Interactive Networking in Agribusiness

Bringing together the value chain for digital transformation

Dr. Coskun Serefoglu

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Asian Productivity Organization

The Asian Productivity Organization (APO) is an intergovernmental organization that promotes productivity as a key enabler for socioeconomic development and organizational and enterprise growth. It promotes productivity improvement tools, techniques, and methodologies; supports the National Productivity Organizations of its members; conducts research on productivity trends; and disseminates productivity information, analyses, and data. The APO was established in 1961 and comprises 21 members.

APO Members
Bangladesh, Cambodia, ROC, Fiji, Hong Kong, India, Indonesia, Islamic Republic of Iran, Japan, ROK, Lao PDR, Malaysia, Mongolia, Nepal, Pakistan, Philippines, Singapore, Sri Lanka, Thailand, Turkiye, and Vietnam.

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Interactive Networking in Agribusiness

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PREFACE

The P-Insights, short for "Productivity Insights," is an extension of the Productivity Talk (P-Talk) series, which is a flagship program under the APO Secretariat's digital information initiative. Born out of both necessity and creativity under the prolonged COVID-19 pandemic, the interactive, livestreamed P-Talks bring practitioners, experts, policymakers, and ordinary citizens from all walks of life with a passion for productivity to share their experience, views, and practical tips on productivity improvement.

With speakers from every corner of the world, the P-Talks effectively convey productivity information to APO member countries and beyond. However, it was recognized that many of the P-Talk speakers had much more to offer beyond the 60-minute presentations and Q&A sessions that are the hallmarks of the series. To take full advantage of their broad knowledge and expertise, some were invited to elaborate on their P-Talks, resulting in this publication. It is hoped that the P-Insights will give readers a deeper understanding of the practices and applications of productivity as they are evolving during the pandemic and being adapted to meet different needs in the anticipated new normal.

INTRODUCTION

A significant number of events has occurred in the agriculture sector with changing socioeconomic conditions such as aging populations, broadening gaps between rural and urban populations, and progress in nonagricultural sectors in the last two decades. First, the socioeconomic structures in agriculture have shifted considerably. Rapid urbanization in many countries has continued. According to World Bank Statistics, the rural population was 66% in 1960 but had decreased to 44% in 2021 [1]. With progress in Industry 4.0 and smart agriculture, agriculture is becoming more integrated with other sectors such as IT in spite of the fact that the speed of development of agriculture is lower than that of the industrial sector.

As shown by Rostow [2], there are five stages of growth: traditional society; the preconditions for takeoff; takeoff; the drive to maturity; and the age of high mass of consumption. Most developing and least developed countries failed to take off in the agriculture sector before industrializing. Past policies and tools were insufficient to achieve progress in agricultural growth. The interactive networking model presented in this report is based on a bottom-up instead of a top-down approach. The role and catalytic effects of interface organizations like development agencies on regional/local scales are essential in terms of interaction among various sectors. The interactive approach aims to reduce the dominant role of linear models in technology transfer by strengthening the linkages among education, research, and innovation in agriculture. This model also allows new actors in the ecosystem to interact with traditional players.

The model is based on diffusing existing knowledge, induced technical change, and developing high-payoff inputs, which could work perfectly in an imperfect market where there are low-level yields for traditional farmers, a lack of innovation capabilities of traditional firms in the agrifood sector, and insufficient cooperation and coordination among sectors. This report first provides basic statistics from Asian Productivity Organization (APO) members. The second section focuses on food systems in Turkiye, while interactive modeling is the focus of the third section. The theoretical framework and assumptions of the model are presented in the fourth section, and then the

