THE IMPORTANCE OF AGRICULTURAL EXTENSION IN REDUCING PESTICIDE USE IN LINE WITH THE GREEN DEAL TARGETS

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Abstract

Within the scope of the green deal, it has been determined that there is an urgent need to reduce the dependence on pesticides in line with the sustainable agriculture goal. However, chemical control is still one of the most preferred methods because it is easier than other control methods and results can be obtained in a short time with less labor. The total amount of pesticide uses in Turkey in 2020 increased by 4.63% compared to 2019 and reached 53,672 tons. Fungicides 38.38%, herbicides 24.69%, insecticides 23.00%, acaricides 4.10%, rodenticides, and molluscicides 0.52%, and others 9.31% constituted of total pesticide use. The provinces with the highest pesticide use in Turkey are Antalya, Manisa, and Adana, where agriculture is also intensive. In the study, the current situation of pesticide uses in Turkey, the issues to be considered for reducing pesticide use, the importance of agricultural extension in reducing pesticide use in line with the green deal targets were analyzed. In addition, the reduction of pesticide use, which is included in the green deal targets, has been evaluated in terms of the EU and Turkey. The research was conducted using secondary data. Agricultural extension is one of the most effective ways to reduce pesticide use by farmers. Agricultural extension accelerates knowledge transfer, helps farmers become better managers, and acts as a bridge to bring knowledge from global research to farmers. Individual, group, and mass extension methods should be used to reduce pesticide use. Especially in Turkey, socio-economic characteristics of farmers and pesticide use vary according to regions. Agricultural extension activities should be carried out with this in mind.

Keywords: *agricultural extension, green deal, pesticide, Turkey*

1. INTRODUCTION

According to the neo-classical capitalist world view that emerged with the industrial revolution, producing a lot is called prosperity, and consuming a lot is happiness. However, environmental problems have been ignored [1]. After the industrial revolution, concepts such as global warming, climate change, carbon emissions, and the greenhouse gas effect have emerged. In December 2019, Ursula von der Leyen, President of the European Union Commission, announced the European Green Deal (EGD). This program has completely changed the agenda in many areas on climate change. In this context, the European Union (EU) aims to be climate neutral by 2050 in order to protect human life, animals and plants by reducing pollution. The Green Deal, as the EU's new growth strategy, is not just designed to improve people's well-being. At the same time, as part of the new growth strategy, making Europe climate-neutral and protecting natural habitats will have a positive impact not only on people, but also on other living things, the economy, and the entire planet, and will make their well-being sustainable [2]. Growing environmental and climate problems in the EU have become a problem in all sectors, including agriculture, and the search for solutions has begun. In order to overcome these problems in the sectors, the most important issue is the change of production methods. [3, 4]. Strategies and sustainability programs are implemented on the basis of sectors in the EU. Despite the desired change in the agricultural sector, this change is still insufficient. Adaptation and transformations to the green economy within the scope of the EGD's were also included in Turkey's Medium Term Program. Studies will be carried out to reduce the use of pesticides, antimicrobials and chemical fertilizers in our country in line with the targets set by the EU, which is Turkey's largest market, for the reduction of pesticides and antimicrobials [5]. Within the framework of studies aimed at reducing the use of pesticides, cultural,

physical, mechanical, biological, and biotechnical control methods should be emphasized before chemical control. Especially in recent years, with the increase in environmental awareness, it is important to popularize the use of biotechnical and biological control methods that do not have any negative effects on the environment, non-target organisms and humans. Agricultural extension is one of the most effective ways to reduce farmers' pesticide use. Agricultural extension accelerates knowledge transfer and helps farmers become better managers. The information obtained by national and international researchers is delivered to farmers through agricultural extension. The agricultural extension improves farmer decisions, contributing to increased productivity, potentially agricultural development, and higher incomes [6, 7, 8]. Agricultural extension services are widespread all over the world and more than 90% of agricultural extension in developing countries is done by the public sector [9]. Recently, agricultural extension has started to change as a public and private consultancy service. Agricultural extension systems have become more pluralistic over time, based on multiple distribution mechanisms and alternative financing sources in the public and private sectors [10, 11, 12]. In this study, the importance of agricultural extension in reducing pesticide use in Turkey in line with the green deal targets has been analyzed.

