令和7年度特色入試問題

《 農学部 食料・環境経済学科 》

小論文試験

200点満点

（注　意）

1. 問題冊子および解答冊子は係員の指示があるまで開かないこと。
2. 問題冊子は表紙のほかに12ページある。
3. 解答冊子は表紙のほかに，下書き用紙を含め10ページある。
4. 試験開始後，解答冊子の表紙所定欄に受験番号・氏名をはっきり記入すること。
   表紙には，これら以外のことを書いてはならない。
5. 解答はすべて解答冊子の指定された箇所に記入すること。
6. 解答に関係のないことを書いた答案は無効にすることがある。
7. 解答冊子は，どのページも切り離してはならない。
8. 問題冊子は持ち帰ること。解答冊子は持ち帰ってはならない。
9. 解答は日本語で記入すること。

1 以下の英文を読んで問１～問５に答えなさい。（100 点）

Agricultural intensification can be technically defined as an increase in agricultural production per unit of inputs (which may be labour, land, time, fertilizer, seed, feed or cash). For practical purposes, ①intensification occurs when there is an increase in the total volume of agricultural production that results from a higher productivity of inputs, or agricultural production is maintained while certain inputs are decreased (such as by more effective delivery of smaller amounts of fertilizer, better targeting of plant or animal protection, and mixed or relay cropping on smaller fields). Intensification that takes the form of increased production is most critical when there is a need to expand the food supply, for example during periods of rapid population growth. ②Intensification that makes more efficient use of inputs may be more critical when environmental problems or social issues are involved. In either case, changes caused by intensification are to be understood conceptually in contrast to extensive adjustments, which involve increases or decreases in the amount of inputs used. Historically, the most common and effective extensive adjustment in agricultural production has been to increase or decrease the area of land planted.

For the purposes of this discussion, the contrast between intensification and extensive adjustment is intended to indicate the contrast between two broad strategies that human beings have had for affecting their food supply, rather than concepts applicable to economic or technical analysis of specific cases. The technical specifications and measurement of intensification or extensive adjustment in any given case are actually quite complex. Changes in the productivity of one input are likely to be accompanied by adjustments in the amount of other inputs. This complexity notwithstanding, there is little doubt that agricultural intensification has been a prerequisite to human civilization. The Neolithic*[1] technological revolution was built on collecting, concentrating, selecting and harvesting plant and animal species in an organized fashion, with the aim of having more products closer to hand and easier to convert into nutrition. The domestication*[2] of farm animals and the development of crops, in the context of ever more productive farming systems, enabled the human population to grow and towns and villages to develop, having governments, laws, trade and economies with specialized employment.

As agricultural production became more efficient, so populations increased. ③ Historians have argued whether higher populations drove technological development, or whether technological development made higher populations possible. Nevertheless, throughout this development, most societies were chronically malnourished*[3], or prey to episodic famine. Relatively high transport costs meant that most societies relied on local production, except when water transport made imports possible. Classical Athens was largely fed from the Crimea, and Rome from Egypt and southern Spain. For more than 95 percent of the history of civilization, food has been scarce for nearly all people. This has meant low life expectancy*[4], susceptibility to disease and little capacity to face wars, droughts, floods and other human and natural catastrophes. Food scarcity and social disorder brought about major migrations of people and caused wars and massive cultural disruption.

Conversely, when scarcity was relieved, major cultural advances were made. About 1 000 years ago, new varieties of rice were taken to southern China from the Champa Kingdom (now Viet Nam). These were not sensitive to photoperiod*[5], and produced two crops a year instead of only one. When these varieties were grown, the intensive techniques that had developed slowly in China to increase productivity per unit of land, although requiring more labour, resulted in dramatic production gains. The subsequent rice surplus triggered changes across various sectors of China's economy, stimulating the construction of roads, canals, dams, ironworks, grain storage facilities and the production of weapons. For five centuries southern China experienced sustained economic growth and had favourable trade terms for silk, spices and technology with late Mediaeval and early Renaissance Europe.

