

Natural Bioeconomic Exchange Contracts: Intelligence, Efficiency and Failures

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How to cite this paper: Ouedraogo, F. (2025). Natural Bioeconomic Exchange Contracts: Intelligence, Efficiency and Failures. *Theoretical Economics Letters*, 15, 133-149. <https://doi.org/10.4236/tel.2025.151008>

Received: September 20, 2024

Accepted: February 7, 2025

Published: February 10, 2025

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Abstract

Human living cells need certain nutrients derived from certain foods that humans should contribute to their eating habits. These habits have very important economic consequences, thus deserving the examination of new lines of research by researchers. Economic equilibrium and bioeconomic equilibria are the only effective equilibrium that maximize the well-being of individuals: satisfaction and health in the consumption of food. Any equilibrium deviating from these two equilibria is ineffective. Shortages in the consumption of food could cause dissatisfaction to the consumer and certainly cause his organism to malfunction. However, excess consumption beyond the optimal quantity known as normal represents a waste of resources and could decrease consumer satisfaction and even become toxic to the body. Man should thus have precise information on the types of food and their optimal quantities corresponding to such or such optimal quantities of nutrients essential for the proper functioning of his organism in order to avoid falling into shortages or excess for the nourishment of his body. The results of this study show too that risk-averse and risk-loving consumers are those who maximize the total expected utility the most in situations of imperfect information on the attributes of food goods to the proper functioning of the body. In the context of the analysis of the bioeconomic natural contract, the risk-loving consumer is the one who generates a lot of waste of food goods by seeking to maximize his utility or satisfaction in the consumption of food goods to satisfy the needs of the 100 million cells.

Keywords

Economic and Bioeconomic Equilibria, Maximizing Utility and Well-Being, Organism Dysfunction, Consumer, Risks

1. Introduction

The living body of a human being is made up of nearly one trillion billion cells,

each representing the smallest living unit capable of reproducing autonomously.

These small living units have specific functions for the management of the human organism, the most essential of which are: feeding, manufacturing products, producing energy, sending chemical and electrical signals and processing information, multiplying repair or die.

To properly perform their functions and be able to keep humans alive, cells need certain nutrients derived from certain foods that humans should contribute to their eating habits. And these habits have very important economic consequences which deserve all attention.

In fact, humans are always subject to cognitive impulses that cause them to react to signals from certain cells expressing the desire to eat to maintain the proper functioning of the organism. This is what motivates him to go to produce food or to go to the market in accordance with the chemical and electrical signals sent by cells in the organism. In doing so, one could admit, contrary to classical and neo-classical theories, that the human being is in itself a complex market. A market where the quantities of food produced or bought on the market by man for the needs of his organism represents the supply, and the quantities of food transformed into nutrients for the needs of the 100 trillion cells contained in his organism, demand. The equilibrium price is represented here by the cost of acquiring these foods on the market in accordance with the weight or size of the nutrients intended for these cells.

The neoclassical analysis of well-being has so far been confined to the analysis of the consumer and producer surplus. The consumer's goal has always been to maximize his satisfaction under the constraint of his budget in the consumption of goods. However, well-being is not only linked to the pleasure one gets in the consumption of goods but could come from the permanent health of the individual guaranteed by the consumption of certain food goods.

This study examines the relationship between economic and bioeconomic equilibria, emphasizing their role in optimizing human well-being through proper food consumption. It highlights the implications of shortages and excesses in food intake, relating them to risks and the functionality of human cells. Additionally, it explores the decision-making processes of consumers under conditions of imperfect information, focusing on risk preferences and their effects on utility.

The aim of this study is to shed light on this point by presenting and analyzing the coexistence between the economic balance that maximizes the spiritual and material well-being of the individual, including satisfaction and surplus of the gains obtained, and the bioeconomic balance that also maximizes his bodily well-being, including his happiness through the health of his body.

2. The Theoretical Determinants of the Value of Goods and the Beliefs of Users

The most essential works on the determinants of the value of goods and the beliefs of users are those of Menger (1871), Wieser (1927) and Böhm-Bawerk (1914). However, authors like Von Mises (1949), Hayek (1952), Commons (1934) and

Simon (1962) have deepened the work of these first three authors by bringing their critical analysis but especially new insights on the theme.

The usefulness of goods, the beliefs of individuals about the ability of the good to meet their needs are presented by Menger (1871), as determining factors in the value of goods. And according to this author, the value of a good for an individual is determined by individual cognitive mechanisms, meaning that it does not exist outside his consciousness.

Menger (1871), for example, notes that the goods market is made up of products with different characteristics and very often not apparent; and that goods of the same kind may not all have the same shelf life. And according to him, goods deemed to keep longer will be preferred by buyers, because they best satisfy their personal interest. And, for Menger (1871), if the economic agent ignores, a priori, all the characteristics attached to a good, he will nevertheless seek to discover which characteristic of this good will best satisfy his need. Thus, over time, the individual learns to “recognize” the characteristics of the good that could best meet his need and some individuals will notice faster than others the non-apparent characteristics attached to the good. Once these characteristics attributed to a good are recognized by a sufficiently large proportion of the community, the knowledge thus produced will then be imposed on the rest of the community through a process of imitation and therefore a subjective value of the good will end up establishing itself as a value accepted by all, regardless of the intrinsic characteristics of this good.