2. MATERIALS AND METHODS

Secondary data were used in the study. As secondary data, sector reports, and national and international articles prepared by institutions and organizations were examined. In addition, the databases of the United Nations Food and Agriculture Organization and the Turkish Statistical Institute were used. In the research findings, the current situation of pesticide use in Turkey, the issues to be considered for reducing pesticide use, and the importance of agricultural extension in reducing pesticide use in line with the green deal targets were examined. The section on pesticide use in EU-28 and Turkey was written controversially with support from the literature.

3. RESULTS

3.1. European Green Deal and Agriculture

The EGD, put forward by the European Commission at the end of 2019, aims to decarbonize Europe by 2050, as the long-awaited final climate action plan of the EU; for this purpose, it envisages a radical transformation in the economy and achieving climate neutrality (harmlessness) in the European continent (Figure 1). The aim of the EGD, which has been determined as a new strategy for growth, is to reach net zero greenhouse gas emissions by 2050 and to create a competitive economy with the optimal and efficient use of natural resources [2]. This deal is a supplementary part of the strategy aimed at implementing the UN 2030 Agenda for Sustainable Development and the Sustainable Development Goals [13].

For this purpose, measures have been taken to expand agriculture and increase the role of farmers in protecting the environment. In addition, food security and rural development processes were supported [14].

3.2. Turkey Green Deal and Agriculture

The agricultural sector plays an important role in feeding the world population and ensuring food security [15, 16, 17]. The agricultural sector has a different level of importance in terms of many socio-economic criteria depending on the level of development in the country's economy [18]. Turkey ranks 7th in the world in terms of agricultural production value and 1st among European countries [19]. The agricultural sector is a sector dependent on natural events. Therefore, it is very important to prevent the negative effects of climate change on agricultural production and to adapt agricultural production to climate change. At the same time, the agricultural sector accounts for a large part of greenhouse gas emissions [20]. The United States is the country in the first place in terms of greenhouse gas emissions from agricultural production in the world. Turkey ranks 5th in greenhouse gas emissions originating from agricultural production [21]. Therefore, a will has been put forward in terms of adapting to the green

economy transformation process in Turkey, and this has increased the expectations in the transformation process. In addition to this important step towards the protection of the environment, thanks to this harmonization, a new dynamic will come to the relations between Turkey and the EU, as the EU's green deal rules are based [22].

