

令和5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10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9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)

Benefits of urban agriculture

Environmental benefits

The expansion of green areas in cities can potentially contribute to climate change mitigation and adaptation, heat and flood mitigation, erosion reduction and carbon capture. It can also contribute to the maintenance of agricultural biodiversity and related knowledge, the increased presence of pollinators ^{*1} and the consequent reduction in biodiversity loss. Agricultural areas on city fringes ^{*2} can serve as essential transition zones ^{*3} between urban land use and forests, ensuring the maintenance of ecosystem services. However, such benefits can only be achieved when urban agriculture is circular (using regenerative practices, eliminating pollutants, recycling waste and maximizing exploitation ^{*4} of the inputs used) and is fair and equitable for producers and consumers.

Besides providing food and fiber, highly efficient and integrated urban agriculture systems generate other environmental benefits. Drip irrigation ^{*5} and hydroponics ^{*6} can greatly impact crop water yield. Agricultural irrigation represents around 85 per cent of global water use, and drip irrigation can increase yields up to 90 per cent. Urban agriculture can benefit ecosystems by preventing erosion ^{*7}, supporting pollination and seed dispersion, and regulating the microclimate.

By using organic waste as fertilizer, urban agriculture can mitigate the environmental impacts of mineral fertilizers as well as the emissions from landfilling. Worldwide, an estimated 30-50 per cent of produce is lost due to lack of cold storage and inadequate infrastructure, with fruits and vegetables recording the highest losses. Although per capita food waste is much higher in Europe and North America than in Asia and Africa, food losses in developed and developing countries are the same. ① In developing countries, they occur mainly during post-harvest and processing, whereas in developed countries they occur at the retail and consumer levels. Urban agriculture's proximity ^{*8} to markets can potentially reduce emissions as well as food loss during transport.

Overall, urban agriculture's contribution to reducing the environmental impacts from food systems remains limited for several reasons. First, a relatively small amount of land in urban areas is used in agriculture, and rooftop and high-tech vertical farming are still a niche. Second, only a few crops can be grown economically in cities or in controlled indoor environments, and those crops (vegetables, herbs, fruits) are not the biggest contributors to the food system's environmental impact. Studies on urban agriculture's impacts on reducing food waste and transport emissions are limited. Third, increasing urban agriculture in cities can increase environmental stresses, including fertilizer

pollution, water/energy use, and growing on contaminated land.

Decision makers who want to promote urban agriculture with positive effects on the environment should consider impacts on energy, land and water use, and the potential effects of pollution on food quality.

Social and nutritional benefits

② Urban agriculture's most significant contribution is to promote food and nutritional security in cities by expanding the supply of fresh and healthy food at fair prices. Policies that promote urban agriculture have great potential to make urban food systems more resilient ^{*9} in times of shortage, reduce impacts of price fluctuations, improve food access for socially vulnerable ^{*10} populations and reduce social inequality.

Urban agriculture also has the potential to enhance local food culture. Increasing the supply of local products and maintaining traditional farmers on their land enhance traditional knowledge, customs and the preservation of agrobiodiversity. Different types of urban agriculture, such as institutional, backyard, and community gardens, can promote mental and physical health, offer opportunities to socialize, and help establish networks to exchange inputs and knowledge. The social and nutritional benefits of urban agriculture are amplified ^{*11} for women in low-income developing countries, particularly as they seek to improve household food security, health and financial security. Even in cases where the economic potential of urban agriculture is limited, it helps socially empower women through social networks, creating a greater sense of community, engagement in community development and financial independence.

Economic benefits

In principle, commercial urban agriculture has the potential to generate employment and income and to boost the local economy. Technical assistance aimed at commercialization and scaling-up, as well as policies for accessing land to credit, are therefore essential. Urban agriculture also promotes the development of high technology and green industry.

③ Non-commercial (subsistence) urban agriculture, such as household and community gardens, also plays a vital role in the economy, helping to reduce food costs for participants. Particularly in low-income developing countries in Asia and Africa, social, cultural and gender norms often result in women having lower levels of education, limited autonomy, greater domestic responsibilities, and limited access to finances and well-paying employment. In such cases, urban agriculture provides

women with the opportunity to engage in income-generating activity with minimal capital investment while taking care of other household responsibilities.

Conventional land-based urban agriculture is relatively low-paying. It is often practiced as a hobby or by groups that face food insecurity, more so in developing, low-income countries where it is used mainly for household consumption. The economic benefits of such operations have been found to vary based on agriculture type and process, crops grown, farmer income level, gender, etc.

