Co-funded by the Erasmus+ Programme of the European Union

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Good Agricultural Practices (GAP): Precision Farming Training Material

ENHANCING SOCIAL INCLUSION OF YOUTH THROUGH EMPLOYMENT IN AGRIFOOD SECTOR

AGRIFOOD PROJECT

Project Number:
2019-3-TR01-KA205-079155

2021

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CONTENTS

FIGURES and TABLES

ABBREVIATIONS

EU: European Union

EUREP: Euro-Retailer Produce Working Group

FAO: Food and Agriculture Organization of the United Nations

GAP: Good Agricultural Practices

GHPs: Good Hygienic Practice

GMPs: Good Manufacturing Practice

GPS: Global Positioning System

HACCP: Hazard Analysis and Critical Control Point

ICM: Integrated Crop Management

INM: Integrated Nutrient Management

IPM: Integrated Pest Management

ISO: International Organization for Standardization

NEET: Youth Not in Employment, Education or Training

TEAGASC: The Agriculture and Food Development Authority

VRT: Variable Rate Technology

INTRODUCTION

The EU Strategic Partnership project titled "Enhancing Social Inclusion of Youth Through Employment in the Agri-Food Sector [AGRI-FOOD]", supported by the European Commission under the Erasmus+ Program, is coordinated by Bursa Metropolitan Municipality (TARIM A.Ş.) and is carried out with the project stakeholders from two countries. Project stakeholders are Central Research Institute of Food and Feed Control (CRIFFC) and General Directorate of Agriculture and Research Policies (GDAR) from Turkey, the National Food and Canning Technology Center (CTC) from Spain and the Food and Fermentation Technologies Center (TFTAK) from Estonia.

The EU farming sector is faced with an ageing population. Also, young people in the disadvantaged group in EU countries suffer from social exclusion due to unemployment. Therefore, directing the young workforce to the agricultural sector will be an appropriate solution for both problems. The project aims to identify these people's weaknesses and enhance their job-related skills so as to improve their employment opportunities and social inclusion. For this purpose, at first, the training material needs of target groups (i.e. unemployed youth, future farmers, agri-food professionals, local authorities, NEETs, students at high-school or university etc.) were examined. It was seen that most of the young people surveyed had limited knowledge about good agricultural practices and precision farming. It was also found that they found training materials related to these topics inadequate.

"Good Agricultural Practices (GAP): Precision Farming Training Material" aims to increase work-related qualifications of target groups who are working or wants to work in agri-food sector because low-skilled young people find themselves inadequate to do a business in agri-food sector. It has been also reported that yield and product losses may occur due to not implementing procedures of GAPs and precision farming. Hence, the training materials prepared for increasing knowledge of target groups about GAP and precision farming are very important and necessary. This training material provides a crucial information about GAPs and precision farming (their benefits and limitations), international quality standards, regulations and certification procedures for GAP, supports and good examples of GAPs for farming in Turkey and Europe as well as technologies used in precision farming. It should be considered that increasing knowledge of agri-food workers about these topics may serve different benefits such as enhancing the safety and quality of food, preventing the non-compliance risks with regulations, preventing soil, water and air pollution and serving new market opportunities and so on.

1. General Information and Development Process of Good Agricultural Practices

Today, the significance of reaching and consumption of healthy and safe food is increasing owing to world population growth. Good Agricultural Practices (GAPs) come in sight in this context and can be easily defined as doing things well and assuring it has been done so (FAO, 2007). According to FAO, GAPs are a sum of rules to be applied during production (on-farm and post-production processes), which help to obtain safe and healthy food and non-food agriculture products, while considering sustainability criteria (economic, social and environmental) (FAO, 2016).

Problems related to the safety of foodstuffs that threatened the public health experienced in the recent past have brought the formation of EUREPGAP to the agenda. Examples of these problems are mad cow disease, dioxin found in eggs, chlormequadine found in pears and ciprodinil found in strawberries (İçel, 2007). In 1997, retailers dominating the majority of the fresh fruit and vegetable market in Europe gathered under the name EUREP (Euro-Retailer Produce Working Group) so as to decrease some risks that threaten human health in the supply of fresh fruit and vegetable products and they generated EUREPGAP standards, which create the basis of today's GAPs. The revision of EUREPGAP standard was done in 1999 and was named as GLOBALG.A.P. and approved by all the countries in the world. With this protocol, retailers request assurance from the producers and the suppliers concerning the product that is sold will not harm their customers. Afterwards, the working group established the EUREPGAP technical and standards committee in 2007 and this committee conducted studies to control the conformity of agricultural products with the specified protocol rules and to conduct certification procedures (Anonymous, 2018). These standards are created for guaranteeing consumers that agricultural product is grown with minimum harmful environmental effects, minimum chemical usage and the highest responsibility in terms of health and safety of workers and animals (Kankane, 2015).

In the late 1990's, food based illnesses and worries on progressively finished natural resources have led to reconsider conventional agricultural production system. New techniques for agricultural production systems (e.g. organic farming, precision farming) have been regarded as alternatives to conventional agricultural production to encounter consumer demands and sustainability in agriculture after 1970's. The consumer desires to feel certain that foods they buy are produced safely and ecologically. Due to these expectations, producers and retailers know that they need to bring food products to the market with certain standards. Hence, several ventures have been made to guard consumers and enhance their reliance at national and international level. In this scope, GAPs that consider monitoring from production to consumption as a primary priority was started to be applied in the worldwide. The basic of GAPs is the application of new crop production systems (such as integrated pest management (IPM), integrated crop management (ICM) and integrated nutrient management (INM)). Moreover, GAPs take into consideration economic and social sustainability aspects together with the production systems mentioned above (Table 1) (Akkaya, Yalcin and Ozkan, 2005; Yılmaz, Ersoy, Gümüş and Aydın, 2017).

Table 1. The Good Agricultural Practices Standard Items (Baghasa, 2008)

Fertilizer application	Documentation and internal review
Irrigation	Website management
Soil management	Traceability
Crop protection	Loss and pollution management
Harvesting	Post-harvest treatment
Workers' health, safety and training	Varieties and stocks for plantation

Whole steps from production to marketing are in the scope of GAPs. Farmers should evaluate the potential impacts of these practices on human health and environment before implementation of these practices. If there are some risks, they should not be implemented. GAPs are based on voluntariness, these practices are crucial in terms of quality, safety and productivity of agricultural production. By means of GAPs, the competitiveness and earnings of farmers are improved and human health is protected. Recently, GAP applications have been commonly done for plant production, fisheries and animal husbandry (Turkey Ministry of Agriculture and Forestry, 2020).

GAPs could be applied on agricultural and animal products. They are applied to the products that are given below (Baghasa, 2008):

- Vegetable and fruit production
- Flower production (ornamentals)
- Agricultural plant production
- Animal breeding
- Aquaculture
- Coffee shrub production (green coffee)

GAP concept is different from ecological or organic agriculture. Agricultural fertilizers and pesticides are utilized in GAP; nonetheless, no chemicals are used in organic agriculture. The main purpose of GAP is to ensure that each item is recorded, such as seeds, seedlings, soil, water resources, pesticides and quality reports of the food produced by the farmer. The factors taken into consideration during the GAP assessment are water resources in the production area, production conditions in neighboring lands, possible pollution status in the surrounding area, the existence of sustainable water resources and water quality, keeping plant health high and regulation of pesticide use, type of soil in the production area and planting plan. Farmers with this certificate cannot randomly spray pesticides in the field. The amount and type of pesticides to be used and the reason for their use are determined, documented and audited by the experts from the certification institution conducting the inspection. The same approach applies to fertilization. GAP necessitates fertilizing in accordance with the recommendations to be made by experts by determining the nutrient requirements of the soil and the product grown. GAP ensures not only the safety of product produced, but also the safety of workers who apply pesticides and fertilizers. Chemical residue analysis of food produced within the framework of GAP regulations are regularly performed. If products exceed the maximum pesticide limit set by the state, an urgent action plan is identified to decrease the residue. Nevertheless, it does not mean that there is no chemical residue in the foods produced by GAP standards. Farmers having GAP certification also have the chance to meet GLOBALG.A.P. conditions so they are in the front of their competitors in exporting abroad. Low interest loans, grants and financial support are provided for them by the state as farmers with GAP certification produce for the protection of environment and human health (Aytekin, 2016).

