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The macroeconomic indicators influence the consumption of selected organic food under the conditions of global climate change – a case study from the Czech Republic

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ABSTRACT

Since the beginning of the 21st century, within the framework of food consumption in the Czech Republic, organic food consumption has also begun to be statistically monitored. This consumption is influenced by several factors, such as consumer demand, their changing attitudes, and beliefs about the correctness of their consumption, but also the owners and managers of companies producing organic food and their willingness and decision to offer organic food to consumers. The content of this paper is to search for the connections between selected macroeconomic indicators and their influence on total household consumption and, within it, on the consumption of certain groups of food and organic food. More than twenty years of statistical monitoring shows how selected macroeconomic indicators and food consumption, including organic foods and their main groups, were developed. During approximately twenty years of development, it is possible to identify several fluctuations with varying intensity in growth, stagnation and decrease. An example is the current economic situation manifested by significant movements in the leading macroeconomic indicators to varying extents in the Czech Republic and several other countries, not only in Europe. The deterioration of the macroeconomic indicators results understandably raises concerns about the future development of consumption and the applicability of the generally produced more expensive organic food on the market. Therefore, The author team investigated the correlation between selected macroeconomic indicators, total food consumption and, in particular, the consumption of selected organic foods and evaluated the course of changes over time between 1993-2021. The influence of selected macro indicators on changes in the consumption of organic foods in the Czech Republic was assessed. The previously published papers deal with food and organic food consumption from different perspectives but not from the perspective of examining the correlation between consumption and three chosen macroeconomic indicators. The present contribution thus aims to fill this existing gap.

Keywords: demand, consumption, gross domestic product, price indices, green marketing, organic food

INTRODUCTION

The theoretical starting point for examining the relationship between selected macroeconomic indicators and the total consumption of food and selected groups of organic foods in the Czech Republic explains their nature and interrelationships.

Macroeconomic indicators, also known as fundamental data, according to **[1]**, are statistics or data that reflect the production or output of an economy, government or sector and vary in frequency, impact, and significance (Nominal GDP is an indicator of current (real) prices, real GDP is an indicator of comparable (constant) prices.).

These include the gross domestic product (GDP), average inflation rate, household consumption, employment indicators, retail sales, public debt, monetary policy, and interest rate announcements. They are related to the economy, population, geography, etc. They are collected by agencies and offices of various government statistical organizations and sometimes by private organizations using similar techniques. Macroeconomic indicators are used to assess the state of a country's economy and measure a country's overall economic performance. These are different quantities that focus on certain countries or sectors. Their results can be continuously monitored, examined, evaluated and compared. By comparison, it is possible to determine the position of the national economy within other countries. Not all known macroeconomic indicators have a direct link to the consumption of food and organic food.

The most important indicator of the performance of the economy of the given country as a whole, which is related to supply and demand and consumption, is GDP. It is defined as the sum of monetary values of (final) products and services produced during one year by production factors allocated in a given country, regardless of the ownership of these factors **[2]**. GDP represents the total volume of products and services created for a certain period (final production) in monetary units **[3]**. According to its valuation method, two categories are distinguished, i.e., nominal GDP and real GDP. 1Nominal GDP is an indicator of current (real) prices. The real GDP is an indicator of comparable (constant) prices **[4]**. GDP captures the output created by production factors on a given state's territory. The number of resources that are available for (re)distribution in a given economy is also expressed by the gross national income (GNI), Gross National Product (GNP). In this concept, primary incomes from non-residents (wages, profits, annuities, etc.) are added to GDP, and conversely, incomes paid to non-residents are deducted. The difference between GNI and GDP is net income relative to the rest of the world. If this difference is positive, it means that more pensions flow into the economy from non-residents than are paid to them (the net income of non-residents is, therefore, negative from the point of view of the national economist). Gross disposable national income and gross national savings are important aggregate economic indicators related to consumption **[5]**.

The unemployment rate is among the predicted macroeconomic indicators that can influence consumption. The unemployment rate is calculated as the percentage of unemployed in the labour force of a given territory.

The labour force includes both employed and unemployed populations. According to the **[6]**, all persons aged 15 and over, usually living in the monitored territory, who meet three conditions during the reference week are considered unemployed: 1) they are not employed, 2) they are actively looking for work, and 3) they are ready to start to work no later than 14 days.

Frictional unemployment arises as a result of worker mobility or as a result of the constant movement of people between places or job opportunities. Workers have different abilities and preferences, which make them look for better employment. This type of unemployment is normal in the labour market because it is temporary. Changes in frictional unemployment can be caused by voluntary changes in the time spent searching for a job that the unemployed are willing to accept. Frictional unemployment is distinguished from other types of unemployment by three factors. The first factor is the existence of enough jobs for those who are frictionally unemployed. The second factor is that the frictionally unemployed have sufficient qualifications for available jobs where they are required. The third factor is the short time of searching for a job. A specific part of frictional unemployment is considered to be seasonal unemployment, which occurs in sectors whose production fluctuates depending on the season, for example, in construction or in agriculture for crop production **[7]**.

Structural unemployment arises when some sectors are depressed and others, on the contrary, are expanding. Employers affected by a shrinking industry are laying off workers, and retraining is needed to move these workers to another (expanding) industry. Structural unemployment usually lasts longer than frictional unemployment. For many people, the search for work can drag on for months or years because they do not have the qualifications that companies need. In the economy, there is constant technological development, which is manifested in the gradual decline of some fields and the development of other fields. Thus, structural unemployment can be considered a natural and inevitable part of every economy, but at the same time, it represents a more serious problem than frictional unemployment and, as such is not compatible with the idea of full employment **[8]**.

Cyclical unemployment is related to cyclical fluctuations in the performance of the economy. Unemployment of this kind is dependent on the performance of the economy, when unemployment will decrease with its growth and vice versa. If the economy is in recession, employers lay off workers **[9]**.

Among the mentioned indicators, the unemployment rate indicator has an effect on consumption, which could also be analyzed as the correlation between this indicator and total consumption, consumption of organic food and organic dairy food.

Inflation is a macroeconomic phenomenon that reduces the purchasing power of money over a defined period of time and increases the price level of all goods and services. It, therefore, contributes to economic instability and uncertainty about the development of macroeconomic variables. Inflation is an average quantity that expresses

the change in the price level in a given economy. "Inflation means a general increase in the price level over time **[10]**". An increase in the price of an individual product or a group of products does not necessarily mean inflation (In this case, it is a so-called short-term price shock). A rise in the price level is associated with a decline in the purchasing power of money. Deflation is the opposite macroeconomic phenomenon when the price level falls or disinflation when the inflation rate decreases. The price level is measured using price indexes. The price index is the ratio of the costs of acquiring a certain set of goods and services in the current period and in the base period. The price index can then be used to calculate the growth rate of the price level or the rate of inflation **[12]**.

