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A New Model Trial in Turkish Agri-Food Sector

Türk tarım-gıda sektöründe yeni bir model denemesi

Coşkun Şerefoğlu*[a]

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Öz

Çalışma, Ankara Bölgesel Yenilik Stratejisinde öncelikli olan tarım sektörü için bir tarım-gıda modelinin geliştirilmesini amaçlamaktadır. Model Ankara Kalkınma Ajansı tarafından tasarlanmış ve pilot düzeyde uygulanmıştır. Model iki bileşenden oluşmuştur. Bunlardan biri, teknolojiyi bu sektöre getirmek için teknoloji geliştiriciler ile çiftçileri veya şirketleri eşleştiren teknoloji özümseme modeli, diğeri ise üniversite, araştırma istasyonları ve çiftçiler ile gıda şirketlerinin yeniliği yaymak için birlikte çalıştığı yayım modelidir. Bu model, teknolojik gelişmeler ve start-upların ve kamu politikalarının tarım-gıda sektörüne olan yoğun ilgisi sayesinde gelişmekte olan ülkelerde farklı bir yaklaşıma ışık tutacaktır. Pilot model çiftçiler, gıda firmaları ve üniversiteler arasındaki on karşılaşmaya dayanmaktadır. Ön sonuçlar, programın çiftçiler ve gıda şirketlerinin yanı sıra yeni kurulan şirketler tarafından da memnuniyetle karşılandığını göstermiştir.

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Abstract

The study aims to develop an agri-food model for the agriculture sector which was prioritized in Ankara Regional Innovation Strategy. The model was designed by Ankara Development Agency and implemented at the pilot level. The model consisted of two components. One of them is technology absorption, which matches technology makers and farmers or companies in order to bring technology to this sector, and another one is an extension model that university, research stations, farmers, and food companies work together to spread innovation. This model will shed light on a different approach in developing countries thanks to technological improvement and the great interest of startups and public policies for the agro-food sector. The pilot model was based on ten matches in between farmers, food firms, and universities. The preliminary results showed that the program was welcomed by farmers and food companies as well as start-ups.

***Sorumlu Yazar/Corresponding Author:** cserefoglu@gmail.com
[a] Ankara Development Agency, Türkiye, http://orcid.org/0000-0002-8260-7687

1. Introduction

The study aims to develop an agri-food model for the agriculture sector which was prioritized in Ankara Regional Innovation Strategy. It was stated by Blazer and Uhlir (2007) that research policy is considered a national matter by many European countries such as Germany, Belgium and Spain. However, innovation needs to be developed by regional actors regardless of how a sector is traditional. Old industrial policies failed to spread innovation in sectors due to the limited resources. So, some countries within OECD take interest in smart specialization with the aim of knowledge-intensive economic development like Estonia and Finland (OECD, 2013). Therefore, most countries endeavour to set their priorities in a few sectors and sub-domains where they can get a critical mass. On the other side, innovation policies are best developed by regional actors where regional policymakers have adequate technical capacity such as regional development agencies in order to create more competitive fields since they need some network activities including local social networks. Dargan and Shucksmith quoted in Pires et al. (2014), in contrast, suggested that innovation at the national policy level is crucial for technological development. The main difference behind the regional innovation strategies developed in the EU is that European firms are not as competitive as American firms. McCann and Ortega-Argiles (2011) highlighted the crucial role of ICT-related technologies which are lagging behind in European firms in comparison with American firms. A different model was employed by the Japanese government in order to increase the competitiveness of Small and Medium Enterprises (SMS's). According to that model, lean production plays a vital role in Japanese competition, which forces large firms to require greater innovation from SMS's by providing the required services (Cooke, 1996). A similar stance comes from (Landabaso and Mouton, 2005). They stressed the ineffectiveness of the old industrial policies by indicating "positively discriminating in favour of winners" with the help of public grants at the national and regional level. What they discussed is that the funded projects by those authorities might have no sufficient technical know-how on the basis of a strong consultation with key stakeholders. The European Union thus made a great effort to obtain competitiveness in the regions of the Union by encouraging the regions to develop their own regional innovation strategies based on smart specialization patterns (Castillo et al., 2011). As underlined by Pires et al. (2014) that regions need to be innovative in order to be able to challenge with changing patterns in the globalised economy.