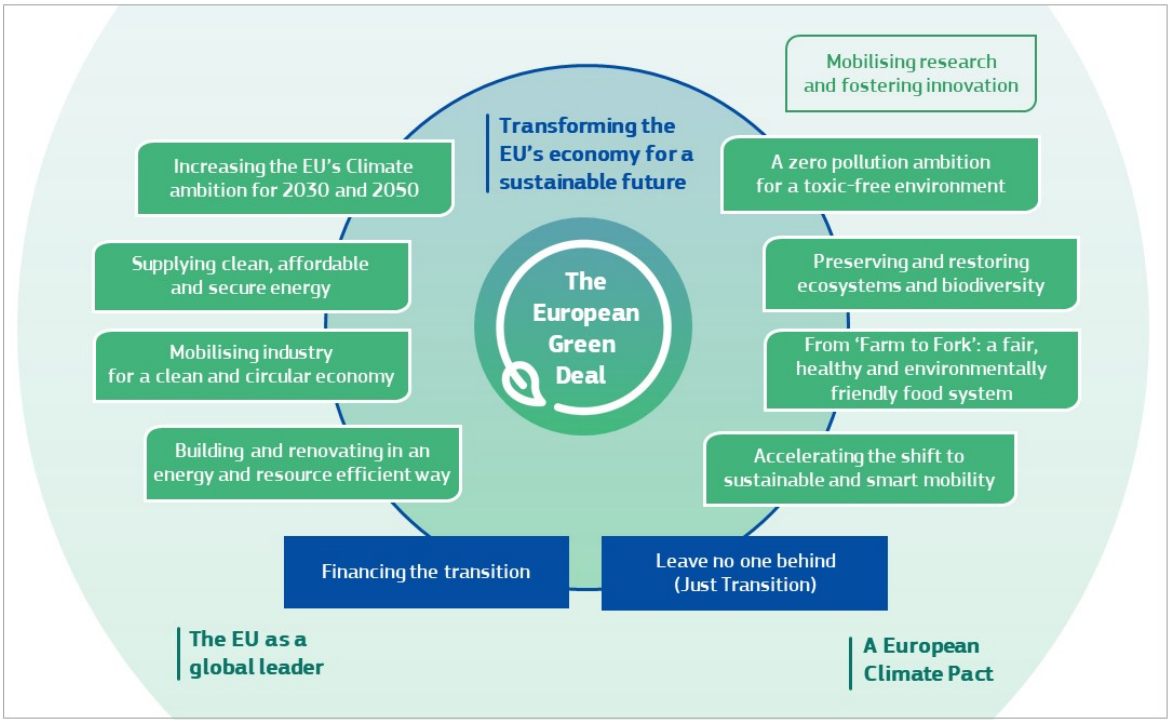


Fig. 1. Elements of EU Green Deal Agreement

Source: [2]

As envisaged in the EGD, the Ministry of Industry and Technology has started to take steps for the transition to a circular economy by making arrangements within the framework of environmentally friendly and green economy in the field of industry with the 2023 Industry and Technology Strategy. Turkey's Green Reconciliation Action Plan lists the actions planned to be carried out under 9 headings, including 32 targets and 81 actions. These titles [5]:

• Border carbon regulations,

• A green and circular economy

• Green financing,

• Clean, economical, and safe energy supply,

• Sustainable agriculture

• Sustainable smart transportation,

• Combating climate change,

• Diplomacy,

• EGD information and awareness activities.

3.3. Pesticide Use in Turkey

Chemical control is still one of the most preferred methods because it is easier than other control methods and results can be obtained in a short time with less labor. The total amount of pesticide uses

in Turkey in 2020 increased by 4.63% compared to 2019 and reached 53,672 tons. Fungicides made up 38.38% of total pesticide use, herbicides 24.69%, insecticides 23.00%, acaricide 4.10%, rodenticides, and molluscicides 0.52%, and others 9.31% (Figure 2).

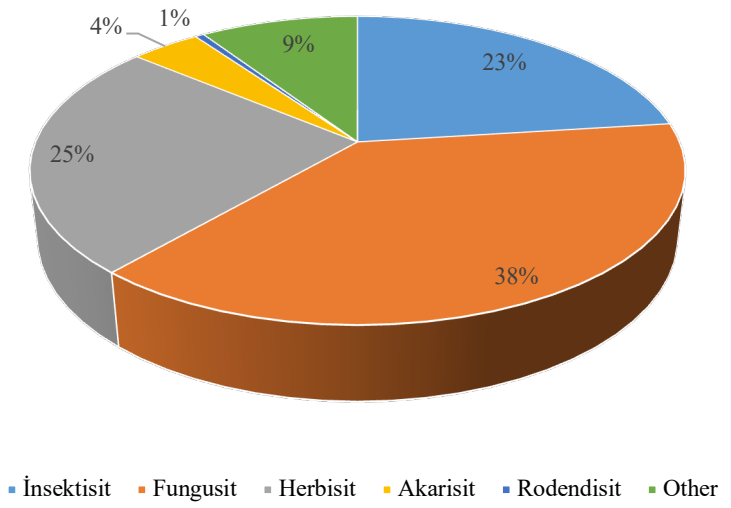


Fig. 2. Amount of pesticides used in Turkey, 2020 (%)

