# EquiFood

## A Scenario about Climate Change and Health Surveillance

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**ABSTRACT**

In the year 2026 a worldwide food scarcity crisis arises, caused by ongoing environmental catastrophes such as floods and droughts. As new alternative approaches to grow food are not enough to solve the global hunger a food distribution app that aims to ensure equitable access to the remaining food resources is developed. In this paper the potential implications and ethical considerations of this fictional future scenario are explored. Especially the consequences that emerge when the app incorporates personal health data collected through wearable health trackers to further improve its functionality and efficiency. Further, this data can be used to enhance workplace productivity through targeted interventions based on the health monitoring. This paper introduces this scenario and the concept of the app EquiFood and its evaluation in a small user study. This scenario should be used as a basis for discussion and raise awareness about climate change, the potential problems of health surveillance and of missing data privacy and security.

**Author Keywords**

pictorial; dystopia; fiction; data privacy and security; health data; tracking

**INTRODUCTION**

Climate change is one of the greatest challenges of our time, leading to more natural disasters such as storms, floods and droughts that cause economic losses and negatively affect global crop yields [1,14,23,24]. This affects people in poorer countries who depend on their own food and do not have the means to import goods to the same extent as other countries. This leads to food shortages and hunger in these areas. This issue brings many people out to demonstrate, but despite movements such as Fridays for Future, not enough is being done to drastically reduce pollution and CO2 emissions [18,23]. Instead, CO2 emissions continue to rise, and without social change, the climate goals set at various international climate conferences cannot be achieved. Such goals are formulated, for example, in the UN's SDGs [22].

In this context, digitalization offers many opportunities to implement these plans, and can support the societal transformation needed for a zero-carbon economy, while implementing the other goals of the SDGs. Digitalization is already advancing in many areas of society, but beyond the problems of the ICT sector alone being responsible for up to 4% of global greenhouse gas emissions [12], digitalization also poses risks in terms of privacy and data security [17]. On the one hand, digital data, once stored, can be used and analyzed for a wide variety of purposes, and on the other hand, technical means offer more and more opportunities to collect data. As a result, people, whether voluntarily or under compulsion, share a lot of personal data in order to be able to use various services and offers and to be able to participate at all in various parts of social interaction, for example on social media platforms [17]. This data can be misused for social control, as in the Chinese Social Credit System [8], or for political purposes, as the Cambridge Analytica scandal has shown [6]. This is countered by regulations such as the GDPR, which regulate and restrict access to and handling of personal data [4].

With the digitalization of medicine, digital health data is increasingly being tracked by devices such as fitness trackers and smartwatches and, in addition to personal use with fitness apps and the like, is being used for professional medical applications, shared with doctors and available at any time [3,4,13,19]. This data is collected over a long period of time and is high-dimensional, so medical data can be linked to information about user activity. This is in contrast to data that can be collected in a clinical setting and therefore this long-term data has high value and provides information about the health and lifestyle of the individual [13,20]. It should also be noted that changes to this data can lead to incorrect diagnoses and treatments, and can be misused for identity theft, social categorization, profiling and discrimination, and more [17,19]. Privacy and data security are therefore particularly important in the medical field.

In this work, these issues are considered using the method of speculative design [10], for which a scenario is

developed in which global environmental disasters lead to an unprecedented famine in 2026. To solve this, an application is developed in the following years that is supposed to optimise the allocation of the remaining food and is used by state authorities as a last resort. In order to achieve these optimisations, however, this application aggressively accesses the personal data of the users and brings about profound social changes, enables surveillance and social control.

The developed scenario was explored in a small user study. Semi-structured interviews were conducted, and the results were grouped and analyzed using the Sustainability Awareness Framework [25] and a thematic analysis [16]. The aim of this work is to identify potential impacts and stimulate discussion on climate change, global hunger and the growing challenges of data security and privacy in the digital age, particularly in relation to high dimensional datasets generated by wearables, and to consider how the curtailment of established conventions and human rights may affect society.