The agricultural revolution in the early modern United Kingdom greatly increased agricultural productivity. It relied heavily on techniques based on horse power, soil-supporting crop rotations, land drainage*[6] and grazing systems, which were developed on the European continent in the very densely populated and often scarcity-ridden Low Countries (the present-day Benelux). When these innovations were applied to larger areas at lower human population densities, a significant surplus was produced, which made the Industrial Revolution possible. At the same time, the harnessing of energy sources became more efficient. The late eighteenth century saw improved water mills and windmills, the use of sea coals*[7] and the development of steam engines. Transport costs fell, making it economically viable, for example, to ship bones long distances for use in fertilizer. Internal combustion*[8] and hydropower later greatly increased returns to labour and the availability of products such as nitrogen fertilizers.

However, any technology exists within a social and political system. The way that this British agricultural surplus was generated, controlled and distributed under the restrictive Enclosure Acts*[9] forced most of the rural population off the land to serve as industrial labour. The result was high food insecurity and a structural form of urban poverty, where families no longer had access to land or to traditional rights such as commons*[10] and gleaning*[11]. Yet the growing surpluses allowed greater specialization, provided capital and cheap labour for industrialization in Europe and drove the long, violent European nineteenth century. They also resulted in much larger markets in food to supply a burgeoning population, which produced many more goods and services than at any time in previous history. ④However, the costs paid in human suffering by three or four generations of impoverished families were considerable.

出典：FAO ETHICS SERIES 3, *The ethics of sustainable agricultural intensification*, Produced by the Editorial Production and Design Group, FAO, Rome, 2004, pp.3-5 を一部改変。

（語注）*1 Neolithic：新石器時代の、*2 domestication：家畜化、*3 chronically malnourished：慢性的な質と量の栄養不足状態、*4 life expectancy ：平均余命、*5 photoperiod：日長、*6 drainage：排水、*7 sea coals：イングランド北部海岸からロンドンに海運された石炭、*8 internal combustion：内燃機関、*9 Enclosure Acts：1800 年前後に発布された一連の農地囲い込み法令、*10 commons：共有地、*11 gleaning：落ち穂拾い

問１　下線部①をもとに、農業の集約化が起きる場合の二つの方向性を述べなさい。

問２　下線部②および第１段落の記述全体を参考にして、環境問題の解決にむけた農業の集約化の貢献について考えられるところを述べなさい。

問３　農業の技術開発と人口増加との関係について、下線部③を参考にして説明しなさい。

問４　表１は、1961 年から 2021 年までの世界の穀物生産量（ただしダイズは除く）の推移を表している。

（１）この表からこの 60 年間における重要な変化や傾向として指摘できる点を、３点あげなさい。

（２）この 60 年間で耕地面積は 1.1 倍程度の増加であり、穀物用耕地面積も同程度の増加であったと想定するとき、農業の集約化という考え方をもちいて、穀物農業に起こった予想される変化について述べなさい。

表１　世界の穀物生産量の推移（1961-2021 年）

1961 年 作物	生産量 (%)	1981 年 作物	生産量 (%)	2001 年 作物	生産量 (%)	2021 年 作物	生産量 (%)
コムギ	222.4 (25.4)	トウモロコシ	452.0 (27.7)	トウモロコシ	625.3 (29.7)	トウモロコシ	1,217.7 (39.6)
コメ	215.6 (24.6)	コムギ	449.6 (27.5)	コメ	600.5 (28.5)	コメ	789.0 (25.7)
トウモロコシ	209.1 (23.8)	コメ	410.1 (25.1)	コムギ	588.2 (27.9)	コムギ	772.8 (25.2)
オオムギ	72.4 (8.3)	オオムギ	149.6 (9.2)	オオムギ	140.6 (6.7)	オオムギ	145.1 (4.7)
エンバク	49.6 (5.7)	ソルガム	73.3 (4.5)	ソルガム	59.8 (2.8)	ソルガム	62.1 (2.0)
ソルガム	40.9 (4.7)	エンバク	40.3 (2.5)	キビ、ほか	28.9 (1.4)	キビ、ほか	29.6 (1.0)
ライムギ	35.1 (4.0)	キビ、ほか	27.0 (1.7)	エンバク	26.9 (1.3)	エンバク	22.7 (0.7)
キビ、ほか	25.7 (2.9)	ライムギ	24.9 (1.5)	ライムギ	23.4 (1.1)	ライコムギ	14.2 (0.5)
穀物類合計	876.9 (100)	穀物類合計	1,632.4 (100)	穀物類合計	2,105.1 (100)	穀物類合計	3,071.3 (100)
3 大穀物以外	229.8 (26.2)	3 大穀物以外	320.7 (19.6)	3 大穀物以外	291.1 (13.8)	3 大穀物以外	291.7 (9.5)