What should farmers do during the adaptation to good agricultural practices?

- Wastes must be collected and stored.
- Adequate waste collection building should be provided.
- Fertilizers and chemical nitrogen should not be applied in October and December.
- When nitrate sensitive areas are selected, they should follow the work plan that can be applied in these areas.
- Internal regulations regarding agricultural practices in water storage basins should be applied.
- The Agriculture and Food Development Authority (Teagasc) recommendations should be considered when using organic and chemical fertilizers and lime.
- Provisions on water pollution from nitrate published by the rural development unit should be taken into account (İçel, 2007).

1.1. The Importance of Good Agricultural Practices

A major worry for all food producers is food safety. Unsafe food owing to microbial contamination takes part in the center of this concern. The unsanitary harvesting, handling, water source, employees with poor hygiene, improper fertilizer and a variety of other factors are some of contamination sources. By means of GAPs, farmers may prevent contamination of agricultural products. GAPs are a new way of thinking about food safety and these practices are also used to increase the quality of products. Each producer should learn food safety hazards and apply some preventive steps to avoid contamination with harmful microorganisms. GAP standards protect people's business by means of the right steps. GAPs both protect people from illness and farm business from economic results of the pollution (Kumar, 2017). The application of GAPs supports the optimum use of resources like water, pesticides and fertilizers. The protection of farmers' health from improper use of chemicals is its social dimension (FAO, 2016).

1.2. The Links between GAPs and Human Health as well as the Environment

Although noticeable links exist between nutrition, agriculture, agricultural technology and health, developing people health is not usually a clear aim of agricultural policy. Agriculture and agricultural science may impact several health topics such as under nutrition, chronic and infectious diseases and occupational and environmental health. Long-term poor diet causes chronic diseases, which are main reason of global deaths. Consumer and dietary quality should be main focus of production, that is, not only quantity and income is taken into consideration during production. Globalization of the food supply and growing consumer awareness enhance the necessity for good and effective national food safety systems. Health concerns originating from pesticide residues, heavy metals, various additives in the food system and large-scale livestock (e.g. zoonose diseases) can be solved by agricultural science and technology. Enhanced food safety measures are crucial for national and international markets. Nonetheless, it might increase costs. Food control costs (e.g. inspection) could be high for certain countries and they might want help. Using an extensive agroecosystem and human health approach could ease determination of health risks for animal, plant and human (IAASTD, 2008).

Environmental conditions have effects on agricultural practices, these practices also impact the environment. Agricultural activities influence greenhouse gas formation. The forest land is generally destructed to get an agricultural area. This activity leads to generation of greenhouse gases. The greenhouse gas methane may also form during agricultural activity. 40% of global methane emission comes from rice cultivation. Microbial degradation of organic materials causes methane releasing. 15% of global methane emission comes from ruminant livestock owing to digestion of the cellulose. Another greenhouse gas, nitrous oxide (N_2O), is closely connected to farming (Önder, Ceyhan & Kahraman, 2011).

Many changes occurred in the environment are long term, forming slowly over time. Water, soil and air should be protected to obtain a sustainable environment. Controlling of livestock manures may decrease releases of gases (such as ammonia), restrict nitrate leaching to groundwater, contaminants in soil and stop microorganisms being passed into surface waters. The properties of manure can be shaped by changing composition of animal feed. It may decrease excessive nitrogen (N) being sent to the environment and restrict the accumulation of phosphorus (P) in the soil. It will decrease the risk of water and soil contamination due to feed supplements (e.g. copper and zinc) (DEFRA, 2009).

1.3. The Benefits and Challenges of Good Agricultural Practices

Important improvement in agricultural products' quality and safety can be obtained by GAP. The risk of non-compliance with national and international regulations regarding maximum levels of contaminants (e.g. pesticides, mycotoxins and veterinary drugs) or other chemical, microbiological and physical contamination hazards in agricultural products is obviously reducing by means of GAP. Sustainable agriculture is promoted by the adoption of GAP. Nonetheless, several challenges exist related to GAP. For example, the production cost increases happen. There is a lack of consistence between GAP-related schemes and availability of certification systems causing enhanced confusion and certification costs. Small-scale farmers cannot catch export market opportunities if not they are sufficiently informed or technically prepared to overcome new problems (Essays, 2018).

According to Anonymous (2012), potential benefits and challenges related to GAPs are summarized below:

Potential benefits

- Adoption of GAP aids promoting the agricultural products' safety and quality during harvesting or packaging and reduce risks coming from animal and manure.
- It may help decrease the non-compliance risk with national and international regulations, standards and guidelines concerning maximum contaminant levels (e.g. veterinary drugs, pesticides and mycotoxins) in food and non-food agricultural products and other contamination hazards (physical, chemical or microbiological).
- GAP procedure aids making sustainable agriculture activities and meeting social and environmental development objectives.
- It may improve workers' health and hygiene conditions.
- It may prevent water, soil and air pollution.
- It may serve new market opportunities for farmers and exporters.
- It may help catch new market chances by changing supply chain management.
- Developing a food safety plan may improve efficiency and ease inventory control and management of their products.

Potential problems

- GAP implementation may rise production costs for farmers and exporters in some conditions, especially record keeping and certification.
- A risk exists that small scale farmers cannot able to catch export market opportunities if they are not sufficiently informed and technically prepared.
- The application of GAP principles does not always provide all the environmental and social benefits.

2. The International Quality Standards

Certain institutions established international quality standards, they are rules which assist for the determination of conformity across the national borders. These standards facilitate to perform business on a related field as well as permit more cooperation by coping with national or international limitations. These rules centralize topics like the rules of measurement units, symbol usages or a process definition to meet quality control. Some organizations have taken in hand to monitor and manage these standards. The International Organization for Standardization (ISO) is the most effective body which pursues global standards (Das, 2017).

Globally, certification schemes are becoming more significant with time. In European countries, the most common schemes are ISO 9001, ISO 14001, GLOBALG.A.P., ISO 22000 and BRC Global Standard. Nowadays, in the food industry, GLOBALG.A.P. is one of the most widespread global certified schemes. It is generally considered as a main reference for GAP. In countries such as Austria, Chile, Denmark, France, Germany, Spain, and the UK, the GLOBALG.A.P. has been united with their domestic GAP standards (Bešić et al., 2015).

According to the GLOBALG.A.P., producers should form an appropriate control and monitoring system. The registration of products is performed and it can be traced back to the farm where they were cultivated. The principles of GLOBALG.A.P. are highly flexible about farming activities like fertilizer usage. Nonetheless, there are solid regulations concerning the storage of pesticide and residue limits. Moreover, detailed records about farming activities should be formed (FAO, 2020a). Today, more than 200000 GLOBALG.A.P certified farms currently exists in 135 countries around the world (Anonymous, 2020a) (Figure 1).

Figure 1. Spread of GLOBALG.A.P in countries in the world (Anonymous, 2020b)

Due to the GLOBALG.A.P system being accepted all over the world and the advantages it serves to the producers, the count of certified producers has increased. The number of certified producers, which was 18000 in 2004, has soared over the years (Table 2) (Aba and Işın 2014). The highest number of GLOBALG.A.P certified producers was found in Spain, Italy and Greece countries in 2011-2012 (Table 3).

Years	Producer Numbers
2004	18000
2005	35000
2006	57000
2007	81000
2008	94000
2009	99500
2010	102300
2011	112575
2012	123115

Table 2. The Number of GLOBALG.A.P. Certified Producers by Years (Aba and Işın, 2014)

Country	2011	2012
	Number of producers	Number of producers
Spain	25923	29853
Italy	15892	18792
Greece	12414	10764
Germany	8997	8650
Netherlands	5288	9516
France	3737	3415
Belgium	3330	3186
Turkey	3009	2442
Israil	1337	1266
Other countries	11961	12923

Table 3. GLOBALG.A.P. Certified Producers by Country (Statista Research Department, 2013)

Quality assurance systems are implemented to produce safe and high quality foods. These control systems include GAP, Good Manufacturing Practices (GMPs), Good Hygienic Practices (GHPs), Hazard Analysis and Critical Control Point (HACCP) (FAO, 2020b). The main certification programs is HACCP for food processing activities. The focus of HACCP is to ensure food safety from production to packaging via process control protocols which avoid food contamination with microorganisms and the presence of residuals like stone and metal is controlled. HACCP serves a process revision from beginning to end and it includes the GMP certification requirements. HACCP is generated for applying on processed foods, while GAPs are only applied on fresh products. HACCP is obligatory by law for meat, poultry, seafood and juices producers, but it is not mandatory for other food products. GAPs is not legally compulsory and it is based on voluntariness (Rodriguez, 2017).