## BACKGROUND

### Climate Change

With steadily increasing emissions of greenhouse gases such as CO2, humans are making a significant contribution to climate change [18]. The rising global average temperatures and local temperature extremes lead to changes in weather conditions, threatening livelihoods, infrastructure, habitats and ecosystems. There are also direct impacts on human health, such as disease. Rising sea levels and floods, as well as droughts and fires, will have a variety of negative impacts on drinking water resources and agriculture, with lower yields to be expected [14,23]. Climate change is thus a driving factor in world hunger [24]. CO2 emissions are not evenly distributed, with a few countries responsible for the majority of emissions. However, the climate targets set by these countries are not sufficient to reduce their emissions to the extent that targets such as limiting global warming to a maximum of 2°C are unlikely to be met [1,18,23].

### Privacy and Security in the Health Domain

In the digital age, the privacy and security of personal information is of paramount importance as data can be easily collected, shared and analyzed [17]. This is especially important in the medical domain where extremely sensitive data is collected and e.g., small changes to the data can lead to faulty medical treatments [19].

With the digitization progressing in the medical domain and the Internet of Medical Things personal health monitoring systems make it possible to collect pervasive physiological and behavioral data, such as individual´s heart rate, sleep patterns, dietary habits and many more [15,19]. This data can be shared with medical personal who can remotely review the data and provide customized help for the patients [4,13,20].

The systems used to collect the data are often wearables devices like smartphones, smartwatches, wristbands and others which are already used by millions of people [3,20,21].

With these devices it is possible to gather long-term medical data which could not be replicated with traditional methods [20]. Next to the medical information about a person they collect different environmental variables such as movement, location and temperature. This high dimensional data can be used for many different purposes and is highly valuable as it can be used to infer sensitive information, identity theft or discrimination [17].

This enables data sharing, mining and social categorization and creates ethical implications considering user privacy [11,15].

This has been recognized by several different countries, resulting in various regulatory frameworks, such as the GDPR, which have been established to ensure the protection and responsible handling of personal data with the result of strengthening individual rights [4,26].

One mayor drawback is that the new regulations for data privacy and security impose new challenges especially for smaller businesses which are not capable of complying with the new requirements thus leaving the European market, leading to an increased market concentration [26]. Less engagement with websites and approximately 15% overall traffic goes along with this [9]. The GPDR also introduces changes to the innovations of firms that for the time being there is a shift towards incremental rather than radical innovation with more impact on smaller and newer firms [5].

### Applications using Health Data

Health data is no longer collected only by professionals and specialized medical devices, but increasingly by wearable devices such as fitness trackers and smartwatches [15,20]. Smartwatches account for the largest share, with tens of millions of users, because they are easy to wear, inexpensive and suitable for everyday use compared to other devices [13,21]. The data collected is high-dimensional data collected over a long period of time. In addition to health data such as pulse and oxygen saturation in the blood, environmental data such as position and altitude, movement with an accelerometer, pressure, temperature, sounds and more are recorded [20]. This allows the user's activities to be analyzed together with the health data, providing detailed information about the individual's health. By recording data over a longer period of time, this can be done with greater accuracy than in short routine examinations, for example in hospitals. This data is therefore particularly important for medical professionals to use in the prevention, diagnosis and treatment of disease [4]. Such data also offer great benefits for use in science, but are often not shared by users or healthcare organizations with experts due to technical limitations and privacy and data security concerns [4,13]. Common applications include quantifiable self-assessment fitness trackers that help

users manage their fitness, improve sleep, reduce stress and optimize work performance [3,20]. AI and ML methods can also be used to directly analyze this data and make suggestions to the user [20].

This is explored in the work of Arriba-Perez et al., who identify stressors from the data collected and use it to support students in different learning scenarios, create specific work plans, work in groups with a similar chronotype, warn of unhealthy markers and more [3]. The multifunctional application *HealthTracker* is designed to collect, display and analyze health data. It also collects nutritional data so that it can be combined to provide an overall picture of an individual's physical condition, rather than individual applications for specific areas, such as fitness trackers for running. This application shows how a mobile approach can function for tracking and monitoring ones health condition and simultaneously be used as a recommendation system [2].