3.4. Reducing pesticide use

Unfortunately, chemical control is the first method that comes to the minds of farmers in the control of diseases, pests, and weeds all over the world. Pesticides play an important role in agriculture. They are used to protect our products from diseases, pests and weeds, but if they are not used carefully and consciously, they have negative effects on the environment and human health [23, 24, 25, 26, 27].

Reducing pesticide use is a shared responsibility of not only farmers, but also of society as a whole, including scientists, consumers, governments and the private sector [25]. So, what should we do to reduce pesticide use? First of all, in order to reduce pesticide use, farmers need to use cultural, physical, mechanical, biological, and biotechnical control methods instead of chemical control in the control of pests, diseases, and weeds. However, the advantages such as easier application of chemical control compared to these control methods, being effective in larger areas with less labor force, and getting results in a short time make this situation difficult.

Some researchers have listed the steps to be taken to reduce pesticide use under the following headings: agronomic practices, resistant varieties, bio-control and natural pesticides, integrated pest management, agroecology, organic agriculture, optimal use of chemical active substances and use of less hazardous pesticides [25, 28]. For example, Pimentel [29] declared that fungicide use can be effectively reduced through the employment of crop rotations, monitoring, and forecasting, and also a reduction of approximately 50% can be achieved by using non-chemical alternatives instead of some herbicides and fungicides used in 40 main products. In another study, it was concluded that crop insurance is a very important way to reduce pesticide use [30].

Determining the reduction in pesticide use first requires a good follow-up. Therefore, improving pesticide use monitoring will facilitate the EGD's target of reducing pesticide use by 50% by 2030 and encourage a move towards a more sustainable agri-food system [31].

Maybe, for now, it is not possible to completely remove pesticides from agricultural production. However, using it by paying attention to the economic injury level will prevent us from using more pesticides than necessary, and thus, there will be fewer negative effects on humans, the environment,

and non-target organisms. However, it should not be pessimistic about the fact that pesticide use cannot be reduced or farmers cannot give up pesticide use. In France, Lechenet et al. [32] analyzed data from nearly 1000 commercial farms covering various production situations, and concluded that pesticide reduction is already accessible to farmers. There are also successful results at the country level. For example, the Swedish and Indonesian Governments achieved a 61 % and 65 % reduction, respectively in pesticide use without a reduction in crop yields [33, 34].

There is no quick and effective solution that will reduce the use of pesticides and eliminate the negative effects of pesticide use. It is only possible to reduce the use of pesticides by making some changes in our current production system, making the necessary legal arrangements, informing the producers about alternative control methods to the use of pesticides, and raising awareness of both the producer and the consumer about the negative effects caused by pesticides.