Menger (1871) points that it is through his participation in market exchanges that the economic agent acquires subjective and tacit knowledge, thus representing the foundations of the beliefs of the economic agent. First of all, specific to each economic agent, beliefs according to Menger can become common and shared by all agents having the same preferences and communicating perfectly with each other. From Menger’s theory, one could thus argue that the value that an economic agent attributes to a good depends on the beliefs he has about the ability of the good to meet a need.

As an extension of Menger’s work, mention should be made of that of Wieser (1927) and Böhm-Bawerk (1914) who maintain that the subjective knowledge of the individual has an influence on the functioning of the goods market. The latter clearly differentiate between the use value and the exchange value of a good. For them, the use value refers to the usefulness of the good felt by the consumer. It is a subjective criterion represented by personal factors, while the exchange value emanates from objective criteria existing apart from personal factors: the price. For these authors, the use value of a good is a subjective value representing an economic variable which should be taken into account in the analysis of individual decisions. Von Mises (1949) and Hayek (1952), Austrian economists of the second generation have deepened the works of Menger (1871), Wieser (1927) and Böhm-Bawerk (1914) by distinguishing them from these nuances brought to the assumption of perfect knowledge of the economic agent and shared by all the other economic agents.

For Von Mises (1949), the agent is a being of “reason” and it is from this reason

that he mobilizes his knowledge. Thus he argues that human behavior is the result of intentional individual actions or “conscious adjustment”, in other words, of willed and prepared individual actions. He explains human action by the fact that each individual has an “innate mental map” thus reflecting his mental capacities. According to him, this mental map is identical in all the individuals inducing the latter in the same mode of reasoning or in the same logic. Von Mises (1949) argues that agents can communicate perfectly through the market to obtain the same level of beliefs about the causal relationship between good and its usefulness which have an environment similarly reflected in their minds. Thus, according to Berkane (2011), it is thanks to the relationships of market exchanges that individuals can share their individual beliefs. The market according to Von Mises (1949) is not a place, nor a thing or a collective entity, but rather a process of adjusting agents’ value judgments thus demonstrating the link that exists between the subjectivist conception of individual beliefs and market coordination.

However, authors like Arena and Festré (2002) have pointed out that in Von Mises “approach, the agents” individual beliefs become beliefs shared by all the other agents because the latter supposes, a priori, that all the agents are with the same reasoning skills. In the 1950s, Hayek took the opposite direction from Von Mises’ theory, rather supporting a process of knowledge accumulation through a learning effect. Indeed, according to him, if the mind maps of individuals are innate, there is undoubtedly knowledge that is acquired by learning and this knowledge in its understanding represents a tacit, fragmented and dispersed set of information. Hayek therefore believes that economic science must then be oriented towards the search for coordination of individual actions resulting from this subjective, fragmented and dispersed knowledge of individuals. He thus maintains that beliefs are maintained and strengthened by a process of experiences through the acquisition of additional knowledge from the individual. This knowledge is cumulative, and he calls this process “self-reinforcing beliefs”. He therefore rejects Von Mises’ view that human action is necessarily intentional, arguing that behavior can be the result of unprepared “unconscious” actions. According to Hayek, the individual may have routine behaviors without always being able to give meaning.

The author of decision theory, Von Neumann-Morgenstern (1947) in his utility theorem demonstrates that rational choice under uncertainty involves making decisions that take the form of maximizing the expected value of a cardinal utility function. This function is known as the Von Neumann-Morgenstern utility function. The theorem he developed forms the foundation of expected utility theory.

Von Neumann-Morgenstern utility theory is a promising method to measure and model consumer preference. Its theoretical foundations provide explicit risk measures and testable behavioral conditions for alternative preference models. This paper summarizes selected results from the theory, addresses measurement and validity issues, and discusses the applicability of the theory to consumer research (Hauser & Urbain, 1979).

Thus, contributions from the Austrian school have shed light on the role and

importance of individual and also collective beliefs in the exchange relationships between individuals.

Simon (1962) in his theory put forward that the individual is endowed with a procedural rationality which imposes limits on his calculating capacities. In their theories, Simon (1962), like Commons (1934), thus rejected the hypothesis of “optimizing” behavior in a situation of perfect information attributed to the actor. Simon (1962) suggests instead the “satisficing” hypothesis in a situation of procedural rationality, thus reflecting the fact that the individual is not always looking for optimal solutions to solve the problems he encounters, but that it is content with accessible and satisfactory solutions.