## EQUIFOOD – A SCENARIO ABOUT CLIMATE CHANGE AND HEALTH SURVEILLANCE

In this section the developed application called EquiFood and a timeline of the scenario are introduced. The timeline will motivate the app and depict the impact it has on society, individuals, environment and economy. These topics will be discussed further in the following sections.

After the timeline the concept of EquiFood will be described in more detail, along with mock-ups for its design and functionality, as well as its changes based on the events in the scenario.

**2024**

Much of the permafrost in Siberia is thawing completely, releasing large amounts of greenhouse gases. Climate change forecasts are then recalculated and show much more drastic climate change than previously assumed. Despite this, there is still the belief that technological innovations of the future will solve this problem.

**2025**

Many islands are sinking faster than expected due to rising sea levels, and their inhabitants are being relocated, as in the case of the islands of Panama.

**2026**

Droughts in China and the granary of Europe, and severe flooding due to prolonged monsoons in India, are destroying valuable agricultural land and are just one example of the impact of drastically increasing environmental disasters. As a result, food production has already fallen by 40% and key supply chains are stagnating. Developed countries are buying food and raw materials in bulk and building up their own stocks. Supermarkets are being emptied by the population, even more so than during the Corona crisis.

**2027**

The global South cannot keep up with the financial resources of the industrialized countries, and is trying to raise enough money through exploitative contracts on natural resources to ensure the import of vital food despite higher prices. Large flows of refugees from poorer areas particularly affected by environmental disasters are already burdening richer countries and creating social divisions. International emergency conferences are held to determine rights to remaining food resources and to find transnational solutions.

**2028**

With food running out even in the developed world, drastic rationing plans are being implemented. Supermarkets sell only limited quantities. This gives rise to black market sales and increased crime. As alternative growing areas cannot be cultivated and more efficient solutions for growing and harvesting more food cannot be developed quickly enough, the European Union is commissioning the development of an app that will use intelligent algorithms to optimize the distribution of food. The aim is to reduce hunger and crime through fairer distribution.

**2029**

As a result of organized crime raiding supermarkets and warehouses to get their hands on food, they are turned into central distribution points and guarded by armed units. At the same time, the first version of the app is launched, which issues food stamps based on height, weight and age, which can be redeemed in the form of a QR code at the central distribution points. Despite the reduced choice, extreme price rises make the app effectively compulsory for many groups of the population. In the same year, following demonstrations against the still relatively affluent population, the application becomes mandatory for everyone.

**2030**

As the climate crisis worsens and agricultural products become increasingly scarce, further development of the application should make it possible to reduce food consumption even further without compromising human health. To this end, the EquiFood app will collect data on the user's health and use it to inform its intelligent algorithms. In addition to manual input into the app, health data from devices such as smartwatches will be used. To accelerate these developments, privacy and data security rules will be lifted for the EquiFood app.

**2031**

Although countries with more rural areas, such as the US, Russia or China, have so far been able to meet their own needs by developing large new agricultural areas for the years from 2029, the European solution of rationing through the EquiFood app is now being introduced there as well. In the European area, the combination with health data could stabilize the mood and economic power of the population. As a result of this development, large companies are approaching EquiFood and negotiating collaborations in which EquiFood will also monitor the work management of employees via wearable devices and draw up plans to optimize processes.