The inflation rate is expressed as a percentage change in the average price level for the last twelve months compared to the average price level for the previous twelve months. **[2]**, i.e., the inflation rate is the percentage increase in consumer price indices. For the correct interpretation of each price index, it is always necessary to know the period for which it is calculated. When expressing the rate of the consumer price index, precise factual, spatial, and temporal delimitation is important. This means it is necessary to clearly state the period for which the inflation rate is calculated and determine the basis on which it is compared. Price indices are used to calculate inflation, such as the GDP or implicit price deflator, producer or consumer price index, and cost of living index **[11]**. Three price indices are commonly distinguished: consumer price index (CPI – Consumer's Price Index), GDP deflator (IPD – Implicit Price Deflator), and producer price index (PPI – Producer's Price Index). Inflation rates are expressed by the increase in the average annual consumer price index, expressed by the increase in the consumer price index to the same month of the previous year, or the inflation rate expressed by the increase in the consumer price index to the previous month or the increase in the consumer price index to the base period (e.g., year 2015 = 100) are most often used) **[12]**.

In the Czech Republic, the Czech Statistical Office monitors the movement of inflation based on the measurement of net price changes using consumer price indices **[10]**. The consumer basket represents a set of products and services purchased by households over a certain period of time. "Price indices measure the price level of a selected basket of representative products and services (approx. 450) in two compared periods, while the weight (or importance) assigned to individual price representatives in the consumption basket corresponds to the share of the given type of consumption they represent in the total household consumption **[13]**". The selection of representatives for the consumption basket depends on the share of household consumption **[14]**. The consumer basket is composed of food goods (food, beverages, tobacco), non-food goods (clothing, furniture, household goods, drugstore and small goods, transport and leisure goods, personal care goods, etc.) and services (repair from the areas of housing, household operations, healthcare, social care, transport, leisure, education, catering and accommodation, personal care and financial services).

A demand is a phenomenon that expresses the relationship between the number of goods buyers are willing to consume and the price they are willing to pay for goods at a certain time and place. The theory of demand distinguishes between different types of demand, mainly individual, market and aggregate demand. About the objective of the article, the essential demand is aggregate. Aggregate demand expresses the various quantities of a good that consumers, firms, the government, and the rest of the world are willing to buy at certain price levels. Aggregate demand is, therefore, nothing more than the sum of household consumption expenditure, investment expenditure by firms, government purchases of goods and services and net exports, the amount of which depends on the price level **[11]**.

Household consumption is the most significant component of these aggregate expenditures and the gross domestic product (GDP) in demand, normally reaching around 60.0% of its level. The largest item households demand is food **[15]**, **[16]**.

Consumption represents the expenditure of all households in the economy on short-term and long-term consumption of goods and services. Consumption reaches more than 50% of the gross domestic product. Consumption depends on a number of factors.

The consumption function (Assuming a "two-sector economy") expresses consumption C as the sum of autonomous consumption Ca and the product of the marginal propensity to consume c (indicating how consumption changes if disposable income changes by one unit) and disposable income YD. i.e., the consumption function can be expressed as $C = Ca + cYD$. The basic characteristic of this consumption function is the decreasing share of consumption in total income. Empirical research did not confirm that the share of consumption in income would decrease in the long term, rather, it turned out that consumption shows a stable share, and the consumption function is only valid for a short period. An alternative to Keynes' theory is the microeconomic model of intertemporal choice (Irving Fisher: The Theory of Interest (1930)). According to him, the amount of consumption depends on the income in both periods, the interest rate, and the consumer's preferences. Another alternative is, for example, the so-called life cycle theory, which is based on the model of intertemporal choice and explains the long-term stable share of consumption. She claims that people want to maintain a stable level of consumption throughout their lives, and therefore, when they have a low income, they have to borrow in their youth. In their

working age, they spend less than they earn and save more, and in their old age, they have a higher consumption than their pension, and they spend what they have saved in their working age. According to Friedman's permanent income theory, consumption depends only on the so-called permanent income (YP): C = c.YP is the average long-term expected income, which depends on the expected income from labour (from human capital) and the expected income from assets held.

According to **[17]**, the amount of consumption depends on the income in both periods, the interest rate and the consumer's preferences. They recommend considering household consumption in the context of savings, as households are generally an important creator of national savings. According to economic theory, this is the basis of economic growth and prosperity. The starting point for considerations about the economic behaviour of Czech households is the analysis of the development of the consumption structure and the sources of payment for this consumption, i.e., disposable income. Disposable income represents the sum of households' primary and secondary incomes (consumers and entrepreneurs). It is the sum of gross wages and salaries, pensions from business and property, and the sum of the balance of social and other pensions. The balance of social pensions represents the difference between the value of cash social benefits of households from the state, insurance companies and employers, and social contributions (mandatory and voluntary), and benefits that households pay. Other pensions are considered "other ordinary transfers, i.e., net insurance premiums, or reimbursements in non-life insurance, contributions to non-profit organizations, fines and penalties, winnings and bets and other pensions **[17]**." Common taxes that households pay are primarily income and property taxes.

From a macroeconomic point of view, household consumption is expressed as "an indicator of household final consumption expenditure, which includes the value of goods and services (short-term and long-term consumption, except for houses and apartments) purchased by households and also includes part of unpaid consumption **[17]**." Unpaid consumption is represented, for example, by the value of self-supply of agricultural products. Autonomous consumption is part of consumption that does not depend on the size of the income and is financed from earlier savings. Saving is generally interpreted as the difference between disposable income and final consumption (According to Hronová and Hindls, the specific value of savings is, however, still influenced by the value of savings that households created in pension funds during the given period (so-called changes in the net share of households in).

Empirical research on consumer demand is almost overwhelmingly based on the neoclassical theory of consumer behaviour: the choice of the best consumer basket by the relevant consumer entity. Within this theory, two approaches can be distinguished in the search for the optimal consumption basket. First, the consumer strives for the most useful consumption basket that he can buy from his income and at a certain level of market prices. Or else secondly, the consumer chooses among useful baskets the one with the lowest expenses **[18]**.

