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Factors influencing the adoption of agro-ecological innovations by farmers in Bosnia and Hercegovina

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Author: Bc. Hana Gablerová

Chief supervisor: prof. Ing. Jan Banout, Ph.D.

Declaration

I hereby declare that I have done this thesis entitled "Factors Influencing the Adoption of Agro-ecological Innovations by Farmers in Bosnia and Hercegovina" independently, all texts in this thesis are original, and all the sources have been quoted and acknowledged by means of complete references and according to Citation rules of the FTA.

In Prague 22 April 2023

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Hana Gablerová

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Abstract

Agriculture plays an important role in rural areas of Bosnia and Herzegovina, but the sector faces numerous challenges as low overall production and productivity, therefore providing suitable conditions for the intensification of agriculture by using the means of sustainable innovations. Sustainable practices play an important role in improving farm productivity, ensuring food security as well as reducing the environmental risks of conventional agriculture. This thesis was focused on factors influencing the adoption of agroecological practices and farmers' attitudes towards organic agriculture. We found out that various socioeconomic factors influence the adoption of reduced tillage (off-farm income, land ownership and organic certification). Farmers in Bosnia and Herzegovina perceived the environmental benefits of organic agriculture but had a negative attitude towards the additional cost of inputs and lower yields. However, the adoption of sustainable ecological practices is a complex decision.

Key words: sustainable practices, organic agriculture, Western Balkan, small-holder farmer

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BiH – Bosnia and Herzegovina

OA – Organic Agriculture

SAP – Sustainable Agricultural Practices

1. Introduction and Literature Review

The world's agriculture and food systems are not presently delivering desirable food security and nutrition outcomes. There is consensus that global transformation of the food system is needed at multiple levels to meet the challenges of persistent malnutrition, rural poverty, and growing consequences of climatic change and alarming loss of biodiversity (FAO, 2014; IPBES, 2019).

World food demand forecasts predicted that the global population needs double the current food production by the year 2050 (Ridley & Hill, 2018; Sayer & Cassman, 2013). Globally, the food production system is facing unprecedented challenges (Cassman & Grassini, 2020). Achieving global food security becomes increasingly challenging and presents a huge logistical and technological challenge for the world, given the nature of global food production and the demands of an ever-growing world population. On the consumer side, the population grows and changes its consumption patterns. On the production side, increasing food production is limited by land availability for agricultural expansion and trade-offs related to intensification. The growing food demand, shifts in climatic patterns, and degradation of natural resource bases are increasingly stressing global food security (A. Smith et al., 2017). Moreover, it is increasingly recognized that, in a human-dominated world, people and nature are interdependent, and their demands must be tackled simultaneously (Mace, 2014). An increase in agricultural productivity is reliant on innovation, which is necessary to increase agricultural productivity and the quality of produce (Biswas et al., 2014; Ridley & Hill, 2018).

During the green revolution, innovation such as fertilizers, pesticides and herbicides, mechanization, and nowadays, digitalization has been used for the intensification of agriculture, but intensification brought new challenges for the farmers and for the conservation of the ecosystems (Biswas et al., 2014; Ridley & Hill, 2018). Intensification is often attained at the expense of environmental integrity; for example, irrigation and fertilization drive water scarcity (Scherer & Pfister, 2016), eutrophication, and acidification (Tian & Niu, 2015). Despite the intensification of agriculture during the past decades, there are still yield gaps in many parts of the world that could be closed (Mueller et al., 2012; Pradhan et al., 2015; Yu et al., 2017).

Some scholars see the intensification and environmental sustainability as contractionary (Garnett et al., 2013), but consequently, many sciences emphasise the need for sustainable intensification of agriculture (J. A. Foley et al., 2011; Godfray et al., 2010; Petersen & Snapp, 2015; Pretty et al., 2018; A. Smith et al., 2017; P. Smith, 2013). Environmentally sustainable intensification, known as well as ecological or green innovation, is investigated means to ensure food security while mitigating negative consequences for the environment and has captured significant interest from academia and industry due to increasing stakeholder pressures and consumer awareness around green products. (Tseng et al., 2013).

Sustainable practices and innovation play an important role in improving farm productivity, food security and enhancing economic growth (Kassie et al., 2013; Teklewold et al., 2013) as well as reducing the risk of drought and water shortage, reducing erosion, maintaining biodiversity and improving soil fertility (K. M. Foley, 2013; Price & Leviston, 2014; Wauters & Mathijs, 2014; Yazdanpanah et al., 2014). In addition, sustainable practices can involve reducing the use of inputs that are potentially harmful to the environment or a shift towards more locally available resources while maintaining the competitiveness and economic viability of agriculture (Yazdanpanah et al., 2014).

The existing literature reports that sustainable practices have supported many communities in refining their resources and enhancing production, but the diffusion is still lower than the desired levels, mainly in developing countries (Jat et al., 2019; Mango et al., 2017). Multiple authors have investigated the reasons for the low adoption rates. Those studies associate the adoption with various factors such as demographic variables, farm-location characteristics, financial resources and information access. (Kassie et al., 2013; Kotu et al., 2017; Teklewold et al., 2013) Certainly, the results from previous studies are inconstant and vary from location to location (Mungai et al., 2016).

A pathway out of rural poverty is through improving productivity, profitability and sustainability of smallholder farming systems (Wegren & O'Brien, 2018). Scientific evidence from specific geographical and social contexts is needed to inform the implementation of effective instruments targeting vulnerable smallholder farmers. Despite the extensive literature devoted to this topic, extension agencies and policymakers continue to struggle to understand what motivates and influences farmers to adopt or reject the integration of new technologies into their farming systems. Pathways to sustainable intensification can be diverse and must be adapted to the location and context (Garnett et al., 2013).

In the past decade, the impact of climate change has been particularly evident in Bosnia and Herzegovina with the repeated occurrence of extreme events. These extremes directly triggered a decline in field crop yields, which caused significant economic damage and social and political disputes. Accordingly, adaptation strategies are needed to respond to the challenges imposed by climate change, considering specific soil and climate characteristics and local peculiarities of agricultural systems (Stricevic et al., 2017). Climate change leads to adaptation among farmers and their agricultural production in the affected areas. However, adaptation does not occur independently but rather as a process influenced by socio-economic, political, cultural, geographical, ecological and institutional factors (Eriksen et al., 2011).

Bosnian agriculture needs a profound transformation to achieve both food security and food system sustainability (Luketina et al., 2018). There are enough opportunities for the growth and intensification of agriculture by using the means of "sustainable or eco-friendly" innovations. However, despite the fact and the potential, agriculture in BiH is facing many constraints to growth, and farmers are vulnerable to climate change.

1.1. Sustainable agricultural practices

Sustaining agricultural productivity and food security depend on quality and availability of natural resources. Sustainable agricultural practices (SAP) use existing soil nutrient and water cycles and naturally occurring energy flow for food production and help to improve farming productivity with small negative effect on the environment. Sustainable agricultural practices (SAP) can be broadly defined as an agricultural system that involves practices that simultaneously promote productivity and sustainability (Adnan et al., 2017a; Zeweld et al., 2017). More specifically, according to Food and Agriculture Organization (FAO, 2017), the concept of SAP refers to environmentally non-degrading, socially acceptable, resource conserving, economically viable and technically appropriate practices.

These practices aim at producing sufficient amount of food while enhancing ecosystem service and ecological processes instead of using external inputs (Bezner Kerr et al., 2021; Wezel et al., 2014), while maintaining the ecological integrity of farming system (Kleijn et al., 2019; Tamburini et al., 2020). Agroecological systems can rely on biological and ecological processes, ecosystem services and traditional knowledge rather than on inputs (Bretagnolle et al., 2018; Wezel et al., 2014). These practices contribute to increasing yields, farm income, biological diversity, improving soil fertility and sequestering carbon (Manda et al., 2016; Cariola et al., 2020; Lemeilleur et al., 2020). Therefore, they offer a potential solution to global challenges including growing population, climate change and degradation of natural resources.

Most of the methods may be classified into five farming categories. The first category are practices associated with pests control, primarily concerned with avoiding the use of pesticides and herbicides to maintain soil resilience, biodiversity and maintain the natural environment (Dara, 2019). The second group focuses on techniques that replace ploughing or eradicating tillage to preserve original soil structure and quality (Sims & Kienzle, 2017). When soil disturbance is minimized, the natural cover is being kept on the soil's surface, cover crops can be used to maximize the crops yields. The third set of techniques is directly connected o nutrient management with no additional sources of nutrients. The fourth category mix plant with trees or livestock to produce more natural nutrient flows and energy cycles and the last group practices is concerned with soil and water to avoid wind and water erosion (López-Vicente & Wu, 2019). It has been claimed that agroecology can generate more stable farmer income, also because of more resilient soils and farming systems (Erisman et al., 2016) .

The most important sustainable practices concepts are conservation agriculture, good agricultural practices (GAP), permaculture, sustainable intensification and organic farming. The acceptance of new agricultural techniques among farmers has been a subject of scientific research since the 1950s (Manzano Lepe, 2016). .

There are several visions of what makes an agricultural system sustainable (Koohafkan, Altieri et al. 2011, Cook, Silici et al. 2015) and there is still debate as to what extent a given agricultural practice is sustainable (Pretty 2008)

1.1.1. Agroecological practices in this study

Agro-ecological practices and farming practices in general overlaps in different concepts such as sustainable intensification, ecological agriculture, conservation agriculture, precision farming and organic agriculture. Some shared measures and themes include zero tillage, crop rotation, cover cropping, intercropping, organic fertilizers, and natural pest control. The specific practices used in this study are briefly described in this chapter, but it is important to take in the consideration that the optimalization of agroecological principles and adoption of practices depends on the type of agricultural activity involved, climate conditions, soil characteristic, intensity of farming and socio-economic contexts (Gliessman, 2016; Therond et al., 2017; Wezel et al., 2014).

1.1.1.1. Intercropping

Intercropping, sometimes termed as a polyculture or mixed cropping can be described as a cultivation of two or more crop species which coexist for a significant part of the crop cycle (Anil et al., 1998). In general, intercropping is comprised of the main crop and one or more companion crops, where the production of the main crop is the prime goal. Various types of plants species can be included in intercropping, for example: cereals, legumes, oilseeds, fodder crops.

Intercropping is a traditional practice know from ancient periods and has been documented in different parts of the planet. It is observed that intercropping began disappearing from many areas with the advent of modern industrial agriculture and monoculture became popular and widely used in many areas. This drift was motivated by the use of high energy inputs, improved farm machinery and specialization and these were considered as the prime strategy for enhancing crop yield. However, intensive agricultural monocultures are also associated increased risk of crop pest and disease outbreaks, soil degradation, and environmental pollution (FAO, 2019; Rockström et al., 2017).