**…2040**

Climate change will continue in the coming years, making life in conventional cities impossible in many parts of the world due to severe storms with flooding, high temperatures and temperature fluctuations. Residential areas inspired by developments such as THE LINE [27] are being built, but on a much smaller scale. This allows people to live closer together in a smaller space. In addition, EquiFood technology is shaping people's lives and a clear dependency on the application has developed. On the one hand, it continues to promote a healthy lifestyle and has a positive impact on the health of many people, despite the still limited means of nutrition. On the other hand, the tracking of people and their health conditions leads to a loss of privacy and omnipresent social control. What was accepted as the only solution at the beginning of the crisis is increasingly becoming a burden, as the lack of freedom, the fear of receiving less food if you don't do what the app suggests, leads to immense social pressure. Some people are therefore constantly trying to outwit the app's algorithm and create their own advantages, such as saving enough food for birthday parties, but this hardly works for people who share their health data collected by wearables such as smartwatches. On the other hand, people who do not share this data, especially if the app is used to optimize work performance, suffer from additional pressure to perform. Increased productivity leads to additional rewards, which in turn increases people's power and productivity. The inequality with people who are not in this feedback loop leads to discrimination and social tensions.

At this point, the scenario can develop in different directions. On the one hand, innovations in farming techniques or amelioration of the climate crisis could lead to higher agricultural yields and improve the situation, or social tensions could come to a head and lead to conflict. This does not even take into account global interdependencies.

**Mock-Ups EquiFood**

Several iterations of mock-ups were used to develop the concept for EquiFood. After a rough first draft, consideration was given to which aspects were relevant to the described scenario and three different versions of EquiFood were designed. In addition to the mock-ups themselves, the scope of these versions is described below, although not all steps and functions of the application have been visualized, as an evaluation of the design was not the aim of this work.

The first version, shown in Figure 1, is a simple interface that allows users to see what food they have been allocated by EquiFood and a personal code to collect it without having to pay for it elsewhere. The distribution of food at this stage is based on data previously entered by users on height, weight and age, as well as data on available food resources within Europe, so that international exchanges and supply chains can also be optimized in terms of food expiration dates. This is the basic function of EquiFood. The next version, shown in Figure 2, goes as far as to collect not only general data, but also people's health and activity data, either manually or, more importantly, using wearables. This gives EquiFood's algorithms direct feedback on people's condition, taking into account the food allocated, and allows more drastic rationing plans to be implemented. At the same time, EquiFood is still able to improve the health of the user, providing motivating self-monitoring statistics and recommendations for exercise. The last version shows the integration and control of the daily work routine by EquiFood. This can be seen in Figure 3. This is made possible by additional data from each company, together with data collected by EquiFood through wearables on activities, stress and other factors. This makes it possible to create work schedules and groups that take into account, for example, the chronotypes of individual workers in order to optimize processes and make the best possible use of people's economic performance. The app motivates this with special rewards, creating a positive feedback loop.


