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A review of Sustainable Agriculture Role in Economic Modern Market Economics

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Abstract

Sustainability in agriculture, one of the main topics discussed in development circles today, is the result of different concepts of development. A growing population has resulted in an increased need for food, which has expanded agricultural production and negatively affected soil and basic resources. Agricultural sustainability is the process of managing and using resources in a manner that preserves the environment and natural resource reserves while meeting human food demands. Additionally, the food produced from this system is economically dynamic, and efforts have been made to preserve and protect resources for future generations. The role of sustainable agriculture in modern markets is discussed in this review paper. The purpose of this paper is to review previous studies in order to demonstrate the importance of sustainability in agriculture in modern economies.

1. Introduction

Agriculture, as the oldest productive activity, has been the most important economic activity in all countries of the world for many years. Today, the agricultural sector is the dominant sector of the national economy in many developing countries, so the economic growth and development of these countries is very closely related to the overall development of their agricultural sector, in other words, agricultural development in the context of national development placed (Komilova *et al.*, 2019).

Despite the wide variety of economic activities in the urban sector and the development of non-agricultural activities such as services and industry, the role of the agricultural sector in the development process is still more prominent. Strengthening the agricultural sector can create savings, which will help create and develop the industrial sector. The agricultural sector is of special importance in terms of income, employment, currency exchange, market creation and especially food supply among other sectors (Zhong *et al.*, 2020).

A study of economic development trends in different parts of the world over time shows that developed countries, relying on comparative advantages, have been able to make the best use of domestic economic capacity and opportunities in the international arena. And follow the path of growth,

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development, increase per capita income and improve other indicators of development simultaneously. The study of the historical trend of economic development of countries shows that most of the developed countries of the world today have chosen agriculture as an infrastructure sector of their economic development and by using the abundant capacities of this sector, in addition to providing appropriate inputs for the growth of other sectors, the development of other sectors.

The agricultural sector has several roles in the process of economic growth and development of different countries, the most important of which are the supply of raw materials needed by upstream industries, the supply of inputs such as labor and the consumption of other products. He mentioned industrial sectors such as fertilizers, chemical pesticides and agricultural machinery, the currency for the country and financing of other infrastructure sectors (Wang *et al.*, 2019).

In addition to the roles mentioned, the health and food security of a country is directly dependent on the production of the agricultural sector, and any disruption in the production process of this sector can directly threaten the food security and even the political security of that country; Recent sensitivities of developed countries regarding the consumption of agricultural products and healthy and organic food indicate the high attention of policymakers and consumers in these countries to the discussion of healthy products in the agricultural sector (Qaim, 2020).

Agricultural economists emphasize the important role of the agricultural sector in economic development. For many low-income developing countries, agriculture is the largest sector in the economy and in total employment. Large size often matters in explaining the role of agriculture. Because of this, agriculture can catalyze economic growth, and create jobs, in addition to undoubtedly outcomes of poverty reduction and improvement in food and nutrition security (Barrett *et al.*, 2019).

The strong agriculture sector always strengthens the economy, because each 1% increase in per-capita agriculture growth leads to 1.5% increases in per-capita nonagricultural growth. The growth of the agriculture sector has a strong correlation with the population; a high population leads to increases per unit of land use as per the proportional increase in population. Nevertheless, in the contemporary world, the agriculture sector across the globe facing daunting challenges, farmers are being expected to produce adequate output in given resources, therefore, since the second half of the twentieth century farmers are moved from long fallow to short fallow and from annual cropping to multiple cropping cycles per year (Bashir and Yuliana, 2019).

Agriculture in Western Europe faces a variety of problems, regarding for instance the reduced welfare of animals in housing systems in the 1970s, the use of pesticides in the early 80s, susceptibility to infectious diseases in the 90s, and at the beginning of the twenty-first century erosion and the high use of antibiotics and vaccines. These problems will decrease the amount of available future agricultural products. Incremental innovation has always been at the centre of agriculture.

Farmers have from the start tried to improve the use of plants and animals for human consumption. By using trial and error breeding processes they slowly domesticated crop plants and animals. This process of thousands of years of domestication has led to an enormous extension of cultivated fields, with only a few kinds of uniform crop plants that are produced in monocultures, and the use of mainly five species of animals in animal livestock farming. Next to incremental innovation, in the last few hundred years, agricultural research has led to many radical innovations in agriculture. These innovations, ranging from mechanization to hybrid cultivars and from the Green Revolution to modern biotechnology, have shaped conventional agriculture on a global scale (Gremmen *et al.*, 2019).