Objectives given below can be achieved by using quality standards for guidelines, definitions, and procedures. Actually, the usage of quality standards is based on voluntariness, nonetheless certain groups of stakeholders might want the application of these standards. Furthermore, some organizations and agencies could desire suppliers and partners using a specific standard as a prerequisite for doing business (ASQ, 2020).

- Fulfilling quality requirements for consumers
- Assuring that their products are safe
- Complying with regulations
- Reaching environmental objectives and standards
- Guarding products against negative conditions
- Assuring that internal processes are defined and controlled

2.1. Regulations and Certification Procedures for Good Agricultural Practices

The EUREPGAP Reference Standard Fruit and Vegetables (Version 2) was represented in "Towards Global Harmonization 2003" conference in Spain. The new versions of the documents has been reviewed and approved by the EUREPGAP. Version 2 certificate was valid after 2005. The new version (V3.0-Mar07) can only be used together with the new version of Control Points and Regulations. Certification with previous versions can be used until the end of 2007 (Baghasa, 2008).

GAP is a generally accepted set of agricultural rules, which consists of statutory environmental requirements and recommended guidelines. Adherence to environmental requirements and recommended guidelines reduces the risk of environmental pollution or deterioration. "Good Agricultural Practice" guidance material for farmers was prepared in cooperation with the Estonian Crop Research Institute and the Ministry of Rural Affairs.

The focus of the guidance material is the Water Act adopted in February 2019. The guidance material addresses the general objectives of water protection, the maintenance of groundwater and surface water status and protection against agricultural pollution. The guidance material includes explanations and recommendations on the use of fertilizers, manure and sewage sludge handling, silage storage, environmentally friendly plant protection and land improvement. Attention is drawn to the sustainable use and protection of soil and the rational choice of crops in land use. Adherence to the guidelines of good agricultural practice helps the farmers to organize production in a balanced way concerning economic objectives and performance as well as maintaining the good state of the environment (Anonymous, 2020c).

In Spain, at the national level, the Ministry of Agriculture, Fisheries and Food promotes the preparation of Good Practice Guides on various topics related to Agriculture. The Ministry works closely with Associations in the sector such as ASAJA, AFHSE, COAG, COEXPHAL, Agro-food Cooperatives of Spain, FEPEX and PROEXPORT. In 2015, the Guide of Good Practices for mixing in situ of plant protection products was published to establish recommendations on the mixing of certain plant protection products as pesticides in the field, as well as for the correct realization of mixtures in the field, in order that their preparation and use does not constitute a risk to human health or the environment, which is the object of the policies on the safe and sustainable use of plant protection products. For compliance with the European regulations contained in the "Hygiene Package", and more specifically based on Regulation (EC) 178/2002 on Food Safety, Regulation (EC) 852/2004 on hygiene of food products, and the Regulation 183/2005 on feed hygiene, European Member States are required to have a register of agricultural holdings, guidelines for good hygiene practices, and the maintenance of a control program for primary agricultural production. These instruments will serve as the basis for establishing a system that can guarantee the hygiene and traceability of primary agricultural production, so that it is possible to act quickly and efficiently in the face of alerts that may put human or animal health at risk. To respond to this, the Ministry of Agriculture, in collaboration with the sector, published in 2015 the Guide to Good Hygienic Practices in Primary Agricultural Production. The monitoring of this guide is voluntary, therefore it is an instrument that is made available to farmers to facilitate compliance with the hygiene requirements and obligations established in the so-called "hygiene package" and in Royal Decree 9/2015, of January 16, which regulates the conditions of application of community regulations on hygiene in primary agricultural production and thereby minimize the risks of contamination of their crops and the health risks for the final consumer.

At the regional level, the different Autonomous Communities of Spain have also published different Good Practice Guides in Agriculture. In the Castilla y León Region, the Good Practice Guide was published in 2006, offering recommendations on:

- Conserve biodiversity
- Maintain and conserve the soil
- Optimize water use
- Optimize energy use
- Rationalize the use of fertilizers
- Rationalize the use of phytosanitary
- Carry out good waste management
- Carry out sustainable agricultural practices
- Carry out good livestock practices

In 2018, in the Spanish Region of Aragon, the Aragonese Catalog of Good Agricultural Practices for low-carbon development and an agricultural sector more resilient to climate change in the development of the agroclimate was published. In 1998, the Ministry of the Environment, Agriculture and Water of the Murcia Region, an eminently agricultural region, launched the Code of Good Agricultural Practices. In various conferences promoted by the regional government focused on Good Agricultural Practices, experts from different companies and sectoral associations share agro-sustainable initiatives to carry out a compatible activity that is respectful of the environment. Measures such as the analysis of the water footprint, the carbon footprint, the green fertilizer, the reduction of containers and packaging, the adjustment of inputs and water supply to the needs of the crop, energy savings, the maintenance of native species in the cultivation areas, biological control or natural pollination ensure an agricultural activity compatible with the environment.

The "Regulation on Good Agricultural Practices" (no: 25577) formed the legal structure of the GAP in Turkey and it was firstly published in 8 September 2004. Now, GAP is performed according to the provisions of the Regulation on the GAP (dated as of 07.12.2010 official gazette no: 27778) in Turkey (Figure 2). On 28 May 2014, the recent change in regulations was announced on official gazette No: 29013. The Ministry of Agriculture and Forestry controls agricultural activities and gives the authority of certification to private audit firms. The audit firms applies to the Ministry in the scope of the regulation. After examining the application by the Ministry, their respective owners are given the authority to certify. Even though functions of the GAP and GLOBALG.A.P. are distinct, the same conditions are basically necessary for their certification procedures. GLOBALG.A.P. document must be got by bodies wanting to participate in the international Marketplace (Yılmaz et al., 2017). The requirement of Turkish legislation and GLOBALG.A.P. are almost the same. Nonetheless, Turkish certification do not have a worldwide acceptance (Koukouliu et al., 2008).

Resmi Gazete Tarihi: 07.12.2010 Resmi Gazete Sayısı: 27778

İYİ TARIM UYGULAMALARI HAKKINDA YÖNETMELİK

BİRİNCİ BÖLÜM
Amaç, Kapsam, Dayanak ve Tanımlar

Amaç

MADDE 1 – (1) Bu Yönetmeliğin amacı; çevre, insan ve hayvan sağlığına zarar vermeyen bir tarımsal üretimin yapılması, doğal kaynakların korunması, tarımda izlenebilirlik ve sürdürülebilirlik ile güvenilir ürün arzının sağlanması için gerçekleştirilecek iyi tarım uygulamalarının usul ve esaslarını düzenlemektir.

Kapsam

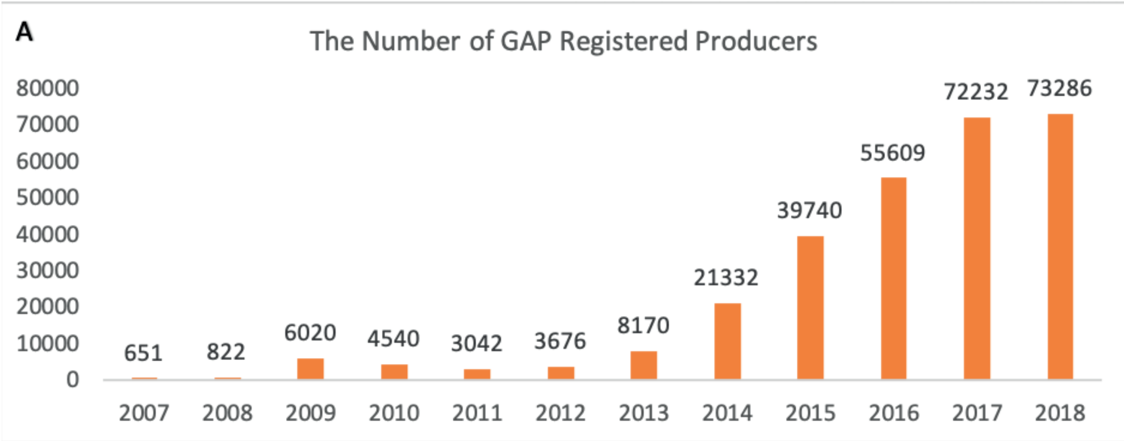
MADDE 2 – (1) Bu Yönetmelik, iyi tarım uygulamalarının genel kuralları, kontrol ve sertifikasyon sistemi ile komitenin, il müdürlüklerinin, üreticilerin, üretici örgütlerinin, müteşebbislerin, kontrol ve sertifikasyon kuruluşlarının, kontrolörlerin, sertifikerlerin ve iç kontrolörlerin görev ve sorumlulukları ile denetim esaslarını kapsar.