*Figure 1: EquiFood Version 1*

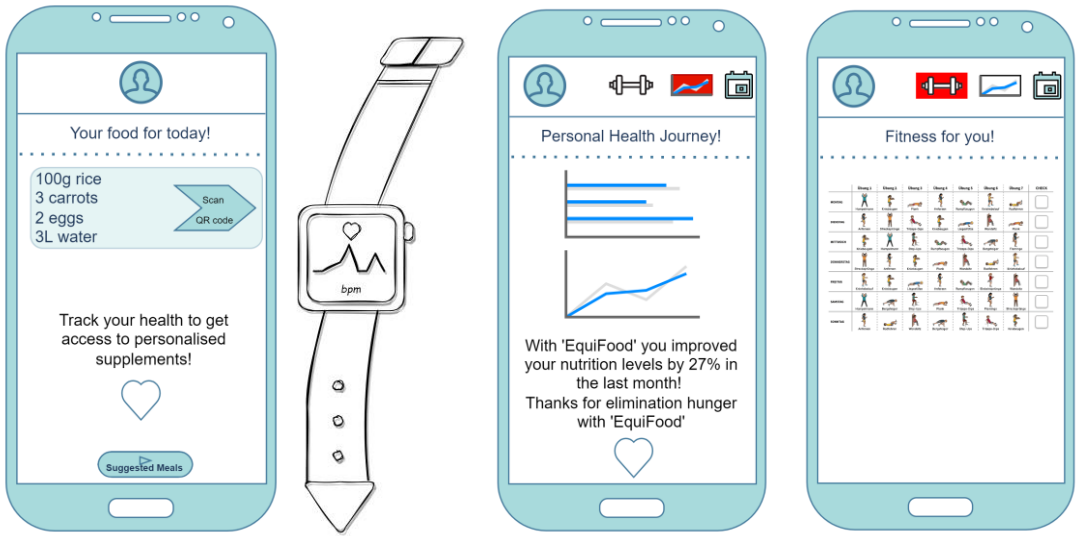


*Figure 2: EquiFood Version 2*

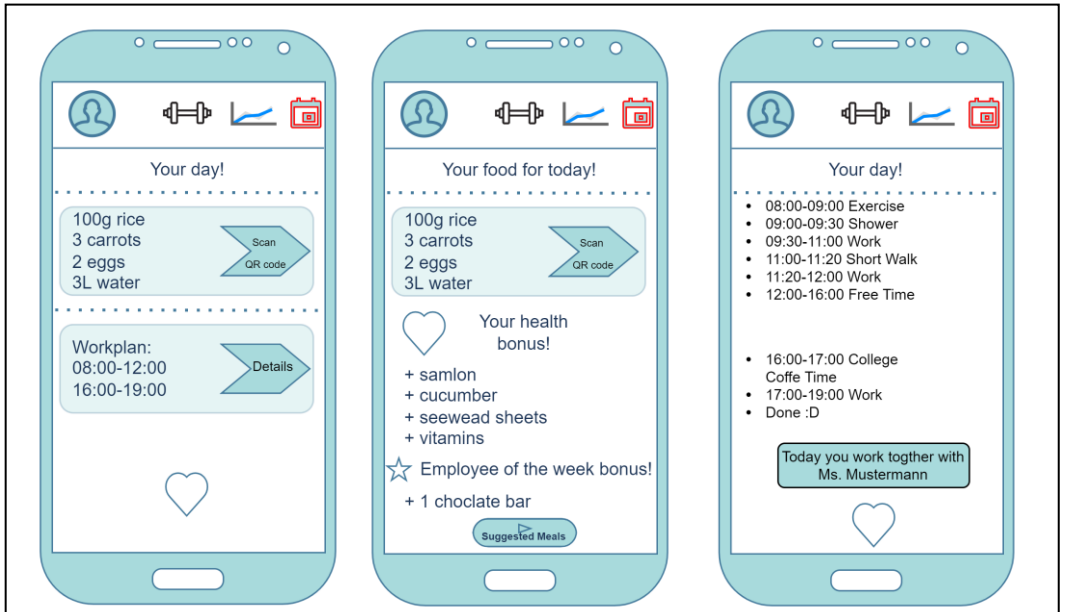


*Figure 3: EquiFood Version 3*

## INTERVIEWS

In order to evaluate the developed application and the scenario, especially in terms of sustainability, a user study was conducted, the results of which are presented in this section.

A total of four semi-structured interviews were conducted. This method made it possible to address key sustainability issues as well as to go into detail on individual aspects. The structure of the interviews was based on the Sustainability Awareness Framework. This made it possible to focus the questions on sustainability and to consider the interrelationships between the effects of the application on each other and on the environment within the scenario. The results were recorded in writing during the interviews, evaluated using thematic analysis [16] and entered into a Sustainability Awareness Diagram [25].

*Table 1: Sustainability Awareness*

| Rating | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| Sustainability conciousness | 0 | 0 | 2 | 0 | 1 | 1 |
| Ecological Products | 0 | 0 | 1 | 3 | 0 | 0 |
| Technology saves the world | 1 | 0 | 2 | 0 | 1 | 0 |
| Social Support | 0 | 0 | 1 | 3 | 0 | 0 |
| Willingness to adapt and renounce | 0 | 0 | 2 | 0 | 2 | 0 |

At the beginning of the interviews, participants were asked about their attitudes towards sustainability. The weightings are shown in Table 1, which shows a positive trend towards sustainability awareness.

The EquiFood application was then presented in the context of the scenario and feedback on the impact of the application was collected.