During the last two to three decades, there have been significant changes in food consumption, structure and volume. These changes were influenced by various factors, primarily the development of consumer prices for food and non-food products and services, the development of the population's income, advertising and promotion, and the offer and availability of products on the market concerning the development of the distribution network. In addition to the factors as mentioned earlier, food consumption is also affected by, for example, the extent of self-supply, the development of quality, the degree of saturation of needs, etc. The biggest influence on food consumption was primarily the development of consumer prices of food and industrial goods and services in relation to the development of incomes, i.e., purchasing power demand. Currently, however, there is a noticeable tendency to reduce the influence of prices on food consumption, and many consumers consider non-financial factors when purchasing **[19]**.

Some consumers began to feel responsible for the negative impact of consumer goods on the environment. It began to purposefully monitor purchased goods' composition, components, packaging, entire distribution chain, etc. In this context, new value attitudes are created based on the principle of sustainable development. An integral part of these changes can also include the application and creation of decision-making methods for individuals in the area of consumer choice. This is not only an issue of choosing the optimal consumer basket from the perspective of the traditional price-quality ratio but also the creation of preferences concerning ecologically suitable consumer goods, for example, organic food **[20]**.

Published studies dealing with macroeconomic determinants of food consumption in general and organic food are not frequent topics in professional journals. Some of the published articles dealing with consumption usually look at the issue from the point of view of malnutrition and famine rather than the consumption of energy-rich foods produced in an environmentally friendly way. Even though organic food is a phenomenon whose importance has been growing significantly recently, the issue of organic food production and consumption and its conditioning variables and barriers on the part of producers are still largely unexplored. After all, finding out consumers' values and attitudes about the environment and organic food consumption is a more frequent topic. As regards the issue addressed in this article, i.e., the investigation of the influence of macroeconomic indicators

on the consumption of food and organic food, existing published studies usually examine the influence of the population's income (respectively the amount of GDP) or the level of the price level (respectively the rate of inflation). In contrast, other macroeconomic variables such as unemployment are not given attention.

The Intergovernmental Panel on Climate Change **[21]** states that adaptation to global climate change aims to reduce risk and vulnerability to climate change, strengthen resilience, improve well-being and the ability to anticipate and successfully respond to changes. Existing international frameworks provide a high level of direction for coordinating, financing and evaluating progress toward these goals. Specifying goals for specific adaptation activities is not easy to define because the impacts of climate change affect people and nature in many ways that require different adaptation measures. Therefore, the goals relate to health, water or food safety, jobs and employment, poverty eradication and social equality, biodiversity and ecosystem services at international, national and local levels.

The most frequently mentioned determinants concerning malnutrition and bad eating habits are primarily the level of GDP and the growth of food prices, i.e., inflation of this group of goods **[22]**, **[23]**. According to their findings, the intrinsic price elasticity of most food groups is close to one, indicating a high response of consumers to a change in food price. However, lower food prices often lead to reduced agricultural production and lower incomes for farmers and may ultimately contribute to a country's lack of staple foods **[22]**.

Examine the relationship between consumer values and their attitude towards environmental issues in selected economies (Brazil, Czech Republic, Germany, India, New Zealand and Russia). According to their findings, egoism (self-focus) predicts a lack of interest in the environment **[24]** . Conversely, transcending one's ego (caring for others, plants, or animals) predicts interest in environmental issues.

Describe the relationship between attitudes and norms of consumers in Denmark and their consumer behaviour with the purchase of organic food **[25]**. The results of their investigation are represented from a consumer perspective. The entrepreneurial perspective is described by **[26]**, who looks for factors of successful business in the organic food market in the Slovak Republic.

It investigates the functioning of retail chains with organic food in southern Bohemia. However, their attention primarily focuses on sales strategies, marketing mix, conditions, and culture **[27]**.

Also, it analyzes the factors influencing the purchase of organic fruits and vegetables in Istanbul, Turkey, and also conclude that the consumer's concern for their health and food safety is the main factor influencing the consumer's preference towards organic food **[28]**.

The organic food market in the Czech Republic concerning organic farming is analyzed by **[29]**.

Dealing in more detail with the question of how consumers in the Czech Republic perceive the health aspect and benefits resulting from the consumption of organic food **[30]**.

It examines the factors influencing expanding consumer demand for organic food in Saudi Arabia **[31]**. They consider lack of information, poor marketing and their high price to be the main factors preventing the wider spread of organic food. On the contrary, among the important factors supporting the development of organic food production and trade are the support of local producers, the clear declaration of organic food standards and the level of education.

Seeking to describe the dependence of organic food consumption in Turkey on political, economic, social and technological factors **[32]**.

Deal with how consumers perceive various attributes of organic food and how this perception affects consumer demand **[33]**.

Factors influencing the intention to buy organic food are also investigated in Pakistan, Turkey and Iran **[34]**. Their conclusions show that the results may be different for different countries. Nevertheless, they consider consumer care for their health to be an important factor playing a significant role in all three examined economies. Li et al., **[35]** examined the demand for organic dairy food.

Applying the theory of consumer values (healthy lifestyle, sustainability, health care, perceived value of organic food) to predict the purchase intention of organic food in Turkey **[36]**.

However, e.g. **[23]** surprisingly showed that raising the price level unexpectedly reduces malnutrition in developing countries because food prices change the eating habits of poor people. As a result of high prices, they were forced to reorient themselves from many tempting foods that were poor in nutrients to basic foods that are more energy beneficial.

As shown by several studies dealing with the issue of organic food consumption **[37]**, the possibility of changing the dietary regime does not depend only on the individual's will, but above all, on the economic conditions in which he lives **[38]**. He is, therefore, greatly influenced by the macroeconomic environment in his choice **[39]**. The economic situation and food prices are important factors influencing food choices; therefore, changes in the inflation rate can be expected to affect organic food consumption **[40]**.

In their study, looked at the consumption of organic products and the determinants that influence it, confirmed that economic factors such as consumer income, prices of organic products compared to conventional products and inflation as some of the main determinants that influence the demand for organic food. In their analysis, the inflation rate was confirmed as the most important macroeconomic variable influencing the development of the consumption of organic products **[41]**.

GDP is a general indicator of income level in studies that influence food consumption factors. The growing economic performance of the country, expressed by the growth of the gross domestic product, is thus a determinant of higher consumption of organic products **[42]**, **[43]**.

From the above-mentioned follows, those studies dealing with the topic of macroeconomic determinants of food consumption generally view the issue from the point of view of malnutrition and famine, not the consumption of energetically important foods produced in an ecologically considerate manner. Even though organic food is a phenomenon whose importance has been fundamentally increasing recently, the need for organic food and its conditioning variables is still a largely unexplored area. In addition, existing studies on organic food consumption usually examine the influence of the population's income (respectively the amount of GDP) or the price level (respectively the rate of inflation), while other macroeconomic variables are not currently being paid attention to.