In this new policy, the place-based approach rather than traditional sectoral approaches is advocated at the regional level (Barca, 2009). The most distinctive feature of regional innovation strategies from previous policies is that innovation could be employed in each sector including traditional sectors such as agriculture. Some suggestions are listed by Cavicchi and Stancova (2016). These are; encouraging a strong collaboration for agri-food innovation among regional actors including public institutions, techno-parks universities, research institutes etc. Collaborating among different stages of agri-food chain, place branding and educational activities related to sustainability, nutrition, food preparation as well as hospitality are required to strengthen community cooperation.

Some models are implemented in different regions on the basis of the sectors in the world. The Netherlands is one of the best examples regarding the use of high-technology in agri-food sector. The Dutch model has been employed initially as a linear innovation model, which resulted in one of the most successful models in the world. But with the progress in technology and changing social situation, it

was replaced by an interactive innovation approach (Nieuwenhuis, 2012). The core instruments of this model are the strong linkages among research, education and extension. In Turkey, on the contrary, a linear model which requires research-education and extension is not successfully implemented because of the weak linkages among universities, research institutes, farmers and food companies. As indicated by Akkoyunlu (2013:18), the research institutes have limited relations with stakeholders. One of the best models are implemented by the U.S.A. The extension service is based on the cooperative arrangement between the land-grant institutions and the United States Department of Agriculture (Kelsey and Hearne, 1952). In this model, the education, research and innovation support each other and the interlinkages are so strong on the contrary the traditional models where the innovation and research do not support each other in the field work.

Ankara Regional Innovation Strategy has been prepared in accordance with the RIS3 guide (2012), by considering of six stages of RIS3. These stages are as follows; an analysis of the current situation and innovation potential of the place, the establishment of a strong and inclusive governance structure, the creation of a common vision, the selection of a limited number of priorities, the creation of appropriate policy components, road map and action plan, and finally the monitoring and assessment mechanisms integrated into the strategy (Foray et al., 2012).

Agri-food sector as one of the priorities of Ankara Regional Innovation Strategy is the most traditional one and not a strong competitive power as much as the other sectors selected since an agricultural activity is a very unstable business by nature. The statistics also show that technical progress had so far had little effect in Turkish farming. Spielman and Birner (2008) stressed that agricultural extension systems are one of the most critical institutions in the countries that have small-scale farms and resource-poor farmers. Therefore, the major problems of Turkish agriculture sector are low level of agricultural productivity to provide rising standards to rural population and the role of extension services, which is limited in the Turkish agricultural innovation systems. In the same way, a report on innovation opportunities in agricultural ecosystem in Turkey prepared by TTGV (2021) stressed that agricultural producers in Turkey have no idea about the benefits of digitalization to a certain extent.

Although the technology has not been adopted by farmers sufficiently or the required technology has not been produced in Turkey on the basis of needs in the last century in Turkey, agriculture has attracted the attention of technology developers in the last decade in Turkey. Particularly, there is a growing demand among start-ups in Ankara region for agri-food sector since it is a virgin area which still needs to be discovered. A model which is named was designed by Ankara Development Agency and is in the implementation as of 2011. The model consists of two components. One of them is technology absorption which matches technology makers and farmers or companies in order to bring technology the sector and other one is extension model that university, research stations and farmers and food companies work together to spread innovation. Not only does Agri-Food Model cover a linear model but it also has an interactive model approach which covers a strong networking in it. Frontrunners were preferred in the first year. Diederen et al. (1999) and Diederen et al. (2003) stated that innovators or early adopters play a vital role in agricultural sector. In the same way, Rogers (1962) pointed out it in diffusion of technology. This model could shed light on a different approach in developing countries thanks to technological improvement and the great interest of start-ups and public policies for agri-food

sector. The approach adopted in this model could be extended to other developing countries which are still lagging behind agricultural development. What this model is distinctive from current practices in developing countries is that this model is quite dynamic and bring instant solution for the problems identified in field. The new players such as start-ups in the ecosystem are not reflected or systematized in the public policies in general. This paper aims to propose a different but applicable model for traditional agro-food sector with a pilot implementation phase. By doing this, what can be done and what cannot be done in the field are being tested perfectly.

The paper is structured as follows. First, the materials and methods were mentioned. After that, a detailed literature review on agri-food innovation system was mentioned. In the subsequent sections, agri-innovation in Turkey and specifically in the Ankara Region were discussed. Finally, an agri-food model for a regional innovation strategy was given and discussed the practical implications of the research before giving the conclusions.