In addition, questions were asked about the impacts in relation to the five dimensions of sustainability as defined by SusAF, so that these aspects were given particular attention in the interviews. Finally, relationships between impacts were discussed.

The main results are summarized in the SusAD in Figure 4. Here we can see that the application has direct positive effects, such as fulfilling people's basic needs, such as the provision of food, leading to better health in general. Effects such as less waste and the optimization of supply chains leads to economic benefits, less emissions and has a positive impact on the environment. On the other hand, restrictions on freedom and doubts about the justice of the system can lead to armed conflict and social division.

The interviews were used to collect potential impacts of the application on different dimensions of sustainability. In summary, an application with the functional scope and environment presented in the scenario should only be used for a short period of time due to the many potential negative social impacts, and care should be taken to ensure that individual rights are not restricted for prolonged periods of time.

## DISCUSSION

This work presents the concept of an application that will be used primarily for the fair distribution of food in a scenario where there is global hunger due to drastic climate change and environmental disasters. To this end, AI and ML methods are used to reduce per capita consumption as much as possible, while at the same time improving people's health by using data on available food resources and data on the health status of all people. As the scenario progresses, the scope of the app expands to include not only dietary and exercise recommendations, but also the structuring of daily work routines. With EquiFood's guidelines, there is a direct dependency on the app and it has a great impact on the lives of individuals and society. These effects have been considered in this thesis through a user study and evaluated in terms of sustainability.

It should be noted that although the concept developed for the EquiFood app and the scenario are inspired by current developments as described in the background to this paper, the scenario describes a dystopian future. Due to the complexity of such a scenario, only speculative predictions about developments and impacts of EquiFood can be formulated and only a small part of the possible impacts can be described. A prototype, as realistic as possible, that could be tested in a controlled environment was not created in this work and is not a goal for the future. Instead, this work is intended to stimulate discussion of these issues.

An application like EquiFood would not only have a negative impact on society, but also a number of positive effects. This was discussed in the interviews, but it can also be compared to existing applications that help users achieve their sports goals and diet plans. For example, EquiFood could help to improve users' diets and have a positive impact on their health. There could also be improvements in waste, as seen with apps now being used to sell food at low prices instead of throwing it away[28]. However, this would be on a different scale to EquiFood, as without the amount of data and algorithms to optimize, it is not possible to plan precisely enough to implement a near-zero waste policy.

In the economic dimension, such an application would probably lead to a planned economy, as in a free market economy the app could not create a sufficient precise plan to reach the desired level of optimization.

In terms of social impact, only negative expectations were mentioned in the interviews, but this could be due to the context of the app in the scenario. In particular, the risk of social division due to skepticism about the fairness of the app and the possible unequal treatment of different social groups was mentioned.

The paper by Böning and Maier-Rigaud it is indicated that there might already be a tendency towards a greater lack of solidarity in the case of behavioral health risks among users of health apps[7]. This effect may be due to

the fact that these apps convey a greater sense of personal responsibility for one´s own health.

In summary, an app on the scale of EquiFood is very unlikely, but many functions are already covered by digital apps today and similarities in term of impact can be identified with EquiFood. Due to the many social problems of EquiFood, which are encouraged by the scale and dependency on the app, such a stand-alone application would not be sustainable even in the scenario described. These issues could be addressed through increased competition and regulations on privacy and data security, so digitalization has a lot of potential for society.

## CONCLUSION

This work used the EquiFood application and scenario to look at developments in climate change, global hunger, digitalization and privacy and data security, particularly in relation to medical data. The scenario also addressed issues such as health monitoring through wearables and social control. Due to the complexity of the issues, the statements made are speculative in nature and are primarily intended to address the issues and stimulate discussion, but are inspired by current developments.

In the user study it was observed that the participants identified some impacts of EquiFood for the scenario that can also be found in existing applications. These were both negative and positive impacts.