Dayanak

MADDE 3 – (1) Bu Yönetmelik, 18/4/2006 tarihli ve 5488 sayılı Tarım Kanununun 4 üncü, 5 inci ve 6 ncı maddelerine, **(Değişik ibare:RG-21/10/2011-28091)** 3/6/2011 tarihli ve 639 sayılı Gıda, Tarım ve Hayvancılık Bakanlığının Teşkilat ve Görevleri Hakkında Kanun Hükmünde Kararnamenin 8 inci maddesinin birinci fıkrasının (ç) bendine, 11/6/2010 tarihli ve 5996 sayılı Veteriner Hizmetleri, Bitki Sağlığı, Gıda ve Yem Kanununun 31 inci ve 43 üncü maddeleri ile 22/3/1971 tarihli ve 1380 sayılı Su Ürünleri Kanununun 13 üncü maddesine dayanılarak hazırlanmıştır.

Figure 2. Regulation on GAPs in Turkey

In Turkey, the number of GAP registered producers were 651 in 2007. The number increased and was found to be 73286 in 2018. Similarly, it has reached nearly 100 times in production areas between 2007-2018 (Figure 3) (Turkey Ministry of Food and Forestry, 2018).



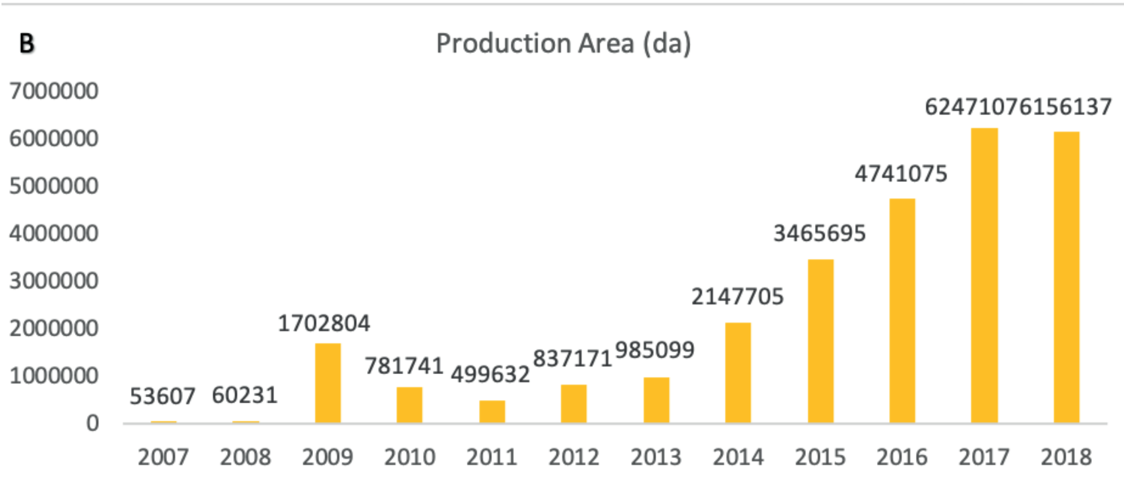


Figure 3.. . The Changes of the Number of GAP Registered Producers by Years in Turkey (A); the changes of area where GAP is implemented by years in Turkey (B

Producers who can apply according to the EUREPGAP Protocol can be grouped into three groups (İçel, 2007):

a) Individual certification

- Individual manufacturer applies for GLOBALG.A.P. (EUREPGAP) certificate.
- The manufacturer must perform an internal audit in accordance with the EUREPGAP checklist for review during the external audit process.

• Internal audit should be carried out at least once a year and these audits should be carried out under the responsibility of the manufacturer.
• The registered production area and related processing areas are audited once a year by the authorized institutions.
• Authorized institutions carry out a minimum 10% unannounced inspection among all certified producers that it has registered.
• External audit reports are formed concerning the EN 45011/ISO Guide 65 requirements.

b) Group certification

• Producer group (associations etc.) apply for this certification.
• More than one producer can gather under the umbrella of the producer group, institutionalize with a certain internal regulation and apply for a EUREPGAP certificate as a single institution.
• Each certified manufacturer must perform an internal audit in accordance with the EUREPGAP checklist to be examined during the inspection period.
• The groups are obliged to ensure that 100% of Eurepgap registered members perform their production according to the protocol with their own internal procedures and controls.

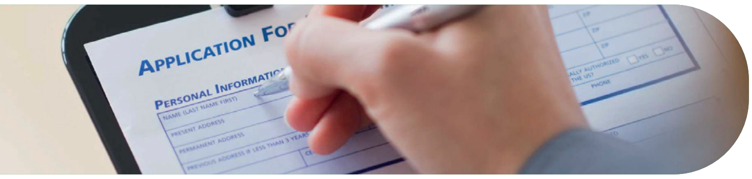
c) Equivalence (Benchmarking)

• It is made to ensure that certificates issued by national institutions and organizations with similar or equivalent standards to EUREPGAP are treated as if they were EUREPGAP certificates.

Certification Process

When producers determine to implement GAPs, they must follow the regulation on GAPs. These producers first need to apply the independent inspection and certification institutions authorized by the Ministry in order to register their production process. Then, the producer and the inspection and certification institution make a contract and this authorized institution inspects the production process of the producer. When it is proved that the producers comply with the defined criteria, the certification is given to the product (Figure 4) (Turkey Ministry of Agriculture and Forestry, 2020).

3 main steps of certification process are application procedures, control process and issuance of certificate (Olhan, 2017).



1. APPLICATION PROCEDURES

2. CONTROL PROCESS

3. ISSUANCE OF CERTIFICATE

Producer, Producer Organization or Entrepreneur's application for GAP control and certification procedures

▼

Realizing pre-control service when necessary

▼

Signing control and certification agreement

▼

Notifying to provincial directorate where agreement will be realized

▼

Determining control dates ofeach product by taking harvest date as a basis

▼

Notifying control dates to provincial directorate where control will be realized at least one week

▼

Performing the control as per current GAP criteria, requesting corrective activities if there is a non-conformity, taking sample for residual analysis and sending it to accredited subcontractor laboratorv.

▼

Examining control reports, residual analysis report result and non-conformity closure evidences if any by certificator and publishing the certificate if appropriate

Figure 4. GAP Certification Procedures (Anonymous, 2021; Yılmaz et al., 2017)

5 main steps so as to receive the GLOBALG.A.P. certificate are:

1. Firstly, the GLOBALG.A.P. documents should be downloaded and the link on the relevant standard page should be followed.
2. These documents should be compared with the certification bodies in your country. Then, the registration should be done with the one you choose.
3. A self-assessment should be performed using the checklist and all the parts not complying with. A GLOBALG.A.P. should be corrected.
4. An appointment with your GLOBALG.A.P. approved certification body should be arranged. Afterwards, the first on-site inspection will be performed by an inspector.
5. When you accord with the standard's requirements, you will receive a GLOBALG.A.P. Integrated Farm Assurance Standard certificate and it is valid for one year (Anonymous, 2020d)

GLOBALG.A.P. certification cycle will be 12 months, depending on the scope of sanctions and extensions defined. A certificate must be issued with a first validity period of 12 months. The validity can only be extended after 12 months (provided that after the next cycle is re-accepted, a maximum of 3 months for herbal products and a maximum of 6 months for livestock) (Güzel, 2012).