Recent analyses have suggested that nations with higher species diversity tend to have greater year-to-year stability of total national agricultural yields (Renard & Tilman, 2019). Intercropping can produce greater yields and decrease the land area required to produce a given amount of food (Li et al., 2020), therefore can lead to reduction of deforestation and its associated greenhouse gas emission caused by agricultural expansion (Jayathilake et al., 2021; Kirschbaum et al., 2013).

Efficient use of plant species can optimize space and yields; for example use of plants species with compatible solar radiation requirements; shade tolerant plant can grow beneath shade-intolerant crop (T. Zhou et al., 2019). Similarly, plants with different root structures can use space more efficiently by exploring different soil layers to extract water and nutrients (Brooker et al., 2015). Efficient use of space leads generally leads to lower weed pressure and lighter weed management requirements (Verret et al., 2017).

Intercropping systems have a great potential in reduction of intensive inputs (Jensen et al., 2020; Tang et al., 2021), stabilization of production (Paut et al., 2020), can protect crops from pests (Manasa et al., 2018) and generally reduce the environmental impact of agriculture.

The practice targets better use of available resources, enhancement of intensity and production sustainability (Casagrande et al., 2017). Developing suitable cropping systems is an enormous job for achieving potential yield under any agro-climatic conditions (B. Zhou et al., 2019). However, farmers have concerns about intercropping that limit it widespread adoption and are particularly deterred by risk of failure and cost of implementation (Arbuckle & Roesch-McNally, 2015; Roesch-Mcnally, 2018). This farming practice offer the ability to grow different variety crop, maintain production and efficient use of resources and less change of crop damage by pest and diseases (Verret et al., 2017).

1.1.1.2. Reduced tillage

The basic function of tillage is to control weeds and provide a suitable seedbed for germination and development (Casagrande et al., 2016). Soil degradation is one of the main challenges to maintaining soil quality. The primary soil degradation processes such a soil erosion or the loss of matter in the soil, are strongly associated with tillage systems. Reduced tillage (conservation tillage) or no -till systems (non-inversion tillage) are sustainable tools in farming to ensures minimum soil disturbances (Carr et al., 2013), prevent soil degradation, enhance water retention capacity (Aziz et al., 2013), increase microbial biomass (Willekens et al., 2014) and improve overall soil health (Aziz et al., 2013). Reduced tillage system can change the soil carbon dynamics compared to conventional tillage and enrich organic carbon in the topsoil (Aziz et al., 2013; Dimassi et al., 2013). Reduced tillage reportedly is up to 60% more profitable than conventional mainly because of cost savings, which more than compensate for the lower yields (Lowry & Brainard, 2019; Mal et al., 2015).

Reduced tillage is not widely applied in organic agriculture, even though can improve soil fertility, which is one of the core ideas of organic agriculture. But there is a one prevailing issue associated. Organically managed soils accumulates more soil organic matter (Gattinger et al., 2012). In addition one of the main issue associated with reduced tillage in the context of organic agriculture is weed management (Bajwa, 2014; Lefèvre et al., 2012). There is still a research gap about the impact of tillage practices in organic farming systems (Bogunovic et al., 2020).

1.1.1.3. Organic fertilizers

Organic fertilizers are naturally available mineral sources, comprised of variety of plant material and animal manure, which are capable to reduce problems associated with synthetic fertilizers and maintain soil fertility. They gradually release nutrients into soil and maintain nutrient balance and act as an effective energy source for soul microbes, while minimising climate change impact (Dalgaard et al., 2011; Rigby et al., 2016; Roy et al., 2011; Sommer et al., 2013). These fertilizers can be broadly classified into three categories: animal-based farmyard manure, green manures and compost based on plant sources and sewage sludge and organic household wastes.

The application of compost or manure enhances numerous indicators of soil health (Gaudin et al., 2015), such as organic matter and soil microbial community composition and activity (Francioli et al., 2016), but their use and adoption is facing numerous challenges. One of the main problem is the labour requirement (Casagrande et al., 2016), when handling with compost can be difficult, especially for women. (Cai et al., 2019).

1.1.1.4. Crop rotation

Crop rotation is an aspect of cropping system in which different kind of crops are grown on the same field in different seasons of years. Planning of crop rotation is the most important decision that every farmer makes. This practice can contribute to climate change mitigation and adaptation of field cropping.

In organic arable crop farming, crop rotation is the most effective agronomic to synthetic pesticides the manipulation of crop sequence to break the life cycle of pests through rotation with crop species belonging to different families is a major lever to strengthen robustness of cropping and farming systems (Tamburini et al., 2020). Diversified crop rotations reduce yield loss and the risk of crop failure under climatic stresses, as well as increase yields during more productive growing conditions (Bowles et al., 2020). Crop rotations can also limit the frequency and severity of pest outbreaks, support more diverse soil biota and enhance nutrient cycling, among other benefits.

1.1.1.5. Cover cropping

The cultivation of cover crops provide both direct and indirect benefits (Peltonen-Sainio et al., 2022). The use of a cover crop between two cash crops brings together soil cover as a living crop or a dead mulch and ensures diversification of the crop rotation.

Cultivation of cover crops is a multifunctional agronomic measure that both benefit from and support ecosystem services (Blanco-Canqui et al., 2015). Recent research show the benefits of cover crops usage on yields, meta-analyses have compiled quantified data on yields impacts (Blanco-Canqui et al., 2015), carbon sequestration (Jian et al., 2020; Poeplau & Don, 2015), soil water (Garba et al., 2022; Peltonen-Sainio et al., 2022), and nutrient dynamics (Garba et al., 2022; Thapa et al., 2018) and overall enhancement of soil functionality (Kim et al., 2020; Peltonen-Sainio et al., 2022; Thapa et al., 2018). A number one benefit of cover crops in organic agriculture is weed suppression (Osipitan et al., 2018).

1.1.1.6. Mechanical weed control methods

A limited number of naturally sourced herbicides are permitted in organic agriculture; however, they can be uneconomical for field crops. Organic field crop producers, therefore, rely on cultural weed control practices such as longer crop rotations use of competitive cultivars, as well as mechanical weed control methods. (Alba et al., 2020). In general, combining multiple weed control methods provides greater results than using only one method.

Mechanical weed control includes a rotary hoe or a harrow which create shallow soil disturbance. Minimum tillage rotary hoe controls small weed species by flicking them out of the ground, as they begin to emerge from the soil surface (Shirtliffe & Johnson, 2012). Weeds are vulnerable to mechanical control when small in size, until the first true leaf begins to unfold and weeding efficacy declines as weeds develop (Hatcher & Froud-Williams, 2017). Larger weeds may be removed with inter-row cultivation by burying them, digging them out or breaking them apart (Shirtliffe & Johnson, 2012).

1.1.1.7. Non-chemical control of pests and diseases

The chemical pesticides affect the quality of agriculture produces in conventional practices. Dependency on pesticides for the protection of crops is associated with undesirable effects on the environment, health and the sustained efficacy of their use (Barzman et al., 2015). As a response to numerous environmental and health threads of chemical pesticides wide range of non-chemical but direct pest control measures have been developed and promoted, such as soil solarization, pheromone- based mating disruption or biological control, suppressive winter cover crops and pre-emergence cultivation (Barzman et al., 2015). A recent global analysis demonstrated how biological control of pests and diseases can alleviate the food safety and environmental health hazards (Wyckhuys et al., 2020).

Bio fertilizers are the product containing carrier based (solid or liquid) living microorganisms which are agriculturally useful in terms of nitrogen fixation, phosphorus solubilization or nutrient mobilization, and to increase the productivity of the soil and/or crop (National Center of Organic Farming, 1985).

Biological control is a form of pest management that uses one kind of organism to control another. Biological approaches include pheromones used for monitoring pest population and to disrupt mating, sterile insect releases and biopesticides which are made from living organisms or the products of living organisms. Some biopesticide definitions include genetically modified plants or organisms other than plants (Baker et al., 2020).

1.1.2. Organic farming and certification

Sustainable agricultural practices include organic farming, which bans the use of synthetic fertilizers and pesticides. Organic agriculture is not a perfect synonym for sustainable agriculture, but it has proven to be better performing on most sustainability metrics than conventional agriculture (Ponisio et al., 2015). Organic farming is a method of food production using natural substances. It encourages the responsible use of natural resources, the maintenance of biodiversity, animal welfare, water quality and soil fertility. Organic farming also strongly relies on closed on-farm nutrient cycling, including biological nitrogen fixation and crop rotations, to support soil fertility by enhancing soil organic matter content (Lefèvre et al., 2012), and it is defined by the International Federation of Organic Agriculture Movements (IFOAM) as a "production systems that sustain the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions rather than using inputs with adverse effects. Organic Agriculture combines tradition, innovation, and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved". Currently, less than 1 % of the world's farmland is under certified organic agriculture. (IFOAM, 2021).

Benefits associated with the richness of species, nitrogen upgrade and soil fertility, water infiltration, and holding capacity are well known. Still, critiques of the approach define organic farming as a low-output system associated with low agricultural productivity, which cannot respond to the grooving food demands of the growing world's population (Kirchmann et al., 2016).

Organic production is still in progress, and according to FIBL, (2020) report 2018 million producers around the are included. Most producers are located in Asia (47%), followed by Africa (28%), Europe (15%) and Latin America (8%). At the European level, Spain has the most agricultural land under organic production, followed by France and Italy. Bosnia and Herzegovina rank 40th place.

1.1.3. Drivers of adoption of sustainable agricultural practices

In agriculture, sustainable agricultural practices, as a form of innovation, are determined by the advancement of society. Organic agriculture is not only a new form of farming. It is a social innovation aiming to change patterns in the relationship between the community and the environment. Some farmers will apply innovative solutions faster than their counterparts. The speed of their adoption is determined by the farmers themselves. The combination of factors ranges from basic demographic (age, fender, education etc.) to economics (profits, cost, capital etc.) (González-Chang et al., 2020; Rodríguez-Entrena et al., 2014).

Essential characteristics include farmers' attitudes towards the environment, sustainability and climate change, and human health, as well as their perception of their knowledge and future risks (Stephenson et al., 2017). Attitudes are formed by what an individual perceives to be true about the attitude-object. This perception may or may not be based upon information and knowledge and an emotional reaction towards the object. Personals motives are factors that influence behaviour and attitudes towards behaviour and subjective norms. Such motivations are rooted in farmers' judgment of the attributes of organic farming and the belief that organic agriculture would meet their expectations (Han et al., 2021). Farmers' motivation to adopt agroecological farming practices include environmental concerns about land protection and biodiversity, animal welfare, public health and public interest of rural communities, lifestyle choices, happiness and quality of life (Kvakkestad et al., 2015; Stephenson et al., 2017; Vlahovic et al., 2015) Eternal motivations commonly includes farm viability, profit maximization and regulations. (Bodiroga, 2017; Brédif et al., 2017; Kvakkestad et al., 2015)

One of the basic motives of the agricultural producers when switching to organic production is economic profitability which depends on several factors, such as: production extent, production costs, finished product prices, technical and technological equipment, marketing development and presence of subsidies and government support (Bodiroga, 2017). Padilla Bravo et al. (2012) found out that the perceived improvement of farm income due to the transformation to organic production shows a significant influence on farmer' satisfaction. Significant economic drivers of adoption included access to agricultural loans, off-farm income, farmer organizational membership, farm size and household labour resources (Mutyasira et al., 2018).