注）FAOSTAT（2024 年 5 月）より 。単位は 100 万トン、合計には 9 位以下も含む。トウモロコシには子実用も含まれる。

問５　下線部④などを参考にして、農業の集約化の功罪について、この英文全体から総合的に考察して述べなさい。

2 以下の英文１から英文３を読んで、問１～問３に答えなさい。(100 点)

英文１

Many scientists now see climate change as the greatest threat to future human wellbeing. Climate is affected by the total amount of greenhouse gases in the atmosphere. This is increasing due to the annual flow of emissions. Increases in the amount of CO_2 in the atmosphere are partially irreversible, which means that our current actions have long-lasting effects on future generations.

What is the trade-off between the benefits of producing and consuming more, and the enjoyment of a less-degraded environment? How should we trade off consumption now, with environmental quality enjoyed both by current and future generations?

We need to consider the ways that the resources of the society could be diverted from their current uses to reduce the environmentally degrading effects of economic activity. The nation may adopt policies to limit environmental damage. We refer to such policies as abatement policies, since they abate (reduce) pollution and environmental damage. The amount of reduction in emissions caused by these policies is referred to as the quantity of abatement.

To get some idea of how economists assess abatement policy options, we look at the estimated cost of reduction of global greenhouse gas emissions in Figure 1, which shows the relationship between potential abatement and the cost of abatement per tonne. Each bar represents a change that could reduce carbon emissions. The height shows the cost of using the technology to reduce carbon emissions, in terms of euros per tonne of reduced CO_2 emissions. The width shows the reduction of CO_2 emissions, compared to the level without policy intervention. Therefore, for each method, a short bar means that there is a lot of abatement per euro spent. A wider bar means that this method has a higher potential to abate emissions.

出典：[文献１] Bowles, S., Carlin, W. and Stevens, M. (2017). ‘Economics of the Environment’. Unit 20 in The CORE team, *The Economy*. Available at: https://www.core-econ.org. [Accessed on May 12, 2024] (*The Economy* 20.2 及び 20.3) より一部改変。

英文２

In considering alternative environmental policies, how much we value the wellbeing of future generations is commonly measured by an interest rate, which is literally the rate at which we discount future generations’ costs or benefits. This rate is a measure of how we currently value the costs and benefits experienced by people who will live in the future.

When considering policies, economists seek to compare the benefits and costs of alternative approaches. Doing this presents especially great challenges when the policy problem is climate change. The reason is that the costs will be borne by the present generation but the benefits of a successful abatement policy will be enjoyed by people in the future.

Are there any reasons why, in summing up the benefits and costs of an abatement policy, I should value the benefits expected to be received by future generations any less than the benefits and costs that will be borne by people today?

The people in the future may have either greater or lesser needs than we do today. For example, as a result of continuing improvements in technology, they may be richer than we are today, so it might seem fair that we should not value the benefits they will receive from our policies as highly as we value the costs that we will bear as a result. This was the approach adopted in the 2006 Stern Review on the Economics of Climate Change. Nicholas Stern selected a discount rate*1 to take account of the likelihood that people in the future would be richer. Based on an estimate of future productivity increases, Stern discounted the benefits to future generations by 1.3% per annum.