The agricultural sector continues to play a crucial role in development, especially in low-income countries where the sector is large both in terms of aggregate income and total labor force. Having been a key preoccupation of developing country governments, donors and the international community during the 1960s and 1970s, agriculture disappeared from the development agenda in the 1980s and 1990s, only to reappear in the first decade of the 21st century because of neglect and underinvestment (Barrett *et al.*, 2020).

Since the late 1980s and early 1990s, two models of agriculture are now emerging because of the integration of this globalization. The first one is an industrial model which advocates the usage of high inputs/output intensive land farming to get high production. Subsequently, the international capital market penetrated in south Asian countries by the elaboration of biotechnology. The alternative model is sustainable agriculture and quality food production (Yaqoob *et al.*, 2022).

Hence, any changes in the climate can impact farm yields. Moreover, crops and livestock can be indirectly affected by changes in the climate, for instance through the availability of water, expansion of weeds, and pests' infestations. The environmental Kuznets curve (EKC) describes the relationship between economic growth and environmental degradation. According to this hypothesis, when a country's income is still low, its attention will be focused on increasing income by ignoring environmental quality problems. As a result, rising incomes will be followed by rising pollution, which will eventually fall with sustained growth. This decline was due to increased social control and government regulation (Tudi *et al.*, 2021).

1.1. Problem statement

In the developed world, agriculture has long ceased to be considered as the major economic sector and its role as a contributor to national economic growth is often underrated or neglected. Even countries such as Greece, traditionally dependent on their agricultural sector have in the last decades reorganized their growth policies in favor of the industrial, trade and/or services sectors following the global economic trends.

However, the onset of the world economic crisis in 2008 has brought again the issue of judging and assessing the development priorities. The crisis spread globally and particularly affected Europe, especially southern European countries where agriculture still plays a more important role than in the northern European countries. Under this unstable and revised economic environment, the role of agriculture particularly within the reformed Common Agricultural Policy (CAP) should be reassessed, as a chance to remunerate the knowledge and depict its significance and potential as an economic growth factor (Loizou *et al.*, 2019).

Traditionally, agriculture is considered as the sector that provides food and fiber; although in contemporary economies, long discussions exist on its indirect historical role, beyond the perceived traditional one. Globalization and agricultural products trade increase were the first causes that initiated serious discussions and currently, the global economic crisis is re-questioning the role of agriculture (Loizou *et al.*, 2019).

Agriculture constitutes an indispensable production process that contributes substantially to every society and economy and remains an essential driver of the rural areas of the European Union. The significant role of agriculture to a regional economy not only involves its output but is linked to other antecedents like those of production and labor that are also required by other sectors (Dudić *et al.*, 2020).

Within a turbulent global economic environment, the role of agriculture is reconsidered and is challenged for a more augmented character. The new broaden role differs from its traditional one as a provider of primary inputs, food, income and employment, and involves food quality and safety provision, environment protection, integrated rural development and rural areas' social structure and cohesion safeguarding.

In this context, agriculture in Greece is called to become a pioneer in the country's difficult economic situation no matter its performance and contribution to the economy; bearing in mind that agriculture remains a sector of economic activity with many and specific problems (Loizou *et al.*, 2019).

There are two challenges related to agriculture. The first is the need to increase food productivity and production in developing countries, especially in Sub-Saharan Africa and with smallholder farmers. To achieve this, several problems need to be addressed: property rights, R&D for seeds and inputs, irrigation, fertilizer, agricultural extension, credit, rural infrastructure, storage, and connection to markets. The second problem is the volatility of food prices, often because of events outside the control of poor countries. An interconnected combination of steps could help ensure that the most vulnerable countries and people get the nutrition they need (Bjornlund *et al.*, 2020).