④ The dynamics of urban and rural settings differ due to the institutional and societal dynamics in cities and rural areas which can create more polarization ^{*12}. As articulated above, women can not only enhance family food security through urban farming, but also generate income through selling excess products. Urban farming empowers women through independence, leadership and capacity-building. Thus, there is value in looking to women to enhance urban agriculture as more of the world's population moves to cities.

To create value-added products, niche urban farms in controlled indoor environments have developed in some countries, with a focus on products such as herbs that can be grown in soil-less media. Major investments in high-tech urban agriculture have occurred. For example, Gotham Greens grows specialty foods year-round in solar- and wind-powered greenhouses, warehouses ^{*13} and roof farms in six US states. With machine learning and artificial intelligence, automation will likely be the next step towards efficiency. The economic benefits and who gets them will depend on whether operations are conventional or high-tech.

Benefits and trade-offs of urban agriculture typologies ^{*14}

While the different typologies of urban agriculture provide economic, social and environmental benefits to urban communities, they also generate environmental, productivity and related trade-offs.

⑤ The optimum benefits lie at some appropriate balance between the production from urban agriculture and the externalities that it generates.

Changes in food production can conflict with other Sustainable Development Goals, such as protecting land resources and mitigating climate change. Decision makers need to understand potential trade-offs between these goals and find a balance between human needs and environmental impacts. For urban agriculture to generate net social benefits, it must be highly efficient and be an integrated production system. It should have lower environmental impacts than conventional agriculture, with production based on efficient water use and fertile soils and integrated into urban land use planning, which can also help mitigate climate change. Modern technologies such as

controlled-environment agriculture should be explored.

(出典：UN Environment Programme, 2022, Urban Agriculture's Potential to Advance Multiple Sustainability Goals - An International Resource Panel Think Piece, pp.30-35 を一部改変)

(語注) *1 pollinator：花粉を運ぶ昆虫や鳥類等の動物, *2 fringe：周辺地域, *3 transition zone：遷移帯, *4 exploitation：利用, *5 drip irrigation：点滴かんがい, *6 hydroponic：水耕農業に関する, *7 erosion：土壌侵食・流失, *8 proximity：近接性, *9 resilient：回復力のある, *10 vulnerable：脆弱である, *11 amplify：増幅させる, *12 polarization：二極化, *13 warehouse：倉庫, *14 typology：分類

- 問1** 下線部①に関して、食品ロスの発生状況が発展途上国と先進国において異なる理由を論じなさい。
- 問2** 下線部②に関して、都市農業が食料と栄養の安全保障の促進に貢献する理由を論じなさい。
- 問3** 下線部③に関して、ジェンダー平等の視点から都市農業の機能を論じなさい。
- 問4** 下線部④を和訳しなさい。
- 問5** 下線部⑤の externalities に関して、ある都市での土地資源の産業利用を農業と工業に区分した場合の負の外部効果が以下の定義式で表されたとする。

$$E(X_A, X_I) = a X_A^2 + b X_I^2$$

ここで、 X_A は農業の土地利用面積、 X_I は工業の土地利用面積を表している。ただし、 a と b は正の実数である。

一方で、この都市の土地利用では、都市計画により産業利用の最大・最小面積が①式と②式、水利条件により農業利用の最大面積が③式によって制約されている。④式、⑤式は非負条件である。

$X_A + X_I \leq 500$	①式
$X_A + X_I \geq 200$	②式
$X_A \leq 375$	③式
$0 \leq X_A$	④式
$0 \leq X_I$	⑤式

- (1) $a = b = 1$ のとき、 $E(X_A, X_I)$ の最大値と最小値を求めなさい。また、 X_A と X_I の値の取りうる範囲と、それらの最大化・最小化が実現する状態を解答用紙の図に示しなさい。
- (2) $a = 1$ のとき、 $E(X_A, X_I)$ の最大値と最小値を b の関数として表しなさい。

2 以下の英文を読んで問 1 ～問 6 に答えなさい。(100 点)

Food Supply Chains: Business Resilience, Innovation, and Adaptation

The COVID-19 pandemic has revealed both the vulnerability and resilience of food supply chains. From farm to retail, supply chains have been disrupted ^{*1}, primarily by government-imposed lockdowns and other restrictions affecting labor supply, input provisioning, logistics ^{*2}, and distribution channels. (See Figure 1 for a simplified presentation of food supply chains.) ①Impacts have differed by type of commodity: Mechanized production of cereals and other staples on large farms proved less vulnerable than labor-intensive and labor-dense production of fruits and vegetables on smaller farms. Postharvest handling, packaging, and processing for many perishable ^{*3} foods were susceptible ^{*4} to outbreaks of COVID-19 among workers because of close working conditions. Disruptions and enhanced virus transmission were especially notable in the meatpacking industry.