2. Materials and Methods

This study was based on a needs analysis that was conducted with lead farmers, lead food firms, and lead agriculture machinery firms. The questionnaire forms were filled out the representatives of firms and farmers. The forms were prepared with the aim of identifying the current needs of the target groups. The results of the needs analysis were shared at a focus group meeting with start-ups, technology firms and university lecturers. A focus group meeting was also organized with experts working on agri-food sector in order to discuss the findings coming from needs analysis. Twenty-four potential applicants identified as being in the lead for adaptation of innovation were visited by Agency staff and analysed their technological needs and if they are open for cooperation for the program. Four farmers and five companies were unwilling to cooperating. So, there were a total of fifteen applicants. They were matched with start-ups and university staff. Each applicant was matched by the evaluation committee and one or two mentors/advisors were appointed for each. After the evaluation was completed, zoom meetings were organized for each matching including the mentors/advisors.

3. Regional Innovation Strategies and Ankara Regional Innovation Strategy

Regional plans were nowadays replaced by regional innovation strategies which are more dynamic in contrast to static regional development plans. Landabaso and Mouton (2005) stated that old industrial policies did not meet the expectations and they were not cost-effective policies. Castillo et al. (2011) underlined the policy change of the European Union after 2000 with the Lisbon strategy supported by Europe 2020 which includes smart, sustainable and inclusive. All regions were encouraged by the European Commission to develop their own regional innovation strategies in order to benefit from cohesion funds. So, the regions, instead of supporting all sectors and areas, need to prioritize the sectors and sub-domains on the basis of their regional needs. One of the most disadvantages of firms in Europe from the firms in the USA is that ICT related technologies. As stated by McCann and Ortega-Argiles (2011) that the diffusion of ICTs and of innovative organizational and management practices have some constraints within the European Union. R&D and innovation play a vital role in the economic development. Blazer and Uhlir (2007) pointed out that R&D is a policy to be considered at national level but innovation policies, contrary to R&D, needs to be best developed and delivered at regional level.

Three main dimensions were identified for innovative regions by the OECD (2011). These are knowledge hubs, industrial production zones and Non- Structural Inertia and de-industrialising regions (S&T) driven regions. The Joint Research Center namely S3 Platform of the European Union pointed out that over 270 agri-food priorities in EU regions as indicated Agri-food as one of their key investment areas under smart specialization (EC, 2020). 3 in 4 regions in the EU selected an agri-food related priority in the strategies and one of the five priorities focuses on new technologies. This shows the essential role of agri-food in EU members.

In Turkey, there are 26 regional development agencies at NUTS 2 level. More than half of those agencies (14 agencies) prepared their own regional innovation strategies. A study conducted by Erdil and Çetin (2018) drew attention to a lack of good governance as the weakest point in the strategies prepared by those agencies. They also highlighted that the strategies did not touch community problems much.

All agencies but Trakya and East Black Sea Development Agencies specified the priority areas to be supported. The majority of those agencies, which specified the priority sectors for their regions, showed agri-food sector among the priority areas.

The agri-food sector chosen by Ankara Development Agency which is based on a model includes new technologies in agriculture and food sector (Ankara Development Agency, 2019).

Sunding and Zilberman (1999) pointed out that agricultural innovation could be splitted in two parts which one of them is embodied innovations and the other one is disembodied innovations. Embodied innovations refer to tractors, new seed varieties and fertilizers while disembodied innovations describe a new formula in irrigation systems. The authors stated that disembodied innovation is mostly based on practical knowledge and could be spread by farmers or users.

Developed and developing countries implement different innovation models according to their own needs. The Netherlands and the New Zealand which are the lead countries in agri-innovation in the world uses different approaches, the old traditional approaches are still in common in the developing countries such as Turkey, India and others. Nieuwenhuis (2012) stated that the success of the Dutch agri-food system comes from a linear model which brings research, extension and education. In the same way, Minh et al. (2011) underlined the essential role of research, education and extension to analyse agricultural innovation diffusion processes. However, Coehoorn (1995) cited in Nieuwenhuis (2012) pointed out that a linear model with the technological and social changes are not functional any longer instead, interactive models are on the agenda of countries such as Netherlands.