Improving agricultural product quality and food safety are among the most important problems to be addressed in the process of agricultural modernization. Farmers form the starting point of the agricultural supply chain, and they are also the stakeholder group most responsible for generating quality-related problems. Excessive application of pesticides and fertilizers is one of the main causes of quality problems at the farm level. Initially, pesticides and fertilizers reduce losses caused by diseases, pests, and weeds. They also enhance soil fertility and improve land use efficiency. In turn, this improves agricultural labor productivity and average yield based on the limited expansion potential of the cultivated area. However, the long-term use of pesticides and fertilizers brings about serious problems (Humphrey, 2017).

In many developing countries, the emphasis has been on achieving higher agricultural productivity, with little regard for sustainability. This resulted in increasing production without any attention to preserving basic and natural resources. Therefore, large areas of the world have faced severe soil degradation, water erosion, groundwater pollution and natural resource depletion. This condition is more obvious in poor and developing countries, which rely on a large extent on agriculture and natural resources for their living (Ebeke and Etoundi, 2017).

The concept of sustainable agriculture is strongly related to the multifunctional role, either explicitly or implicitly, recognized to the primary sector (Di Fazio and Modica, 2018). This sustainability approach comprises a social, an environmental and to a lesser extent, an economic dimension. It takes into account the needs of rural communities and food safety for consumers as well as the impact of agricultural practices on local ecosystem services and the global environment (Serra-Majem *et al.*, 2020). Not only is strong multi functionality predicated on ensuring the protection of the environment, healthy farming and rural communities, but it can also be seen as the most 'moral' system (Kosenchuk *et al.*, 2019).

However, definitions of sustainable agriculture vary considerably, and few quantitative assessments on agricultural sustainability for world countries are available to date. Some scholars and practitioners consider sustainable agriculture as a set of management strategies, while others define sustainable agriculture as an ideology or a set of specific goals (Janker *et al.*, 2018). Nevertheless, there is a growing consensus on framing sustainable agriculture based on its impacts on the three pillars of sustainability, namely the environmental, economic, and social pillars. Several frameworks and indicators have been developed to quantitatively assess the sustainability of food systems from national to global scales and

sustainable agricultural intensification on a farm scale (Colapinto *et al.*, 2020). In this study we investigat that why agriculture is important for country's economic and this is based on role of agriculture in economic growth, financial crisis and financial behavior and also role of sustainable agriculture in economic.

1.2. Research Objectives

The main objective of this study is to investigate the role of agriculture in economic growth.

2. LITERATURE REVIEW

2.1. Background of study

2.1.1. Agriculture and Modern Economic

As a country develops economically, the relative importance of agriculture declines. The primary reason for that was shown by the 19th-century German statistician Ernst Engel, who discovered that as incomes increase, the proportion of income spent on food declines. For example, if a family's income were to increase by 100 percent, the amount it would spend on food might increase by 60 percent; if formerly its expenditures on food had been 50 percent of its budget, after the increase they would amount to only 40 percent of its budget. It follows that as incomes increase, a smaller fraction of the total resources of society is required to produce the amount of food demanded by the population (Qaim, 2020).

That fact would have surprised most economists of the early 19th century, who feared that the limited supply of land in the populated areas of Europe would determine the continent's ability to feed its growing population. Their fear was based on the so-called law of diminishing returns: that under given conditions an increase in the amount of labor and capital applied to a fixed amount of land results in a less-than-proportional increase in the output of food. That principle is a valid one, but what classical economists could not foresee was the extent to which the state of the arts and the methods of production would change. Some of the changes occurred in agriculture; others occurred in other sectors of the economy but had a major effect on the supply of food (Kamps and Kleinberg, 2018).

In looking back upon the history of the more developed countries, one can see that agriculture has played an important part in the process of their enrichment. For one thing, if development is to occur, agriculture must be able to produce a surplus of food to maintain the growing nonagricultural labour force. Since food is more essential for life than are the services provided by merchants or bankers or factories, an economy cannot shift to such activities unless food is available for barter or sale in sufficient quantities to support those engaged in them. Unless food can be obtained through international trade, a country does not normally develop industrially until its farm areas can supply its towns with food in exchange for the products of their factories (Eriksson *et al.*, 2019).

Economic development also requires a growing labour force. In an agricultural country most of the workers needed must come from the rural population. Thus agriculture must not only supply a surplus of food for the towns, but it must also be able to produce the increased amount of food with a relatively smaller labour force. It may do so by substituting animal power for human power or by gradually introducing labour-saving machinery (Ibrahim and Alagidede, 2018).