Existing research on farmers' organic adoption behaviour has been conducted in numerous countries United States (Veldstra et al., 2014), Ireland (Läpple & Kelley, 2013), Syria (Issa & Hamm, 2017), India (Dr. Suresh Patidar, 2015), Sri Lanka (Herath & Wijekoon, 2013) and have been examined by applying diverse adoption theories;

Theory of Reasoned Action, Theory of Planned Behaviour (Azejn, 1980)and The technology acceptance model (Davis, 1985). Regardless of the theory, current research shows increasing evidence of the vital role of farmers' perception in adopting and disseminating sustainable agricultural technologies(Herath & Wijekoon, 2013; Padilla Bravo et al., 2012). Nevertheless, the wide range of studies on the farmers' attitudes also indicates that it is still challenging to understand the concept of innovation adoption completely.

1.2. Agriculture in Bosnia and Herzegovina

Bosnia and Herzegovina (BiH) is a country in Southeast Europe, in the western Balkan region, surrounded by three neighbouring countries – the Republic of Croatia, the Republic of Serbia and the Republic of Montenegro. The political and administrative constitution of BiH is complex, and it is divided into three entities the Federation of Bosnia and Herzegovina, Respublika Srpska and Brčko District. (Matavulj, 2022). This complex political and governance structure also has a significant impact on management and capacity in the agricultural sector, which is influenced by different regulations at different levels with overlapping legislation and limited capacities and communication channel, as well as a lack of clear vision (Zurovec et al., 2015).

Figure 1: Bosnia and Herzegovina

Bosnia and Herzegovina is situated between the northern subtropical and northern temperate climate zones. As part of the general circulation of the atmosphere over the Balkans, there are frequent shifts of tropical air and heat weaves during the summer and the inflow of artic air during winter. The county is divided by mountain relief which splits the country into three different climatic types. In high mountains, depending on the altitude, mountain climate occurs (UNFCCC, 2013). The most widespread is a moderately warm and humid climate in the northern part of the country, which provide favourable condition for agriculture; therefore, food industry has great economic importance in the region. Finally, a Mediterranean climate which is characterized by dry summers and rainy and mild winters is present in the southwestern part of the country (Matavulj, 2022).

Bosnia and Herzegovina (BiH) is predominantly a rural country in the process of transition to a market economy, and agriculture plays an essential socio-economic role in rural areas of the country. The rural population in Bosnia and Herzegovina accounts for 61%, and almost half is engaged in agriculture (Luketina et al., 2018), which makes BiH one of the most rural countries in Europe. Only Montenegro (95%), Ireland (72%) and Finland (61%) have a higher share of the rural population (UNDP, 2013).

Poverty rates in the country are high and account for 20%, with clear differences in rural and urban areas. (Agency for Statistics of Bosnia and Herzegovina, 2016). Poverty in BH is predominantly a rural phenomenon—close to 80% of the total poor live in the rural areas (UNDP, 2013). Around 20% of the rural population suffers chronic material deprivation, and 25% is at risk of falling into material poverty, with 25% in-work-poverty; besides, there is a marked rural-urban divide, with 11% urban poverty rate (Daneilsson, 2015; Obradović et al., 2019).

Bosnia and Herzegovina is characterised by a dual agro-food regime, i.e. traditional farming and intensive agriculture (Luketina et al., 2018). The economic importance of agriculture shows in its contribution to the gross domestic product (6.4% in 2016) and the high number of people employed in agriculture (19.2% in 2016) (The World Bank Group, 2017). The domestic sector, with the available and productive natural resources, is dominated by fruits and vegetable production; the mostly crown cash crop is corn, followed by wheat and potatoes.

BiH has abundant natural resources, rich biodiversity, and favourable conditions for agriculture, but it is faced with numerous challenges: slow progress of structural reforms, low competitiveness, technological backwardness and intense depopulation (Bogdanov et al., 2015). Low investments and low overall production and productivity involve rather extensive farming practices and technologies and production carried out on small and fragmented farms (Zurovec et al., 2015). The level of technological and marketing knowledge among producers is low, which certainly has a negative effect on the productivity of the sector. Furthermore, the high share of the rural population and their dependence on agriculture leaves this population considerably vulnerable to climate change because of their livelihood options (UNDP, 2013; Žurovec et al., 2017). Shift in terms of improving productivity are evident, but these processes are very slow (Žurovec et al., 2017).

1.2.1. The Organic sector in Bosnia and Herzegovina

In accordance with the legal norms of BiH, organic production is defined as the production using the methods of organic production in all stages of the production chain, from agricultural production to transportation ad trade. In the system of organic production, the producers must apply relevant regulations, and the final product must be organically certified by one of the control bodies, Organic Control (OK) and Organic Control System (OCS). In BiH, the organic agricultural production is mainly developed in the plant sector, specifically in the production of medical plants, forest fruits and mushrooms and the distillation of essential oils. The area under organic production in BiH is 1 692 ha which is 0,1% of all agricultural land in the country (Matavulj, 2022). In comparison, Albania 550 ha, Serbia 13 423 ha, Macedonia 2 900 ha, and Montenegro 2797 ha (Zhllima et al., 2021).

The history of organic agriculture in BiH begins in the mid-90s of the last century (Nikolić, 2006). Between 2001 and 2005, the project Development of Organic Agriculture in Bosnia and Herzegovina was implemented by the Swedish International Development Cooperation Agency (SIDA), which enabled further progress in the development of organic farming and the adoption of organic practices among farmers, in 2009 the Association of Organic Producers of Federation of Bosnia and Herzegovina was founded. In 2022, the Ministry of Agriculture, Forestry and Water Management of the Respublika Srpska established the Department of Organic Production (Matavulj, 2022).

Bosnia and Herzegovina do not have legal regulations on organic production at the state level. Jurisdictions in the agriculture sector belong to the entities and the Brčko District. The first legal regulation of organic agriculture in Bosnia and Herzegovina was achieved in 2004 with the adoption of the Law on Organic Food Production in the Republika Srpska (Official Gazette of RS No. 75 / 04). In 2013 new Law on Organic Production, which was adopted (Official Gazette of RS No. 12 / 13) to define the goals, principles, and rules of organic production more clearly. The legislative framework in the Federation of Bosnia and Herzegovina did not follow the development of organic agricultural production, and the Law on Agricultural Organic Production of the Federation of Bosnia and Herzegovina was adopted later in the year 2016 (Matavulj, 2022).

1.2.2. Organic farming in Western Balkans Countries

Western Balkan countries—Serbia, Montenegro, Bosnia and Herzegovina, and Croatia, being a part of the Former Yugoslavia before, show very similar and shallow assessments for organic sector development. The Balkan region still suffers the consequences of the transition period in national economies and lagging behind other European countries. With the exception of Croatia, organic farming is still underdeveloped, and its production is mainly destined for export (Arabska, 2014).

1.2.2.1. Croatia

In Croatia, the organic product marker is still significantly underdeveloped. From 2010 to 2016, organic food production increased from 16,000 to 91,000 ha (Pavlic 2016). But after accession to the EU, the organic sector has grown more rapidly (Malek et al., 2019). The country has been labelled as one of the countries where land under organic farming has been growing faster than in other EU-membered countries (Lenz & Neumann, 2022). The country has great potential for organic agriculture, and the geographical location provides access to numerous natural resources. The ecological production in Croatia is centred around small-scale farmers and family farms, and the products are sold directly to consumers and in a few specialised retail stores (Gajdi´c et al., 2018). Organic production of permanent crops is dominated by grapes (40%), followed by apples and olives. In organic husbandry, the most important is sheep and cattle breeding (Lenz & Neumann, 2022).

1.2.2.2. Serbia

Serbia has a long tradition in agricultural production and the necessary knowledge of agrarian producers, and favourable natural resources, all providing excellent opportunities for the growth of the organic sector (Roljevic et al. 2017). However, the transition period during the 1990s negatively affected the entire agricultural production in Serbia, both organic and conventional (Roljević et al., 2009). Therefore, similar to developing countries, in Serbia, interest in organic production is primarily driven by economic characteristics. And in the last years, organic production in Serbia has had an upward trend and represents an opportunity for small-scale family holdings to provide economic sustainability through value-added production. (Ilić-Kosanović et al., 2019).

Organic food production in Serbia is low, although there is room for expansion. In 2014, 1281 producers were cultivating 9548 ha of organic agricultural land (Vehapi and Doli´canin, 2016); furthermore, the organic sector in the country is still increasing. In 2020 Serbia participated with the share of 7.9 % of the total imported volumes of fruits (excluding citrus and tropical fruit) into the EU market, and from 2020 number of farmers increased by 3.4 % while areas under organic production increased by 12.2 % (Milovanović Kešelj, 2022)

In Serbia, fruit, cereals, and fodder plants are mostly grown according to the principles of organic production. The most prevalent is organic arable production (57%), followed by fruit production (33.5%) (Ilić-Kosanović et al., 2019).

1.2.2.3. Montenegro

Agriculture in Montenegro is in line with the principles of sustainable development; in that view, organic farming plays a vital role (Bataković & Matavulj, 2022). The organic sector in Montenegro is small-scale and carried mainly through family farms. The organic agricultural land of Montenegro was 4753 ha, which is 1.8% of the total cultivated area in 2019, from which arable land vas 319 ha and 509 ha under perennial 509 ha (FIBL, 2020). Livestock production is carried out only by 64 producers (Bataković & Matavulj, 2022).

In recent years, interest in organic production in the country has been growing, but still, the sector's development is lacking behind the desired level. Montenegro Agriculture Sector and Strategy and Action plan emphasized the limitation of the county’s capacity to compete in an international market (Bataković & Matavulj, 2022).

2. Aims of the Thesis

Main objectives

The main objective of the thesis was to determine factors influencing the adoption of agro- ecological technologies and the farmer perception on organic agriculture in Bosnia and Herzegovina.

Specific objectives

1. Examining the agroecological principles farmers use at their farm and they reason behind usage of those technologies.
2. Understanding farmers' perception of organic agriculture and their prejudices towards organic agriculture.
3. Identification of which demographic and socio-economic factors are influencing the adoption of farm techniques and the perception on organic certification.