The cooperative extension work based on cooperation between land-grant institutions and the Department of Agriculture had three phases. At the first point, the science brought to farmers what most needed from the scientific viewpoint, at the second phase, the needs of each community identified and consolidated and at the third stage was the more mature, which is a combination of these ideas of specialists (Kelsey and Cannon, 1952). It is integration of teaching, research, and public service as well as innovation by disseminating technology, shortening period of technology adoption and increasing research-based innovation. Wang (2014) stressed the economic impacts of U.S. extension model in two main points. These are high extension investment returns and higher productivity growth.

These models process the trial and error on the shop floor on the basis of existing knowledge and research infrastructure. Another model on agri-food comes from New Zealand. In this model, private-sector plays the crucial role in the adaptation of technology into agriculture and food sector. Fonterra is the largest single private-sector investor in research and development in the agribusiness sector. Another private company, which is named Livestock Improvement Corporation from New Zealand, is a major investor in innovation. These formations allow the agri-food companies in order to increase the values added component of the products produced by those firms (Vitalis, 2007).

Transferring the know-how from research institutes and universities to farmers are in general realized via agricultural cooperatives (Minh et al., 2011). However, the formation of agricultural cooperatives does not work perfectly in some countries like Turkey. With the first five-year planning period in Turkey, a special attention was given for cooperatives but it cannot be said that the efforts improving cooperative systems in Turkey were good in the past implementations. Aman (2014) found that there are three main inhibitors of collective action among agricultural cooperatives in Turkey. These are; poor relations between cooperative executives and members, state intervention, and lack of member participation. One of the most critical institutions in agricultural innovation systems is agricultural extension services.

Spielman and Birner (2008) underlined the ineffectiveness of old approaches in agricultural extension services which are one of the most critical institutions for small-scale farms. In the old approach, technology transfer is based on the dissemination of improved seed, and chemical fertilizer through public extension services. The authors stressed that alternative approaches in agri-food innovation systems should be used by considering country-specific socio-economic conditions changing from one country to another. They listed some approaches like governance, organization management and financing, educational and advisory systems, capacity of extension services, type of farming models and degree of market access, the nature of local communities.

The British government opened a competition for agri-food innovation in Turkey in 2017. Three challenges were addressed in that competition. One of them is to use waste by-products and residues from the Turkish agri-food industry to reduce their negative environmental impact and add value; the second one is to improve agricultural productivity of small and medium sized-farmers through upgrading agricultural technology and the last one to improve animal and plant breeding within Turkey (InnovateUK, 2017). These are actually main challenges in Turkish agri-food sector. The average yield for agriculture sector and animal husbandry is much lower than in western countries since the average agricultural holdings are small and the technological level of the holdings is insufficient. Tümer and Özerten (2020) showed that the increased rate of average yield in cereals is lagging behind the other middle-high income countries in between 1992-2018.

The authors brought some recommendations for agri-food sector. One of the most important points addressed is to subsidize technology/digitization investments to increase agricultural value added and productivity and the second one is to incentivize the participation of skilled labor into agricultural production activities. Ankara Rural Innovation Road Map also highlighted that providing advanced technologies to local companies and transferring technology to rural areas and transforming from the

farmer concept to the rural entrepreneur concept are the key issues indicated for Ankara region (Şerefoğlu et al., 2017).

Figure 1 shows that how the rural innovation can be applied in Ankara region. It is believed that intraregional development can only be provided with technology integration and rural entrepreneurship (Şerefoğlu et al., 2017).

Figure 1. The Method to apply for the implementation of rural innovation.
Source: Şerefoğlu et al., 2017.

3.1. Agri-Food Model

An agri-food model was developed by Ankara Development Agency. The motto of the model is "discover-seek-match-follow up-finalize". The model which is based on a network approach and it consists of two main instruments. One of them is accelerator programme which is different from the existent accelerator programs that are mostly based on training and mentoring programs which last around three months. Another one is agricultural extension programme which aims to bring universities and research institutes as well as start-ups to the field to work with farmers or food companies together. agri-food model covers both a linear innovation approach and an interactive approach. The technology producers could be involved in problem-solving process of farmers or food companies. But at the same time the needs of those start-ups could be the main point to be solved. Four types of innovative processes were indicated by Dosi (1988).