For Commons (1934), beliefs are evolving and the foreseeable future is about him the most important principle of economics. According to him, beliefs are evolving and it is the prospect of obtaining certain expected results in the future that justifies individual action today. It is the individual’s beliefs about his anticipations, including the future or present consequences of his actions on other individuals, that guide him in his choices and behavior by providing him with information and knowledge in an imperfect information context.

For Schumpeter (1951), agent behaviours are the result of motivations, beliefs and composite determinants which illustrate well the mixture of holism and individualism. For this author, these behaviours result from the combination of a rational motivation based on the search for self-interest and collective beliefs unconsciously inherited from the past. And according to him, economic rationality itself is not a natural characteristic of agents but a collective belief in three principles: the usefulness of economic calculation based on optimisation; acceptance of the “rules” of usual logic; the use of simple hypotheses based on experience.

3. Natural Bioeconomic Exchange Contracts: Efficiency and Failures

3.1. Bioeconomic Natural Contracts: Characterization, Intelligence and Conditions of Efficiency

The 100 trillion cells in the human body need nutrients including fatty acids, proteins, glucoses, vitamins, trace elements to be able to function and perform their missions properly for the benefit of the body.

White blood cells are, for example, cells that protect and defend the human body, neutralizing microbes and producing antibodies. Therefore, they need nutrients from the consumption of meat, fish, eggs and vegetables.

Cells need nutrients including fatty acids, proteins, glucoses, vitamins, trace elements to be able to function and perform their missions properly for the benefit of the body.

Human beings are in themselves a complex internal market where quantities of food produced or purchased, called supply, are used to meet the demand for almost 100 trillion cells in their body at a well-determined cost.

The effectiveness of a natural bioeconomic contract is obtained when perfect information allows an individual to consume healthy foods rich in essential nutrients,

namely fatty acids, amino acids, vitamins, mineral salts, trace elements, everything needed to help the body of this individual to be healthy and function well.

Thus, the good health of the body of this individual and its proper functioning linked to a rational use or consumption of food products rich in essential nutrients, at well-defined costs, are the major determinants of the effectiveness of bioeconomic contracts.

Annual health checks make it possible to determine the good health or proper functioning of the body of an individual by determining the actual proportions based on the normal proportions of essential nutrients contained in the blood of the individual who consumes food products. Links can therefore be established between the quantities and varieties of food consumed and the individual's income level, age, gender, socio-professional category, level of education or literacy, level of socialization (social life relationships), family size, availability in quantity and quality of food on the market he regularly visits, personal beliefs about the usefulness and attributes of the good for his well-being, etc.

Carbohydrates are the main source of energy for our body. Each gram of carbohydrates contains four (4) calories, 70% of which are actually used by our body.

Glucose is the primary source of energy for the brain, which consumes an average of 125 g per day.

Vision problems related to diseases such as xerophthalmia or dry eye are linked to dysfunctions or imbalances in the body, particularly deficiencies in amine A and according to Villafañe (2022) of the National Institute of Health, adults should have 900 micrograms for men and 700 for women.

In Table 1 below we have attempted to assess the minimum vital needs of the human body and the costs that this represents in Burkina Faso.

Table 1. Daily body needs and expenditures.

Daily body needs	Benefits for the body	Daily Cost In CFA currency
225 - 325 g of carbohydrates per day	Source of energy for the body and brain	250 - 400 (325)
2.3 g of mineral salts per day	Tissue constitution, regulation of water balance, excitability, neuromuscular Enzymatic regulation and hormonal production	150 - 300 (225)
650 - 750 µg of vitamin A per day	Good vision and good immune system	250 - 400 (325)
2 - 10 µg of vitamin B12 micrograms per day	Contains cobalt, a mineral needed for the production of red blood cells.	300 - 500 (400)
60 - 10 mg de vitamine C par jour	Supports immune defense, barrier to infections, intervenes in the production and proliferation of white blood cells or antibodies	200 - 300 (250)
Daily expenditure on essential nutrients for the proper functioning of the body or not yet satisfactory of the natural bioeconomic contract		1525

Source: Our study, estimates based on statistics from the ministries of health, economy and finance of Burkina Faso.

The results obtained from **Table 1** allow us to conclude that the populations of low-income countries in the world and particularly those of black African countries such as Burkina Faso, lack sufficient monetary income to acquire the minimum vital food for their organism. As consequences, the populations of these deprived countries become fragile and very vulnerable to diseases, sometimes threatened with disappearance when poverty persists. This could explain the massive immigration of populations from poor countries to developed countries (Europe, America, Asia) or their direct and easy enlistment in circles of violence, delinquency, terrorism and jihadism, because they believe they can escape the precariousness of life.

In Burkina Faso, the food poverty threshold affects 53% of the population. In this country, one in two people are in a situation of food poverty.

Black Africa has 413 million people living on less than 1.9 dollars per day (2015). In 2023, 700 million people in the world lived on less than \$2.15 (**World Bank Group, Report 2024**).

This amount of \$2.15 US representing 1344 FCFA is less than the amount of expenditure for the minimum vital of the human organism, an amount that we have largely underestimated in Burkina Faso at \$2.4 US or the equivalent of 1500 FCFA.