3. Methods

3.1. Data collection

3.1.1. Primary data collection

Primary data were collected from September 2022 to January 2023, partially on-site via in-person interviews conducted with the cooperation of the local university. A pilot test for the questionnaire was conducted during the first two weeks of the research to test and adjust formatting and the translation of the questionnaire according to the local condition. (see appendic) At the beginning of the research, the key informants from the Agricultural University of Mostar provided a list of target respondents to begin the research with. The farmers visited their farms, where the questionnaire was conducted together with personal observation of their farms. Respondents were then asked for the referral to other farmers in their network who fit the target profile (small-scale farmers). Random sampling methods were used. Some of the respondents were known by the students at the university or were found on local online markets and forums.

At the end of the data collection, 50 farmers were interviewed in the local language or English.

3.1.2. Design of the questionnaire

The questionnaire was developed based on a previous literature review of a scientific article with the same or similar objectives from a different location. The survey was created in coordination with the thesis supervisor and professors from CZU and the University of Mostar in order to achieve the objectives of the study. A total of 25 questions were designed, which varied by type. (open and closed questions, dichotomous and continuous Likert scale).

The questionnaire was divided into three parts. The first part's objectives were to determine whether farmers use a specific farm technology and what is the reason behind the adoption or non-adoption of the technology (intercropping, crop rotation, cover cropping, reduced tillage, mechanical weeding, synthetic fertilizers, organic fertilizers, chemical pesticides treatments, non-chemical control of pests and diseases and chemical herbicides). In the second part of the questionnaire, farmers were given 21 statements about organic agriculture with the Likert scale (disagree, somehow disagree, neutral, somehow agree, agree) to determine their perception of organic farming certification. Finally, the third part of the questionnaire included 14 questions about household and farm characteristics, for example, gender, age, education, farm size, and market.

3.1.3. Site Area Description

The Survey was conducted in Bosnia and Herzegovina, Bosnia and Herzegovina (51197 km2), a country situated in the western Balkan Peninsula of Europe, with 3 neighbouring countries; Croatia, the Republic of Serbia and the Republic of Montenegro. BiH is divided into three entities the Federation of Bosnia and Herzegovina, Respublika Srpska and Brčko District, which are divided into ten cantons. Therefore, the agricultural sector in the county is influenced by political structure and different regulations. This study was conducted in three cantons of the Federation of Bosnia and Herzegovina, namely Herzegovina – Neretva Canton, West Herzegovina Canton and Sarajevo Canton (see Figure 2).

The West Herzegovina Canton (1.363 km2) is in the southwest of Bosnia and Herzegovina in the Herzegovina region. The central municipalities are Široki Brijeg, Grude, Ljubuški and Posušje. The canton is primarily mountainous, with a sub-Mediterranean climate.

The Herzegovina- Neretva Canton (4,401 km2), with the city of Mostar as its administrative centre, includes mainly the Neretva River valley area, and it is the only canton with access to the sea. This canton splits into multiple municipalities (Čapljina, Čitluk, Jablanica, Konjic, Mostar, Neum, Ravno and Stolac). The total population of the canton is 222 000 people.

The Sarajevo Canton (1,276.9 km2) is located almost in the centre of Bosnia and Herzegovina, and its cantonal seats are in the capital city of the country Sarajevo. This canton has a predominantly continental climate, lying between the climate zones of central Europe to the North and the Mediterranean to the South.

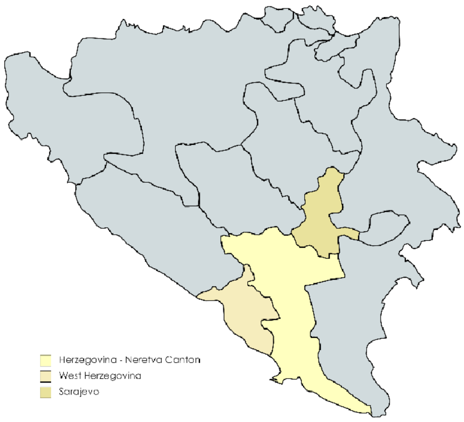

Figure 2: Site Area

3.2. Data analysis

The data were coded into Microsoft Excel, which was used for the descriptive statistic. To analyse factors influencing the adoption of specific technologies program Statictica version 14.0.0.15 was used.

3.2.1. Descriptive statistic

Descriptive statistics were used in the first and second stages, including frequency units and percentages. Firstly, to describe general sample characteristics at the farmer and farm level, as well as insights into the various information sources and other social factors measured by the questionnaire. The second part of the data analysis was to analyse the farmers' perception of organic agriculture and organic certification. This was assessed by asking respondents to indicate their opinion on 18 statements, of which nine were negative and 8 of them positive statements. Their responses were recorded on a five-point Likert scale of Strongly disagree (1), Disagree (2), Neutral (3), Agree (4) and Strongly Agree (5).

The descriptive statistic evaluates the frequency of adoption of individual practices, which are further used in the binary logit model to determine which factors influence their adoption.

3.2.2. Binary Logit Model

Whether a farmer adopts or does not adopt technology is an obvious binary decision-making problem. Based on previous research (Muench et al., 2021; Uddin et al., 2014; Ullah et al., 2015), the Binary Logit Model was used to explore which factors affection the usage of the technology (Guo et al., 2022). The basic form of the model is as follows:

$$P_i\,(Y_i = 1) = \frac{e^{x\beta}}{1 + e^{x\beta}}$$

P_i = probability of the occurrence of the adoption

Y_i = 1 if the sustainable practice is adopted by the farmer; Yi = 0 if the practice is not adopted by the farmer.

$$Log\left(\frac{P}{1-P}\right) = B_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \cdots + \beta_n X_n$$

X_i = explanatory variables

β = vector of the parameters

B_0 = constant

The data set used in the study includes both continuous and categorical variables. This model was used for each technology separately. Each practice is dependent (the outcome variable) measured by a dichotomous variable coded (0,1) when 1 represents the adoption (usage) of the technology and 0 is non-adoption. The independent variable (explanatory variable) is divided into the household, and farm attributes factors. The summary of variables is provided in Table 1, and the explanatory variables are further described in the following chapters.

Table 1: Description variables in the Logit Model

Variable	Description of the variable	Code	Type of variable
Certification	Respondent has organic certification or not	Yes = 1 No =0	Dummy
Gender	Gender of the respondent	Female = 1 Male =0	Dummy
Age	Age of the respondent	≤ 30 1 31-40 41-50 51-60 ≥61	Ordinal
Education	The education level of the respondent	Less than elementary level = 1 Elementary to less than high school =2 High school =3 Two years of college =4 University or above = ř	Ordinal
Years of experience	The number farming experience in years	≤ 10 = 1 11-20 = 2 21-30 =3 31-40 =4 ≥41 = 5	Ordinal
Main source of income	Agriculture is a main source of income	Yes = 1 No =0	Dummy
Farm size	Farm size in hectares		Continuous
Land ownership	Agricultural land is mainly owned or rented	Mainly owned = 1, Mainly rented 0	Dummy
Livestock ownership	Respondent owns livestock	Yes = 1 No =0	Dummy
Main crop	Type of dominant crop	1 = Cereals 2 = Fruits 3 = Vegetables 4 =Viticulture 5 = Fodder 6 = Medical and aromatic plants	Ordinal

3.2.2.1. Description of explanatory variables

Previous studies described that the socioeconomic characteristics of the farm household (farm and farmer characteristics) are reliable indications of the predisposition to adopt sustainable farm practices (Kassie et al., 2013; Mugonola et al., 2013; Teklewold et al., 2013).

3.2.2.1.1 Gender

The result of numerous studies considering the effect of gender on the adoption of sustainable practices is inconsistent. Some previous studies suggest that the gender of the farmer has a significant effect on the adoption of some agroecological practices. Several available studies found that female farmers were more likely to adopt sustainable practices than male farmers (Azam & Banumathi, 2015; Kassie et al., 2013; Malá & Malý, 2013; Sriwichailamphan, 2014). The possible explanation is that female farmers are more concerned about the health effects of pesticides (Sriwichailamphan, 2014).

On the contrary, in Zambia, female-headed households are less likely to adopt the most sustainable practices (Abdulai, 2016). The influence of gender on adoption differs by the type of practice. Kpadonou et al., 2017, in their study in West Africa, identified that female-headed households were less likely to adopt organic fertilizers. Pilarova et al., 2018 did not find any differences in the adoption of sustainable practices related to the gender of the respondents, which is consistent with the previous findings in various countries in New Zealand (Fernandez, 2017), Ethiopia (Tesfaye et al., 2014; Zeweld et al., 2018), Kenya (Van Hulst & Posthumus, 2016) and Malaysia (Tey et al., 2014).

In this study, gender was a dichotomous variable (0 = male; 1 = female).

3.2.2.1.2 Education

Education plays an important role in technology adoption in that it enables households to interpret new information and understand the importance as well as benefits of adopting modern agricultural technologies.

Previous studies have focused on identifying the relationships between the level of education among farmers and their adoption of environmentally friendly practices. Research from various countries shows that education is significantly and positively associated with adopting new practices. The positive relationship between education level and environmental conservation behaviour was reported in China (Zhang et al., 2015), the Philippines (Mariano et al., 2012), Malaysia (Tey et al., 2014), Zambia (Manda et al., 2016), India (Azam & Banumathi, 2015), Pakistan (Hafiz Z et al., 2022; Jabbar et al., 2020). Farmers with higher education are typically assumed to be able to process information better and search for innovation much faster than their less educated counterparts (Despotović et al., 2019; Ghimire et al., 2015; Mugonola et al., 2013). On the contrary negative correlation was found in the adoption of mulching, but these results may be linked to the knowledge of using other practices rather than mulching (Kpadonou et al., 2017).

In some studies, no significant relationship has been found between the level of education and the adoption of environmentally friendly practices (Kunzekweguta et al., 2017; Pilarova et al., 2018) as well as the decision to apply modern technology (Abdulai, 2016; Fosso & Nanfosso, 2016; Kassie et al., 2013).

In this study, the factor was categorized into five categories, and each category is assigned a distinct value such as 1=less than the elementary level of education; 2= elementary to less than high school; 3=high school; 4=two years of college; 5=university degree or above.

3.2.2.1.3 Age of the farmers

The literature shows mixed evidence of the age of the farmers on the adoption of sustainable farming practices. Findings from a study conducted in Nepal suggest that age has a highly significant negative impact on practising organic farming (Singh et al., 2015). Similarly, Malá & Malý, 2013 in their study in the Czech Republic, report that the increasing age negatively affects the transition to and implementation of organic production techniques. The reason could be that with increasing age, farmers are less willing to try new technologies because of their diminishing enthusiasm (Singh et al., 2015). Another reason could be that older farmers are not able to handle the higher workload associated with organic farming, especially with some practices which are psychically demanding. This is supported by results showing a negative correlation in the adoption of organic fertilizers (Folefack, 2015; Paul et al., 2017). It is possible that younger farmers have more opportunities to access organic farming technology and are more open to innovation than older farmers (Malá & Malý, 2013). On the contrary, Wollni & Andersson, 2014 found that older farmers are more likely to adopt organic agricultural practices.