To evaluate the current state of knowledge on the issue of organic food, articles were searched in the WOS and Scopus databases for the period 2002-2022 and also for the last five years, i.e., 2017-2022, on topics related to the issue of organic food from the point of view of macroeconomic indicators (see Table 1):

A. A total of 2,725 papers were published in the WOS database and 2923 papers were published in Scopus on the subject of Organic food in the period 2002-2022.
B. A total of 33,860 papers were published in the WOS database on the topic of unemployment in the period 2002-2022, mainly from the fields of Economics (10,006), Public Environment Occupation Health (2,838), Management (1,502), Sociology (1,501), Business (1,365). The largest number of papers came from the USA (7,605), England (3,177), Germany (2,754), and Spain (2001). 918 papers were published in the Czech Republic. In the last five years, 49% of all papers (16,738) were published, representing an increase in interest in this topic in the last five years.
C. If the topic "organic food" is connected with the topic "unemployment," then in the monitored period 2002-2022, only three papers are listed in the WOS database, namely from the field of Business (1), Agricultural Economics Policy (1) and Agricultural Multidisciplinary (1). These papers come from Bosnia Herceg (1), Indonesia (1), and Italy (1). There is no paper from the Czech Republic. Again, an increased interest in these topics can only be seen in recent years, as 67% (2) were published in the last five years.
D. A total of 40,058 papers were published in the WOS database on the topic "inflation" in 2002-2022, of which 49% of the papers were published in the last five years, indicating a growing interest in the topic in recent years. The papers were mainly from the field of Economics (11,158), Physics Particles Fields (6,636), and Business Finance (3,111); they were published mainly from the USA (10,828), England (3,853), China (3,619), Germany 2,829).
E. If we connect the topic "organic food" and "inflation", there is no paper in the WOS database during the monitored period.
F. A total of 42,886 papers were published on the topic "GDP" or "gross domestic product" in the period 2002-2022, while 23,569 were published in the last five years, which indicates a growing interest in the topic. The papers were mainly from the field of Economics (12,974), Environmental Science (5,640), Environmental Studies (2,850), and Green Sustainability Science Technology (2,539). Most papers came from China (9,210), the USA (7,273), England (2,991), and Germany (1,949).
G. The Connection of the theme "organic food" with the theme of GDP (gross domestic product) in the monitored period, only three papers from the field of Business (1), Development Studies (1), and Economics (1) were found in the WOS database. These papers were published in Bosnia Herzegovina (1), Iran (1), and Poland (1). None of these papers were published in the Czech Republic. Again, an increased interest in these topics can only be seen in recent years, as 67% (2) were published in the last five years.

From the results shown in Table 1, it is evident that the topic of organic food is an emerging topic, covered by many articles, but in combination with the topics of macroeconomic indicators such as GDP, unemployment, and inflation, the number of articles is already very low. Thus, this study fills the gap in knowledge and perspective on the issue of organic food consumption through macroeconomic indicators.

Table 1 Bibliographic records on a query in the Web of Science and Scopus 2000-2021.

Search code	Query	Web of Science 2002-2022	Web of Science 2017-2022	Scopus 2002-2022
A	"organic food"	2,725	1,673	2,923
B	"unemployment"	33,860	16,738	
C	"organic food" and "unemployment"	3	2	
D	"inflation"	40,058	19,897	
E	"organic food" and "inflation"	0	0	
F	"GDP" or "gross domestic product"	42,886	23,569	
D	"organic food" and "GDP" or "gross domestic product"	3	2	

Note: Sources: Calculated by authors, access 2023/03/16.

According to **[44]** priorities for supporting rural development are fulfilled through measures (17 measures) together with the initiative LEADER, which mainly covers the following areas:

- dissemination of knowledge, information activities and consulting services,
- programs to support quality products, including promotion and information programs,
- campaigns,
- investments in tangible assets with a higher rate of assistance to young farmers,
- collective and integrated investments - possibilities for irrigation under certain conditions,
- development of agricultural enterprises and trade with extended support for
- small and young farmers and small businesses,
- development and improvement of forest areas,
- support for establishing groups of producers in all EU member states,
- climate-related agri-environmental payments and organic farming:
- greater flexibility and enhanced support for joint activities,
- a significantly strengthened cooperation measure, including pilot projects, short ones,
- supply chains and local promotion,
- a new set of risk management tools,
- strengthening the "LEADER" approach within EU funds.

MATERIAL AND METHODOLOGY

Statistical analysis

Data published by the Czech Statistical Office for the years x-2021 were used to compare the development of the consumption of selected groups of organic foods with selected macroeconomic indicators. The examined indicators were GDP, inflation, and the unemployment rate. Methodologically, GNI and GDP construction, according to the CZSO, is based on GDP from which primary incomes paid by resident units to non-resident units are subtracted, and primary incomes received by resident units from non-resident units are added, thereby obtaining gross national income. Expenditure current transfers paid by resident units to non-resident units are subtracted from it, and current income transfers received by resident units from non-resident units are added to obtain gross disposable national income. Gross disposable income represents the amount that households have left over after paying taxes and current expenses. It is intended to cover final consumption and savings. The result of subtracting final consumption expenditure from gross disposable national income is gross national savings, which are used to finance expenditure on gross capital formation. National disposable income shows the amount that, adjusted for the balance of secondary incomes flowing from/to the rest of the world, economic entities can spend on final consumption and savings.

The time series of the modelled variables were: (1) total consumption of organic food, (2) consumption of organic dairy products and (3) real GDP were tested for stationarity using ADF (Augmented Dickey-Fuller) tests **[45]**. In all cases of time series with original (logarithmic) values, the null hypothesis of the existence of a unit root was not rejected. After the transformation using the first differences (logarithmic) variables, all-time series were already stationary. The results are summarized in Table 2.

Table 2 ADF stationarity test results of the used time series.

ADF stationarity test		Time series (in logarithms)		
		Real consumption of organic food in total (per 1 inhabitant)	Real consumption of organic dairy products (per 1 inhabitant)	Real GDP (per 1 inhabitant)
Undifferentiated data	Test criterion	-1.27	-0.40	-2.10
	p-value	0.63	0.90	0.52
1st difference of variables	Test criterion	-1.97	-4.47	-6.00
	p-value	0.04 **	0.00 ***	0.00 ***

Source: Own results.

Due to the non-stationarity of the investigated quantities, the error correction model is the chosen model for describing the dependence between the total consumption of organic food (or the consumption of organic dairy products) and the real GDP. This model framework makes it possible to eliminate the problem of spurious regression in a model with non-stationary time series and to describe both the long-term equilibrium relationship between the mentioned variables and the short-term dynamics.