These are; formal R&D, informal knowledge diffusion through journals, organisations, mobility and observation, learning by doing and by using in problem-solving behaviour and purchasing knowledge through machinery and tools. Agri-Food model is mainly based on learning by doing and by using problem-solving behaviour. Disembodied innovations based on practical knowledge, as indicated by Sunding and Zilberman (1999), is the most important part of the model. Another important issue for spreading innovation is to use lead farmers and lead firms in the sector.

When the model was formulated, the H-farm in Italy and Terra Accelerator in the U.S. were analysed in detail. H-farm is one of the most successful accelerator programs implemented in Italy which was founded in 2005. H-farm covers a hybrid business model which includes both a seed capital and a networked business incubator. H-Farm provides technology, administrative and managerial support to all ventures which are named H-ventures or H-farmers (Pavan and Anelli, 2015). Actually, the H-Farm model is totally different from basic accelerator programs on agri-food which has a narrow scope. The H-Farm is not only a service provider but it is a kind of investor and business provider. Another successful accelerator program in agri-food, which is called TERRA, is supported by Radobank and RocketSpace. The program aimed to support mature agri-food start-ups with a four-month of program. This is a tailor-made program for the start-ups which successfully completed their proof of concept stage.

A mixed model by considering of socio-economic conditions of Ankara ecosystem in agri-food sector was employed by Ankara Development Agency which covers both a linear model and and an interactive approach including a networking approach plays a crucial role in this model. Yield-increasing and cost-reducing innovations as well as innovations enhancing product quality consist of the core elements of the model.

The current situation analysis in Ankara Regional Innovation Strategy and AGRİ-FOOD MODEL model showed that the eco-system in agri-food sector in Turkey does not work perfectly (Şerefoğlu et al., 2019). Agri-food model, as seen in Table 1, is a kind of hybrid model of H-farm and Terra Accelerator Program and it is also predominantly differentiated with its field part from other programs. Validation of a prototype in the field or trials in laboratories are the most important instruments of the model and no time span is foreseen to be completed since the agricultural sector is seasonal and many changing patterns like weather, raining, supply-demand etc. The prototypes developed by universities as well as by research institutes and private companies do not reach to the field effectively or the technology developed by start-ups do not meet the exact needs of the farmers or food companies due to the weak relationship among food companies, start-ups, farmers and universities according to the focus groups and in-depth interviews conducted with stakeholders. Regarding extension services, visiting farmers by public staff and academicians in order to transfer know-how and technology produced in the universities and research institutes need to be improved. The model also encourages sharing knowledge among stakeholders.

Table 1. The Main functions of TAG-TECH.

Functions	**Actions**	**Tools**
Technology Integration		
Networking and partnership building	Convening	Catalyst effect
Clustering (farmer, unions, start-ups, research institutes, universities, credit agents etc.)	Brokering	Participatory approach
Mentoring/Training	Facilitating	Evaluation committees
Soil health	Soil testing	Research Institutes, Universities
Testing/Validation	Matching	Funding

Extension		
Networking and partnership building	Convening	Small amount of grant Catalyst effect
Clustering (farmer, unions, start-ups, research institutes, universities, credit agents etc.)	Brokering	Participatory approach
Mentoring/Training	Facilitating	Evaluation committees
Soil health	Soil testing	Research Institutes, Universities
Extension	Demonstration	Field, laboratory etc.

A few start-ups could work together to solve the problem of a farmer or a food company. Rubin et al. (2015) found that collaborations among tenants in a techno park area could increase tenants' knowledge about market needs. Therefore, technology parks need to be improved.

The Development steps of Agri-Food Model are as follow;

4. Findings

4.1. Preparatory Phase

In the preparatory stage of Agri-Food Model, there are two main documents, which are considered as reference documents. One of which is Ankara Regional Innovation Strategy (ARIS) and other one is rural innovation road map. Many inputs of the Agri-food part of ARIS came from the latter document. Before the needs of farmers/food companies and agricultural machinery plants are identified, a design thinking training for Agency staffs was given in order to prepare the application forms with a broad perspective. The Agency, on the basis of knowledge and statistics collected from the field, held face-to-face interviews with the stakeholders and some focus meetings and a workshop, had prepared the application form and also a logo was created and the platform of which address is www.tagtech.org.tr was established. A mentoring pool consisting of experts from public and private-sector and universities was created.