Agriculture may also be a source of the capital needed for industrial development to the extent that it provides a surplus that may be converted into the funds needed to purchase industrial equipment or to build roads and provide public services. For those reasons, a country seeking to develop its economy may be well advised to give a significant priority to agriculture. Experience in the developing countries

has shown that agriculture can be made much more productive with the proper investment in irrigation systems, research, fertilizers, insecticides, and herbicides (Bahn *et al.*, 2021).

As from the 1980s, the view that economic historians had of the interactions between agriculture and economic growth changed drastically. Initially, an in-depth review of the British case was made and subsequently in many other countries the paradigms of the past were questioned. Many recent studies have indicated the existence of positive relationships between agriculture and economic growth. These relationships derive from inter-sectoral links, the strengthening of domestic markets, technological and organizational improvements, or simply the exploitation of comparative advantage in the rural setting.

Analyzing changes in agricultural production and productivity, and their relationship to per capita income levels, is of particular importance in order to assess the potential contribution of agriculture to economic growth. Also of interest is the analysis of the relationships between agriculture and other economic sectors during this process, the use of resources (land, labour, capital) and the influence of institutional and technological factors in the long-run performance of agricultural activity (Pinilla and Willebald, 2018).

In the processes of economic development, structural transformation implies a sustained improvement in agricultural productivity. As productivity grows, the economy creates conditions to process a real structural change in which the transference of resources to other sectors with higher productivity is possible, and the final consequence is an increase in the total factor productivity. This structural transformation requires a highly productive agricultural sector that employs small shares of the whole workforce (Diao *et al.*, 2018).

The sharp increase in growth rates in many developing countries since 1990 is unprecedented in the 200 years since the Industrial Revolution began. This growth has generally not taken the form of unconditional income convergence, with the lowest income countries growing faster than higher income countries. The gains have been greatest in Asian countries, which have been able to take advantage both of improvements in agricultural productivity and market opportunities associated with global production sharing (Martin, 2019).

This shift brings with it profound changes for agricultural economists in all fields and demands more careful and explicit attention than has been the case to date. The impacts come through changes in food demand, changes in production processes, and changes in marketing and trade policies. The change in growth patterns is widely expected to continue, although it will likely evolve in ways that should be monitored and evaluated to fully appreciate the implications for agriculture (Fresco *et al.*, 2021).

Economic growth in developing countries has much greater impacts on demand for food than income growth in the rich countries, where it has essentially no impact. In terms of the demand for resources from agriculture, the critical change in low-income countries is the increase in demand for livestock products, which require greater production effort. In terms of the nutritional impact, increases in consumption of sugar and fat may have a more profound impact. This dietary shift has profoundly changed malnutrition in developing countries—from purely a problem of undernutrition to a double burden of malnutrition involving both persistent undernutrition and problems associated with obesity and related no communicable diseases (Caron *et al.*, 2018).

Many have raised concerns that income-driven increases in demand for food have contributed to past food price crises. While it is true that the demand for food grows much more quickly when income grows in poor countries than in rich countries, the productivity changes that cause growth also tend to raise the supply of food. Developing countries have larger shares of GDP in food production than richer

countries, and many of the largest developing economies have invested heavily in R&D, with substantial impacts on productivity and output (Heisey and Fuglie, 2018).

Economic growth facilitates and, in turn, is promoted by investments in infrastructure, particularly rural transportation. Historically, these investments have been difficult to evaluate because of problems of reverse causation, but innovations of the type discussed in Dave Donaldson's Elmhirst Lecture have allowed for much better assessments of the implications of these infrastructure investments for agricultural productivity and the implications of improved transport for food security in the face of output volatility (Duvaleix-Treguer *et al.*, 2018).

The movement of labor out of agriculture is an important feature of economic growth. Raising the productivity of labor in agriculture relative to nonagricultural is vitally important, either by facilitating movement into higher productivity sectors or by raising productivity within agriculture. The movement of labor out of agriculture has been extremely rapid in high-growth economies, and it appears that the income gap between sectors has declined in those countries as well. But the gap remains extremely large in some regions, particularly in Africa, leaving the vast potential for income gains if economists can help guide ways to reduce it (Lu *et al.*, 2019).