However, the formulated error correction model is not econometrically estimated by the standard two-phase Engle-Granger method **[46]**. The chosen methodology of the error correction model is modified, and the assumption of time-invariant coefficients is replaced by time-varying parameters using Hamilton's Markov-Switching Model (MSM) methodology **[47]**. Leaving the assumption of time-invariant coefficients enables a much more realistic description of the evolution of the modelled quantities within the investigated time interval of 1994-2020, in which the global economic crisis of 2008 occurred. Since the standard error correction model with constant parameters is the default model framework, which is modified, this standard model will first be described. Then a specific way of its modification will be shown.

Standard error correction model

The chosen specific form of the error correction model is illustrated here for the explained variable *real consumption of organic food in total* (in logarithms). Nevertheless, an analogous model was also formulated for the explained variable, *the organic dairy products real consumption.*

The econometric estimation of the long-term equilibrium relationship between the consumption of organic food and GDP is carried out in the same way as in the Engle-Granger methodology **[46]** on non-stationary time series using the least squares method (LSM):

$$\ln(C_t) = \alpha_0 + \alpha_1 \cdot \ln(Y_t) + u_t \quad (1)$$

Where:
C_t means the real consumption of organic food per capita; Y_t represents real GDP per 1 inhabitant; u_t is a random error with white noise properties.

Since the time series$\ln(C_t)$ and $\ln(Y_t)$ are non-stationary, this econometric parameter estimation creates a spurious regression problem. Nevertheless, it is possible to use the estimates of the parameters $\hat{\alpha}$, $\hat{\beta}$ using LSM to estimate the deviation from the long-term equilibrium $\hat{u}_t$:

$$\hat{u}_t = \ln(C_t) - \hat{\alpha}_0 - \hat{\alpha}_1 \cdot \ln(Y_t) \quad (2)$$

Applying the error correction model requires that the used variables $\ln(C_t)$, $\ln(Y_t)$ are cointegrated in the first order, i.e. the deviation from the long-term equilibrium $\hat{u}_t$ have to be stationary. The standard ADF test again tested the stationarity, and the results are summarized in Table 3.

Table 3 The stationarity test results of the deviation from the long-term equilibrium using the ADF test estimation.

ADF test stacionarity	Deviation of $\hat{u}_t$ from the long-term equilibrium in the regression with the explained variable:	
	The logarithm of the real consumption of organic food in total	The logarithm of real consumption of organic dairy products
Test criterion	-2.43	-3.10
p-value	0.017 **	0.003 ***

Note: Source: Authors' own calculations.

The null hypothesis is H_0: $\hat{u}_t$ has *a unit root*, which is rejected in both cases at the standard at a 5% significance level. The deviation from the long-term equilibrium $\hat{u}_t$ is therefore stationary, and an error correction model of the form can be applied in the form as follows:

$$\Delta c_t = \beta_1 \cdot \Delta y_t + \beta_2 \cdot \hat{u}_{t-1} + \varepsilon_t \quad (3)$$

Where:
$\Delta c_t \equiv \ln(C_t) - \ln(C_{t-1})$ is the difference in organic food consumption; $\Delta y_t \equiv \ln(Y_t) - \ln(Y_{t-1})$ represents the real GDP difference; $\hat{u}_{t-1}$ means a deviation from the long-term equilibrium relationship in the previous period; ε_t is a random error with white noise properties.

Since the variables are in logarithms, their absolute difference is approximately the relative difference of the original non-logarithmic variables $\ln(X_t) - \ln(X_{t-1}) \cong \frac{X_t - X_{t-1}}{X_{t-1}}$. The parameters β_1, β_2 therefore have the interpretation of the relative elasticity coefficients. The coefficient β_1 shows the percentage change in organic food consumption if GDP increases by 1%. In a completely analogous way, the parameter β_2 expresses the percentage by which organic food consumption will change, if this consumption was 1% above its long-term equilibrium value in the previous period.

The standard model modification

The stated standard error correction model (3) was modified in such a way that the assumption of the constant parameters in time was neglected, which was quite unrealistic due to the global economic crisis of 2008. Therefore, some coefficients of the model will be modelled as time-varying parameters (TVP, Time-Varying Parameters), while specifically for this purpose, the Markov regime change model (MSM, Markov-Switching Model) will be used in the following form:

$$\Delta c_t = \beta_1(S_t) \cdot \Delta y_t + \beta_2 \cdot \hat{u}_{t-1} + \varepsilon_t \quad (4)$$

while the time-varying coefficient $\beta_1(S_t)$ is a function of an unobservable state variable S_t:

$$\beta_1(S_t) = \begin{cases} \beta_{1,1}, \text{ for } S_t = 1 \\ \beta_{1,2}, \text{ for } S_t = 2 \end{cases}$$

The variable S_t is a discrete random variable with only two possible values $S_t = 1$, $S_t = 2$ characterizing the state of the economy, while its development is determined by a Markov chain with transition probabilities:

$$P = \begin{bmatrix} p_{11} & 1 - p_{11} \\ 1 - p_{22} & p_{22} \end{bmatrix}$$

Where:
$p_{ij} = P(S_t = j \mid S_{t-1} = i)$ is the conditional with the probability that the system will be in time t in the state j, provided that in time $t - 1$ was found in the state i.

The parameter β_2 was left in a constant, unchanging form because in the empirical application of the MSM model, the modelling of its variability caused the statistical insignificance of this parameter and other coefficients.

RESULTS AND DISCUSSION

Results estimation, model verification and interpretation

Econometric estimation of the error correction model parameters with time-varying parameters of the form (4) was performed by Hamilton's methodology **[47]**, with the results summarized in Table 4 for both regression equations (with the explanatory variable based on total organic food consumption even with an explained variable based on the consumption of organic dairy products). In addition to the estimation of the parameters ($\hat{\beta}_i, i = 0,1,2$), the table also shows the P-value of the z-statistic testing its statistical significance in parentheses for each estimation.

Table 4 Results of the econometric estimation of the error correction model (4).