4.2. Needs Analysis

Needs analysis was conducted with lead farmers, lead food firms, and lead agriculture machinery firms. The questionnaire forms were filled by the representatives of firms and farmers. The forms were prepared with the aim of identifying the current needs of the target groups. The results of needs analysis were shared at a focus group meeting with start-ups, technology firms and university lecturers. A focus group meeting was also organized with experts working on agri-food sector in order to discuss the findings coming from needs analysis. According to needs analysis, priority themes are food safety, smart farming applications (smart irrigation systems, sensors, drones, smart farm management, precision fertilization and spraying, etc.), farm management, animal welfare, animal breeding, plant and seed breeding, waste management, e-commerce, packaging and marketing applications, soilless agriculture, alternative and functional foods, medicinal and aromatic plants, pharmaceutical products, perfume and cosmetics, soil analysis and mapping, climate change, agricultural tools and machinery, biological control methods, biotechnology, blockchain applications,

organic farming Technologies, conservation of resources sustainable agriculture, urban agriculture and permaculture applications.

4.3. Consolidation and Connection Phase

4.3.1. Announcement of Call for Proposals and Receipt of Applications

The priorities identified in the needs analysis were announced with a call for proposals and the start-ups were invited to apply for the program.

4.4. Evaluation of Applications Announcement of Successful Solution Ideas

The call for proposals were categorized in two main sections. One is technology integration and the other one is agricultural extension. Concerning technology integration, there are two types of assessment. One is conformity and the other is technical Conformity assessments were conducted by Agency's own staff. The basic evaluation criteria within the scope of conformity of solution applications within the scope of Technology Integration Component are as follows: level of compliance with thematic priorities, the suitability of the sectoral specialization areas and technological levels of the enterprises.

The technical analysis was conducted with a technical evaluation committee of 5 people consisting of representatives of public, university and Agency which was formed. The forms received under needs analysis were shared with members of evaluation board. Compliance with the product development and commercialization phase and TRL (Technology Readiness Level) level of the products that are proposed to be verified and commercialized within the scope of the application.

Technical Evaluation was carried out by the Evaluation Committee of the solution applications within the scope of the Technology Integration Component are as follows: Capacity to produce effective and efficient solutions to needs [Maximum 30 Points] Commercialization capacity [Maximum 20 Points] Contribution to sustainability [Maximum 20 Points] Social benefit level [Maximum 10 Points] Maturity level of the applicant business: production and market level for its other products [Maximum 20 Points].

Regarding agricultural extension, the extension requests of the agri-food producers were received within the scope of the Extension Component. Evaluation criteria under extension instrument were producer's business size [Maximum 20 Points] Number of people working for agricultural production [Maximum 20 Points] Change in turnover in the last 5 years [Maximum 20 Points] Frequency of soil analysis [Maximum 20 Points] Whether it has cooperated with any technology company before [Maximum 20 Points].

4.5. Realization of Solution Owners-Solution Partners Matching

After the assessment was completed, both parties were informed of who they were matched with. During the evaluation process, mentors were also assigned for each matching. So, applicants, solution partners and mentors were invited for an introductory meeting to get to know each other and discuss what they could do and what they could not. Four applications out of 15 were failed. Two machinery companies drew their applications not to go one step forward.

4.6. Training Test/trials Mentor and Extension Expert Support

Regarding, agricultural extension, all the trainings were completed and the farmers were very willing to benefit from trainings given by University lecturers and start-ups. and implement the scientific information in their fields. In respect to technology integration, A prototype developed for the early detection of mastitis in milking cows by one start-up.

4.7. Demonstration Phase

The needs, inputs and outputs are pointed out in Table 2. Twenty-four potential applicants identified as being in the lead to adaptation of innovation were visited by Agency staff and analysed their technological needs and if they are open for cooperation for the program. Four farmer and five companies were unwilling to cooperating. So, there were total 15 applicants. They were matched with start-ups and university staff. Each applicant was matched by the evaluation committee and one or two mentors/advisors were appointed for each. After the evaluation was completed, zoom meetings were organized for each matching including the mentors/advisors. Both sides were gathered together and discussed what they could do and they could not. Organizing these meetings were quite effective and fruitful. Both sides saw if they could get on well with each other and also know mentors/advisors assigned for the match. Four out of 15 applications were failed. Two machinery companies drew their applications to go forward because they were still resistant to innovation. The outputs of the nine matchings are given in Table 2 below.

Table 2. TAG-TECH matchings and outputs.

