Supporting Information for:

Consumers’ acceptance of agricultural fertilizer derived from diverted and recycled human urine

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Figure S1. Methodology framework and research design

1. Altruism  1.0  0
2. Egoism    0.1  1.0  3  0
3. Biospherism 0.7  0.1  1.00  0  2
4. Food Disgust Sensitivity 0.0  0.1  0.08  1.0  8  6  0
5. Risk Perceptions  -  0.0  0.01  0.1  1.00  0.0  4  7  1
6. Benefit Perceptions 0.0  0.0  0.04  -  -0.71  1.0  0.0  4  9  0.1  0
7. Perceived Naturalness 0.0  0.0  0.04  -  -0.62  0.6  1.00  0.0  4  7  0.1  7

Figure S2. Pearson’s correlation matrix for psychological variables used in regressions.
An additional question asked if respondents would eat fruits and vegetables grown using their assigned fertilizer type; response options were “yes”, “maybe”, and “no”. A chi-squared test of goodness of fit was performed to assess whether the three levels of willingness to consume products grown with a given fertilizer was equally distributed (Figure S1). Willingness to consume was not equally distributed in the population, ($X^2_{(N = 2,008)} = 68.25, p < 0.0001$).

Participants indicated a strong willingness to consume fruits and vegetables grown with organic fertilizers when compared to the other three fertilizer types. A relatively smaller proportion of participants (12.7%) were willing to consume foods grown with UDF, though the proportion of participants that indicated “maybe” was large for this (and the other) fertilizer types. The findings pertaining to the high level of acceptability of organic fertilizers were supported by consumers’ willingness to consume foods grown with different fertilizers. Specifically, consumers were much more willing to eat fruits and vegetables grown using organic fertilizers in comparison to all other fertilizer types (Figure S1).

![Figure S3](image)

**Figure S3.** Percentage of participants who indicated a willingness and an unwillingness to eat fruits and vegetables grown using fertilizers derived from diverted and recycled human urine (UDF) as compared to other fertilizer types.
Fertilizers are often used by farmers who grow vegetables and fruits. Fertilizers add important nutrients—like nitrogen, phosphorus, and potassium—to the soil, which supports plant growth.

One way that fertilizers can be made is from human urine, or “pee.” Human urine contains the important nutrients needed for plant growth.

To make fertilizer from urine, it must first be collected from special toilets and urinals. Urine is then processed to remove unhealthy things like harmful microorganisms. These nutrients can then be used to make the fertilizers, in liquid or solid form, and used by farmers.

Fertilizers made from human urine have several potential benefits:

First, fertilizer made from urine recycles nutrients that may be in short supply. This is because the excess nutrients from the food we eat are put back into the soil.

Second, some forms of urine-derived fertilizers can release nutrients quickly to the plant because they dissolve fast. This means that plants can access the nutrients in the fertilizer faster.

Third, by collecting urine before it goes to the wastewater treatment plant, the treatment process is less energy intensive, which is good for people and the planet.

However, fertilizers made from urine come with some potential risks and costs.

For example, if the urine is not treated properly, the fertilizer may contain unhealthy microorganisms that can be unsafe to humans.

Also, if too much fertilizer is applied, especially fertilizer with inorganic ingredients, some of the nutrients may wash away and end up in streams, rivers, and lakes. This, in turn, can lead to “nutrient pollution” which can cause algae to grow and which is bad for plants and animals. It may also make the water unsafe for people to drink. Proper use of fertilizer reduces the risk of nutrient pollution.

Collecting enough urine to make large amounts of high-quality fertilizer means that buildings—like offices, factories, schools, and maybe homes—would need to have special toilets and equipment installed. Doing so will be costly and will take some time.
Fertilizers are often used by farmers who grow vegetables and fruits. Fertilizers add important nutrients—like nitrogen, phosphorus, and potassium—to the soil, which supports plant growth.

One way that fertilizers can be made is from leftover plants and animal parts as well as animal manure. This organic material contains these important nutrients needed for plant growth.

There are many ways to make organic fertilizer. One way is when food and agricultural waste, along with manure, is brought to a factory and processed. Another way to make organic fertilizer is when individuals gather local food scraps and manure to create their own fertilizer.

Organic fertilizers have several potential benefits:

First, this kind of fertilizer can improve the health of the soil. For example, organic fertilizer helps to hold the soil together, which allows plants to absorb water and creates living spaces for insects and healthy microorganisms.

Second, organic fertilizer is widely available. People can go to local stores and buy it or make it themselves.