3.5. Agricultural Extension Methods to be Used in Reducing Pesticide Use

While the extension service was initially carried out to educate people with low cultural levels outside of school, nowadays those living in rural areas; include multidimensional activities that will change their knowledge, skills, practices, and behaviors and increase their living standards [35, 36]. Agricultural extension services are defined globally as modernizing agriculture and promoting rural development [37, 38, 39]. Agricultural extension services solve the problems of individuals engaged in agricultural activities, increase their income sources, improve their welfare level, and increase the level of knowledge, skills and technology use [40, 41, 42, 43, 44, 45, 46]. When we look at this agricultural extension history, it is seen that certain approaches are separated according to the periods in which they dominate the extension. These periods are the technology transfer approach, participatory approach, decentralized approach, and systems thinking approach [47]. In some studies, beyond the transfer of technology in agricultural production, it has been involved in activities such as facilitating the lives of individuals living in rural areas and directing them to livelihoods other than agriculture. The concept has expanded as “rural advisory services” [48, 49, 50]. Therefore, agricultural extension services are very important in reducing the use of pesticides within the scope of the green deal. Agricultural extension services are carried out by the public and private sectors. Turkey has some different approaches to agricultural extension services. These approaches occur at the national, regional, local, and project levels (such as General Publication, Training and Visit, Project, Product, Farming Systems Research, Participatory Approaches, and Cost Sharing). All of these approaches have different experiences [51]. When the agricultural extension methods are examined, we come across individual, group, and mass extension methods. The individual publishing method is a publishing service directly directed to a person, and the publisher and the producer establish mutual relations [52]. In this method, a one-way or two-way information flow is provided [53]. In the method, agricultural enterprises and home visits, office calls, telephone calls, private letters, and field flags are made. Agricultural enterprise interviews, office visits, and telephone calls can be used as individual extension methods to reduce pesticide use [53]. The group extension method is the extension studies made for the communities that consist of a certain and limited number of people and have common problems. This method includes demonstrations, field days and trips, courses, competitions, meetings (conference, forum, symposium, open session, etc.), and campaigns. Mass broadcasting is the fastest and cheapest method to reach producers [53, 54, 55]. Its effectiveness in informing the producers about agricultural innovation is quite high [52, 53, 55]. In the mass broadcast method, television, radio, internet, telephone, and written broadcasting are used.

4. CONCLUSIONS

The last comprehensive step taken by the EU has been the EGD. The EGD aims to stop climate change, regulate the use of resources and move to a circular economy approach. In order for the EGD to be successful and to achieve its goals, a very serious determination is also essential. Because despite the fact that the world has to reduce its greenhouse gas emissions by at least 45% by 2030 to avoid the disastrous consequences of global warming, only 11% of the world's 250 largest corporate emissions producers plan major cuts by 2030 [56]. The EU aims to zero its net greenhouse gas emissions by 2050,

to reduce industrial production and global greenhouse gases, as well as to protect production and employment [57]. In order to achieve this goal, the EGD announced in 2019, that it has designed a "green order" transformation in many main and sub-sectors from agriculture to industry, from energy to transportation. Within the scope of the EGD, adaptation and transformations to the green economy will be ensured. In the green agreement, under the title of "Sustainable Agriculture", studies will be carried out to reduce the use of pesticides, antimicrobials, and chemical fertilizers in Turkey in line with the targets set by the EU for the reduction of pesticides and antimicrobials. These studies, on the other hand, can be possible with the agricultural extension. The agricultural extension will increase the awareness of farmers and enable them to take precautions. Agricultural extension programs are very important in reducing poverty and increasing the level of welfare. Agricultural extension activities help to eliminate the difficulties that arise in farming activities and keep the knowledge skills of the farmers up to date. It also allows researchers to design technologies that fit farmers' needs. However, the most challenging task for an extension program is to be constantly relevant in a rapidly changing world that presents new challenges for farmers. Different extension service delivery approaches will be used in different situations. Extension programs must therefore be sufficiently flexible in their approach to remain relevant and sustainable. In these agricultural extension studies, individual extension methods, group extension methods, and mass media should be used. Awareness of pesticide use should be created in farmers with mass distribution methods. Both the public and private sectors should work on this issue. Public service announcements and advertisements should be created on the awareness of pesticide use on television and the Internet. Among the group extension methods, regional and local meetings should be established. In regional and local areas, workshops should be held with the public, private sector, community organizations, and leading farmers of the village. Thanks to the workshop, the methods to be followed in the regional and local areas should be determined. One of the individual release methods, a control mechanism should be developed by sending a message to their phones about pesticide use.