Which signals to us that if nothing is done to urgently eradicate this endemic poverty in the world and in black African countries in particular, 400 to 700 million people risk disappearing in a few years due to illness, invading the borders of developed countries in search of a better life or being recruited into circles conducive to terrorism and jihadism which sell illusions to the under-informed, very poor and poorly educated young population.

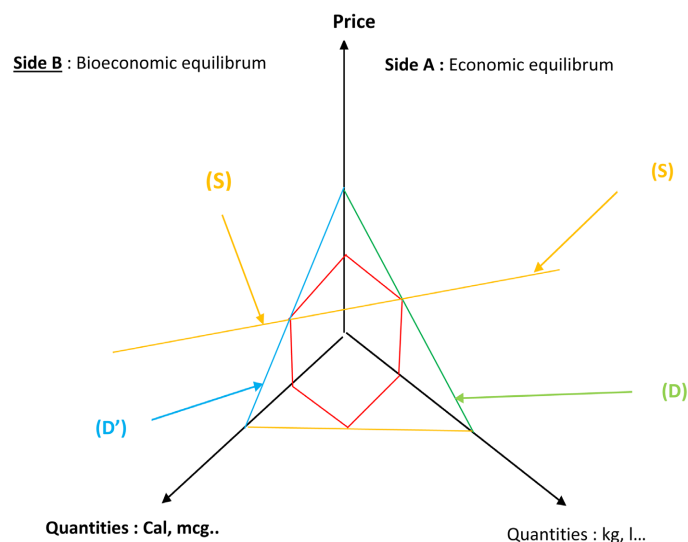


Figure 1. Effective equilibriums maximizing well being: Satisfaction and health.

Figure 1 above represented on a three-dimensional benchmark shows at its side A an equilibrium of economic exchange of a food good characterizing the meeting between a buyer and a seller to exchange a quantity of good at a given rate of money. This equilibrium which results from the crossing of the supply curve (S) with the

demand curve (D) is an effective equilibrium. At this point of equilibrium, the food good is sold by the seller to the consumer at a given quantity and price called the equilibrium price and quantity. This so-called optimal level of equilibrium corresponds to the essential quantity of the good to maximize the satisfaction of the individual and this quantity exists at a given price called the optimal price.

On its opposite side, side B, the graph presents an equilibrium of bioeconomic exchange where the optimal quantity of the food good synthesized with an optimal quantity of nutrients (proteins, lipids, vitamins, calories etc.) for the organism is demanded by the cells to properly perform their functions. The demand for cells in nutrients represented by the curve (D') crosses the supply (S) in nutrients synthesized by the organism at a point of equilibrium called the bioeconomic equilibrium which indicates the optimal quantities of nutrients at a price given. This equilibrium which is also a translation of the economic equilibrium with respect to the ordinate axis is the consequence of an exchange contract between the human body and its living cells.

3.2. Failure of Natural Bioeconomic Contracts, Utility of Goods, Consumer Beliefs and Behavior in the Face of Risks

Economic equilibrium and bioeconomic equilibrium are the only effective equilibria which maximize the well-being of individuals: satisfaction for the case of economic equilibrium and health for the case of bioeconomic equilibrium.

Any equilibrium deviating from these two equilibria is ineffective.

Indeed, natural bioeconomic exchange contracts can also malfunction due to the existence of the same causes of failure of normal markets such as imperfect information or information asymmetry (Akerlof, 1970; Nelson, 1970; Spence, 1974; Rothschild & Stiglitz, 1976), limited rationality (Simon, 1962), high transaction costs (Stigler, 1961; Coase, 1960; Williamson, 1989; North, 1990), negative externalities (Pigou, 1920) and high market power (Stiglitz, 2020).

The failure or inefficiency of the natural bioeconomic contract, often characterized by illness or death, becomes effective or real when an individual's body is not healthy or experiences dysfunctions due to deficiencies in essential nutrients. The absence of imperfect information of the individual on the attributes of food goods to the proper functioning of the body, the insufficiency of monetary income for the sufficient acquisition of food goods, the non-availability in sufficient and varied quantities and quality of food goods on the market could explain the failure or inefficiency of this bioeconomic contract.

The choice of food on the market for human physiological needs is often an uncertain choice based on chance. However, rational choice requires perfect knowledge of the quality and attributes of these foods in terms of meeting the real needs of the organism. Therefore if the man ignores on the market the foods which contain the nutrients (vitamins, proteins, fatty acids, iron etc.) essential for the proper functioning of the cells of his organism, he could waste his money by buying food which would not be at all essential for the proper functioning of his

organism, and could on the contrary even represent a poison. As a result, he could fall ill and even lose his life.

Also, information on the needs of cells in terms of nutrients and on the conditions of fulfillment of their true functions for the organism in terms of defense, protection, manufacturing of products, production of energy, chemical and electrical information and signaling are not known to humans.

Ignorance of these conditions and the foods to consume to help cells perform their functions properly can be dangerous and fatal for the body.