In this study, the age of the farmers was a categorical/ordinal variable where 1= less than 30 years old; 2= 31-40 years old; 3 = 41-50 years old; 4= 51-60 years old; 5= more than 60 years old.

3.2.2.1.4 Farm size

Farm size is one of the factors influencing adoption tested in most of the studies. Baumgart-Getz et al. (2012), in their meta-analysis of relevant literature, concluded that farm size has a relatively large impact on the adoption of sustainable practices. The farm size is an important measure of household wealth and can therefore influence the household decision-making process (Jabbar et al., 2020).

Numerous articles found a negative association between farm size and the adoption of organic or sustainable technologies in the Czech Republic (Malá & Malý, 2013), Serbia (Despotović et al., 2019), the United States (Liebert et al., 2022), India (Sriwichailamphan, 2014) and Pakistan (Ullah et al., 2015). It is possible that larger farms are more challenging to manage regarding crop inputs, and farmers have less motivation to cope with new challenges. Furthermore, organic farming needs more intensive labour for the handling of pests and diseases (Liu et al., 2019; Pradhan et al., 2015)

Furthermore, in Brazil, some of the sustainable practices, specifically crop rotation and green fertilizers, were adopted more often on larger farms (Foguesatto & Machado, 2022). These findings are supported by research conducted in Chile (Jara-Rojas et al., 2012), Zimbabwe (Kunzekweguta et al., 2017) and in Pakistan (Jabbar et al., 2020). On the contrary, Hafiz Z et al. (2022) found a negative correlation between the adoption of sustainable practices and farm size among small-scale farmers in Pakistan.

These results indicate that big cotton farmers tend to adopt BCI practices more than small farmers. (Hafiz Z et al., 2022; Jabbar et al., 2020) Pakistan. Farm size has a positive effect in Pakistan (Jabbar et al., 2020). Nave et al. (2013) in their study found that farm size does not have a significant effect on adoption. Similar results were found in Syria (Issa & Hamm, 2017).

Farm size was a continuous variable expressed in hectares.

3.2.2.1.5 Years of farming experience

With more years of farming experience, a farmer deals with more different scenarios and several socks and climatic variations, which can help them to choose the right combination of practices (Kotu et al., 2017). Farmers with longer experience are usually older and less educated; therefore, it is difficult to shift them to the relatively new concept of organic farming. This negative association was found in Nigeria (Adesope et al., 2012), Thailand (Pinthukas, 2015), and Pakistan (Ullah et al., 2015). On the contrary, in Pakistan, several studies found a significant positive relationship between farming experience and the adoption of sustainable technologies in Pakistan (Hafiz Z et al., 2022; Jabbar et al., 2020).

In this study, the farming experience was a categorical (ordinal) explanatory variable categorized into five categories. 1 = less than 10 years of experience; 2 = 11-20 years of experience; 3 = 21-30 years; 4 = 31-40 years; 5= more than 40 years of experience.

3.2.2.1.6 Land ownership

Land ownership has been found to influence the adoption of agricultural technologies (Kamau et al., 2014). Zhllima et al. (2021) found land ownership significantly related to the adoption of organic farming. Farmers who own their land are more likely to adopt organic farming practices. Several studies show consistent results. Households who own their land are more likely to invest and adopt new practices in Zambia (Manda et al., 2016), Tanzania (Kassie et al., 2013) and Ethiopia (Teklewold et al., 2013) and Ghana (Fosu-Mensah et al., 2012). In addition, farmers who own their land are more conscious of erosion and land degradation and apply erosion control measures more often than tenants (Sklenicka et al., 2015). The return on investment in some farming technologies can take longer; therefore, land ownership has a positive effect on the adoption of new and sustainable technologies.

Land ownership in this study was measured as a dichotomous variable, 1 = yes, the respondent owns the land; 0= no, the land is mainly rented.

3.2.2.1.7 Off-farm income

Numerous studies show that access to off-farm income reduces the likelihood of the adoption of sustainable agricultural practices. Manda et al. (2016) found a significant negative effect of off-farm income in Zambia. The relationship between off-farm income and techniques adoption can be negative because off-farm activities divert time and effort away from agricultural activities, reducing investment in technologies and the availability of labour (Mathenge et al., 2015). Belbase (2022) found a difference between the effects of the primary occupation of the farmers on tillage adoption. They found a negative influence on the no-tillage adoption but a positive effect on reduced tillage adoption; therefore, farmers who have agriculture as a main source of income are more likely to adopt reduced tillage.

Nevertheless, Coulibaly et al. (2021), in their study among farmers in Malawi, found that farmers who are mostly engaged in non-farming activities have a better chance of adoption of sustainable fertilizers. This is in agreement with results found in India, where farmers with extra income show higher participation in organic farming activities, and the additional income from off-farm sources is the basis for the adoption of new practices (Sriwichailamphan, 2014). In addition, farmers identifying farming as their main occupation are more likely to participate in environmental strategies (Khanal & Mishra, 2020).

In this study, we focused on whether agriculture is the main source of income for the respondents. The farm income was a dichotomous variable (1 = yes, agriculture was the main source of income; 0 = no; agriculture was not the main source of income.

3.2.2.1.8 Livestock ownership

Some studies described a positive connection between livestock holding and the adoption of agro-ecological practices (Best, 2010), for example, in Pakistan (Mazhar et al., 2021) and Kenya (Jaleta et al., 2013). In addition, keeping livestock on the farm was also an influential factor leading to the adoption of cover crops/ mulches in Malaysia (Tey et al., 2014).

Multiple studies reported the negative impact of livestock ownership on adoption decisions (Läpple & Rensburg, 2011). It appears that most of the farmers keep livestock from a business point of view, as livestock promises high incentives. Thus, they allocate more resources to animals than investing in agro-ecological practices (Jabbar et al., 2020)

In this study, livestock ownership was a dichotomous variable (1 = farmer owns some kind of livestock, 0 = does not have any livestock).

3.2.2.1.9 Type of dominant crop

Adoption of practices dements on the type of agricultural activity involved (Gliessman, 2016; Therond et al., 2017; Wezel et al., 2014). Kaufmann et al. (2011) in

Lithuania stated that farmers who grew arable crops were more likely to convert to organic farming. Some practices are more beneficial than others in relation to the type of crop and the overall farm management (Folefack, 2015).

In this study, the type of dominant crops was categorized into six categories: 1 = Cereals; 2 = Fruits; 3 = Vegetables; 4 = Viticulture; 5 = Fodder; 6 = Medical and aromatic plants.

3.2.2.1.10 Organic certification

To market products as organic, the producer must obtain organic certification. However, nothing prevents farmers from using organic production practices and marketing their products as conventional. Therefore, the decision to be an organic producer can be separated into two parts, a production decision to use organic practices and a marketing decision to certify (Veldstra et al., 2014).

In this study, the organic certification was a dichotomous variable, where 1 = yes, respondents have an organic certification; 0 = no, respondents do not have an organic certification.

4. Results

4.1. Farmer characteristics

A total of 50 farmers participated in this study. The results of the characteristics of the respondents are presented in Table 2. The sample population is made of 62 % male and 38% female. The majority of the respondents were farmers without organic certification (76 %), which includes farmers with different kinds of certification or farmers in the process of obtaining organic certification. The respondent's age groups were classified into five categories: less than 30 years old, 31-40 years, 41-50 years, 51-60 years and farmers older than 60 years. The most represented age group were farmers between 41-50 years (30%), and the minority were farmers younger than 30 (8%). The level of education was also categorised into five categories, where category number one was the category for illiterate farmers. However, any farmers in this category were part of the questionnaire. Generally, the farmers in this study had a high school education or above, and only 10% of the respondents had elementary education. The most represented groups were farmers with hights school education 50%. Moreover, 34% of the respondents had a university degree. The years of farming experience were also categorised, where 40% of the respondents had less than 10-year experience. However, in general, most farmers in this study did not have more than 30 years of farming experience.

For 58 % of farmers in the study, agriculture was the primary source of income, but this result does not avert the possibility of some off-farm job, which is not the primary source of income.

Table 2: Farmer characteristics

Variable	Category	Responses	
		N (=50)	**%**
Organic certification	Yes	12	24%
	No	38	76%
Gender	Male	31	62%
	Female	19	38%
Age	≤ 30	4	8%
	31-40	9	18%
	41-50	15	30%
	51-60	13	26%
	≥61	9	18%
Education	Less than elementary level (Illiterate)	0	0%
	Elementary to less than high school	4	8%
	High school	25	50%
	Two years of college	4	8%
	University or above	17	34%
Agriculture main source of income	Yes 1	29	58%
	No 0	21	42%
Years of experience	≤ 10 (1)	20	40%
	11-20 (2)	13	26%
	21-30 (3)	7	14%
	31-40 (4)	4	8%
	≥41	6	12%

4.2. Farm characteristic

For 58% of the respondents, agriculture was not the main occupation, and they had different off-farm jobs. These results influence the volume of products sold on the market. Not all of the respondents sell all of their produce. Of the 50 respondents, 16% sell less than half of their total farm production. The produce not sold on the market is consumed by the family.

Of the group of respondents, 24 % did some additional processing of their produce (drying, fermentation, juices or jam, wine production Etc.). Their final product can be sold in various ways under a different type of contract with the wholesalers (sort the contract, long the contract Etc.), but 52% of our farmers did not have any contract, and their production was sold directly to consumers on the local market or via internet e-shops.

Nineteen farmers, 38 % of the respondents, focused mainly on fruit production, followed by vegetable farmers (24 %); in addition, farmers with fruit production also grew some kind of vegetables and vice versa. The domination of fruits and vegetables in this study is also visible in the area cultivated in hectares (table 4). In the comparison of cereals, where cereals occupy 28% of the total cultivated area in this study, Fruits and vegetables stand for 40% of the total area cultivated by farmers in the study, with 23% solely for fruits. Cereals are area demanding and were the main crop for eight farmers in this study. A specific kind of production for the area of this study, mainly for small-scale farmers, is the production of medical and aromatic plants, the total area cultivated in this study is 34 ha (15%), and 12% of the farmers have their production focused mainly on this type of crops. Other types of production in this study were fodder (4 % of the farmers) and viticulture (6%).