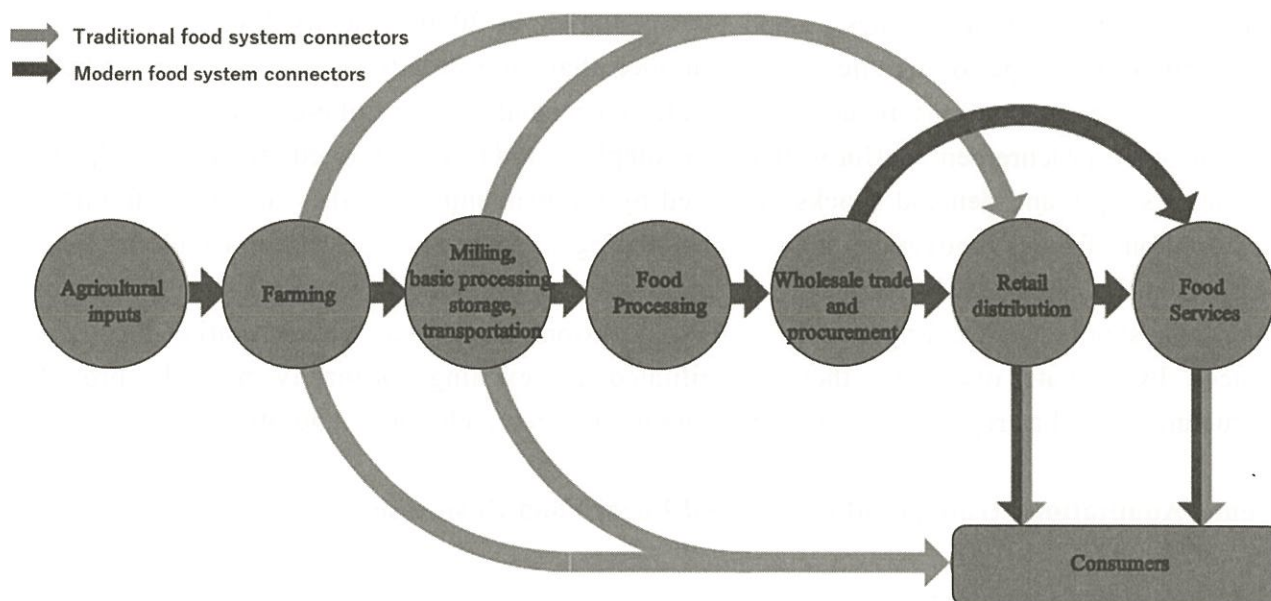


FIGURE 1 Traditional and modern integrated supply chains

②Impacts have also differed by country and degree of integration and modernization of food markets. Countries where food systems are transitioning from traditional to modern appear to have been most vulnerable to supply disruptions and restrictions on labor movements. Transitioning ^{*5} supply chains are long and operations often depend on hired labor, but the multiple stages between farm and retail are still poorly integrated and fragmented ^{*6} - characterized by, for instance, little development of temperature-controlled storage and transportation, poorly connected service and

input markets, and underfinanced suppliers. These supply chains have been vulnerable to COVID-19 restrictions. Border closures and curfews ^{*7} have led to food losses as transport of perishables have had to take place in daytime heat instead of during cooler nights. In other cases, hired workers were unable to report to work. More traditional supply chains (depicted in Figure 1) have also proven vulnerable for much the same reasons, but less so, as these chains remain short and producers and operators are mostly family owned, using little hired labor.

③Modern supply chains (integrating all segments in Figure 1) have generally been the least affected, possessing greater capacity to adjust and innovate to keep supply chains running. Large-scale operators in modern supply chains benefited from a fair degree of control over input supplies and marketing channels, greater flexibility to switch between suppliers within their networks and between destination markets, and sufficient resources to innovate and “pivot” business operations. (“Pivoting” refers to fundamental shifts by businesses in strategy and practices in response to adverse shocks or to take advantage of major new opportunities. Below, we introduce the term “co-pivoting” to refer to significant complementary shifts in business strategies and operations by firms upstream or downstream from pivoting businesses.)