REFERENCES

1. Sefer, U & Villi, B 2021, Avrupa yeşil mutabakatinin çelik sektörüne olasi etkileri. *Journal of Empirical Economics and Social Sciences*, 3(2), 94-113.
2. European Commission, 2019, Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions, European Green Deal, COM(2019) 640 final, 11.12.2019.
3. Wrzaszcz, W & Prandecki, K 2020, Agriculture and the European Green Deal. *Zagadnienia Ekonomiki Rolnej/Problems of Agricultural Economics*, (4).
4. Prandecki, K, Wrzaszcz, W & Zieliński, M 2021, Environmental and climate challenges to agriculture in Poland in the context of objectives adopted in the European green deal strategy. *Sustainability*, 13(18), 10318.
5. Anonymous, 2021, Strategic Response 2021-2024, Republic of Turkey. https://www.ab.gov.tr/siteimages/birimler/prdb/2021_11_18_strategic_response_design.pdf (Accessed: 09.03.2022).
6. Huffman, WE 1977, The Role of Human Capital. Quarterly Journal of Economics 91: 59–79.
7. Anderson, J R & Feder, G 2004, Agricultural extension: Good intentions and hard realities. *The World Bank Research Observer*, 19(1), 41-60.
8. Anderson, JR & Feder, G 2007, Agricultural Extension. InHandbook of Agricultural Economics,Vol3,ed.R. Evenson and P. Pingali, 2343–2378. Amsterdam, The Netherlands: North Holland Press.
9. Swanson, BE & Davis, K 2014, Status of agricultural extension and rural advisory services worldwide: Summary report. In *Global forum for rural advisory services: Lindau, Switzerland.*

10. Rivera, WM, Qamar, MK & Crowder, LV 2001, Agricultural and Rural Extension Worldwide: Options for Institutional Reform in Developing Countries. Rome, Italy: Food and Agricultural Organization of the United Nations.
11. Bitzer, V, Wennink, B & de Steenhuijsen Piters, B 2016, The governance of agricultural extension systems. *KIT Sustainable Economic Development and Gender Working Paper. Royal Tropical Institute.*
12. Davis, K & Franzel, S 2018, Extension and Advisory Services in 10 Developing Countries: A Cross-country Analysis. Developing Local Extension Capacity (DLEC) Project. The US government's global hunger and food security initiatives.
13. UN, 2020, Retrieved from: https://sustainabledevelopment.un.org/post2015/transformingourworld (Accessed: 08.03.2022).
14. Maciejczak, M 2010, Perspektywa środowiskowa reform Wspólnej Polityki Rolnej UE. *Zeszyty Naukowe SGGW w Warszawie. Ekonomika i Organizacja Gospodarki Żywnościowej*, (85), 19-34.
15. Borlaug, NE 2007, Sixty-two years of fighting hunger: personal recollections. *Euphytica*, *157*(3), 287-297.
16. Garnett, T, Appleby, MC, Balmford, A, Bateman, IJ, Benton, TG, Bloomer, P, ... & Godfray, HCJ 2013, Sustainable intensification in agriculture: premises and policies. *Science*, *341*(6141), 33-34.
17. Godfray, HCJ & Garnett, T 2014, Food security and sustainable intensification. *Philosophical transactions of the Royal Society B: biological sciences*, *369*(1639), 20120273.
18. Semerci, A 2018, Hatay ilinde tarım sektörünün yeri ve önemi. *Tarım Ekonomisi Araştırmaları Dergisi*, 4(1), 36-47.
19. Acar M, Aytüre S 2010, Dünyada ve Türkiye'de Tarım ve Tarım Politikalarının Geleceği. Ekin Basım Yayın Dağıtım. Bursa. Türkiye, s.397.
20. Zhang, Y, Li, S, Luo, T & Gao, J 2020, The effect of emission trading policy on carbon emission reduction: evidence from an integrated study of pilot regions in China. *Journal of Cleaner Production*, *265*, 121843.
21. FAO, 2022, https://www.fao.org/faostat/en/#data/GT (Accessed: 08.03.2022).
22. Diriöz, AO 2021, AB Yeşil Mutabakat Kapsamında Yeşil Ekonomiye Dönüşüm Süreci, Türkiye-AB İlişkilerine Olası Etkilerinin Değerlendirilmesi. *Uluslararası Suçlar ve Tarih*, (22), 107-130.
23. Pimentel, D & Burgess, M 2014, Environmental and economic benefits of reducing pesticide use. In *Integrated Pest Management* (pp. 127-139). Springer, Dordrecht.
24. Skevas, T & Lansink, AO 2014, Reducing pesticide use and pesticide impact by productivity growth: the case of Dutch arable farming. *Journal of agricultural economics*, *65*(1), 191-211.
25. Eyhorn, F, Roner, T & Specking, H 2015, Reducing pesticide use and risks-What action is needed. *Briefing paper: Helvetas, Swiss Intercooperation*.
26. Lee, R, den Uyl, R & Runhaar, H 2019, Assessment of policy instruments for pesticide use reduction in Europe; Learning from a systematic literature review. *Crop Protection*, 126, 104929.
27. Jacquet, F, Jeuffroy, MH, Jouan, J, Le Cadre, E, Litrico, I, Malausa, T ... & Huyghe, C 2022, Pesticide-free agriculture as a new paradigm for research. *Agronomy for Sustainable Development*, 42(1), 1-24.
28. Pertot, I, Caffi, T, Rossi, V, Mugnai, L, Hoffmann, C, Grando, M S, ... & Anfora, G 2017, A critical review of plant protection tools for reducing pesticide use on grapevine and new perspectives for the implementation of IPM in viticulture. *Crop Protection*, 97, 70-84.
29. Pimentel, D 2018, Reducing pesticide use through alternative agricultural practices: fungicides and herbicides. In *Pesticide Interactions in Crop Production* (pp. 435-448). CRC Press.