Third, this fertilizer can make healthy soil by adding organic matter to it. The plants that use this organic matter can take carbon dioxide from the atmosphere. Keeping excess carbon dioxide out of the atmosphere has positive effects on people and the environment.

Fertilizers made from organic matter come with some potential risks and costs.

For example, if manure in organic fertilizer is not treated properly, the fertilizer may also have unhealthy things in it like medicines and unhealthy microorganisms, which may be unsafe to humans.

Also, if too much fertilizer is applied, especially fertilizer with inorganic ingredients, some of the nutrients may wash away and end up in streams, rivers, and lakes. This, in turn, can lead to "nutrient pollution" which can cause algae to grow and is bad for plants and animals. It may also make the water unsafe for people to drink. Proper use of fertilizer reduces the risk of nutrient pollution.

There is a difference between fertilizers coming from natural materials and fertilizers that have been officially certified as Organic. If someone wants their fertilizer or farm to be certified as Organic, this process may be costly and take some time.
Fertilizers are often used by farmers who grow vegetables and fruits. Fertilizers add important nutrients—like nitrogen, phosphorus, and potassium—to the soil, which supports plant growth.

One way that fertilizers can be made is from human waste, which is collected in municipal sewage systems. Human waste is turned into "biosolids" that contain important nutrients needed for plant growth.

Biosolids must be treated in a specific way to make them safe for soil application. At wastewater treatment plants, human waste is processed to reduce pathogens and other contaminants. One of the products of this process is biosolids, which are used by farmers.

Fertilizers made from biosolids have several potential benefits:

First, fertilizers made from human waste recycles nutrients that may be in short supply. By applying biosolid fertilizers, leftover nutrients from the food we eat are put back into the soil.

Second, many wastewater treatment plants create fertilizer from biosolids because it can be the cheapest way of disposing of it. Making biosolids into fertilizer can save people money.

Third, biosolids can make healthy soil by adding organic matter to it. The plants that use this organic matter can take carbon dioxide from the atmosphere. Keeping excess carbon dioxide out of the atmosphere has positive effects on people and the environment.

Fertilizers made from biosolids come with some potential risks and costs.

For example, leftover chemicals from industrial processes as well as newer chemicals that aren't regulated may end up in biosolids, and we don't know their impact on soil and plants.

Also, if too much fertilizer is applied, especially fertilizer with inorganic ingredients, some of the nutrients may wash away and end up in streams, rivers, and lakes. This, in turn, can lead to "nutrient pollution" which can cause algae to grow and is bad for plants and animals. It may also make the water unsafe for people to drink. Proper use of fertilizer reduces the risk of nutrient pollution.

Most biosolids are used at commercial farms and are not widely available to the public. If small-scale farmers or gardeners would like to use biosolids as fertilizer, this process may be both complicated and expensive.
Fertilizers are often used by farmers who grow vegetables and fruits. Fertilizers add important nutrients—like nitrogen, phosphorus, and potassium—to the soil, which supports plant growth.

One way fertilizers can be made is by using human-made, or “non-organic”, forms of these important nutrients needed for plant growth.

In this process, the raw nutrients needed for fertilizer are made in a factory when nitrogen from the atmosphere is turned into ammonia. Other raw nutrients like phosphorus and potassium can be obtained from mining the earth. These nutrients can then be used to make the fertilizers, which are used by farmers.

Fertilizers made from synthetic materials have several potential benefits:

First, synthetic fertilizers can release nutrients quickly to the plant because they dissolve fast. This means that plants can access the nutrients in the fertilizer faster.

Second, this kind of fertilizer is widely available. People can go to local stores and buy it.

Third, because this kind of fertilizer may be inexpensive to buy, farmers can put on more than the plants need, to hopefully increase how much the plants grow.

Synthetic fertilizers have some potential risks and costs.

For example, making the nutrients from materials like phosphate rock, coal, and natural gas takes a lot of energy, some of the raw materials must be mined, and some are non-renewable, meaning the planet cannot sustain long-term human use of them. These processes may be unsafe to humans and the environment.

Also, if too much fertilizer is applied, especially fertilizer with inorganic ingredients, some of the nutrients may wash away and end up in streams, rivers, and lakes. This, in turn, can lead to “nutrient pollution” which can cause algae to grow and is bad for plants and animals. It may also make the water unsafe for people to drink. Proper use of fertilizer reduces the risk of nutrient pollution.

Using synthetic fertilizers over time could leave salts and some metals in the soil. These can build up, which can be bad for the plants and the health of soil microorganisms. Fixing this problem on a large scale will be costly and take some time.