareness of, and demand for, organically grown products.

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I.

The sustainability of both agriculture and the environment is a key policy objective of today's common agricultural policy (the "CAP"): "Sustainable development must encompass food production alongside conservation of finite resources and protection of the natural environment so that t he needs of people living today can be met without compromising the ability of future generations to meet their own needs ." This objective requires farmers to consider the effect that their activities will have on the future of agriculture and how the systems they employ shape the environment. As a consequence, farmers, consumers and policy makers have shown a renewed interest in environmentally friendly farming. UK Farm Minister Margaret Beckett has announced a series of new measures, backed by 500 million pounds sterling of funding over t he next three years, to specifically help British farmers reduce their dependence on subsidies, as well as to protect t he environment and promote healthy, local food. The long-awaited Strategy for Sustainable Farming and Food contains "green" targets for farms, promotion of local foods and other measures to bring farmers closer to consumers.

READING PASSAGE 2

You should spend about 20 minutes on Questions 15 — 27 which are based on Reading Passage 2 below.

The Colorful Butterflies

A.

Defensive strategies of butterflies against predators include chemicals, mimicry, aposematic coloration, and evasive flight. Mimicry is the ability to appear to be or to imitate something other than what you really are. The use of mimicry is prevalent throughout nature and is a prime example of evolution by natural selection. Butterflies use it as a protection mechanism in their larva stage and in the final adult stage, either to trick predators into thinking they are an inedible species or perhaps an entirely different organism all together. Foremost, the intention of mimicry is to draw attention to yourself. This is usually achieved, but not always, by advertising your presence with bright colours and is known as "aposematism". These bright colours are probably easier for predators to learn and therefore likely reduce the number of casualties necessary before the predator learns the pattern to avoid and providing the mimic with protection.

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B.

Aposematic caterpillars and butterflies are essentially warning predators of impending unpalitability or other physical dangers. This is achieved in several different ways. Some caterpillars and butterflies are poisonous; they have an ability to ingest the toxins of their host plants as in the classic example of the Monarch and the cardiac glycosides of milkweed. The milkweed leaves on which the Monarch larva feeds contain several substances that are toxic to vertebrates. These poisons are absorbed and retained during the larval stage and passed on, through the transitional stage of metamorphosis, to the adult butterfly, so that adults are unpalatable as well. A short time after a bird eats a portion of a monarch butterfly that had fed on poisonous milkweed, it vomits. Following this episode, the bird refuses to eat any other monarch offered to it.

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C.

In the final adult stage we can find mimicry. One of the most striking examples is that of the Viceroy intimating the Monarch. This type of mimicry was first described in 1862 by: Henry W. Bates, while studying lepidoptera in Brazil. Subsequently the following can be considered a typical example of "Batesian" mimicry. Since Monarchs are distasteful and will cause vomiting if consumed by a predator the lesson of avoiding Monarchs is quickly learned. Viceroys find protection through resemblance. A very important facet to this approach and the key to its success is that the numbers of the impostor should not be too high in relationship the one being imitated. The reasoning here is that if the ratio was as high as or approaching say, 50/50, it would be possible for the predator to eventually learn the deception through trial and error and soon be able to recognize the perpetrator.

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D.

A further point pertaining to the relationship between the Viceroy and the Monarch is that recently some studies have concluded that the Viceroy itself is a distasteful quarry. If this is the case what would be the benefit in mimicking the Monarch? This type of advantage has been describe by Fritz Muller whereby? Certain protected species sometimes seek to enhance their protection by mimicking other protected species as in the case of this model, if indeed the Viceroy is distasteful to predators. Known as "Mullerian" mimicry, the difference between these two forms of mimicry is that the "Batesian" mimics have no protection of their own and "Mullerian" mimics already have a form of protection.

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E.