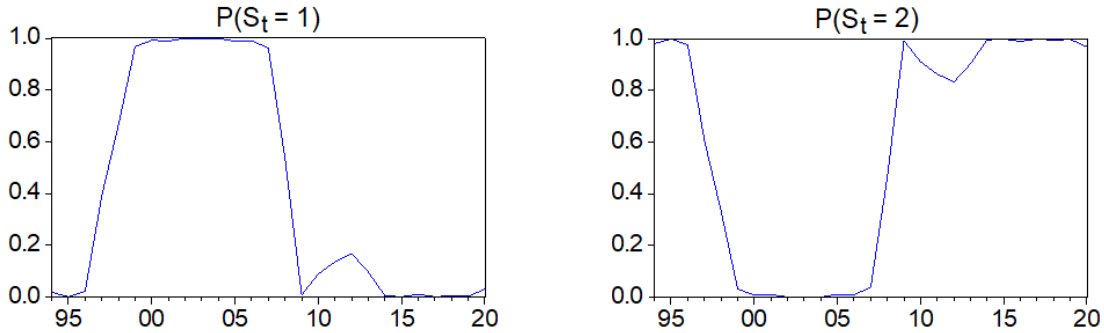
Regression with an explanatory variable	Parameter estimation (p-value of z-statistic)		
	$\hat{\beta}_{1,1}$	$\hat{\beta}_{1,2}$	$\hat{\beta}_2$
The logarithm difference of organic food consumption in total	0.592 (0.000) ***	-0.024 (0.808)	-0.269 (0.004) ***
The logarithm difference between the organic dairy products consumption	0.605 (0.000) ***	-0.346 (0.104)	-0.570 (0.000) ***

Note: Source: Author's own calculations.

The statistical importance of $\beta_{1,1}$ was, according to z-statistics, proven even at the 1% significance level in both cases. Therefore, both regression equations reject the null hypothesis cap H sub 0: beta sub 1,1 equals 0. Thus, if the economy is in the first state, the regressor Δy_t has a statistically significant effect on organic food consumption. In this case, the year-on-year growth of real GDP per capita by 1% leads to a year-on-year increase: the total real consumption of organic food per 1 inhabitant by 0.592 percentage points; real consumption of organic dairy products per 1 inhabitant by 0.605 percentage points.

However, if the economy finds itself in its second state, this statistical dependence of organic food consumption on real GDP disappears, which is proven by the statistical insignificance of the parameter $\beta_{1,2}$, in both considered regression equations.

A smoothed probabilities estimation of the individual modes $S_t = 1$, $S_t = 2$, using all the information from the entire data set, is shown for both estimated regression equations in Figure 1 below.



a) Regression equation with the organic dairy food consumption

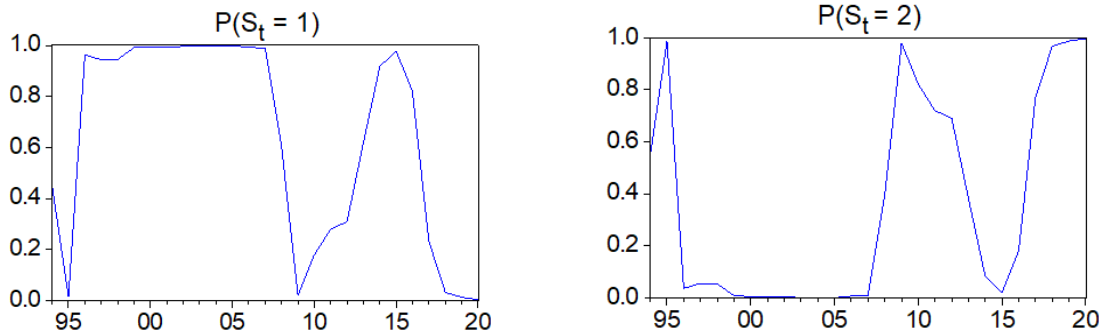
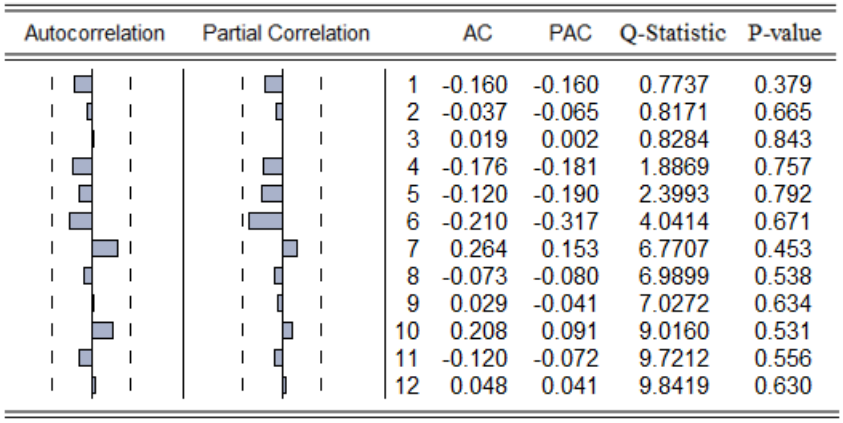


Figure 1 Smoothed probabilities estimation $P(S_t = 1), P(S_t = 2)$ for both regression relationships. Regression equation with the organic food total consumption.

The above graphs demonstrate that in 2008 there was a change in the dependence of organic food consumption on GDP in connection with the global economic crisis. This change turned out to be more pronounced and more permanent in the regression in the total consumption of organic food. For the regression equation with the consumption of organic dairy products, the system tended to return to its original first regime around 2015. However, this tendency did not prevail in the end, and in 2000 the system found itself again in its second regime, just as in the case of the first regression. It can therefore be summarized that the statistical significance of the dependence of organic food consumption on GDP disappeared after the economic crisis in 2008.

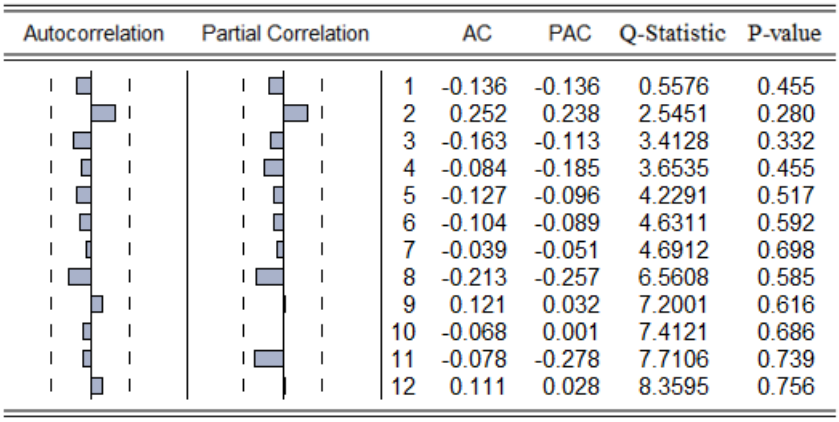
The coefficient β_2 fulfills a priori condition $\beta_2 \in (-1,0)$ in both considered regression equations. The fulfillment of this condition ensures that the consumption of organic food partially returns to its long-term balance if it has deviated from the balance in the previous period. The statistical significance of this adjustment mechanism, which keeps the given variables close to equilibrium, was demonstrated in both considered regressions, even at the 1% level of statistical significance. Therefore, if the total consumption of organic food (or milk consumption) deviates from its equilibrium value by 1 percentage point, then in the following period, the total consumption of organic food (or milk consumption) will decrease by 0.269 (or 0.570) percentage points.