Pivoting by private food businesses and intermediaries in 2020 typically leveraged ^{*8} digital platforms and/or new types of logistics business models that were already beginning to emerge before the pandemic. Such innovations in business operations, especially the use of e-commerce, e-logistics, e-payment, and e-procurement platforms to link to suppliers and buyers, proved effective in adjusting to the major supply and demand shocks provoked by the pandemic, and they are likely to endure. While adoption of these innovations may be challenging in some contexts, they provide important new opportunities, particularly for the many small and medium enterprises (SMEs) in developing-country food supply chains. Importantly, these innovations have been wholly market driven and introduced by private operators, though facilitated by existing, primarily publicly provided infrastructure as well as regulations for mobile communication technology and other connectivity.

Pandemic Adaptation Strategies of Global and Local Food Businesses

SUPPLY: Resilience and adaptation

In some contexts, the modernization processes have led to strongly dualistic ^{*9} market structures, with modern vertically integrated supply chains serving one market segment and traditional SMEs serving another. Senegal’s fresh fruit and vegetable supply chains illustrate the stark contrast in ability to adjust to the pandemic shock. The vertically integrated, large-scale modern firms, which cater exclusively to export markets, have suffered little impact from the pandemic. ④These firms were able to adjust market channels and adapt business operations to circumvent ^{*10} labor restrictions. In contrast, small-scale farms, traders, and handlers operating in Senegal’s poorly integrated domestic markets were severely affected by labor restrictions and disruptions in input supply, aggravated ^{*11}

by a lack of adequate storage and limited capacity to manage risks.

In Ethiopia, vegetable supply chains were also severely affected by disruptions in transport and in the supply of key farm inputs. In response to the pandemic, the government introduced trade restrictions to protect domestic producers from import competition. The impact on Ethiopian vegetable farmers was mixed. Those farmers who could sell into urban markets benefited from reduced local and international competition and higher prices, but those who could not trade to other parts of the country lost out. However, Ethiopia's smaller vegetable farms were less affected by pandemic-related disruptions than medium-sized farms, as smaller farms rely less on hired labor. This finding is consistent with the more general hypothesis that vulnerability to reduced labor availability, as resulted from pandemic restrictions, shows ⑤an inverted U-shaped relationship with farm size. That is, small farms that rely on family labor have been largely unaffected by labor restrictions, but vulnerability increases among medium-sized farms with relatively high dependence on hired labor. Resilience has been much greater among agribusinesses large enough to benefit from significant economies of scale and financial capacity; these businesses managed to assure their labor supply by reorganizing labor shifts and arranging for safe transportation for workers, as was observed in Senegal's large export firms.

DEMAND: Modern retail and e-commerce

Previous food and health safety crises led to increased supermarket purchases and declines in shopping at traditional wet markets ^{*12}, the SARS epidemic, for example, jumpstarted e-commerce in China. ⑥The COVID-19 pandemic likewise has increased modern grocery store sales at the expense of traditional stores (Figure 2). Albeit starting from low levels, e-commerce in food retail jumped by over 100 percent during 2020 in many middle-income countries, including Brazil, Indonesia, and South Africa, and by almost 50 percent worldwide. Although Figure 2 refers to consumer e-purchases at the retail stage only, use of e-commerce platforms in other segments of the supply chain such as logistics is growing even faster and fundamentally changing the structure of food business operations.