Other butterflies of a "Batesian" example, are the Red Spotted Purple and the female Eastern Tiger Swallowtail which mimic the Pipevine Swallowtail, a distasteful butterfly due to the host plants it eats (Dutchman's Pipevine). The Eastern Tiger Swallowtail females are an intriguing example of mimicry in that they are dimorphic, which means that there are two forms—one yellow like the male and one black form. Only the black form of the female is a mimic. The number of females presenting themselves in this black mimic form is proportional to the numbers of Pipevine Swallowtails in the area. Again there is no advantage in high ratios between the mimic and the protected specie.

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F.

Another approach to survival is protective colouration or crypsis. The formula for success with this survival technique is quite the opposite of mimicry. Here, instead of drawing attention to yourself, the implementer's goal is to camouflage their presence. The larvae of species such as Hairstreaks and Skippers choose this more subtle approach of protective colouration by resembling their host plant colour and patterning. With their uncanny colours and markings they are virtually undetectable and are able to feed in relative obscurity.

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G.

Visual cues such as the flight behavior of butterflies, too, are often used as a defensive strategy. Slower fliers are not often attacked or eaten by birds whereas faster fliers are often attacked and eaten. In the palatability experiments, birds either consumed the butterflies or they did not, indicating that there was a very clear distribution of butterfly palatability. The best indicator of bird behavioral response to butterflies was body shape and flight pattern. Slow flying butterflies with long, thin bodies are easily caught, but are also released quickly and not usually harmed. Hard-to-catch butterflies with short, stout bodies maybe evasive, but are quickly consumed when captured.

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H.

It has been suggested that the predator can learn the palatability of prey in association with visual characteristics such as body shape and coloration. The behavioral flight pattern of butterflies may also contribute to this associative learning. Once a bird has "learned" the flight characteristics, coloration, palatability, and body shape of surrounding butterflies, it does not try to catch prey exhibiting slow flight, brightly colored wings, and long, thin bodies even though these butterflies are easily caught. Young birds can learn palatability categories as quickly as adults can. During other feeding experiments, male birds were better at discriminating between unpalatable and palatable meals than female birds, although both sexes were able to associate color patterns with palatabilities rapidly. Captive birds could memorize the color pattern and palatabilities of many different butterflies as well as distinguish between similar Batesian mimics.

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I.

The flight patterns of butterflies may have evolved as a result of selective pressure from predators. Unpalatable species may advertise their bad taste by flying slowly. Leisurely flights enhance predator associative learning and decrease the number of accidental encounters between butterfly and predator. The divergence of flight patterns between unpalatable and palatable butterfly species defines different forms of defense mechanisms.

READING PASSAGE 3

You should spend about 20 minutes on Questions 28 — 40 which are based on Reading Passage 3 below.

THE FEDERAL AVIATION ADMINISTRATION

A.

Nobody goes up, up, and away until the folks at the FAA say it's OK. The Federal Aviation Administration (FAA) is the government agency responsible for overseeing air transportation in the US. An arm of the US Department of Transportation, the FAA focuses on air transportation safety, including the enforcement of safety standards for aircraft manufacturing, operation, and maintenance. It also manages air traffic in the US through a network of towers at more than 19,000 airports. It maintains radar systems, communication equipment, and air traffic security systems. Outside the US, the FAA works with international aviation authorities in developing safety practices implemented globally.

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B.

As commercial flying emerged and increased, the Bureau of Air Commerce encouraged a group of airlines to establish the first three centers for providing air traffic control (ATC) along the airways. The pioneer air traffic controllers used maps, blackboards, and mental calculations to ensure the safe separation of aircraft traveling along designated routes between cities. The application of radar to ATC helped controllers in their drive to keep abreast of the postwar boom in commercial air transportation. The approaching era of jet travel, and a series of midair collisions, prompted passage of the Federal Aviation Act of 1958. This legislation gave rise to a new independent body, the Federal Aviation Agency. The act also gave the FAA sole responsibility for a common civil-military system of air navigation and air traffic control.

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C.