Table 3: Farm characteristics in the study

Variable	Category	Response N (=50)	Percentages
Livestock ownership	Yes	26	52%
	No	24	48%
Processing	Yes	12	24%
	No	38	76%
Amount of produce sold on the market	50% and more	42	84%
	Less than 50%	8	16%
Contract	Yes	24	48%
	No	26	52%
Land ownership	Mainly owned	36	72%
	Mainly rented	14	28%
Main crop	Cereals	8	16%
	Fruits	19	38%
	Vegetables	12	24%
	Wine	3	6%
	Fodder	2	4%
	Aromatic plants	6	12%

The questionnaire was focused on farmers with plant production, but among small-scale farmers in this area is prevailing that their production is mixed with livestock production. In this study, 52% of the respondents had some livestock. Land ownership is an essential indicator of household wealth; in this study, 72 % of the respondents owned most of their agricultural land.

Table 4: Main crops cultivated in the study area

Type of crop	Cultivated area (ha)	%	N (=50)	Percentages
Vegetable	39,25	17	12	24
Fruits	53,35	23	19	38
Cereals	64,2	28	8	16
Fodder	31,6	14	2	4
Viticulture	4,6	2	3	6
Medical and aromatic plants	34	15	6	12
Other	1,8	01		

4.3. Adoption of practices

The overview of adoption rates among farmers in the study area is summarized in Table 5. Some of the technologies as synthetic fertilizers, chemical pesticide treatment and chemical herbicides treatment, are not considered agroecological practices and are included in this study solely for comparison and are not used by any organic farmers in this study.

The most used sustainable technology was mechanical weeding, used by 38 farmers, followed by the use of organic fertilizers, used by 36 farmers (31 % organic and 69 % non-certified). Reduced tillage was adopted by only 13 farmers, where 63% of them were organically certified. Intercropping was adopted by 20 farmers, primarily nonorganic (85%) and crop rotation by 23 farmers, where 78 % did not have an organic certification. The technology with lower adoption rates is cover cropping which was adopted by only seven farmers in this study.

Table 5: Rates of adoption of technologies in the study

Technology		Organic		Noncertified	
	N=50	N	%	N	%
Intercropping	**20**	3	15	17	85
Crop rotation	**23**	5	22	18	78
Cover cropping	7	1	14	6	86
Reduced tillage	**13**	8	62	5	38
Mechanical weeding	**38**	10	26	28	74
Synthetic fertilizers	21	0	0	21	100
Organic fertilizers	**36**	11	31	25	69
Chemical pesticides treatment	17	0	0	17	100
Non-chemical control of pests and diseases	**13**	5	38	8	62
Chemical herbicides	18	0	0	18	100

Note: highlighted practices are used in the logit model

4.4. Farmers perception about organic farming

Farmers in this study were asked how informed they felt about organic farming. Only 14% of farmers identified as very well informed, the most frequent answer among farmers was informed (30%), moderately informed was selected by 24 % of the respondents, and 10 % did not feel informed about organic agriculture at all. Nevertheless, 40 % of the respondents determine the discussion about organic farming as very important and 24% important. Only three farmers (6 %) of the study group did not see any importance in a discussion about organic farming. This result correlates with whether conversion to organic farming was possible for respondents in this study, where 42% of farmers indicated it as definitely possible. These rates of positive attitude towards getting an organic certification are formed by the fact that the sample of the respondents were farmers who are already certified or are currently in the process of obtaining organic certification. Conversion to organic farming was classified as impossible or definitely impossible is for 14 % of the farmers, which corresponds with the percentage of farmers who do not see organic farming as a topic of discussion (See table 6).

Table 6: Farmers perception about organic farming

How informed do you feel about organic farming?	N	%
Not at all	5	10%
Little informed	11	22%
Moderately	12	24%
Informed	15	30%
Very well informed	7	14%

Is the conversion to organic farming within the next five years possible for you?	N	%
Definitely impossible	1	2%
Impossible	6	12%
Not decided	13	26%
Probably possible	9	18%
Definitely Possible	21	42%

How important is organic farming for you as a topic of discussion?	N	%
Not important at all	3	6%
Unimportant	4	8%
Neither	11	22%
Important	12	24%
Very important	20	40%

Eighteen statements about organic farming with the Likert scale (disagree, somehow disagree, neutral, somehow agree, agree) were given to farmers to determine their perception of organic farming. All the statements are summarized in Figure number 1. Most of the farmers agree that organic farming has a positive effect on reducing water pollution, improving biodiversity and enhancing soil quality. With the statement that organic farming gives a positive image to a farm agree, 78 % of the respondents (strongly agree N= 30; agree N=9)

Most of the farmers agree that organic farming has a positive effect on reducing water pollution; 34 respondents (68 %) strongly agree with this statement. This opinion is very similar to other statements considering environmental questions. Thirty respondents think that organic farming improves biodiversity, and 40 respondents agree with the statement that soil quality is improved under organic farming management. None of the respondents marked the environmental question as "strongly disagree".

Twenty farmers have a neutral opinion about the additional profitability of organic products, and the rate difference between agree or disagree answers is insignificant. In comparison, the yield of higher profitability among farmers is considered false. 56% of the respondents disagree with this statement. 18 (36 %) respondents disagree with these statements, and 10 (20%) disagree. Positive perception about higher yield has only seven respondents. With the statement “organic farming gives a positive image to the farm, agree most of the respondents, 30 agree, and nine somehow agree.

The costs of farm inputs do not have a positive image among farmers. Sixteen agree, and 14 somewhat agree that organic pesticides are expensive. With the statement that organic fertilizers are expensive, 11 farmers agree, and 15 somehow agree. If we compare solely these two statements, the cost of organic fertilizers is among farmers considered more accessible than organic pesticides. 13 farmers disagree or somewhat disagree that the cost of organic fertilizers is too high. Only five disagree or somewhat disagree with organic pesticides.

Farmers disagree than agree that local consumers would be willing to pay a higher price for organic products; 17 disagree with the statement, and 16 somehow disagree. Farmers also think it is hard to find retailers for organic produce. With this statement agrees, 22 farmers and 12 somehow agree.

Fifteen farmers agree, and 18 somewhat agree that conversion to organic farming requires a high investment cost. The subsidies from the government to provide financial support 28 farmers see as insufficient, 20 farmers disagree, and eight somehow disagree that the subsidies are sufficient. Farmers also mostly agree or somehow agree with the statement that the cost of organic certification is too high.

The farmers were also asked if they see obtaining information about organic farming as difficult, where 18 farmers disagree with this statement and six somewhat agree, but obtaining information about the export market of organic products seems more complicated; 12 disagree, five somehow disagree, 12 neutral, 14 somehow agree and nine agree.

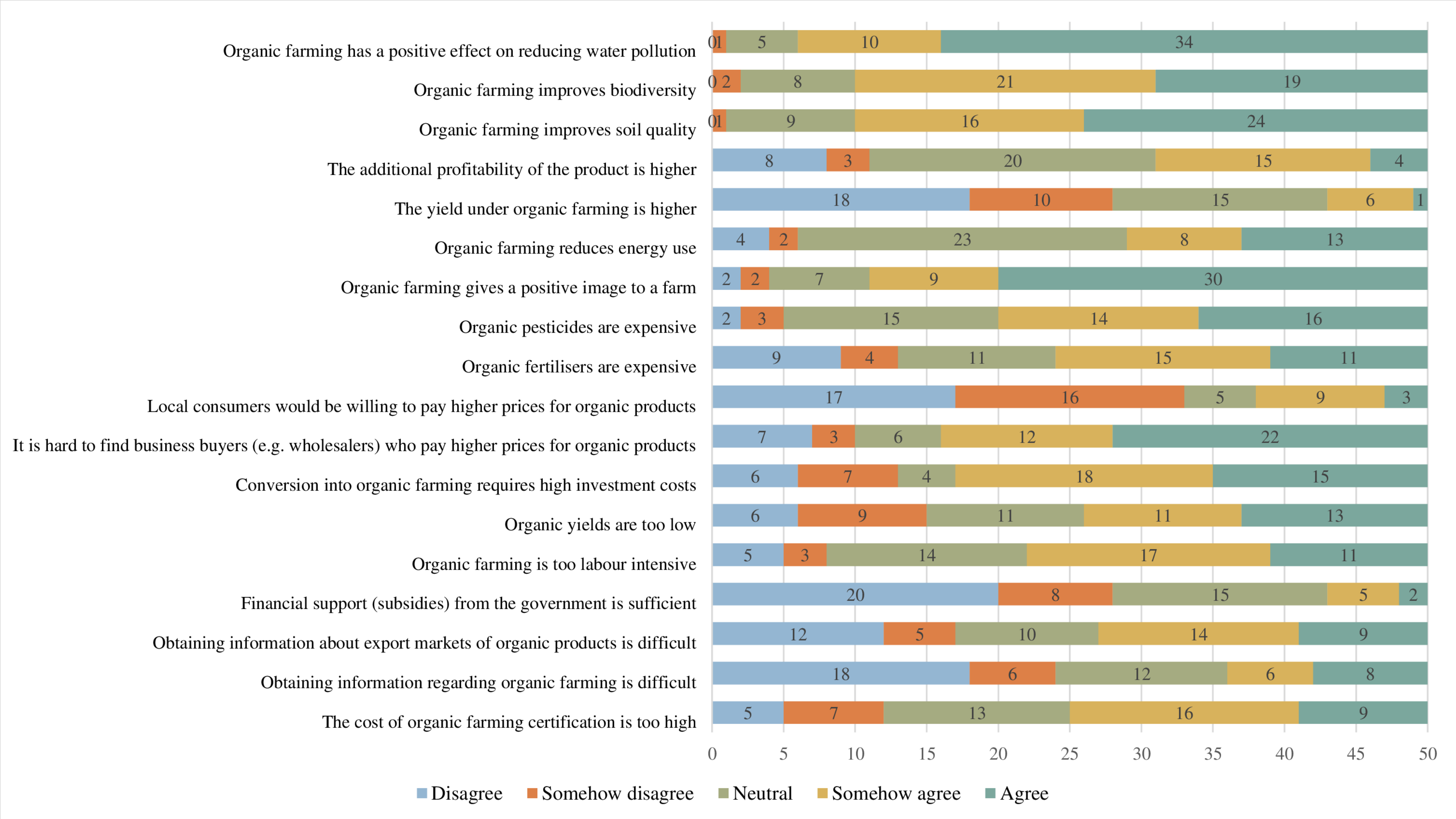

Figure 3: Farmers perception about organic farming

4.5. Binary logit model

In this study, we focused on six sustainable practices (intercropping, crop rotation, reduced tillage, mechanical weeding, organic fertilizers and non-chemical control of pests and diseases) used by the farmers in Bosnia and Herzegovina. The Binary logit model was used for each practice separately, and the results are described in the following chapter. In addition, the explanatory variables were used following farm and farmer characteristics: age, education, years of experience, farm size, main crop, certification, gender, primary agriculture source of income, land ownership and livestock ownership.

Although ten descriptive variables were used in this model, only four factors of adoption were determined as statistically significant factors of adoption. Certification, Main employment, and land ownership influence the adoption of reduced tillage and gender the adoption of organic fertilizers. We did not find any statistical significance between explanatory variables and intercoping; crop rotation; mechanical weeding and non-chemical control of pests and diseases The results of the binary logit model are summarized in Table 7.