30. Li, H, Yuan, K, Cao, A, Zhao, X & Guo, L 2022, The role of crop insurance in reducing pesticide use: Evidence from rice farmers in China. *Journal of Environmental Management*, *306*, 114456.

31. Mesnage, R, Straw, EA, Antoniou, MN, Benbrook, C, Brown, MJ, Chauzat, MP ... & Zioga, E 2021, Improving pesticide-use data for the EU. *Nature ecology & evolution*, 5(12), 1560-1560.

32. Lechenet, M, Dessaint, F, Py, G, Makowski, D & Munier-Jolain, N 2017, Reducing pesticide use while preserving crop productivity and profitability on arable farms. *Nature Plants*, 3(3), 1-6.

33. Oka, IN 1991, Success and challenges of the Indonesia National Integrated Pest Management Program in the rice-based cropping system. *Crop Protection*, 10(3), 163-165.

34. Resosundarmo, BP 1997, The economy-wide impact of integrated food crop pest management in Indonesia. *Economy and Environment Program for Southeast Asia*.

35. Taluğ, C 1977, Yayım ve Haberleşme I. A.Ü. Ziraat Fakültesi Ders Notu No 3. Ankara.

36. Özçatalbaş, O 2009, Bilişim Teknolojileri ve Yayım. Türktarım Dergisi, Tarım ve Köyişleri Bakanlığı, Ocak-Şubat 2009, ISSN:1303-2364, Ankara.

37. Ali, AS, Altarawneh, M & Altahat, E 2012, Effectiveness of agricultural extension activities. *American Journal of Agricultural and Biological Sciences*, 7(2), 194-200.

38. Buadi, DK, Anaman, KA & Kwarteng, JA 2013, Farmers' perceptions of the quality of extension services provided by non-governmental organisations in two municipalities in the Central Region of Ghana. *Agricultural Systems*, 120, 20-26.

39. Baiyegunhi, LJS, Majokweni, ZP & Ferrer, SRD 2019, Impact of outsourced agricultural extension program on smallholder farmers' net farm income in Msinga, KwaZulu-Natal, South Africa. *Technology in Society*, *57*, 1-7.