Figure 2 below, which analyses the economic equilibrium and the bioeconomic equilibrium in the event of contract failures, shows that a drop in the price of the food good leads to an increase in its consumption and a decrease in its supply marked by the shift of the supply curve to the right from (S) to (S') forming a new equilibrium by the crossing between the new supply curve (S') and the demand curve (D) . At this cross between (S') and (D) the equilibrium price decreases while the equilibrium quantity is increasing.

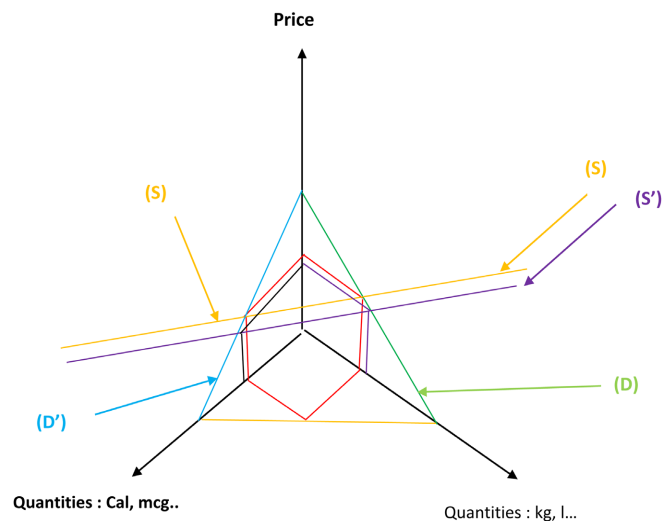


Figure 2. Economic and bioeconomic equilibriums in the event of failing contracts.

This new equilibrium is not an effective equilibrium that maximizes the well-being of the individual. At the level of the economic exchange market, any consumption of much less than the optimal quantity provides less satisfaction and any higher consumption decreases the pleasure, thus leading to disutility or dissatisfaction. Insufficient satisfaction, dissatisfaction, saturation and deprivation are physically felt by the individual through the desire to eat, or to stop eating. It remains sensational, cognitive and even psychological. On the other hand, at the level of the bioeconomic exchange contract, the use by the cells of a quantity of nutrients less compared to the optimal quantity which is normal can cause serious dysfunctions of the organism because the cells will not have insufficient resources to allow it to function properly. Also, any amount of nutrients greater than the optimal amount represents a waste of resources and could become toxic for the organism if the latter does not manage to eliminate the surpluses. Man should

thus have precise information on the types of food and their optimal quantities corresponding to such or such optimal quantities of nutrients essential for the proper functioning of the organism, thus avoiding falling into excess and shortages.

Also, there should be certain abilities to sort and interpret the information available on the functioning of the human body. It is only the health professionals who know how to do it and in relation to their state of health, the nutrients which the cells need for a better functioning of the organism most of the patients are in asymmetries of information in front of their doctors. Thus for lack of honesty or opportunism could abnormally increase the costs of treatment by examinations, consultations, and abusive prescriptions to create more revenue in his medical office than to make a normal treatment which would cure the patient at lower cost. Having for the most part limited income, the high costs of care in the event of illness, represent a shortfall in terms of the proportion devoted to food, and possibly an insufficiency in terms of quality and quantity of essential nutrients the proper functioning of the cells. This would leave a door open for a total dysfunction of the patient's immune system and the worsening of his illness, thus slowing down his participation in the economy and his contribution to the creation of wealth.

The market power exercised by economically strong actors face to face to the weakest can lead to monopolization of the markets for certain foodstuffs thus making them more expensive for household consumption. This could limit their use in daily household rations. Especially when the latter are not aware of the availability of other foods in terms of perfect substitutes containing more or less the same proportions of nutrients. Yet it is food goods at prices beyond the reach of consumers that are essential to the proper functioning of the organization.

Contamination of vegetables with chemicals including arsenic linked to gold extraction can cause enormous health damage to individuals preventing any contribution to production and wealth creation activities.

We also assume that any user of a food good has a demand function determined by the utility of the good he consumes, by his income level, by the price of the good, by beliefs in the attributes of this good to well-being (health, longevity etc.). This last aspect has retained a lot of our attention in the case of the present study.

Indeed, the beliefs of individuals on the capacities and attributes of goods to satisfy their needs and maximize their well-being are according to [Menger \(1871\)](#) individual cognitive mechanisms, which essentially determine the value of these goods. By putting forward his theory of shared beliefs from the learning and recognition by the individual of the characteristics and attributes of the good to satisfy his need, and then from the imitation effect by a significant proportion of the community systematically sharing the same beliefs [Menger \(1871\)](#) concludes that it is a subjective value of the good that will impose itself as a value accepted by all whatever its intrinsic characteristics, rather than its so-called normal real value. [Von Mises \(1949\)](#) and [Hayek \(1952\)](#) further deepened Carl Menger theory by highlighting the market as a channel for communicating and amplifying collective

beliefs about the usefulness of goods.