To develop pastille product	X1 Start up– Solution Partner: Y1 food firm	Laboratory, testing, mentoring for commercialization (6 hours)	A pastille was developed not commercialized yet.	Food supplement was produced. The commercialization process continues.
To validate its prototypes for mastitis	X2 Start up – Solution Partner: Y2 Dairy farm– Mentor: Z1	Mentoring, a farm to test the prototypes Mentoring, (24 hours), Laboratory, testing, validation	The testing period was extended due to the COVID 19. No result yet.	The expected results have not been reached yet. So, the firm will extend the study for another testing period.
To increase productivity and to solve marketing problems	X3 Start up– Solution Partner: Y3 Farmer	Laboratory, soil analysis, training (8 hours), mentoring (18 hours)	No sufficient irrigation, the organic structure of soil is limited, high lime, argillaceous soil do not transfer nutrition to plants. The wind in the region causes plant diseases.	Soil analysis were carried out, specific trainings on good agricultural practices realized in the farm.
To increase nutritional value in broiler breeding (diseases)	X 4 Mentoring by Ankara University, The Faculty of Veterinary– Solution Partner: Y4 Broiler Farm	Field testing, mentoring (66 hours)	A limited testing was conducted in the broiler farming.	Field testing conducted with the suggested probiotic. Positive effects were observed for the suggested probiotics.

To provide standardization on aromatic and medicinal plants to select the right product	X 5 Mentoring by Ankara University, The Faculty of Agriculture– Solution Partner: Y5 Aromatic and Medicinal plant grower	Oil analysis, soil analysis, training (8 hours), mentoring (24 hours)	Fungus, Propazine active ingredient is high, mangan, zinc and iron deficiency and weak growth of cumin. Fertilizing with rich micro elements.	Specific trainings were given in the field, lavatory analysis was done.
To increase management capabilities and to acquire sound knowledge for good agricultural practices	X 6 Mentoring by a private advisory company, Solution Partner: Y6 Vegetable Grower	Mentoring, Training (60 hours)		Plant breeding conducted, samplings in different varieties for lettuce and salad were tested. The right varieties identified in the demonstrations will continue in the following year.
To develop an innovative product for consumer's tastes in broiler breeding	X 7 Mentoring by Ankara University, The Faculty of Veterinary – Solution Partner: Y7 Broiler Farmer	Laboratory, mentoring (70 hours)		Intrinsic and extrinsic parameters were evaluated and taste tests were conducted. No distinction taste was observed.
To increase productivity of cereals	X8 Mentoring by Ankara University, The Faculty of Agriculture – Solution Partner: Y8 Farmer	Soil analysis, training (20 hours), mentoring (20 hours), field testing		Fertilizing according to the soil analysis, the plant varieties developed by TAGEM were put to the test. It takes time to see the results.
To provide standardization on aromatic and medicinal plants (black seed) and to acquire sound knowledge on pharmacy use	X 9 Mentoring by Ankara University, The Faculty of Agriculture– Solution Partner: Y9 Aromatic and Medicinal plant grower	Laboratory, soil analysis, mentoring (15 hours), training (15 hours)	Germination rate, protein rate, constant oil rate is good, but effective rate is high. Sorting is necessary. Domestic and Syrian seeds: high peroxide value and specifiable matter	Trainings and laboratory experiments were conducted.

Due to the pandemic came out in March 2021, the activities had to be put off. However, one of the start-ups in technology integration instrument succeeded to develop a pastille. Regarding, agricultural extension, all the trainings were completed and the farmers were very willing to benefit from trainings and implement the theory in their fields.

5. Results

In developing countries, agricultural productivity is lower than developed countries since there is a lack of integration between agriculture and industry. The food industry is mostly traditional and technology use of small-scale firms is insufficient. So, agriculture and industry need some interfaces to bring all the actors together under the same target. An interactive networking model has been employed theoretically in this model instead of a linear model. The type of innovation which was used in this model is based on product, process and organizational innovation. Agricultural innovation systems are particularly implemented by the European Commission through Agricultural Knowledge and Information Systems.

The main argument for that program is to support innovation solutions. In agri-food sector, one of the major challenges is that the knowledge and innovation do not reach to farmers, farmers unions or food firms. In spite of the fact that there are great efforts to support innovation ecosystem, there is still room to improve in the intervention areas, particularly in the phase of validation process of products and services.