A combination of economic growth and developments in marketing technologies has given rise to a "supermarket revolution" that has seen food retailing move much earlier and faster away from traditional markets than in the past. This together with related marketing innovations has created an entirely new field of research in recent years, studying both the implications for consumers and the opportunities for linking poor farmers to these new marketing channels (Devaux *et al.*, 2018).

2.1.2. Agriculture and Economic Crisis

Agricultural production today faces several challenges: an increasing world population has to be fed, but at the same time the environment and animal welfare need to be protected. Globalization has led to increasing international competition, while the agricultural sector is also under heavy economic pressure as a result of regulation. Also the economic crisis effect agriculture part (Calicioglu *et al.*, 2019).

In World Economic History, there are 8 major financial crises that the world witnessed in the last 100 years. The 8 crises are the Great Depression 1932; the Suez Crisis 1956; the International Debt Crisis 1982; the East Asian Economic Crisis 1997-2001; the Russian Economic Crisis 1992-97, the Latin American Debt Crisis in Mexico, Brazil and Argentina 1994-2002, the Global Economic Recession 2007-09 and the European crisis 2010. Table 1 shows the summary of the Financial crisis in history.

Table 1. Summary of the Financial crisis in the history

Name of financial	Started	Ended	Location	Reason	How solved
The great depression 1932	1928	1933	Started from USA. USA and EUROPE	Us stock market crash	Laying the foundations of the American welfare state – federal aid to the unemployed, stiffer regulation of the industry, legal protections for workers, and the social security program.
The Suez crisis	1956	1957	Suez canal	The suez canal was closed for 6 months because of the military action	The war finished

Name of financial	Started	Ended	Location	Reason	How solved
The international debt crisis	1982	1989	Mexico	Mexico could not repay the loan that was due and engulfed 20 countries.	By 1989, there was a marked improvement in the external economic environment facing many of the indebted countries which brought an end to the international debt crisis.
The East Asian crisis	1997	2001	East Asian	Large external deficits, inflated property and stock market values, poor prudential regulation,	The IMF programs promoted the restructuring and recapitalization of financial institutions.
The Russian crisis	1992	1997	Russia	The government ran huge budget deficits financed by the central bank of Russia. There was large scale tax evasion and huge capital flight.	Russia declared across-the-board suspension of debt-service payments including ruble-denominated debt and suspension of private sector external payments.
Latin American debt crisis	1994	2002	Latin American	Cannot pay their debt because of Asian and Russian crisis	Improvement in the external economic environment
The great recession	2008	2009	USA	U.s. housing bubble and the global financial crisis.	Economic growth turned positive as wide-ranging policy intervention supported demand and lowered the uncertainty of systemic risks to the financial system
The European crisis 2010	2010	2012	European	The European sovereign debt crisis began in 2008 with the collapse of Iceland's banking system	Received the package from a European bank for solving the problem

The economic crisis rapidly spread to countries characterized by large public budget deficits. Greece has been the worst-hit country within the European Union (EU), being still deep into recession for six consecutive years and having lost a cumulative almost 25 percent of its GDP (Giannakis and Bruggeman, 2017).

Important recent impacts of the crisis have included: declines in commodity prices, particularly prices of investment goods. Another consequence has been declining in migration—both between regions and between countries—and a reduction in remittance flows. Increases in the cost of finance for production and trade have had unfavorable impacts—both directly and indirectly on producers and consumers in poor countries, and have been associated with a sharp reduction in lending to developing countries. Declines in the demand for labor resulting from reductions in investment and in exports have put downward pressure on employment and wages for unskilled labor in many poor countries. Finally, increases in interest rates, particularly for trade credit, have raised the costs of production and trade (World Bank). We must always be cautious in assessing the impacts of the crisis. As noted above, great uncertainty surrounds the precise nature of the shocks involved. Many of the policy responses to the shock—such as expansionary monetary policy—also appear to have their impacts with long and unpredictable lags. Under these circumstances, it is probably prudent to examine the vulnerability of poor people to different types of shocks, and the effectiveness of particular policies, rather than seeking to examine the impacts of shocks of the size observed to date (World Bank, 2012).