GLOBALG.A.P. (EUREPGAP) certification means that (Akkaya et al., 2005):

- Product is free of microbial, physical and chemical residues that can be harmful for human health
- Production method is environmentally-friendly
- Food meet the essential requirements for consumers and producers in producer and importer countries

3. The Supports and Examples of GAPs for Farming in Turkey and Europe

All over the world, a lot of farmers and agri-food practitioners face difficulties in terms of understanding and applying the GAP standards which was set by national or international authorities. Thus, they think that GAP standards will prevent many of their farming activities. Moreover, an important number of farmers using traditional farming techniques believe that GAP gives affront to their practices (APO, 2016). However, their ideas and perspectives about GAPs can change by introducing them supports and good practices.

The average income of farmers is relatively lower than average incomes in the rest of the European Union (EU) economy (Figure 5), it shows us that they need support. Farming is generally over costing and risky business. The climate condition has more significant effect on agriculture compared to other sectors. Farmers need time and investment in order to increase the supply (e.g. for more wheat or milk). The increasing global trade in foods and trade liberalisation lead to pressure on EU farmers. The competition is increased by the developments on global markets, which also creates new opportunities for the European agri-food sector. Also, agricultural market prices are more variable in recent years owing to globalisation and fluctuations in supply and demand. These variations in agriculture justify the crucial role of the public sector in terms of ensuring a safety net for income of farmers (EC, 2020).

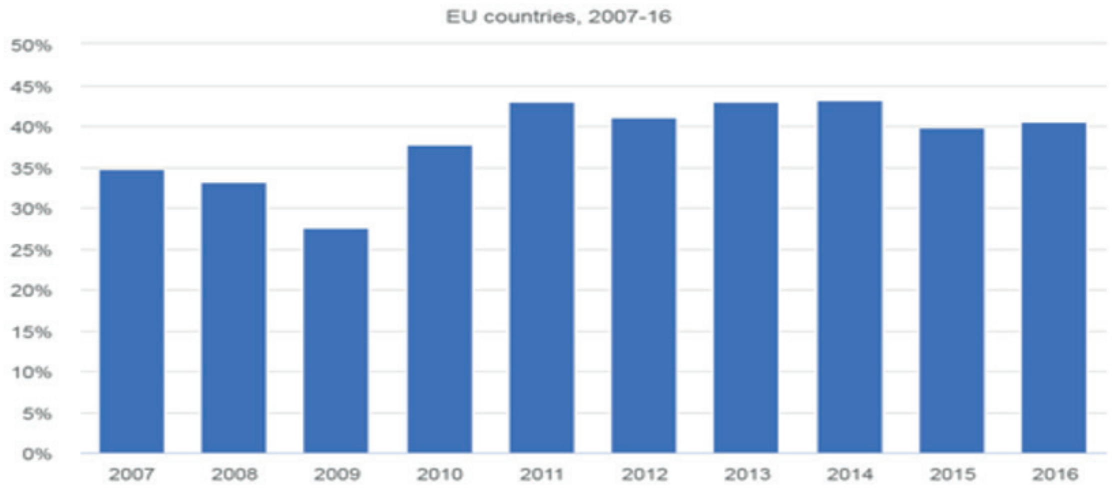


Figure 5. Farm income per family worker compared to wages in the wider economy (EC, 2020)

Income support and direct payments are provided by the EU to function as a safety net and make farming more profitable and secure and help them for healthy and affordable food production and award farmers for protecting public goods. Income support is received by farmers according to their farm's size (hectares). Whole countries in the EU must offer a basic payment for sustainable farming methods ("greening") and young farmers. These payments are often obligatory payments for EU countries. Furthermore, these countries may select to offer other payments focusing on specific sectors or types of farming. Specific schemes are designed to assist different sized farms, young farmers and/or sectors experiencing difficulties (EC, 2020).

Farmers should ensure some eligibility conditions given below so as to get income support:

- They should have farm located in the EU;
- They need to fulfill the minimum requirements to get income support, which is not granted for amounts lower than €100 to €500 and/or where the eligible area is less than 0.3 to 5 ha;
- They should carry out an agricultural activity (such as production, rearing or growing of agricultural products, etc.) on their farms;

• They must meet the "active farmer" definition. People operating an activity on the list like airports, waterworks, real estate services, railway services and permanent sport were not considered as "active farmers" if not they could show that their farming activity was not restricted. This condition is optional and only 9 EU countries apply this provision from 2018 (EC, 2020).

In 2018, in Turkey, the support payment of 50 TL/decare and 40 TL/decare were made for fruit and vegetable producers with individual and group certification, respectively. 150 TL/decare was paid for greenhouse growers. 100 TL/decare and 80 TL/decare were paid for ornamental plants, medicinal and aromatic plants producers with individual and group certification, respectively. A support payment of 10 TL/decare was made for rice producers with individual and group certification, and 0.25 TL/decare was given for seafood (sea bass, trout and sea bream) producers (up to 250000 kg). In 2018, 203199000 TL were paid to 65733 Turkish producers in the area of 4462618 within the scope of GAPs in Turkey (Turkey Ministry of Food and Forestry, 2018).

The efficiency of the GAP protocol was evaluated in greenhouses in terms of microbiological-quality of tomatoes and peppers in Greece. 240 vegetable samples that are produced under the GAP protocol tested and satisfactory quality results (L. *monocytogenes* absent per 25 g; E. Coli<20 CFU/g; total coliforms 4.37–4.68 log CFU/g; aerobic plate counts 5.78–5.92 log CFU/g) was obtained. According to results, it was concluded that the GAP protocol can decrease microbial hazards for consumers and also can establish practices in keeping with basic EUREPGAP requirements (Kokkinakis et al., 2007).

In the study in Murcia, Spain, the impact of some fungicide residues was examined in relation to the aroma composition of Monastrell red wines concerning the concentration of each pesticide and odour activity values. 2 fungicide treatments were performed following the manufacturer doses. The first one was performed under GAPs and the second one was performed under critical agricultural practices (CAP), applying at the day of harvesting. In the study, all tested pesticides (famoxadone, fenhexamid, fluquinconazole, kresoxim-methyl, quinoxyfen and trifloxystrobin) affected the aromatic content of the Monastrell wines. It was seen that the fluquinconazole and fenhexamid applied wines under GAP had the best sensory properties (Oliva et al., 2008).

While the number of provinces where good agricultural practices were implemented within the scope of the regulation published in 2004 was 18 in 2007, it became 63 in 2018, showing a bumpy graphic in the past years in Turkey. In the study by Subaşı et al. (2016), it was aimed to compare the economies of the companies according to whether they implement or not implement GAPs in citrus production in Mersin/Turkey province. In general, it was observed that although the producers who apply GAP practices in lemon, orange and mandarin production obtain relatively lower products, they have made a more profitable production compared to the producers who do not apply GAP due to a lower amount of pharmaceutical, fertilizer and irrigation water used.

A general assessment of good agriculture certified strawberry cultivation has been made by Tok (2019) in Aydın in Turkey, where strawberry production is intensive. In the study, some of the characteristics of the enterprises, the publication-information status of the companies/ producers, the sustainability of strawberry production, information communication systems for good agricultural practices, human health and environmental sensitivity of the producers have been tried to be revealed to a certain extent. It is determined that producers try to grow their products within a certain systematic framework with good agricultural practices. In addition, it has been determined that the producers are trying to cooperate with many public and private sector organizations for the production of better quality, clean and healthy strawberries, based on the expectation of selling their products at higher prices.

Aydın et al. (2016) conducted a study related to the comparison of farmers who apply and do not apply GAP in Çanakkale. 31 peach and 24 cherry producers applying GAP attended the survey. The same number of producers, not applying GAPs, also attended. The cost of producing one kg of peach is 1.34 TL at the firms applying GAP. 1200 kg average yield was obtained. Gross output production value, gross profit, absolute profit and relative profit values were found as 3025 TL, 2084.26 TL, 1416.88 TL and 1.88 respectively. However, the cost of one kg of peach production was 1.37 TL at the firms not applying GAP. 1100 kg average yield was obtained. Gross output production value, gross profit, absolute profit and relative profit values were 2775 TL, 1887.46 TL, 1262.52 TL and 1.83, respectively. Cherry production cost was 1.23 TL for 1 kg at the firms applying GAP. 1500 kg yield was averagely obtained. The cost of one kg of cherry production was 1.25 TL at the firms not applying GAP. 1400 kg yield was obtained.