Table 7: Binary logit model results

Intercropping	**Estimate**	**Standard error**	**p**	**Crop rotation**	**Estimate**	**Standard error**	**p**
Age	0.20519	0.380940	0.590129	Age	-0.142494	0.368390	0.698902
Education	0.56995	0.418491	0.173226	Education	0.216051	0.360347	0.548797
Years of experience	0.07022	0.317672	0.825051	Years of experience	0.279657	0.317513	0.378442
Farm size	-0.05070	0.056757	0.371726	Farm size	-0.043367	0.049775	0.383607
Main crop	0.16257	0.247620	0.511495	Main crop	-0.074272	0.230506	0.747291
Certification	0.72784	0.488957	0.136603	Certification	0.029725	0.400485	0.940834
Gender	0.33392	0.409472	0.414794	Gender	-0.196495	0.372980	0.598315
Main employment	-0.75626	0.437968	0.084215	Main employment	-0.719075	0.399758	0.072054
Land ownership	-0.18338	0.410397	0.654994	Land ownership	-0.227576	0.395399	0.564913
Livestock	-0.49200	0.384421	0.200601	Livestock	0.233761	0.337297	0.488283
Reduced Tillage	**Estimate**	**Standard error**	**p**	**Mechanical weeding**	**Estimate**	**Standard error**	**p**
Age	-0.16286	0.538497	0.762323	Age	-0.37815	0.527686	0.473610
Education	-0.74100	0.639559	0.246616	Education	1.14139	0.693352	0.099725

Years of experience	0.17763	0.453644	0.695390	Years of experience	1.15258	0.759662	0.129209
Farm size	-0.01323	0.101393	0.896191	Farm size	-0.18389	0.185534	0.321610
Main crop	0.44680	0.358278	0.212371	Main crop	0.21949	0.459690	0.633029
Certification	**-1.94963**	**0.706395**	**0.005781****	Certification	0.26016	0.622567	0.676035
Gender	0.14208	0.575786	0.805101	Gender	0.19724	0.620859	0.750722
Main employment	**1.99170**	**0.894313**	**0.025942***	Main employment	1.02202	0.683284	0.134720
Land ownership	**1.72387**	**0.710351**	**0.015233***	Land ownership	0.50704	0.748926	0.498388
Livestock	0.77490	0.501056	0.121976	Livestock	0.48595	0.589634	0.409853
Organic fertilizers	**Estimate**	**Standard error**	**p**	**Non-chemical control of pests and diseases**	**Estimate**	**Standard error**	**p**
Age	0.33124	0.511511	0.517268	Age	0.23748	0.446735	0.595008
Education	-0.13603	0.484091	0.778714	Education	0.27183	0.469023	0.562210
Years of experience	-0.01076	0.412751	0.979209	Years of experience	0.76141	0.403925	0.059425
Farm size	0.01624	0.050601	0.748278	Farm size	-0.14274	0.110941	0.198228
Main crop	-0.04159	0.399106	0.917010	Main crop	0.10378	0.280150	0.711064
Certification	0.12562	0.635546	0.843313	Certification	-1.06354	0.554292	0.055017
Gender	**-1.04572**	**0.528012**	**0.047649***	Gender	-0.38661	0.442831	0.382640
Main employment	-0.30209	0.484608	0.533049	Main employment	0.87012	0.520114	0.094339
Land ownership	-0.06104	0.501611	0.903140	Land ownership	-0.14472	0.444846	0.744937
Livestock	-0.12288	0.504808	0.807678	Livestock	0.15286	0.426915	0.720309

Note *Significant at $p \leq 0.05$. **Significant at $p \leq 0.01$.

In this study, we focused on six sustainable practices (intercropping, crop. Most of the statistically significant data were on factors influencing the adoption of reduced tillage. Adopting reduced tillage as a sustainable practice is statistically positively (p = 0,025942) influenced by main employment. If agriculture is the primary employment of the farmer, he is more likely to adopt reduced tillage. The same result applies to land ownership and reduced tillage adoption. The relationship between these two variables is positive p =0,015233. If the respondents own the land, they are expected to adopt reduced tillage as a practice. In our study area, the use of reduced tillage is in a negative relationship with organic certification at p=0,005781. Results show that farmers with organic certification have a significantly lower chance of adopting reduced tillage as a practice.

The adoption of organic fertilizers is influenced by the gender of the respondents—statistical significance at p 0,047649. The male farmers in this study have a higher chance of using organic fertilizers.

5. Discussion

One of the aims of this thesis was to examine the agro-technologies farmers use in the area. In the total sample size of 50 farmers, the most used sustainable technology was the mechanical weed control and the use of organic fertilizer. On the opposite, cover cropping is not widely adopted by farmers in this study. The benefit of cover crop adoption is the impact on weed suppression (Osipitan et al., 2018). The possible explanation is that farmers in this area use different techniques for weed control, such as intercropping or crop rotation (Alba et al., 2020). There could be a possible correlation between the use of cover cropping and the use of conventional tillage, as both practices have the same function in weed control. Further research on the correlation between the use of farm techniques is needed.

We used the binary logit model to determine the relationship between the adoption of sustainable techniques and socio-economic factors. In the area of the study, women are less likely to use organic fertilizers than their male counterparts. A significant positive relationship was found between the adoption of reduced tillage and main employment. Respondents with agricultural work as their main source of income have a higher chance of reduced tillage adoption. Land ownership is another significant factor influencing the adoption of reduced tillage. Farmers who own their land are more likely to adopt reduced tillage as a practice. On the other hand, organic certification negatively influences reduced tillage adoption.

The negative relationship between the use of reduced tillage and organic certification is the unanticipated result of the thesis. It is expected that organic farmers will be more conscious about the environment. Therefore, the correlation between organic certification and the use of agro-ecological practices will be positive. Gattinger et al. (2012), in their study, describe that reduced tillage is not widely applied in organic agriculture. The benefit of reduced tillage is the accumulation of organic matter in the soil. However, this function is usually performed by different practices in organic agriculture, for example, cover cropping, intercropping and by the use of organic fertilizers (Kim et al., 2020; Peltonen-Sainio et al., 2022; Thapa et al., 2018). In addition, organic agriculture bans the use of chemical herbicides (Bajwa, 2014; Lefèvre et al., 2012); therefore, the agronomical function of reduced tillage is the suppression of weeds (Alba et al., 2020). Moreover, for organic farmers, organic agriculture remains an alternative form of agriculture based on the prohibition of pesticides and other chemical substances. However, it has been observed that informational exchanges concerning tillage practices are not yet widespread among organic farmers (Peigné et al., 2015), and there is still a research gap about the benefit of adopting reduced tillage in organic agriculture (Bogunovic et al., 2020).

Farmers with agriculture as a main source of income have a higher chance of reduced tillage adoption. Studies conducted in the United States are in agreement with our results from Bosnia and Herzegovina. Khanal & Mishra (2020), in their study in the United States, found out that farmers identifying farming as a main source of income, are more likely to participate in environmental strategies, therefore, adopt new agro-ecological techniques. Belbase (2022) later supported this result. On the other hand, some studies describe the negative effect of off-farm income on the adoption of sustainable technologies (Manda et al., 2016) and argue that off-farm income shifts farmer's focus away from agricultural activities and reduces investment in sustainable agricultural practices (Mathenge et al., 2015). This follows our results, but it is essential to mention that many do not specify whether the off-farm income is an additional source of income and whether farming remains the main job of the farmer. On the contrary, Coulibaly et al. (2021) argue that farmers who mainly engage in no-farming activities are most likely to adopt new sustainable practices; similar results were found by Sriwichailamphan (2014) in India. They argue that farmers with extra income have a financial source which is the basis for adopting new practices, but none of these studies specify if farming is the main occupation.

Another important factor which significantly influences the adoption of reduced tillage is land ownership. Farmers who own their land are more likely to adopt reduced tillage. Various studies focusing on adopting organic farming and new practices agree with those findings (Fosu-Mensah et al., 2012; Kassie et al., 2013; Manda et al., 2016; Teklewold et al., 2013). The possible explanation is that the return on investment can take a longer time; therefore, farmers who own their land are more likely to adopt new practices. However, it is important to mention that not many studies are focused on the factors affecting the adoption of reduced tillage. Conventional tillage systems are strongly associated with soil degradation and soil erosion (Carr et al., 2013).

The explanation for the higher adoption of reduced tillage among farmers who owns their land could be soil degradation and soil erosion, which are strongly associated with conventional tillage systems (Carr et al., 2013). Sklenicka et al. (2015), in their study from the Czech Republic, found that farmers who own their land apply erosion control measures to a greater extent than those who are renting the land from the landowner. This could be the reason behind the relationship between land ownership and reduced tillage adoption in Bosnia and Herzegovina, as land degradation is an emerging thread for Bosnian agriculture (Zurovec et al., 2015).

The result of the study shows a significant negative correlation between gender and the adoption of organic fertilizers. Similar results were found by Kpadonou et al., 2017 in West Africa, where female-headed households were more likely to use inorganic fertilizers than organic. Comparably to our study, gender did not have any impact on the adoption of any of the other practices. The authors discuss the limitation of their study, where female-headed households were only around 5% of the sample. Such findings are inconsistent with previous studies, which found that female farmers are more likely to adopt sustainable practices (Azam & Banumathi, 2015; Kassie et al., 2013; Malá & Malý, 2013; Sriwichailamphan, 2014). Various researchers argue that women are more concerned about the effect of pesticides on health and the environment, therefore, will tend to adopt organic agriculture (Sriwichailamphan, 2014). One of the explanations for this result could be that use of organic fertilizers are more labour-intensive (Casagrande et al., 2016). The handling and use of organic fertilizers can be physically difficult; men generally have more physical strength and, thus, are more powerful to carry or manage heavy and voluminous inputs like compost or farmyard manure (Cai et al., 2019). The difficulty of handling organic fertilizer, which is a limitation of adoption, is also supported by Folefack (2015) in his study of determinants of compost adoption; he argues that male farmers are more likely to adopt compost.

In this study, we also explored the farmer's perception towards organic farming. Most farmers in the study area (64%) see organic farming as an important topic of discussion, which is in correlation with the result of whether the convention to organic farming is possible for them; the majority of our respondents (60%) agree with this statement. One of the reasons for these positive attitudes towards conversion to organic farming is the positive image of the farms under organic farming. Respondents in the study also see the environmental benefits as the main important factor of organic agriculture, the same results were found in Sri Lanka. Herath & Wijekoon (2013) found out that both inorganic and organic growers had see the positive effect of OA towards the environment. On the other hand, the barriers to organic certification are financial and market barriers. Farmers in this study mostly disagree with the statement that local consumers would be willing to pay a higher price for organic products, which is a crucial marker barrier considering that farmers in the study area sell most of the product locally directly to consumers. This is in agreement with the results from Serbia. Bajagić et al. (2022) found that 44 % of the respondent in their study perceive insufficient financial support as a high risk of organic production. These results were later supported by Ilić-Kosanović et al. (2019), where 42.7% of the respondents perceive the financial support from the government as an important factor in organic certification. In addition, farmers perceive organic farming as too labour-intensive with low yields. Finally, farmers see difficulties in obtaining information about organic farming and the organic market in the area.