William Nordhaus criticized the Stern Review for its low discount rate. Nordhaus wrote that Stern's choice of discount rate 'magnifies impacts in the distant future.' He concluded that, with a higher discount rate, 'the Review's dramatic results disappear.' Nordhaus advocated the use of a discount rate of 4.3%, which gave vastly different implications. Not surprisingly, Nordhaus' recommendations for climate change abatement were far less extensive and less costly than those that Stern proposed.

<u>① Why did the two economists differ by so much?</u> They agreed on the need to discount for the likelihood that future generations would be better off. But Nordhaus had an additional reason to discount future benefits: impatience. Nordhaus used estimates based on market interest rates as measures of how people today value future versus present consumption. Using this method, he came up with a discount rate of 3% to measure the way people discount future benefits and costs that they themselves may experience. Nordhaus included this in his discount rate, which is why Nordhaus' discount rate is so much higher than Stern's.

Critics of Nordhaus pointed out that in evaluating the claims that future generations should have on our concern, a psychological fact like our own impatience is not a reason to discount the needs and aspirations of other people in future generations. Stern's approach counts all generations as equally worthy of our concern for their wellbeing. Nordhaus, in contrast, takes the current generation's point of view and counts future generations as less worthy of our concern than the current generation, much in the way that, for reasons of impatience, we typically value current consumption more highly than our own future consumption. ② Is the debate resolved?

出典：[文献２] Bowles, S., Carlin, W. and Stevens, M. (2017). ‘Economics of the Environment’. Unit 20 in The CORE team, *The Economy*. Available at: https://www.core-econ.org. [Accessed on May 12, 2024] (*The Economy* 20.9)より部改変。

（語注）*1 discount rate 割引率

英文３

英文3・文献3は出典のみ公開する。

出典：[文献３] Rennert, K., Errickson, F., Prest, B.C. et al. Comprehensive evidence implies a higher social cost of CO_2. *Nature* 610, 687–692 (2022).