Karabat et al. (2016) investigated the profitability of a total of 25 grape producers in Manisa/Turkey province and the effects of GAP on this profitability. As a result of the study, it has been observed that the production of table grapes with GAP certification increases both the product price and the yield. The cost per kg of grape is 0.66 TL, average yield is 3720 kg/decare, sales price is 1.22 TL/kg and relative profit is 1.85 for producers with GAP certification. For non-certified producers, the cost is 0.73 TL, the average yield is 3112 kg/decare, the sales price is 1.05 TL and the relative profit is 1.43. When the values were analyzed, the researchers concluded that the products grown with GAP had higher profitability.

The impacts of GAPs on retailers were also studied in Turkey. In 2010, a retail sector as a first have launched their good agricultural practices in Turkey and introduced them to consumers of these products. The company first contacted the producers especially in the Mediterranean and Bursa regions and encouraged the transition to GAPs by increasing the potential of these producers to supply their products. In this way, the company's transition to GAPs has enabled producers to make world-class agricultural production and to sell these products regularly and steadily. As a result of this method, in 2015, the company supplied products from 882 producers having 245 GAP certificates for 117 products. Following the transition to GAP, the average basket of the company in fresh food increased by 32%, and the rate of being preferred by consumers in vegetables and fruits increased even more. After vegetable fruit, it started to produce in accordance with GAP rules by establishing its own facilities in white meat and red meat production. As a result, 20% increase in white meat sales and 13.5% increase in red meat sales (Yaşar, 2017).

4. General Information about Precision Farming

For many years, "Precision Farming" or "Precision Agriculture" terms have been used in agricultural science. The first appearance of precision farming happened in 1992 in USA and then it started to be mentioned in many conferences. In literature, many different definitions of precision farming exist. Certain definitions are related to the strategic nature of precision farming; how to get data and how to convert it into information for decision-making. Others focus on production system and management adaptation sides of precision farming. In most wider definition, the precision farming is regarded as an information technology applied to agriculture. Different technologies and agronomic principles are applied in precision agriculture to direct spatial and temporal variation related to agricultural production so as to increase crop performance and environmental quality (Beluhova-Uzunova and Dunchev, 2019).

The basic rules underlying precision farming are also inevitable for GAPs and they are stated below (De Baerdemaeker, 2013).

- Correct information
- Correct observation
- Correct analysis
- Correct genotype
- Correct dose
- Correct chemical or biological compound
- Correct place and time
- Appropriate climatic condition
- Correct equipment

Soil management in traditional agriculture production environment is made by handling and operating in a uniform manner. Although producers know that they obtain different amounts of products from different parts of their fields or have different soil structure, they cannot evaluate this information for production. For this reason, they always apply the same amount of fertilizer and pesticide needed by the plant grown in the field, regardless of size, as a whole. This approach causes some places in the land to receive more input and some places to receive less input. Precision farming is a form of business that occurs by the grower using the information technologies to correctly identify, understand the variability in their land and apply the appropriate input to this variability in the lower parts of the land (Vatandaş et al., 2005).

The information technology and various items like GPS guidance, control systems, sensors, robotics, drones, autonomous vehicles, variable rate technology (VRT), GPS-based soil sampling, and software are used in precision farming approach (Schmaltz, 2017).

4.1. Technologies Used for Precision Farming

Today, agriculture is an important activity for all countries. On the same land area, farmers have to produce more agricultural products in spite of limited resources. A significant increase has occurred in order to meet worldwide food demand by means of improved farming technology (digitalized, smart, GPS-navigated, and more precise). The precise farm technology usage has brought a novel approach to farming activities. Farm productivity and profitability that are the main goal of most farmers can be optimized by means of precision farming (real-time information and decision making). Also, the use of inputs (pesticides, water, seeds etc.) is decreased and the natural sources are protected (Folnovic, 2020a).

Precision farming relying on technology is used for farm management. A lot of new technologies are developed in the scope of precision farming within years. Some of them are remote sensing, global positioning system (GPS), automated steering system, geo-mapping and VRT (Figure 6). When these technologies are used together, they provide a reliable information concerning farm management practices; for example, harvesting, fertilizer and pesticide application (Folnovic, 2020a).

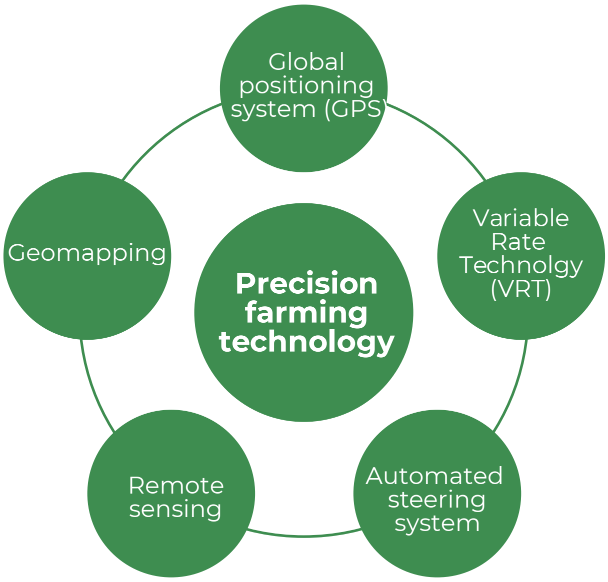


Figure 6. Technologies Used for Precision Farming (Folnovic, 2020a)

Global Positioning System (GPS)

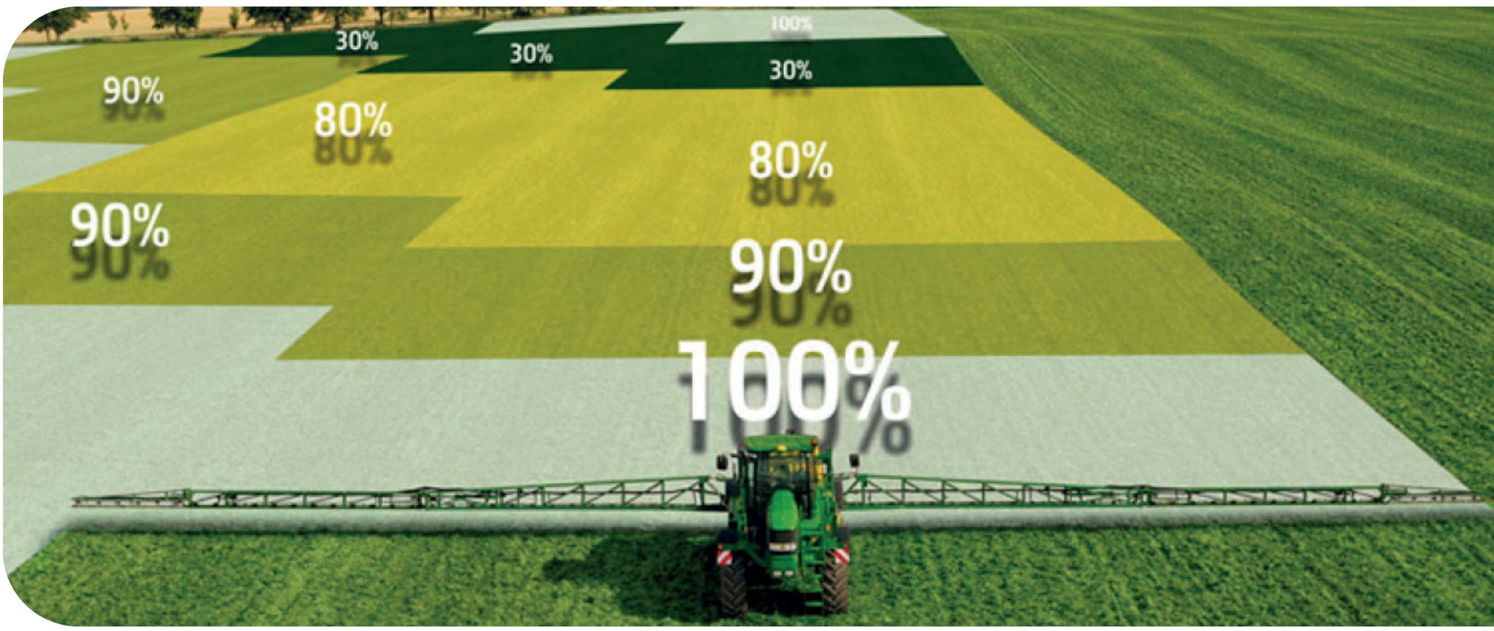
Even though global positioning system mainly started as a navigation system, it reformed positioning concept. Now, the GPS is an international program. GPS is very popular owing to its high accuracy in determining position, time and direction and it is easy to use in all-weather conditions. Satellites of GPS send signals which permits GPS receivers to calculate their position. While it is in motion, continuous position information is provided. Crop, soil and water measurements could be mapped via this precise location information. GPS receivers give permission users to turn back to specific locations to sample or handle these areas (Figure 7) (Shanwad et al., 2002).