However, by examining the order of magnitude of particular shocks, and their "leverage" on poverty impacts, we may at least obtain some idea of which changes need to be monitored most carefully when assessing the implications of emerging changes. The declines in commodity prices began from very high levels in 2008 for many commodities and have proceeded unevenly across commodities. The prices of some products such as rubber, oil and minerals that are linked to investment demand have generally fallen more than the prices of pure consumption goods5 (Bourguignon, 2018). From experience in analyzing the consequences of the food crisis of 2008, we know that the effects of commodity prices on people in poor countries are very complex. It is tempting to conclude that, since farmers are poorer than urban residents in almost all poor countries, higher prices would therefore result in lower poverty. But declines in the prices of staple foods typically reduce poverty in poor countries because the poorest people spend such a large share of their incomes on these foods, and because many poor rural people, including farmers, are net buyers of these foods (Bellmann and Hepburn, 2017).

Declines in the prices of some higher-income-elasticity foods such as dairy products or beef may, however, increase poverty by lowering the incomes of small producers who produce and sell these commodities but are unable to afford to buy many of these foods. Declines in the prices of cash crops such as cotton, coffee, cocoa and rubber are, however, more likely to increase poverty because farmers in poor countries are typically net sellers of these goods, and poor people spend only small shares of their incomes on them (Debuquet *et al.*, 2020).

One simple indicator of the relationship between prices of agricultural commodities and financial sector shocks is given by the relationship between agricultural prices and stock market indexes.

The impact of the crisis on poor people depends heavily upon its impact on the prices they face, and the transfers they receive. Food prices appear to be both subject to particularly sharp swings and to have disproportionately large impacts on poverty because of the importance of spending on food by the poor. Changes in wage rates for unskilled labor sold outside the family firm also have relatively large impacts on the poverty rate (Skogstad, 2019).

Roosen and Marette (Roosen and Marette, 2011) analyze how the experiments contribute to the regulatory debate existing about the information referring to food quality and safety. They conduct a brief review of how laboratory and field experiments on food are complemented with theoretical analysis, discussing strengths and weaknesses.

Concerning nutritional aspects, Réquillart and Soler (Réquillart and Soler, 2014) study how government policies related to nutrition have focused on informing consumers about the benefits of balanced diets, which has had a positive but modest effect. Recently, the attention of these policies has been directed towards market environments, with an emphasis on the characteristics of the food supply.

Economic sustainability is defined as the economic viability of farming systems, i.e., their ability to be profitable in order "to provide prosperity to the farming community" (Lebacq *et al.*, 2013). As suggested by van Cauwenbergh *et al*. (2007), agriculture should "provide prosperity to the farming community". In this context, economic sustainability is generally viewed as economic viability, namely whether a farming system can survive in the long term in a changing economic context.

Changes in the economic context may be driven by variability in output and input prices, yields, output outlets, and public support and regulation. The concept of the 'long term' can be understood as during the professional life of the farmer, or across generations. The latter is related to durability, i.e. the capacity of a farm to be transferred to a successor. Economic viability is mainly measured through profitability, liquidity, stability and productivity (Van Cauwenbergh *et al.*, 2007).

Profitability is calculated by comparing revenue and cost, either as a difference or as a ratio, or proxied by income variables such as farm income. Liquidity measures the availability of cash to meet immediate and short-term obligations, and stability is usually measured by the share and development of equity capital. Productivity is a measure of the ability of the factors of production to generate output. It is generally measured as a partial productivity indicator which is a ratio of output to one input, but also by measures that account for the possibility of input substitution or output substitution, such as total factor productivity (TFP) and technical efficiency (Latruffe *et al.*, 2016).

Profitability and productivity indicators are mainly quantitative indicators and are expressed in monetary terms or as ratios; more rarely, reference scales are used. Although the measurement of economic sustainability does not typically extend beyond such economic indicators, a wider range of indicators has been proposed to capture other economic properties of farming systems that are associated with sustainability (Dantsis *et al.*, 2010).

A study by Pani mentioned that the economic face of sustainability has been neglected and silent i.e. "Enhancing production and productivity safeguard agroecology" has been given more focus with "Minimising cost of Production and environmental factors". Also, the high cost of production and low return, with high environmental cost breaches the standard to meet agricultural sustainability (Pani *et al.*, 2020).