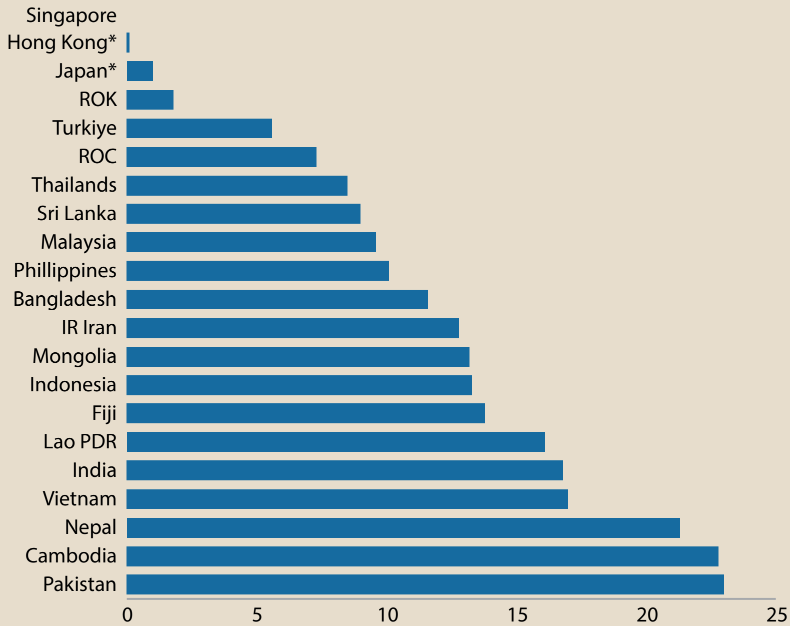
Entrepreneurship and Technology in Agriculture (TAG-TECH) platform is introduced. Section seven briefly explains a model suggested for APO members. The report concludes with a summary of results.

BASIC STATISTICS ON AGRICULTURE IN APO MEMBERS

Agriculture is an important part of the economy in many Asia-Pacific countries. Figure 1 shows the significant role of agriculture in most APO member countries in 2021. Pakistan, Nepal, and India were the leading countries in terms of agriculture's share of GDP in 2021.

FIGURE 1

SHARES OF THE AGRICULTURE SECTORS IN GDP IN APO MEMBERS, 2021 (%).



Source: Reproduced with permission from the World Bank [3].

The share of the rural population is still high in many APO members. Sri Lanka, Nepal, Cambodia, and India still have predominantly rural populations while the rural populations in Hong Kong and Japan are much smaller [1].

Agricultural land in Bangladesh, Mongolia, India, and the ROC has a higher share in the total land area, while its share in Hong Kong, Lao PDR, and Japan is lower [1].

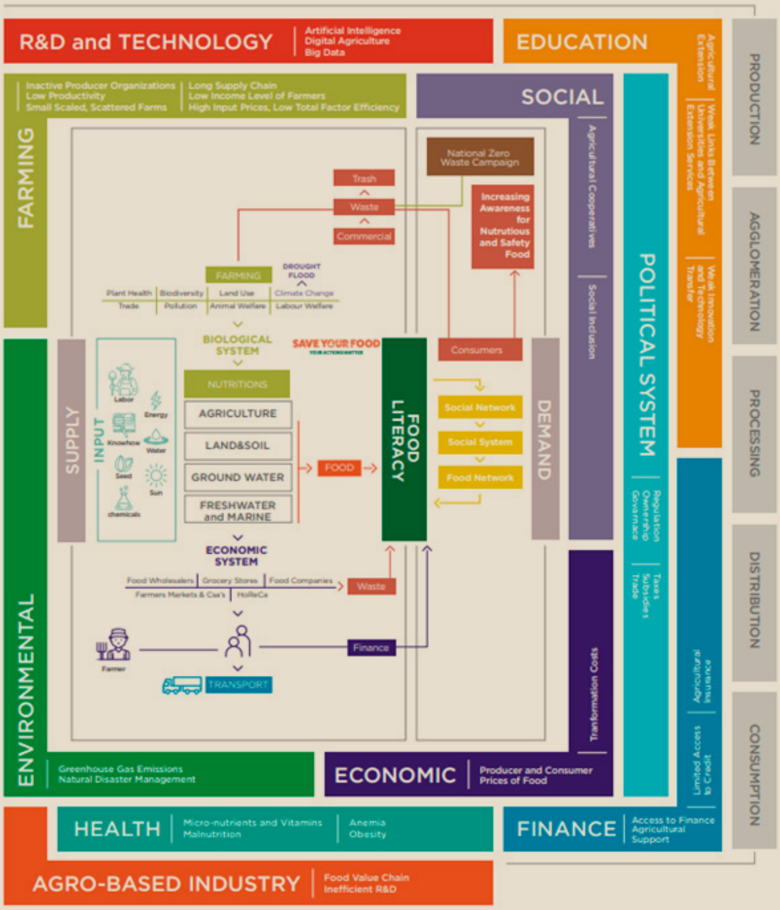
The use of technology and mechanization in the transformation of traditional agriculture is an effective tool. Japan has the highest rate of agricultural machinery and tractor use per 100 km^2 of arable land among APO members, while most other members have very low levels [1].