Agricultural extension has been one of the areas where development experts addressed in their report which is related with Turkey. When considered the number of small-scale farmers in Turkey, extension issue could be a serious one regarding agricultural productivity. In the ecosystem, each actor works perfectly but no sufficient coordination among actors in order to transfer knowledge and innovation. Therefore, this model directly focuses a niche area where the ecosystem needs to be improved. A survey aiming to analyse R&D on agri-food sector was conducted with 24 agri-food companies showed that the competitiveness scale of agricultural and food firms is 64.0 % on the basis of responses. The sector is very traditional and need to be upgraded with technological progress.

The accelerator program was implemented at pilot level in 2020 with a small target group. This program aims to bring all actors together by implementing a networking approach. An interactive model rather than linear model is also adopted in the content of the program. This model is considered to strengthen Entrepreneurial Discovery Process (EDP).

In the following period of implementation, the resistant farmers, food companies or machinery firms will probably be convinced in getting involved in the model after they see the initial results of the model. Following the accelerator program, the successful matchings in technology integration will be awarded with a grant of which budget is up to $ 120.000 for commercialization of prototype. A venture capital is going to be used in the following year for the prototypes that are validated and ready for the commercialization. A linear model is common in current practices in Turkish agri-food sector. However, the diffusion of innovation has not absorbed in agri-food sector in a successful way yet. Although Turkey have good universities, research institutes and researchers, the networking among those institutions need to be well functioned. So, rather than a linear model which is no longer not in use in countries such as the Netherlands, the New Zealand and in other developed countries due to the socio-economic changes. Two instruments are implemented in this model. One of which is technology integration and another one extension which is considered as one of the most critical elements of agricultural innovation systems. Particularly disembodied knowledge based on practical knowledge plays a crucial role. 15

applications being considered as front runners were received by Ankara Development Agency, five of them were failed to go forward. Two machinery producers of four applications drew their applications because they were still resistant to innovation and not have enough courage to be involved in the model. One start-up was matched with a food firm, one start-up was with a fattening farm and one with a farmer for good agricultural practices. The other 8 applications were considered for agricultural extension. In each match, a staff from University or from research institutes was assigned. The preliminary results showed that the program was welcomed by farmers and food companies as well as start-ups. One of the inferences from implementation of Agri-Food Model is that the program should increase the budget set up for each matching and another one is that the program should open in the beginning of the year and end up at the end of the year because of the seasonal changes in agriculture such seeding, harvesting etc.

The model is implemented at pilot level; one fits all approaches are not preferred by current development practices. This model differentiates with traditional practices that accepts a linear approach. Instead, in this model, the experts at the Universities and research institutes are encouraged to go farmers' field. Another important issue the new actors such as start-ups are integrated with the traditional actors and also engaged to work together with farmers and University staff together as a solution partner.

Regarding agricultural sector, most of the farmers in the least developed sub-regions of Ankara metropolitan have insufficient knowledge about technological progress, particularly disembodied innovation. Of small-scaled farms, traditional knowledge and farming practices are still common the average size of agricultural holdings is small and also scattered. One of the most important challenges in agriculture is that limited technology use by traditional farmers. For instance, one farmer could have a tractor and uses it not in an optimal size of farm. The tractor is thus idle in most of the time. Most farmers do not apply soil analysis in their farms and they even do not know which seed is more suitable or how much fertilizer they could use in their fields. With respect to animal breeding, the infrastructure like barns is not suitable for animal welfare. Also, the farmers complain about the extension services because the extension staffs do not often visit the farms and keep the farmers updated about the latest technologies. The technology developed by tech companies or publicly funded institutions have no much opportunity to be validated in the field in current practices. Some financial mechanisms need to be developed for start-ups which aim to find some solutions of Turkish agriculture.

The agri-food sector is quite traditional and not too much open for innovation. With respect to human resources, the sector encounters difficulty to have qualified staff. There is mismatch for qualified staff in agri-food sector. Therefore, interfaces such as development agencies play a crucial role in the improving the agri-food ecosystem with tailored made approaches.

6. Conclusions

Linear innovation models have not successfully implemented in Turkey in agri-food sector due to the fact that the extension services do not work perfectly in a harmony with Universities and private-sector. The cooperative extension work conducted by the U.S. could be an alternative in order to disseminate the knowledge and technology in traditional villages. The role of new players of the

ecosystems such as start-ups need to be clearly identified and integrated with the research institutes and State grants.

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