Let us recall that for certain authors extending the neoclassical theory, beliefs are evolving (Commons, 1934) and the behaviors of economic agents (consumer or producer decisions) are based on their individual motivations, their personal interests and their past experiences (Schumpeter, 1951).

The analyses of these eminent economists (Carl Menger, Von Mises, Hayeck, Commons and Schumpeter) all highlight that individual beliefs, the imitation effect by a significant proportion of the community systematically sharing the same beliefs and thereby generating collective beliefs have a great influence on individuals in relation to their decision to acquire and consume food goods and hence an influence on the balance and bioeconomics, namely their failure or their efficiency depending on the quality of the information which guides these beliefs.

Let us also recall that Von Neumann-Morgenstern utility theory is considered like a promising method to measure and model consumer preference and his behavior face to risks.

The Von-Morgenstern model based on the fact that in the presence of risk, individuals make choices based on the expected utility or the mathematical expectation of utilities is the one that seems to us the most appropriate for the analysis of the natural bioeconomic contract between the 100 million cells and the organism.

The consumer of food goods to maximize his satisfaction or his total utility combines goods of which he is aware of their utility (w_0) for the health of his organism with others of which he has no precise information on their utility (X) for the proper functioning of his organism.

Figures 3-5 below show the gain in utility or satisfaction of the indifferent, risk-averse or risk-loving consumer when faced with risks.

Thus for the overall health of his organism he needs a total utility $\tilde{w}_f = w_0 + X$.

Let p and $1 - p$ represent respectively the proportions of certain and uncertain utility.

According to the theory of Von Neumann-Morgenstern if the consumer has the choice of obtaining between the uncertain utility $w_0 + X$ and the certain utility $E(\tilde{w}_f)$ and that the latter remains indifferent we say that he is neutral with respect to the risk.

$$E(\tilde{w}_f) \sim \tilde{w}_f \Leftrightarrow Eu(\tilde{w}_f) = u(E(\tilde{w}_f))$$

Two situations arise: situation 1: Utility X to known health (1/2) and situation 2: utility X to unknown health.

The total utility function could be written in this case as follows:

$$W_f = L(W_o + X; W_o - X; p, 1 - p)$$

$$p = 1/2 \quad 1 - p = 1/2 \quad \text{and}$$

$$\tilde{w}_f = L\left(w_0 + x, w_0 - x; \frac{1}{2}, \frac{1}{2}\right)$$

$$u\left(E\left(\tilde{w}_f\right)\right)=u\left[\frac{1}{2}\left(w_0+x\right)+\frac{1}{2}\left(w_0-x\right)\right]=u\left[w_0\right]$$

The expected utility of the consumer who is indifferent or neutral to uncertainties is $u\left[w_0\right]$. When the consumer is afraid of taking risks, he is said to be risk-averse, that is, he hates risks.

If the consumer prefers to obtain the expected value of his total utility with certainty, he is said to be risk-averse.

$$E\left(\tilde{w}_f\right) \succ \tilde{w}_f \Leftrightarrow u\left(E\left(\tilde{w}_f\right)\right) > Eu\left(\tilde{w}_f\right)$$

His choice becomes $X = L(x, -x; p) \quad Eu\left(\tilde{w}_f\right) = 2pu\left[w_0\right]$.

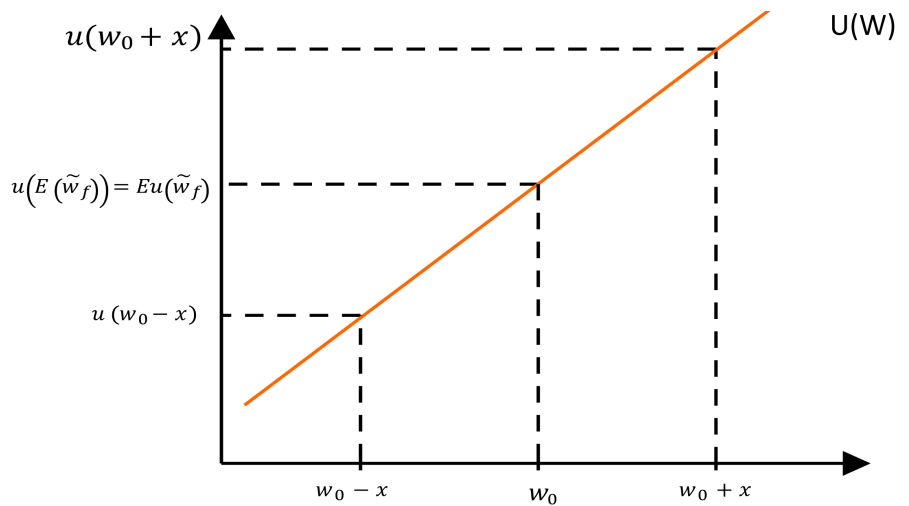


Figure 3. When consumer is indifferent to risks.