Two principal categories of rules governing air traffic are visual flight rules (VFR) and instrument flight rules (IFR). Aircraft operating under visual flight rules (VFR aircraft) maintain separation from other aircraft visually. IFR aircraft in controlled airspace operate in accordance with clearances and instructions provided by air-traffic controllers for the purpose of maintaining separation and expediting the flow of traffic. Flight crews operating under instrument flight rules are responsible for seeing and avoiding other aircraft, but the air-traffic control clearances they receive provide substantial added assurance of safe separation. Consequently, flight crews often will operate under instrument flight rules even though the weather satisfies visual meteorological conditions. Many technologies are used in air traffic control systems. The radar information is used to develop clearances and instructions for separating aircraft operating under instrument flight rules, and to provide traffic advisories to IFR aircraft and to VFR aircraft receiving the traffic advisory service. Traffic advisories provide the ranges, bearings, and altitudes of aircraft in the pilot's immediate vicinity. The pilot is responsible for visually acquiring and avoiding any traffic that may be a collision threat.

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D.

Primary and secondary radar are used to enhance a controller's "situational awareness" within his assigned airspace. Secondary radar is an interrogate-respond system. The rotating directional antenna of the ground station transmits a pulse pair to the transponder in the aircraft. The pulse spacing encodes one of two messages—"transmit your altitude" (the Mode C interrogation) or "transmit your identity" (the Mode A interrogation). The aircraft then transmits an encoded pressure-altitude reply in response to the first interrogation and a four-digit identity code, assigned by air-traffic control and entered into the transponder by the pilot, in response to the second.

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E.

Primary radar operates by transmitting high-power, radio-frequency pulses from a rotating directional antenna. The energy is reflected from any aircraft in the directional beam and received by the antenna. The aircraft is displayed at the azimuth corresponding to the pointing direction of the antenna and the range corresponding to the round-trip time between pulse transmission and receipt of the reflected signal. Primary radar has the advantage that aircraft without air-traffic control transponders can he detected, and energy reflected from heavy precipitation indicates to the controller areas of potentially hazardous weather. However, extraneous returns (clutter) from surrounding buildings and terrain can reduce the effectiveness of primary radar in detecting aircraft, At most air-traffic control radar sites, the secondary radar antenna is mounted on the primary radar antenna, and they are turned by a common drive system.

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F.

With the number of aircraft flying over the United States today, proper airspace usage is critical for flight safety and efficient service to pilots and the flying public. To assist in this goal, the airspace is divided into five classes A– E. Class A airspace is the airspace from 18,000 feet to 60,000 feet. All pilots flying in Class A airspace shall file an IFR flight plan and receive an appropriate air traffic control clearance. Class B airspace is generally the airspace from the surface to 10,000 feet. This airspace is normally around the busiest airports in terms of aircraft traffic such as Chicago or Los Angeles. Class B airspace is individually designed to meet the needs of the particular airport and consists of a surface area and two more layers. Most Class B airspace resembles an upside down wedding cake. Pilots must contact air traffic control to receive an air traffic control clearance to enter Class B airspace. The airspace from the surface to 4,000 feet above the airport elevation is called the Class C airspace. Class C airspace will only be found at airports that have an operational control tower, are serviced by a radar approach control. Pilots must establish and maintain two-way radio communications with the ATC facility prior to entering airspace.

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G.

The fourth airspace is Class D airspace which is generally that airspace from the surface to 2,500 feet above the airport elevation. Like Class C airspace, Class D airspace only surrounds airports that have an operational control tower and is also tailored to meet the needs of the airport. Pilots are also required to establish and maintain two-way radio communications with the ATC facility before entering the airspace. No separation services will be provided to pilots of VFR aircraft. Pilots operating under VFR must still use "see-and-avoid" for aircraft separation. The fifth airspace is Class E airspace which is generally that airspace that is not Class A , B, C, or D. Class E airspace extends upward from either the surface or a designated altitude to the overlying or adjacent controlled airspace. If an aircraft is flying on a Federal airway below 18,000 feet, it is in Class E airspace. Class E airspace is also the airspace used by aircraft transiting to and from the terminal.