In time series regression models, the problem of autocorrelation of random errors is very common. For this reason, the estimated error correction model (4) with time-varying parameters according to the Markov methodology was statistically tested for autocorrelation. Autocorrelation was tested using the Q-statistic as part of the correlogram analysis. The results are shown in Figures 2 and 3.



Autocorrelation	Partial Correlation		AC	PAC	Q-Statistic	P-value
		1	-0.160	-0.160	0.7737	0.379
		2	-0.037	-0.065	0.8171	0.665
		3	0.019	0.002	0.8284	0.843
		4	-0.176	-0.181	1.8869	0.757
		5	-0.120	-0.190	2.3993	0.792
		6	-0.210	-0.317	4.0414	0.671
		7	0.264	0.153	6.7707	0.453
		8	-0.073	-0.080	6.9899	0.538
		9	0.029	-0.041	7.0272	0.634
		10	0.208	0.091	9.0160	0.531
		11	-0.120	-0.072	9.7212	0.556
		12	0.048	0.041	9.8419	0.630

Figure 2 Autocorrelation (AC) and partial autocorrelation (PAC) functions of the regression model residuals (4) with the explained variable logarithm of the difference in total organic food consumption.



Autocorrelation	Partial Correlation		AC	PAC	Q-Statistic	P-value
		1	-0.136	-0.136	0.5576	0.455
		2	0.252	0.238	2.5451	0.280
		3	-0.163	-0.113	3.4128	0.332
		4	-0.084	-0.185	3.6535	0.455
		5	-0.127	-0.096	4.2291	0.517
		6	-0.104	-0.089	4.6311	0.592
		7	-0.039	-0.051	4.6912	0.698
		8	-0.213	-0.257	6.5608	0.585
		9	0.121	0.032	7.2001	0.616
		10	-0.068	0.001	7.4121	0.686
		11	-0.078	-0.278	7.7106	0.739
		12	0.111	0.028	8.3595	0.756

Figure 3 Autocorrelation (AC) and partial autocorrelation (PAC) functions of the regression model residuals (4) with the explained variable logarithm of the difference in organic dairy foods consumption.

The results in Figures 2 and 3 show that the null hypothesis of no autocorrelation was not rejected in both regression equations.

The results of the econometric analysis of non-stationary time series proved the existence of a long-term equilibrium relationship between organic food consumption and real GDP, both in the case of the indicator of the total consumption of organic food and the indicator of consumption of organic dairy products. The econometric estimation of the modified error correction model in both of these cases showed:

1) The statistical significance of the adjustment mechanism towards long-term equilibrium, even at the 1% level of statistical significance.
2) The intensity of this mechanism action was quantified as follows: If the total consumption of organic food (or milk consumption) deviates from its equilibrium value by 1 percentage point, then in the following period, the total consumption of organic food (or milk consumption) will decrease by 0.269 (or 0.570) percentage point.
3) In the case of both regression equations, the statistical significance of the dependence of real consumption of organic food on real GDP was proven before 2008, even at the 1% significance level.
4) The intensity of this mechanism action before the year 2008 was quantified as follows: Year-on-year growth of real GDP per 1 inhabitant by 1% leads to year-on-year increase:
   - the total real consumption of organic food per 1 inhabitant by 0.592 percentage points;
   - the real consumption of organic dairy products per 1 inhabitant by 0.605 percentage points.
5) However, in 2008, in connection with the global economic crisis, there was a regime change, and the statistical significance of this relationship disappeared. This conclusion turned out to be more permanent in the case of the relationship between total organic food consumption and GDP. In the case of the consumption of organic dairy foods, this dependence also changed in 2008, but it turned out to be of a less permanent nature. Around the year 2015, a short-term tendency to return to the original regime was characterized by a statistically significant dependence between the consumption of organic dairy products and GDP, and it was detected using the Markov models of regime change methodology.

The topic of this paper opens up the discussion of a whole range of other contexts and possibilities of investigating the economic and monetary policy influence as a tool for solving global climate change and also the inflation estimates or the search for efficient organic farming systems to ensure sustainable consumption of the world.

A number of economic schools dealt with consumption. According to classical economics/neoclassical economics, consumption depends on the real wage C= C(W/P); households decide on both consumption and labour supply (employment and real wages are endogenous from the model's point of view). According to Keynes, real consumption depends on current real income C = C(Y). Keynes analyzed the components of effective demand, such as household consumption, company investment, government spending on purchasing goods and services, transfer payments, autonomous taxes, and the income tax rate, and imports and exports in an open economy. His model addressed how to use this aggregate expenditure to stimulate real output growth to approach or reach the level of potential output and ensure full employment. Keynes's linear consumption function (the consumption theory: 45°) considers households' disposable income for consumption and savings. Total consumption increases as income increases but also regularly increases by a certain percentage of the additional product. For example, for every additional CZK 100 million in income, households spend CZK 80 billion and save CZK 20 billion. This stable share is called the marginal propensity to consume. Indicators measuring the size of these aggregates and their dynamics are usually used to monitor the development of final consumption expenditure and disposable income, i.e., the propensity to consume. Disposable income can be considered gross (including consumption of fixed capital) or net (without consumption of fixed capital). It is also possible to compare the development of final consumption expenditure and disposable income using indicators measuring absolute and relative increases in the values of these indicators. In the first case, it is the marginal propensity to consume, and in the second case, the elasticity coefficient.