FOOD SYSTEMS IN TURKIYE

A report on the National Pathway for Food Systems in Turkiye was prepared by the Ministry of Agriculture and Forestry in 2022 [4]. Figure 2 sums up food

FIGURE 2

FOOD SYSTEMS IN TURKIYE.



SOURCE: Reproduced with permission from the Ministry of Agriculture and Forestry of Turkey [4].

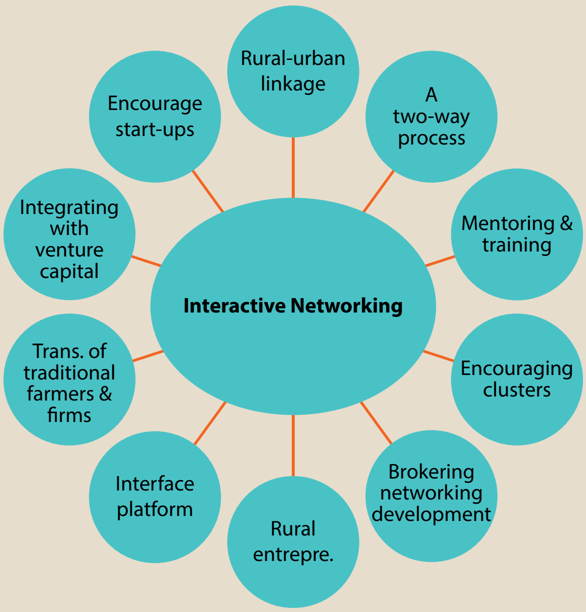
systems in Turkiye. Shortening food value chains, giving more emphasis to R&D and innovation, focusing on financial literacy in the farming sector, reaching the SDGs, prioritizing land consolidation, focusing on environmentally friendly production, and strengthening technology transfer and agricultural insurance systems are seen as areas to be improved.

INTERACTIVE NETWORKING MODEL

An interactive model for the agrifood sector was developed by the Ankara Development Agency in 2020. The components of interactive networking are summed up in Figure 3. The model aims to strengthen rural–urban linkages by decreasing the broadened gap in between urban and rural populations due to rapid urbanization. One of the most distinguishing features of the model is not to exclude any actors from farmers to consumers. A two-way process rather than a one-way linear model is employed. By doing that, not only farmers/industrialists but also technology providers can apply for the program so that they can validate and test their products.

FIGURE 3

COMPONENTS OF INTERACTIVE NETWORKING.



SOURCE: Reproduced with permission from Asian Productivity Organization [5].

This model encourages the formation of startup ecosystems and makes the necessary connections with relevant financial institutions. For example, some events are regularly organized by the Ankara Development Agency to increase awareness of other financial instruments such as venture capital and fund finders in the agrifood sector. The Ankara Development Agency plays the role of a brokering networking developer. A dynamic process based on snap decisions is employed in place of an outdated static process. In spite of the fact that the agrifood sector is directly affected by external factors like weather conditions or price fluctuations, each phase/process is conducted under the control of the agency, and the processes could be perennial based on the multistep process where each phase can be supported in each following year. The model is demand driven, with actions centered between the bottom-up and top-down approaches.