Various studies have been conducted in the country and abroad about agricultural sustainability. In these studies, different methods have been used to assess agricultural sustainability; Among the comprehensive data analysis (DEA) in studies (Geng *et al.*, 2019; He *et al.*, 2016; Picazo-Tadeo *et al.*, 2011) , fuzzy set theory in research (Kaya *et al.*, 2019), agreement planning (Shen *et al.*, 2011), pointed out that all the mentioned methods have examined the sustainability of agriculture in a period of time and at the farm or regional level.

Various research papers suggest diverse sets of indicators for assessing sustainability in agriculture. A research study on theoretical possibilities for assessing the sustainable intensification of agricultural systems found that up to 500 various indicators were suggested for sustainable intensification assessment. Of the indicators, 202 could be characterized as relating to social dimensions, 95 – to economic dimensions and 198 related to environmental assessment (Buckwell *et al.*, 2014).

Integration of economic, social, and environmental dimensions is crucial to achieving sustainable development (ESCAP and Scientific, 2015). According to Sulewski et al, this approach is important, because a long-term development of one subsystem is somewhat dependent on the others. According to them, economic and ecological components should be considered together, including their interplay, because finally they constitute one system (Sulewski *et al.*, 2018). A similar view is represented by Bardy et al, (Bardy *et al.*, 2015). Sadok et al. (Sadok *et al.*, 2008) point to a similar problem, highlighting that in order to assess sustainability realistically, we need "the integration of diverse information concerning economic, social and environmental objectives; and the handling of conflicting aspects of these objectives as a function of the views and opinions of the individuals involved in the assessment process".

2.1.3. Agriculture and Financial behavior

Sustainable agriculture is a practice that meets current and long-term needs for food, fiber and other related needs of society while maximizing net benefits through the conservation of resources to maintain other ecosystem services, functions and long-term human development. Agricultural sustainability is not about technical fixes and expertise. It is development processes that need to

integrate ecological and societal knowledge through changes in policy, institutions and behavior (Boström *et al.*, 2018).

Behavioural Economics has contributed to the agricultural field in one way by focusing on animal species. In this sense, Jung et al. (Jung *et al.*, 2019) study the behaviour of laying hens and the elasticity of demand with respect to certain types of litter (straw and feathers). Huijps et al. (Huijps *et al.*, 2010) explore the sub-optimal economic behavior in the decision-making of Dutch dairy farmers in order to adopt measures to improve udder health, concluding that the low rate of adoption and of following the advice of the dairy industry is due to a certain level of inertia in the behavior of the farmers. In order to obtain the desired behaviour, penalties are more effective than bonuses.

Kristensen and Jakobsen (Kristensen and Jakobsen, 2011) identify the role of veterinarians as dairy herd health advisers to farmers, as they have the capacity to translate their knowledge within the farming system. The "irrational" actions of the farmers can be explained as their values, behaviours and risk perception are incorporated in the decision-making process. Instead of assuming that farmers seek to maximise profits, other explanatory factors are included in their utility function, such as animal health, animal welfare or other farmer's recognition. Toma et al. (Toma *et al.*, 2013) focus on the determining factors explaining the biosecurity behaviour of farmers in Great Britain. The results show that the farmer's perceived importance of specific biosecurity strategies is explained through 13 variables including the attitude towards animal well-being and the organic certification of the farm.

Brugere et al. (Brugere *et al.*, 2017) studied aquaculture. The objective of this article is to argue for farmer-based, syndromic surveillance as a way of overcoming the current limitations of the conventional surveillance systems and demonstrate its usefulness in aquaculture. The authors highlight the complex interconnection of behavioural factors (economic and social) underlying farmer's reporting of disease. Another important area of study is the field of management.

Barnes et al. (Barnes *et al.*, 2011) compare the voluntary adoption of water quality management techniques within a Nitrate Vulnerable Zone (NVZ) in Scotland. They find that different behavioural groups can be observed depending on the acceptance of the regulation, the responsibility towards issues related to water pollution and the degree of compliance with the established regulation. The authors indicate that these behaviours recorded by the farmers are explained by a range of attitudinal alignments and should include across designations in order to change social norms.