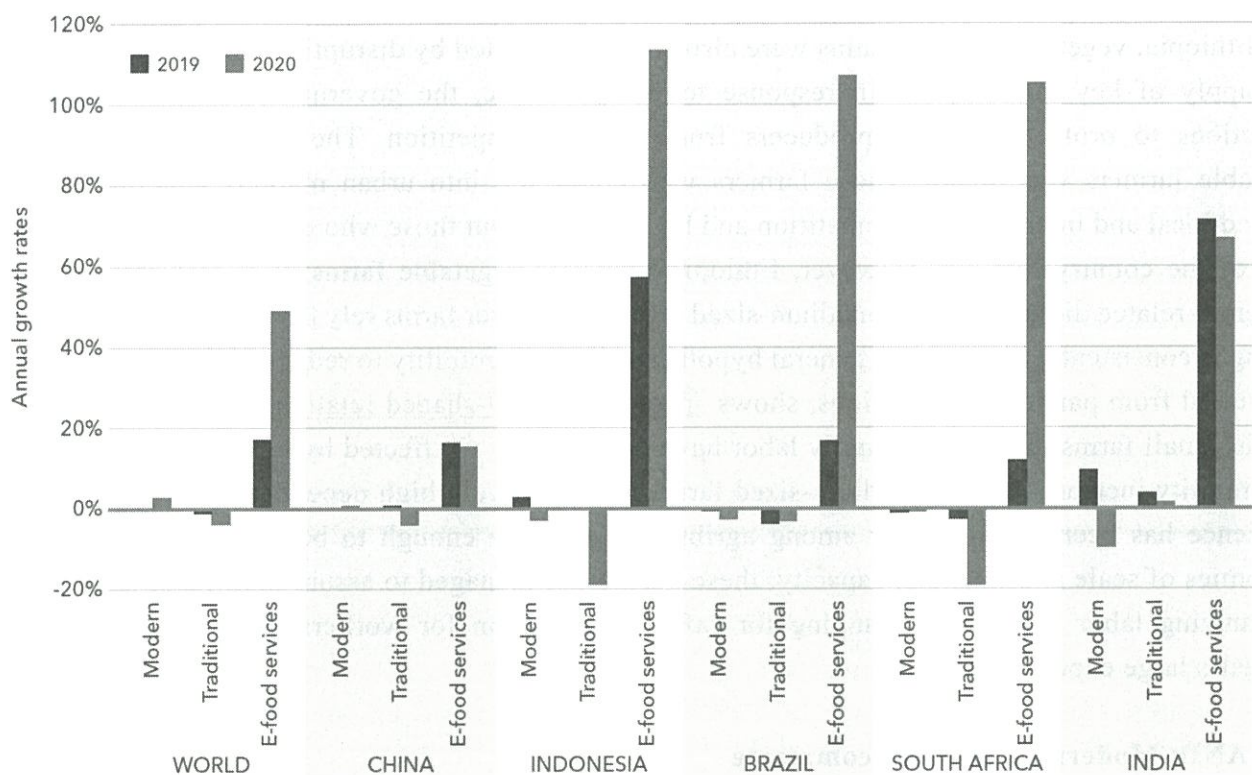


FIGURE 2 Growth rates of retail food purchases by type of provider in middle-income countries, 2019–2020

Source: Based on data from Euromonitor International, accessed January 20, 2021.

Note: Growth rate is for real per capita food purchases at retail level. “World” data cover 103 countries. “Modern” retail stores include convenience stores, supermarkets, hypermarkets, and discounters. “Traditional” grocery retailers are those that are “non-chained,” small-scale stores owned by families, and/or run on an individual basis, and do not include informal retailers in open markets or street vendors.

(出典：Thomas Reardon and Rob Vos, Food Supply Chains: Business Resilience, Innovation, and Adaptation, International Food Policy Research Institute (IFPRI), *Transforming Food System After COVID-19*, 2021, pp. 64-69 を一部改変)

(語注) *1 disrupt: 混乱させる, *2 logistics: 資材調達, *3 perishable: 腐りやすい(生鮮の), *4 susceptible: 敏感な(影響されやすい), *5 transitioning: 移行している(過渡期の), *6 fragmented: 分断されている, *7 curfew: 外出禁止令, *8 leverage: てこ入れする, *9 dualistic: 二重の, *10 circumvent: 回避する, *11 aggravate: 悪化させる, *12 wet market: 魚, 肉などを売る市場

- 問1** 下線部①について、本文を参考にして、food supply chains の脆弱さがあからさまになった商品を挙げるとともに、その理由について説明しなさい。
- 問2** 下線部②について、本文を参考にして、food supply chains の脆弱さが最もあからさまになった国々の特徴と、脆弱である理由について説明しなさい。
- 問3** 下線部③を参考にして、FIGURE 1 から読み取れる modern supply chains の特徴を説明しなさい。
- 問4** 下線部④を和訳しなさい。
- 問5** 下線部⑤の「an inverted U-shaped relationship with farm size」について、本文を参考にして説明しなさい。
- 問6** 下線部⑥を参考にして、FIGURE 2 から読み取れる新型コロナウイルス感染症の影響を挙げるとともに、その影響が生じた理由についてあなた自身の考えを述べなさい。

問題訂正

農学部 食料・環境経済学科 小論文試験

下記の問題訂正があります。

記

問題訂正

農学部 食料・環境経済学科 小論文試験 問題冊子

問題 2

9 ページ

出典 2 行目

(誤) …, *Transforming Food System After*

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(正) …, *Transforming Food Systems After*

以上