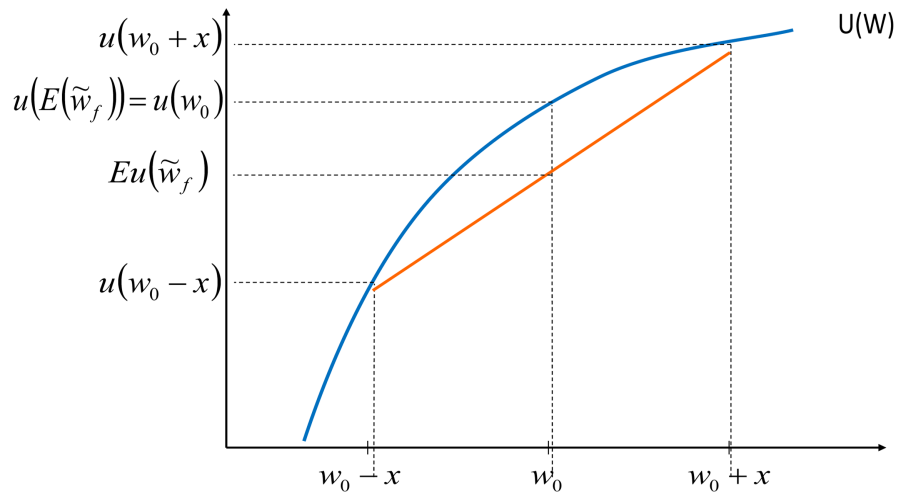


Figure 4. When consumer is risk-averse.

The total utility expected by the risk-averse consumer is $2pu\left[w_0\right]$

A simulation of the behavior of this type of consumer facing risk following the Von Neumann-Morgenstern model shows that if the consumer prefers to keep his

total utility rather than to obtain with certainty the expectation of his total utility

$$\tilde{w}_f \succ E(\tilde{w}_f) \Leftrightarrow Eu(\tilde{w}_f) > u(E(\tilde{w}_f))$$

He is said to be a risk-taker.

The choice becomes

$$X = L(x, -x; p, 1-p)$$

$$Eu(\tilde{w}_f) = pu(w_0 + x) + (1-p)u(w_0 - x) + (1-p)u(w_0 + x) + pu(w_0 - x)$$

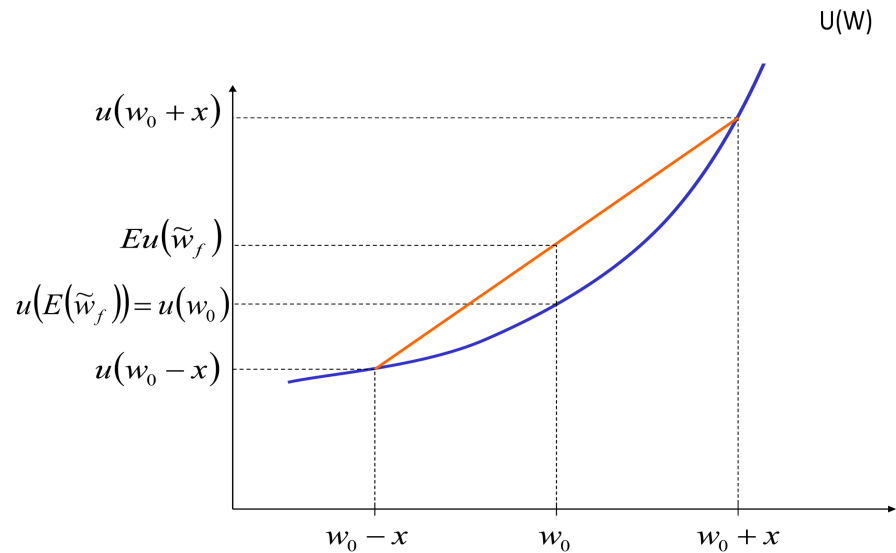


Figure 5. When consumer is a risk-taker.

The total utility expected by the risk-taking consumer is $Eu(\tilde{w}_f) = 2u[w_0]$.

The total expected utilities of different types of food consumers depending on whether they are risk-indifferent, risk-averse or risk-loving can be analyzed as follows:

$$u[w_0] < 2pu[w_0] \leq 2u[w_0] \quad \text{with } p \in [1/2, 1[\quad \text{being understood that } p > \text{or} = 1 - p.$$

Table 2. Comparison of expected consumer utilities versus risks.

Behavior of consumer face to risks	Utility expected
Risk-indifferent consumer	$u[w_0]$
Risk-averse consumer	$2pu[w_0]$
Risk-taking consumer or Risk loving consumer	$2u[w_0]$

Source: Our study.