Mills et al. (Rust *et al.*, 2020) identify the main drivers of farmer's decision-making in relation to environmental management practices that are sustainable over time. They conclude that there is enormous heterogeneity in farmer's beliefs and values in relation to custodianship and productivity. Another area in which behavioural economics has been significant in agriculture is in the field of development. Datta and Mullainathan (Datta and Mullainathan, 2014) conduct a review of human behaviour and its application to development policy. Through behavioural economics, they indicate the principal pitfalls faced by policymakers in developing countries when seeking to design effective policies for these problems. Specifically, they use as a case study of agricultural policy the intervention made to promote the use of fertilizers among farmers in Sub-Saharan Africa.

Brune et al. (Brune *et al.*, 2016) studied the use of policy intervention through savings accounts for the case of developing countries in order to increase the use of agricultural inputs by households. An experiment was carried out in Malawi among cash crop farm households. The results show that offering savings accounts increases the number of bank transactions, but also has a significant and positive effect on measures of household well-being. Another framework that has received particular interest is economic policy. Bishop et al. (Bishop *et al.*, 2010) studied the attitudes towards adopting new

technology in dairy farms. They examined the behaviour, motivations and intentions of the potential adopter. An important implication is that it could be beneficial for decision-makers to guide the policies previously targeting different types of agents.

Pedersen et al. (Pedersen *et al.*, 2012) question whether the search for profit is the only goal, as assumed by traditional economic theory, or whether there are other factors that explain decision-making as suggested by behavioural economics. They research the effectiveness of incentive-based environmental policies. The results reveal two groups that are differentiated in terms of the use of pesticides: there are farmers who are more interested in maximising profits and others who focus more on land yields and who are less sensitive to the implementation of exclusively economic policy instruments.

Clarke and Grenham (Clarke and Grenham, 2013) study micro-insurance markets and their protection against catastrophes. Taking into consideration issues of supply and demand, aspects such as climate change and the associated risks are contemplated, which are typically covered by this type of insurance. In order to increase the demand for acquiring disaster insurance, governments should promote it, maybe using subsidies, with a commitment to limit the subsequent post-disaster financial assistance given to the uninsured. Lusk (Lusk and Tonsor, 2021) highlights the importance of the findings generated by BEA, revealing that the behaviour of the subjects is not consistent with the results of classic economic theory. However, he also indicates that Behavioural Economics cannot be used to justify all market failures. This is because consumers suffer from cognitive biases and, therefore, governments must act in a paternalistic way to conduct policy interventions.

Kuhfuss et al. (Kuhfuss *et al.*, 2019), continue studying the AESs. In order to improve the participation of the farmers and increase land enrolment for lower overall budgetary cost, they contemplate the implementation of a conditional collective bonus. This bonus would be paid in addition to the usual AES payment if a given threshold is reached in terms of farmers' participation. The authors show that these bonuses increase expectations of farmers on others' participation, therefore favouring a change towards a pro-environmental social norm and the adoption of less pesticide-intensive farming practices.

Bonfante (Bonfante *et al.*, 2020) studied how, despite a commitment made by 195 countries of the United Nations when they signed the Sustainable Development Goals (SDGs) in 2015 and the research existing in this respect, the soil–water–plant–climate system still poses basic problems regarding soil behaviour that have yet to be resolved. It is necessary to share more information in order to be able to link the existing research with stakeholders and policy-makers. This is even more the case with the information revolution which affects the attitudes of increasingly critical stakeholders, making it difficult to discern between irrelevant and relevant information on the internet and social media. Another field of study is related to policies referring to food production, food consumption and food security.

CONCLUSION

Agriculture, which can continuously provide food and other resources to the world's growing population, is vital to human existence and therefore to any human activity. However, many problems threaten the ability of agriculture to meet human needs now and in the future, including climate change. High rate of biodiversity loss; Land degradation through soil erosion, compaction, salinization and

pollution; Reduction and pollution of water resources; Increase production costs; The number of farms is declining and in connection with that poverty and declining rural population. Sustainable agriculture is defined as a commitment to meet the nutritional and human fiber needs and improve the quality of life of farmers and society as a whole, now and in the future. Sustainable agricultural development can help governments to control the economy because sustainability contains three dimensions, one of which is economic. So to achieve a better and more manageable economy, they can focus on it, and by increasing control over it, they can avoid future failures and crises.

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