In the discussion it was pointed out that an application like EquiFood would not be sustainable, especially because of the societal impacts, but that digitalization still has great potential to improve various areas of social life, of individuals, the economy and the environment. However, this requires sound regulation that guarantees the rights of individuals, including privacy and data security, as well as fair solutions, innovation and competition.

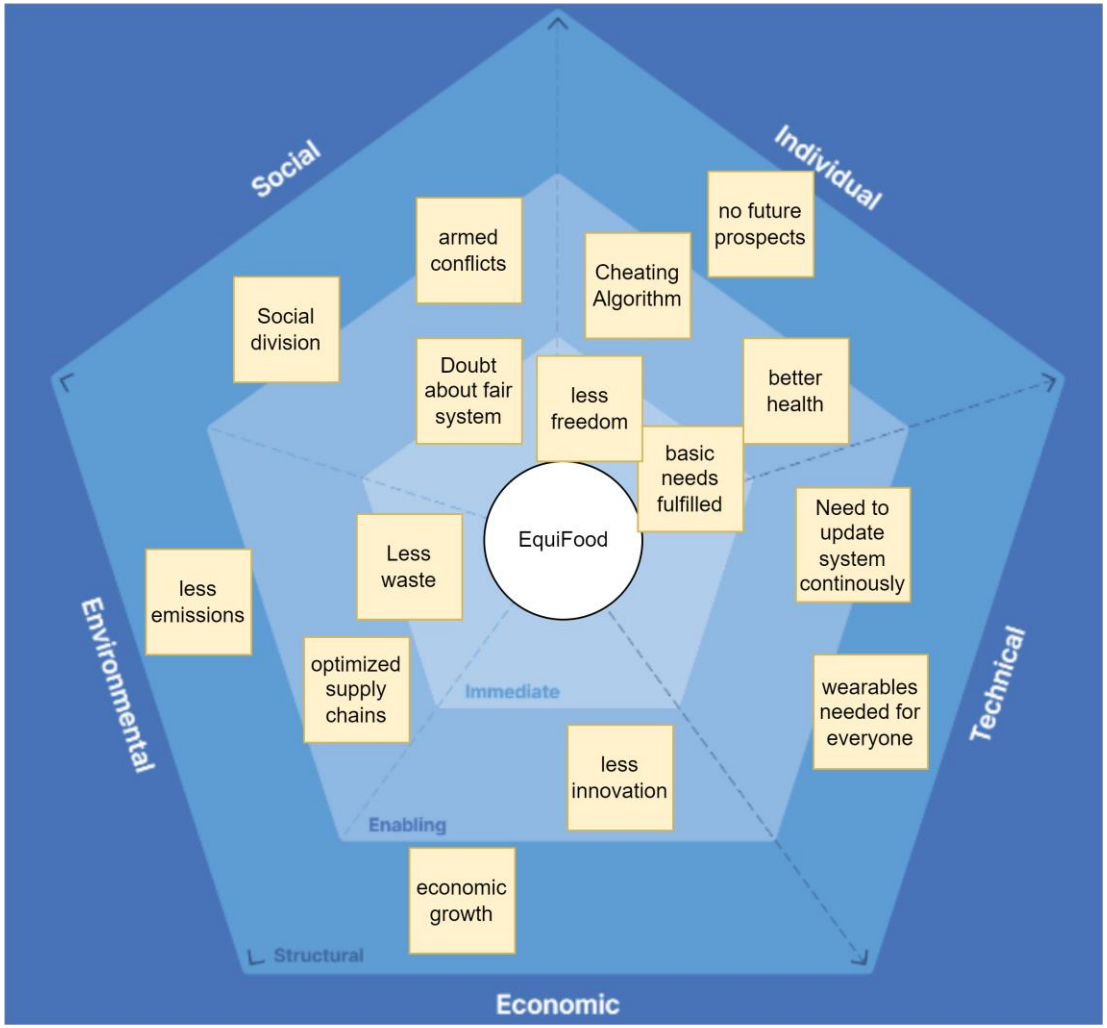


*Figure 4: Sustainability Awareness Diagram*

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