The results reported in **Table 2** above show that risk-averse and risk-loving consumers are those who maximize the total expected utility the most in situations

of imperfect information on the attributes of food goods for the proper functioning of the organism. In the context of the analysis of the bioeconomic natural contract, the risk-loving consumer is the one who generates a lot of waste of food goods by seeking to maximize his utility or satisfaction in the consumption of food goods to satisfy the needs of the 100 million cells. The risk-averse consumer is the one who remains in the middle ground, at an optimal level of maximization of his utility or satisfaction just to compensate for the needs of the 100 million cells. On the other hand, the risk-indifferent consumer runs the risk of maximizing his utility at a level of consumption of food goods that does not allow him to cover the needs of the 100 million cells, or maximizing his utility at a level of consumption that exceeds the needs of the body (100 million cells) and the elimination of surpluses becomes very complicated for the body. This could unbalance the body, make the natural bioeconomic contract fail with disastrous consequences such as the development of all kinds of diseases that can degrade human capital and compromise the economic and social development of a country if many individuals find themselves in this situation.

4. Conclusions and Recommendations

The human being is in itself a complex internal market where quantities of food produced in the fields or bought on the markets, called supply, are used to satisfy a demand of nearly 100 trillion cells contained in its organism. a well-defined cost.

The demand for cells in nutrients synthesized by the body indicates the optimal amounts of nutrients, resulting from an exchange contract between the human body and the 100 trillion living cells.

Economic equilibrium and bioeconomic equilibrium are the only effective equilibriums that maximize the well-being of individuals: satisfaction and health in the consumption of food. Any equilibrium deviating from these two equilibria is ineffective.

As in neoliberal theory of failing markets, natural bioeconomic exchange contracts can also malfunction due to imperfect information, limited rationality, high transaction costs, high market power, and negative externalities.

In fact, the choice of food on the market for human physiological needs is often an uncertain choice based on chance. Thus, if man ignores on the market foods that contain the nutrients (vitamins, proteins, fatty acids, iron etc.) essential for the proper functioning of the cells of his body, he could waste his money by buying foods that do not would not be at all essential for the proper functioning of his body, and could even in the worst case intoxicate him.

Information about cell needs may not be known to humans. This lack of knowledge of the actual needs of cells can be dangerous and fatal for the proper functioning of the organism.

Shortages in the consumption of foodstuffs face to face to the quantities essential for the proper functioning of the body could cause dissatisfaction to the consumer and certainly cause after deficiencies and dysfunctions of his organism.

The market power exercised by economically strong actors face to face to the weakest can lead to monopolization of the markets for certain foodstuffs thus making them more expensive for household consumption. This could limit their use in daily household rations. Especially when the latter are not aware of the availability of other foods in terms of perfect substitutes containing more or less the same proportions of nutrients. Yet it is food goods at prices beyond the reach of consumers that are essential to the proper functioning of the organization.

However, the excess in consumption beyond the optimal quantity known as normal represents waste of resources and could decrease satisfaction in accordance with the theory of marginal utility, and even become toxic for the organism if the latter does not arrive. to eliminate the surpluses.

Man should thus have precise information on the types of food and their optimal quantities corresponding to such or such optimal quantities of nutrients essential for the proper functioning of the organism, thus avoiding going into excess and shortages.

Also it would be necessary to have certain capacities to sort and interpret the information available on the functioning of the human body because the human being is always endowed with a limited rationality (Simon, 1962).

The contamination of certain foods like vegetables with chemicals like arsenic linked to the extraction of gold can cause huge damage to health in individuals thus preventing their contribution to production activities and wealth creation.

The risk-loving consumer is the one who generates a lot of waste of food goods by seeking to maximize his utility or satisfaction in the consumption of food goods to satisfy the needs of the 100 million cells. The risk-phobic consumer is the one who remains in the middle ground, at an optimal level of maximization of his utility or satisfaction just to compensate for the needs of the 100 million cells. The risk-indifferent consumer is the one who runs more risks. He runs the risk of maximizing his utility at a level of consumption of food goods that does not allow him to cover the needs of the 100 million cells, or maximizing his utility at a level of consumption that exceeds the needs of the body and the elimination of surpluses become toxic to the body. This could unbalance the body, make the natural bioeconomic contract fail with disastrous consequences such as the development of all kinds of diseases that can degrade human capital and compromise the economic and social development of a country if many individuals find themselves in this situation.

About this present study, the populations of low-income countries in the world and particularly those of black African countries such as Burkina Faso, lack sufficient monetary income to acquire the minimum vital food for their organism. Consequently, the populations of these deprived countries become fragile and very vulnerable to diseases, sometimes threatened with disappearance when poverty persists. This could explain the massive immigration of populations from poor countries to developed countries (Europe, America, Asia) or their direct and easy enlistment in circles of violence, delinquency, terrorism and jihadism, because they

believe they can escape the precariousness of life.

If nothing is done to urgently eradicate this endemic poverty in the world and in black African countries in particular, 400 to 700 million people risk disappearing in a few years due to illness, invading the borders of developed countries in search of a better life or being recruited into circles conducive to terrorism and jihadism which sell illusions to the under-informed, very poor and poorly educated young population.

A policy of popularizing information on the attributes of consumer food products for the prevention of certain diseases, the improvement and consolidation of health and social well-being will be very essential for the development of effective and sustainable human capital.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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