https://doi.org/10.1038/s41586-022-05224-9 より一部改変。

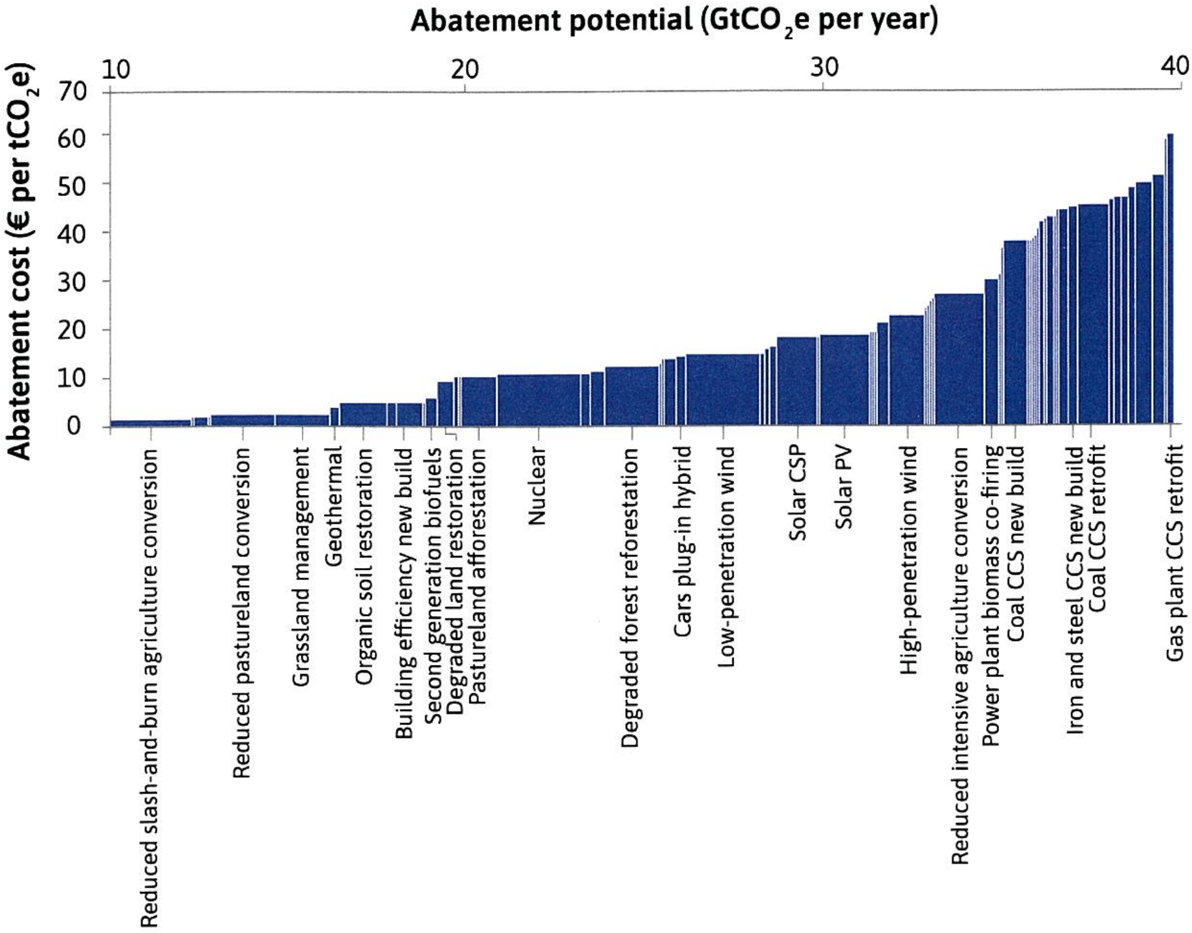

Figure 1: The cost of potential global greenhouse abatement (compared with business as usual), using different policies.

図注：

1) The measure of potential abatement, gigatonnes (10^9 tonnes) of carbon dioxide equivalent ($GtCO_2e$), expresses how much warming a given type of greenhouse gas would cause by using the equivalent amount of CO_2 emissions that would have the same effect.
2) CSP = Concentrated solar power
3) PV = Solar photovoltaics
4) CCS = Carbon capture and storage

出典：文献 1　Figure 20.9

問１

Figure 1 に関して以下の問いに答えなさい。

（１）Figure 1 の縦軸と横軸の意味するところをそれぞれ説明しなさい。

（２）Figure 1 からわかることを簡潔に要約して説明しなさい。

（３）仮に、Figure 1 の近似として、横軸の変数（$x \geqq 0$とする）と縦軸の変数（yとする）の関係が次の式で表されたとする。

$$y = \left(\frac{e^{\frac{x}{10}}}{10} + \frac{x}{50}\right)\left(e^{\frac{x}{10}} + \frac{x^2}{100}\right)$$

このとき、1 年間で 10 Gt（ギガトン）の CO_2 排出を削減するのに最低限必要な費用を求めなさい。Figure 1 と同じく、y の単位は Euro per tCO_2e とし、x の単位は $GtCO_2e$ per year とする。なお、計算にはeの近似値として 2.72 を用いなさい。

問２

下線部①について以下の問いに答えなさい。

（１）Stern が用いた割引率の算出根拠を説明しなさい。

（２）Nordhaus が用いた割引率の算出根拠を説明しなさい。

（３）この二人が用いた割引率の算出根拠の違いを踏まえて、下線部②の “debate” の論点を説明しなさい。

問３

下線部③について以下の問いに答えなさい。

（１）2200 年の世界人口の予測に関して、Figure 2 からわかることを説明しなさい。

（２）割引率を 2.0%としたときの SC-CO_2 の分布の統計的特性に関して、Figure 3 からわかることを説明しなさい。

（３）下線部③を踏まえて、割引率を 2.0%としたときの SC-CO_2 の推定値に散らばりがある理由を考えて、簡潔に説明しなさい。また、分布の左裾と右裾についても解釈を与えること。

（４）Figure 3 では、用いる割引率が低くなるにつれて SC-CO_2 推定値の四分位範囲（25%-75% quantile range）が大きくなっていることがわかる。Figure 2 も参考にして、この理由を考えて、簡潔に説明しなさい。