This study explores the socio-economic factors, which are, as confirmed by many studies, important factors influencing the adoption of new practices, but understanding the factors that influence the adoption of sustainable agricultural technologies is a very complex and long-standing issue. The adoption of agroecological practices and the decision to obtain an organic certification is not a single decision (Veldstra et al., 2014). The driver of adoption includes multiple factors. The essential driver of adoption is a farmer's personal attitudes towards the environment, climate change, human health (Stephenson et al., 2017), and economic motives such as profit maximization, cost of inputs, and farm viability (Bodiroga, 2017; Brédif et al., 2017; Kvakkestad et al., 2015). Therefore, there is a need to enhance understanding of the whole concept and philosophy of organic agriculture and secure state institutional support and financial assistance.

5.1. Limitation of the study

In this study, the sample size is 50 farmers, which is a limited representation. This study uses convenient sampling methods based on informants from the University of Mostar; therefore, many respondents knew each other; therefore, their perception of organic farming may differ from farmers within reach of the questionnaire.

6. Conclusions

The main objective of the thesis was to determine factors influencing the adoption of agro-ecological technologies and the farmer's perception of organic agriculture in Bosnia and Herzegovina.

We explored the farmers' perception about organic farming and found out that farmers agree with the environmental benefits of organic agriculture. They also perceive the positive image of the farm as a crucial part of organic certification. Although most of the farmers in the study area recognized convention to organic farming as a possible option for their further development, they perceived some disadvantages in lower yield under organic agriculture. In addition, they did not think that local consumers would be willing to pay a higher price for their produce, which was one of the possible barriers to the transition to organic farming.

We investigated the factors influencing the adoption of agro-ecological practices and found that reduced tillage is the factor most influenced by farm and farmer characteristics. We found a positive correlation between the adoption of reduced tillage and land ownership, which indicates that farmers who own their land have a higher chance of adopting this practice. Similarly, the main employment of the farmers is a significant determinant of whether farmers adopt reduced tillage. We noted that farmers who have agriculture as a primary employment have a higher chance of reduced tillage adoption.

A negative correlation was found between the adoption of reduced tillage and organic certification. The main benefit of reduced tillage in organic agriculture is weed protection which cannot be subsidised by chemical herbicides in organic agriculture. We found one factor influencing the adoption of organic fertilisers. The gender of the respondent negatively influenced the adoption of the practice. Women in the study area had a higher chance of using chemical fertilisers than organic fertilisers such as compost or farmyard manure.

In conclusion, Bosnian agriculture has enough opportunities for sustainable intensification. The organic sector in Bosnia and Herzegovina is relatively young, but farmers have a positive attitude about organic farming and are generally conscious about the environment. The adoption of agroecological practices and the decision to obtain an organic certification is a complex decision, which includes multiple factors among smallholder farmers, focusing on both economic and psycho-social factors. Future research using transdisciplinary and holistic approaches is needed to obtain a better understanding of this topic.

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List of the Appendices

Ministry of Foreign Affairs of the Czech Republic | CZECH REPUBLIC DEVELOPMENT COOPERATION | Czech University of Life Sciences Prague | SVEUČILIŠTE U MOSTARU

APENDIX I: General Questionnaire (English)

Small-scale farmers survey on ecological practices and organic certification perception

This survey aims to determine if farmers in Bosnia and Hercegovina use agroecological practices and if they intend to get organic certification. To determine the barriers and motivation for such certification.

This survey is conducted by the Faculty of Agriculture and Food Technology, the University of Mostar (https://aptf.sum.ba/) in partnership with the Czech University of Life Sciences in Prague (https://www.czu.cz/en) and University of Džemal Bijedić Mostar, Agro-Mediterranean Faculty (https://af.unmo.ba/). The answers will be used to publish scientific work. All responses are kept strictly confidential all answers are confidential and will not be passed on to third parties.

The interviewee may, at any time, quit their participation including the withdrawal of any information they have provided. If they complete the interview, it will be understood that they have consented the participation in this research and agree with the publication of the overall results of this research with understanding the anonymity

QUESTIONAIRE N ☐

INTERVIEWER NAME ___________________________

DATE ______________________

MUNICIPALITY ____________________

VILLAGE NAME ___________________

ARE YOU CERTIFIED ORGANIC FARMER? YES ☐ NO ☐

Part 1: TECHNOLOGIES USED IN FARM

This part is to find out which technologies according to IFOAM certification standards you use on your farm.

QUESTION 1.1 Do you currently use the following technologies/practices on your farm? Please fill the table.

PRACTICES			**IF YES**	**IF YES**	**IF YES**	**IF NO**	**IF NO**
	USAGE		**When first implemented? (Year)**	**Type of crop.** 1. Cereals 2. Fruits 3. Vegetables 4. Wine grapes (viticulture) 5. Fodder 6. Medical and aromatic plants *(May select more than one)*	**Main objectives** 1. Pest control 2. Weed control 3. Soil protection 4. Profit increase 5. Yield increase 6. Climate change adaptation *(May select more than one)*	**Did you practice in the last 5 years?**	**Main reason** 1. Too costly 2. Too time-consuming 3. Not beneficial 4. Not enough information *(May select more than one)*
	YES	**NO**					
Intercropping [1]							
Crop rotation							
Cover cropping [2]							
Reduced tillage							
Mechanical weeding							
Synthetic fertilizers							
Organic fertilizers							
Chemical pesticides treatment							
Non-chemical control of pests and diseases							
Chemical herbicides							

[1] Intercropping - two or more crops on the same field at the same time.

[2] Cover cropping – one of the plant sis grown for the purpose of soil health or fertility rather than being harvested.

QUESTION 1.2 Do you have any animals

Yes □ No □

Which and number: ________________________________

QUESTION 1.3 In case organic fertilizers are applied, please fill the following table, and indicate which kind you use and how often.

	Never	**At least once in 5 years**	**At least once a year**
Animal manure			
Poultry manure			
Green manure [3]			
Compost			
Other (specify)			

[3] crops cultivated primarily to improve the soil with nutrients and organic

QUESTION 1.4 In case synthetic fertilisers are applied, please specify________________

____

QUESTION 1.5 In case non-chemical control of pests and diseases (plant protection) is used, please fill the following table

	Never	**At least once in 5 years**	**At least once a year**
Mechanical ways			
Physical and pheromone traps			
Biological enemies of pests			
Plants based materials			
Microbiological treatments			

QUESTION 1.6 In case that you use chemical herbicides, please specify_________________

____

PART 2: ORGANIC FARMING AND CERTIFICATION

QUESTION 2.1 Are you an organic certified farmer?

Yes ☐ No ☐

QUESTION 2.2 How informed do you feel about organic farming (regulation, certification, cost, profits etc…)

☐	☐	☐	☐	☐
Not at all	Little informed	Moderately	Informed	Very well informed

QUESTION 2. 3 Is the conversion to organic farming within the next five years possible for you?

☐	☐	☐	☐	☐
Definitely impossible	Impossible	Not decided	Probably possible	Definitely Possible

QUESTION 2.4. How important is organic farming for you as a topic of discussion?

☐	☐	☐	☐	☐
Not important at all	Unimportant	Neither	important	Very important

QUESTION 2.5 Please fill the table and indicate how you agree or disagree with the following statement.

Statement	**Disagree**	**Somehow disagree**	**Neutral**	**Somehow agree**	**Agree**
The cost of organic farming certification is too high					
Obtaining information regarding organic farming is difficult					
Obtaining information about export markets of organic products is difficult					
Financial support (subsidies) from the government is sufficient					
Organic farming is too labour intensive					
Organic yields are too low					
Conversion into organic farming requires high investment costs					
It is hard to find business buyers (e.g. wholesalers) who pay higher prices for organic products					
Local consumers would be willing to pay higher prices for organic products					
Organic fertilisers are expensive					
Organic pesticides are expensive					
Organic farming gives a positive image to a farm					
Organic farming reduces energy use					
The yield under organic farming is higher					
The additional profitability of the product is higher					
Organic farming improves soil quality					
Organic farming improves biodiversity					
Organic farming has a positive effect on reducing water pollution					

Part 3: FARM AND HOUSEHOLDS' ATTRIBUTES

3.1 What is your gender?

Male ☐ Female ☐

3.2. How old are you?

- ☐ ≤30
- ☐ 31-40
- ☐ 41-50
- ☐ 51-60
- ☐ ≥60

3.3. the Current number of people living in your household:

Men____ Women___

3.4. Apart from you, how many members of your household are involved in farming?

Men ___ Women___

3.5. What is your highest level of education?

- ☐ Less than elementary level (Illiterate)
- ☐ Elementary to less than high school
- ☐ High school
- ☐ Two years of college
- ☐ University or above

3.6. Is agriculture your main occupation?

Yes ☐ No ☐

3.7. For how many years have you been engaged in farming? _______ years

3.8. What is the farm size in ha? __________

3.9. Please complete the table with farm details:

	Unit (Hectares)
Agricultural land ownership	
Agricultural land rented	
Agricultural land in use of which	
Field vegetable	
Fruit	
Cereal	
Fodder	
Wine grapes (viticulture)	
Medical and aromatic plants	
Other cultivated	
Uncultivated	

Do you do any processing, specify	

3.10. Please indicate the % of farm production for family consumption vs. market sale:

Personal/Family consumption ____________%

Sale on market ____________%

3.11. Please indicate the % of produce sold under the contract

At the local market ____________%

Local short-term contract ____________%

Local long-term contract ____________%

International short-term ____________%
International long term ____________%

Others ____________%

3.12. Please indicate the % produce sold

Export ____________%

In the country ____________%

3.13. Please indicate the % to whom do sell your produce?

Directly to consumers __________%

Traders __________%

Others __________%

3.14. Do you have employees on your farm who aren't your family members? If yes, how many?

____

3.15. Further farm expectations. What is your plans or intention within the next 5 years (please tick one box only)

- ☐ I will continue with my current business as usual
- ☐ I will expand my farming business
- ☐ I will sell/rent it for agricultural purposes
- ☐ I plan to get organically certified
- ☐ I plan to get any other certification
- ☐ Other. Please specify _________

Is the anything else you would like to tell us? If you would like to provide your contact which will be used just in case further clarification will be needed, you are highly encouraged to do so.