Reviews how climate change and its policies may affect the macro economy in ways that are relevant for central banks' monetary policy assessment of the inflation outlook **[48]**. This review concludes with evidence regarding the potential channels of transmission and economic impacts of climate change and climate mitigation policies with potential significance for macroeconomic policymakers. **[49]** even describes how monetary policy can react to climate change and underlines the impact on key economic variables. Therefore **[50]** emphasises that the costs and benefits of any action to proactively mitigate climate change must be carefully balanced. Organic agriculture can be a part of the solution and help tackle climate change through its ability to reduce greenhouse gas emissions, store away huge amounts of carbon, and enable farmers to be resilient in an evolving climate **[51]**. According to **[52]** organic agricultural systems' mitigation and adaptation potential along three main features: I.) farming system design, II.) cropland management and III.) grassland and livestock management. These authors also confirmed that an important potential contribution of organically managed systems to climate change mitigation is identified in the careful management of nutrients and, hence, the reduction of N_2O emissions from soils. Another high mitigation potential of organic agriculture lies in carbon sequestration in soils. The Strategies for feeding the world more sustainably with organic agriculture is also discussed by **[53]**, where it is stated that

an organic agriculture is proposed as a promising approach to achieving sustainable food systems, but its feasibility is also contested. Meanwhile, biodiversity loss due to food production has increased by 50% in freshwater ecosystems. Agriculture accounts for some 70% of freshwater withdrawals worldwide and contributes to water pollution from agrochemicals, organic matter, drug residues, sediments and saline drainage into water bodies **[54]**. Finally, **[55]** provided a high-level overview of the evidence favouring nature-positive food systems, discussing opportunities and challenges associated with sustainable, efficient agricultural production with a view towards concrete policy suggestions. This study concludes that, on average, and particularly in temperate zones with highly intensive agriculture, conversion to nature-positive systems typically results in a reduction of yields that must be compensated by cost savings, higher product prices, or other support measures as to ensure the economic viability of the farms. This is particularly true in the case of organic farming **[56]**, **[57]**, but much less distinctive for integrated production systems with restrictions on plant protection and nitrogen fertilization **[58]**. Therefore ecosystem-based adaptation, defined as the 'use of ecosystem management activities to increase the resilience and reduce the vulnerability of people and ecosystems to climate change' **[59]**, has its core recognition that unexploited synergies in agricultural systems can increase productivity and resilience. These can result from increasing biodiversity, adding organic matter to soils, integrating livestock and aquatic species, including aquaculture, into farming practices, broadening landscape practices to exploit crop–forestry synergies, supporting beneficial insect populations and altering pest management practices that have unintended negative consequences **[60]**. The review of **[61]** also determines that transformative adaptation is characterized as restructuring, path-shifting, innovative, multiscale, systemwide, and persistent. Despite several barriers to implementing transformative adaptation, policymakers and practitioners should consider this option in adaptation plans to help societies to anticipate, guide, or recover from radical climate change impact. Using transformative adaptation to navigate shifts driven by climate change can increase the efficiency and sustainability of climate solutions. Another area for discussion related to assessing the influence of macroeconomic indicators and consumption, including organic food, is the relevance of these indicators. The findings are based on statistical data related only to data for the Czech Republic. To confirm the correctness of the answer to the research question, it would therefore be appropriate to investigate other similarly developed EU countries, possibly for the EU countries as a whole or even for non-EU countries. The authors examined only a selected group of organic foods, and the findings would be appropriate to analyse for other groups of statistically reported organic foods.

One of the certainly significant factors influencing organic food consumption are the customers' attitudes towards green marketing and the actual purchase and consumption of organic food. The measurement of consumer attitudes was not the subject of research, but the authors should certainly investigate this issue, and search based on the results of already conducted research abroad and in the Czech Republic.

Based on the results obtained in this research, it can be concluded that organic food has recently been considered trendy and, therefore, fashionable. However, organic products and products must comply with all generally valid hygiene and food standards for ordinary foods, and, in addition, they must comply with the rules for organic agriculture. Therefore, organic farming is a key ally in the transition towards a more sustainable food system and better biodiversity protection. The main reasons for its application are **[62]**:

1.) Organic farming reduces the number of greenhouse gases;
2.) Organic farming improves soil carbon sequestration;
3.) Organic farming increases the resilience of farms by building healthy soil and crops that allow them to adapt better to a changing climate.

The **[21]** emphasizes that changes in people's lifestyles and consumption patterns are crucial for climate action **[63]**, **[64]**. With rapidly changing dietary habits, increasing purchasing power, and lifestyle changes in countries across Asia, especially those with large populations such as China and India, contributing to global climate solutions will be critical **[64]**. Lifestyle changes that can help with adaptation include:

- Engaging in urban agriculture through rooftop gardening, building community gardens in urban and suburban areas **[65]**, **[66]**, **[67]**;
- Moving towards organic farming and creating demand for organic food and other raw materials;
- Moving towards water conservation, such as rainwater harvesting, water conservation, reducing water consumption, etc.

The transition to organic farming and agroecological practices is the key to reducing and adapting to the adverse impacts of climate change. The transition to sustainable food systems must occur now and cannot be delayed any longer **[68]**.

Understanding the motivations and processes underpinning decisions to adapt or not is key to enabling adaptation (see: **[63]**, **[69]**, **[70]**, because how and why certain people adapt is shaped by sociocultural factors, ways of making sense of risks and uncertainty, and personal motivations to undertake action **[71]** in **[21]**. The IPCC's Assessment Report 5 was critiqued for silences on how perceptions shape climate action and the behavioural drivers of adaptation responses **[71]**. Addressing this gap and assessing the growing literature from social sciences, notably psychology, behavioural economics and risk perception studies, the IPCC Special Report on 1.5 °C **[63]** comprehensively assessed behavioural dimensions of CCA for the first time; however, compared with studies on mitigation behaviour, the literature on what motivates adaptation remains incomplete **[69]**.

According to **[21]**, there are three key aspects of adaptation to which psychology and behavioural science contribute: understanding perceptions of climate risk, identifying the behavioural drivers of adaptation actions and analysing the impacts of climate change on human well-being **[69]**. Overall, there is growing acknowledgement that individual adaptation is significantly shaped by perceptions of risk, perceived self-efficacy (i.e., beliefs about which options are effective and one's ability to implement specific adaptation interventions), sociocultural norms and beliefs within which adaptation decisions are taken, past experiences of risk management and the nature of the intervention itself **[70]**, **[71]**, **[72]**, **[73]**. This is in addition to more commonly understood factors shaping adaptation behaviour, such as technical know-how and the cost and benefits of an individual alternative.

CONCLUSION

The changes in the approach to organic food require a fundamental shift in the paradigms that are the basis of the current dominant thinking and action. However, this approach will provide an innovative, proactive stance, enabling and facilitating meaningful change for sustainable agriculture. This paper provides a basic framework for developing effective local, contextual, collaborative, integrated planning and action to achieve sustainability within the food systems, which is critical nowadays. The literature as mentioned earlier source also presents the consequences of the transition from current conventional agriculture and so-called shallow organic production to more sustainable deep organic production, using social ecology as a tool for their implementation. When evaluating macroeconomic indicators for the consumption of selected crops, it is, therefore, necessary to emphasize the need to understand and solve the psychological and psychosocial roots of the challenges of unsustainability for many contemporary modern societies.

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