40. Leonard, DK 1977, Reaching the Peasant Farmer: Organization Theory and Practice in Kenya. Chicago: University of Chicago Press.

41. Garforth, C 1982, "Reaching the Rural Poor: A Review of Extension Strategies and Methods." In G. E. Jones and M. J. Rolls, eds., Progress in Rural Extension and Community Development, Vol. 1. New York: Wiley.

42. Jarrett, FG 1985, "Sources and Models of Agricultural Innovation in Developed and Developing Countries." *Agricultural Administration*, 18(4):217–34.

43. Feder, G, Just, RE & Zilberman, D 1986, "Adoption of Agricultural Innovations in Developing Countries: A Survey." Economic Development and Cultural Change 33(2):255–98.

44. Roberts, N 1989, Agricultural Extension in Africa. Proceedings of a World Bank Symposium, Eldoret, Kenya, 20 June 1984. Washington, D.C.: World Bank.

45. Davis, KE, Babu, SC & Ragasa, C 2020, *Agricultural extension: Global status and performance in selected countries*. Intl Food Policy Res Inst.

46. Kassem, HS, Alotaibi, BA, Muddassir, M & Herab, A 2021, Factors influencing farmers' satisfaction with the quality of agricultural extension services. *Evaluation and Program Planning*, 85, 101912.

47. Cook, BR, Satizábal, P & Curnow, J 2021, Humanising agricultural extension: A review. *World Development*, 140, 105337.

48. Faure, G, Desjeux, Y & Gasselin, P 2012, New challenges in agricultural advisory services from a research perspective: A literature review, synthesis and research agenda. *The Journal of Agricultural Education and Extension*, 18(5), 461-492.

49. Swanson, BE & Rajalahti, R 2010, Strengthening agricultural extension and advisory systems.

50. World Bank, 2012, *Agricultural innovation systems: An investment sourcebook*. Washington, DC. http://siteresources.worldbank.org/INTARD/Resources/335807- 1330620492317 /9780821386842_ch3.pdf. (Accessed 14.04.2022).
51. Boyaci, M & Yildiz, Ö 2014, Türkiye'de Tarımsal Yayım Sisteminde Çoğulcu Yapının Bir Görünümü. *Ege Üniversitesi Ziraat Fakültesi Dergisi*, 51(1), 1-11.
52. Şentürk, CO 2013, Çeltik Üretimi Yapan Tarım İşletmelerinde Tarımsal İlaç Kullanımında Yayım Yaklaşımları: Edirne İli Örneği. Yüksek Lisans Tezi, Namık Kemal Üniversitesi.
53. Özçatalbaş, O & Gürgen, Y 1998, Tarımsal Yayım ve Haberleşme. *Baki Kitabevi, Adana*, 385.
54. Avkiran, B & Yilmaz, H 2021, Çeltik Üreticilerinin Katıldıkları Tarımsal Yayım Yöntemlerinin Sürdürülebilir Tarım Algılama Düzeylerine Göre Değerlendirilmesi. *Çukurova Tarım ve Gıda Bilimleri Dergisi*, 36(2), 405-416.
55. Kayabaş, Z 2016, İstanbul İli Silivri İlçesinde Tarımsal Üretim ve Yayım Yaklaşımlarının Analizi Üzerine Bir Araştırma. Yüksek Lisans Tezi, Namık Kemal Üniversitesi.
56. Murugaboopathy, P & Jessop, S 2021, What's the plan? Corporate polluters lag on setting climate goals. Reuters: https://www.reuters.com/business/sustainable-business/whats-plan-corporatepolluters-lag-setting-climate-goals-2021-06-21 (Accessed: 08.03.2022).
57. Aşıcı, MA 2021, Avrupa Birliği'nin Sınırda Karbon Uyarlaması Mekanizması ve Türkiye Ekonomisi. *İstanbul: IPM-Mercator*.