Figure 7. GPS for precision farming

In precision farming, some of GPS applications are soil sample collection, chemical applications control and harvest yield monitors. By means of GPS, soil samples are collected from a predefined grid. Information related to chemical property of soils (such as nitrogen and organic material) can be got after testing of samples. These data are mapped and they are used as a reference to lead farmers. By this means, these farmers can solve their soil problems economically and efficiently. GPS and aerial guidance system can be integrated and it can show the way to the field sprayer through a moving map display. The chemicals will be applied at the ideal point, time and rate based on the sprayer's location. It ensures that chemicals and fuel are utilized ideally and the productivity is enhanced. Moreover, crop yields are mapped via GPS (Figure 5). Yield rates can be recorded when GPS-equipped harvester moves across the field. Then, these data are mapped to indicate the rate of yield (El-Rabbany, 2006).

Variable Rate Technology (VRT)

By means of VRT, farm inputs such as irrigation water, lime, fertilizer and pesticides can be applied at different rates across a field. It is not necessary to change rate settings on equipment manually or have to make many passes over the field. In VRT technology, materials are applied at variable rate. In variable rate application (VRA), flow rate, chemical mix, application pattern and rate management can be controlled. Certain input rates may cause a more efficient system and minimising potential environmental impacts, VRA can match these changes with potential of crop yield. Advantages of VRA are usually higher when the input cost is comparatively higher, the spatial variation is larger, the fewer rate changes are required and variability patterns are more stable (SRA, 2014).



VRT might be utilized to cope with spatial variability between lands or between management zones. Two types of VRT exist as stated below (SRA, 2014).

1. Map-based VRT: A map of landscape is generated according to soil analyses. Within each zone of the map, the information is used to control the application rates. It is a popular approach because it allows the creation of prescription maps (Decipher, 2020).

2. Real-time control: During the operation, data are collected and decisions are made about what rates to be applied in various locations. It requires sensors to specify essential information 'on-the-go' and is generally designed for a specific job like herbicide application (SRA, 2014).

Geo-mapping

In this technology, maps of different soil and crop conditions (such as pH, type of soil, soil nutrient level, pest occurrence etc.) are created. Maps of soil are formed via sensors attached to a vehicle or from a distance, by airplanes, remote sensing drones and satellites. By means of sensors and GPS, datas are collected from areas and this information is used to evaluate soil and crop health. Farmers, using the geo-maps, can obviously detect alterations in soil properties and ensure a matching output (Figure 8) (Folnovic, 2020a).

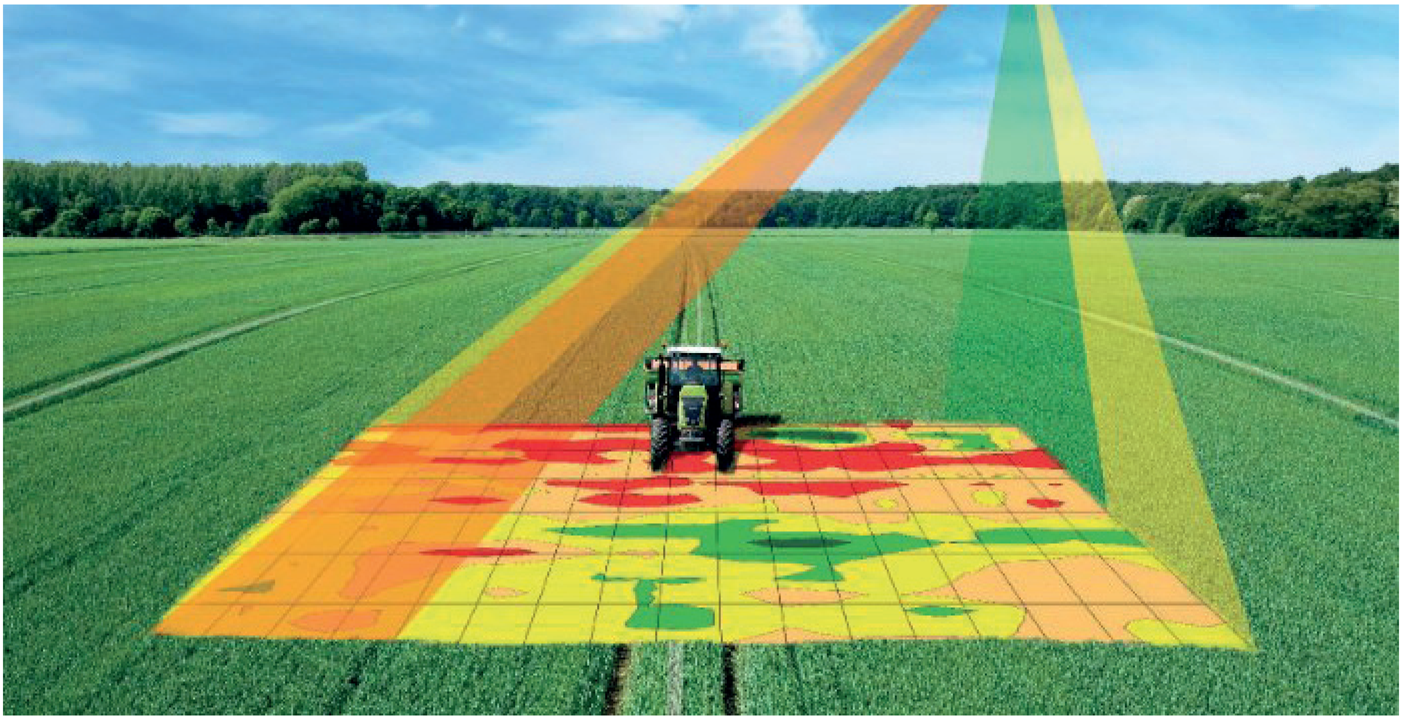
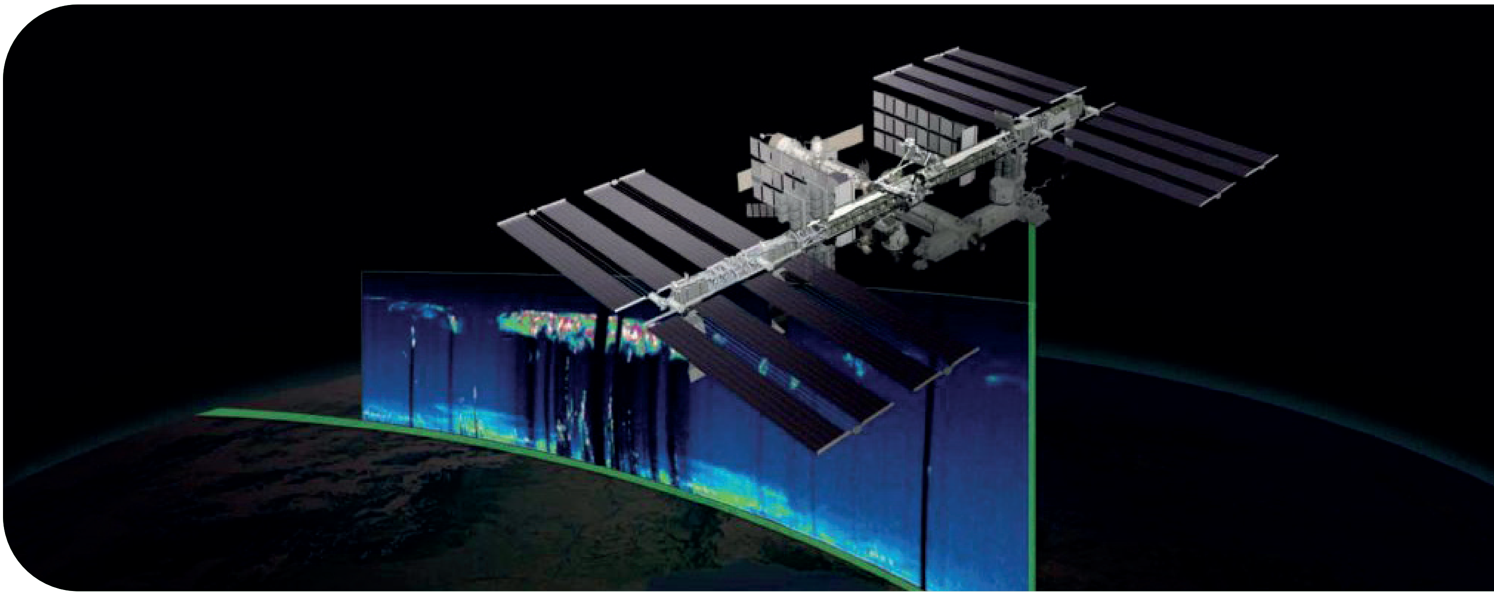


Figure 8. Sensor on a Tractor Mapping the Soil Properties

Remote Sensing Technology

After 1960, this technology has been started to be used in agriculture. Remote sensing is the science of getting data about areas from a distance, generally from satellites, drones and planes. The energy which is reflected from Earth is collected by remote sensors (NOAA, 2017). It is a golden tool in terms of monitoring and managing water, land or other sources. At a specific point and time, it may aid determine everything from which factors may be stressing for agricultural products. On the farm, decision-making process is enriched by using this information (Schmaltz, 2017).



Automated Steering System

The vehicle can be automatically steered by means of navigation systems. Human error could be decreased by auto-steering system. Farmer can control the equipment better and effective field management can be provided (Folnovic, 2020a).

4.2. Level of Information

As stated in Figure 9, information quality is developed by means of 4 phases, which are data, information, knowledge and wisdom. A set of signals and numerical values creates data-phase. In information phase, meanings of a set of data are provided. Knowledge-phase means individualization of information, which can give one to make a decision, such as application guidelines. A farmer can create an original solution in wisdom phase. In levels up to knowledge-phase, information technology inclines to be powerful; however, intellectual and creative activities are necessary for the wisdom phase. Whole phases of information and linkage between phases are essential on the agricultural production system for precision farming. The information technology needs to be improved to collaborate with the wisdom activities (Shibusawa, 2001).

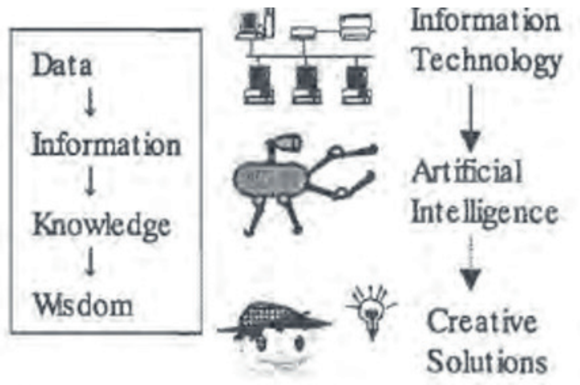


Figure 9. Level of information (Shibusawa, 2001)

4.3. The Importance of Precision Farming

Today, for farmers, one of the biggest problem is the necessity to assure food products for a rapidly increasing population, while balancing climate change and scarce water problem. Climate change leads to new demands on land and environmental resources. It is supporting opportunities for the development of novel crops and systems, which increases food production and protects the environment. Engineering developments and technology are used in precision farming to create novel efficiency dimensions and environmental management. Some of these technologies are nanotechnology, use of GPS and drones to advocate more accurate farming methods. By means of precision farming, farmers can select the right inputs and apply the right amount at the right rate. For instance, technology can be used by farmers to determine fertiliser where it is most needed. Fertiliser is applied more accurately in terms of doses across the field instead of applying it at the same amount in whole field. In the end, the cost decreases, the yield increases and the effect on the environment diminishes due to decreasement in the spread of liquid and solid based applications. Similarly, the use of fossil fuel based machinery and synthetic fertilizer causes greenhouse gas emissions, precision farming helps to stop these emissions (CLA, 2015).

4.4. Advantages and Limitations of Precision Farming

An approach of directing small areas in fields assuming all fields as one unit is called precision farming. A lot of farmers stated the importance of using site-specific data in order to manage chemicals, nutrients, water and other resources more efficiently. Precision agriculture is relevant developed technologies in satellites and computers. Most of the farmers do not unfortunately possess the financial or physical resources to operate. Nevertheless, this farming technique could still be applied to promote different crop management decisions even without costly technologies. Many advantages of precision agriculture exist but there are some limitations of this farming technique. These limitations need to be considered before adopting the technology (Ondoua, 2017; Folnovic, 2020b).

Benefits

- The soil and plant physicochemical parameters (temperature, soil moisture, nitrates etc.) can be monitored by placing sensors. By this means, the ideal conditions can be found for the plant growth.
- Data in real time can be obtained. The using of sensing devices in the area will permit a continuous monitoring of the selected parameters and will provide real time data. An updated status of the area and parameters of plant can be ensured at all time.
- For management decisions, better information will be provided.
- Time and costs will be saved. Chemical application costs and pollution will be reduced.
- Essential farm records will be provided for sale and succession.
- It can be integrated with management software which makes all activities on farm more easy and increase productivity.
- By means of GPS, fields can be surveyed easily.
- Maps concerning yield and soil characteristics can be created.
- Irregular fields can be split into smaller areas according to their particular needs.
- Opportunities are provided for better resource management and so wastage could be reduced.
- The risk to the environment can be decreased concerning nitrate leaching and groundwater contamination by means of the agrochemical products optimisation

Limitations

- Technologies are developing rapidly so people find difficult to follow these advances
- Due to lighter air frames, poor quality images can be obtained
- It should be considered that data collected using different drones and sensors can't be compared among each other (especially if they are not calibrated). Knowledge, time and specialized software are required for doing calibration
- The biggest limitation for farmers is that they do not know how to interpret the data obtained
- High initial capital cost
- For implementing the system fully, many years are necessary
- It is not easy work to collect and analyse data

5. Conclusions

Unemployment is still highly prevalent among young people in Europe. FAO consider agriculture to be among the most viable potential source of employment for youth. However, young people do not find farming activities attractive and they continue to leave rural areas at alarming rates. Thus, the youths' participation in the agriculture sector is becoming a prominent issue economically and socially. The main source of income is probably coming from agriculture in developing countries and it is crucial to connect young generation to farming. Unfortunately, there are several problems that these people faced in the sector. One of them is that youth lacks skills required on the job market. Survey showed that knowledge and skills of farmers about precision agriculture and GAP is considerably limited and this situation decreases people's self-confidence and desire to start agri-food businesses. Thus, activities and training programs are needed to improve their skills related to GAP and precision farming, training plays a crucial role where youth employment is concerned. This training material contains useful information related to GAP and precision farming which can enhance the competency of target groups.

It can be concluded with the following information that:

- The significance of healthy and safe food consumption is rising and GAPs are born in this context.
- A sum of principles which is applied on-farm and post-production processes forms GAPs.
- EUREP established EUREPGAP standards, which form the basis of today's GAPs.
- GAPs cover all stages from production and marketing and they decrease negative environmental effects of farming activities, diminish the chemical use, decrease the non-compliance risk with regulations and guidelines regarding maximum levels of contaminants and protect worker and animal health and safety.
- GAPs can used for crop farms and reared animals.
- GAP concept is different from ecological or organic agriculture.
- There are links between GAPs and human health and the environment.
- In the field of food industry, GLOBALG.A.P. certification is used the most commonly in the world.
- Producers who can apply according to the EUREPGAP Protocol can be grouped into three groups: individual certification, group certification and equivalence.
- Three main steps of certification process are application procedures, control process and issuance of certificate.

- An information technology applied to agriculture refers to precision farming.
- A lot of novel technologies have been developed over years for precision farming. Some of them are GPS, remote sensing, geo-mapping, and VRT etc.
- Information quality is developed by means of four phases (data, information, knowledge and wisdom)
- Even though there are certain disadvantages of precision farming, it is clear that using this technology can greatly increase the benefits of farmers who determined to apply this technology.

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Project Number:
2019-3-TR01-KA205-079155

2021