THEORETICAL FRAMEWORK OF THE MODEL

The theoretical framework of the interactive networking model covers diffusing existing knowledge, inducing technical change, and developing technical change. The first is mostly conducted with research institutes, universities, and lead farmers. What determines whether technologies developed are suitable for all farmers, particularly smallholders, or only for some farmers with larger-sized farms? In general, farmers demand new technologies not only from private input suppliers but also from the public sector including research institutes. This contributes to the development of the research system by validating and testing products or newly developed crops. Induced technical change involves improved seeds and fertilizers to help to save land and use the labor force more intensively. The third element of developing technical change is meant to create high-payoff inputs associated with land productivity by using fertilizers, crop varieties, or irrigation [6].

Assumptions of the Model

In agricultural growth, there are assumptions of models. The main assumptions of the interactive networking model are:

- Imperfect market conditions.
- Lower average yields of traditional farmers.
- Lack of innovation capabilities of traditional food firms/agricultural machinery manufacturers.
- Inefficient grant systems.
- A low rate of public support for innovation in the agrifood sector.
- A lack of coordination under the spiral triangle of research–education–innovation.

TAG-TECH: ENTREPRENEURSHIP AND TECHNOLOGY IN AGRICULTURE

TAG-TECH is based on an interactive networking model. It is a platform with three main components: an accelerator program; urban agriculture program; and children's agrifood program. The accelerator program, which is based on the demand-driven approach, consists of two main instruments. One is technological integration, and the other is agricultural extension. The main aim of the accelerator program is to speed up the commercialization of agrifood prototypes as well as strengthen the connections among education, research, and innovation through agricultural extension.

The commercialization rate in the agrifood sector is quite low, although the volume of the sector is large in developing countries. This model mainly leverages the innovation processes of firms. Startups have the opportunity to test and validate up-to-date technological solution proposals thanks to the program. Therefore, TAG-TECH enables commercialization by validating these ideas during the program implementation phase and enables new technologies to move to the mass production phase. All project phases are mentored from project initiation to a final product rather than partial mentoring. The TAG-Accelerator Program helps commercialization of the projects on the shelf, for which R&D has been completed with financial support from national or international organizations. The most distinctive part is the validation. As shown in Table 1, TAG-TECH is based on interactive networking rather than a linear model; adopts a bottom-up rather than top-down approach; focuses on problems, demand, and the market thanks to the IoT rather than mechanization; and encourages cooperation rather than individual efforts.

Academicians and researchers play an essential role in agricultural extension. This is considered the most important instrument to increase productivity or change production patterns in the agrifood sector. It should be stressed that agricultural extension programs in least developed countries cannot contribute to economic growth since many farmers in those countries operate under the economic restraints of traditional agriculture [6]. Setting up a functional agricultural extension model in traditional agriculture therefore plays an essential role.

TABLE 1

SHIFTING FROM TRADITIONAL APPROACHES TO TAG-TECH.

From	To
Linear model (mainly public research)	Interactive networking model (new interfaces such as development agencies)
Top-down	Bottom-up
Mechanization	Smart agriculture
Focus on technology	Problem, demand, and market focus
Individualism	Collectivism

Table 2 shows the seven main steps in TAG-TECH. The Ankara Development Agency works in close collaboration with local/regional public agencies and NGOs to find the best matches for proposals received. The preevaluation shown as the second step is conducted by agency staff. Those staff may decide to conduct site visits to identify needs/problems, and the potential beneficiaries are informed about site visits in advance. An Evaluation Committee of up to five members is set up with representatives from the public and private sectors as well as NGOs. The Evaluation Committee makes the selection for eligibility on the basis of the applications. Under each matching, a mentor(s) is assigned by the Evaluation Committee.

TABLE 2

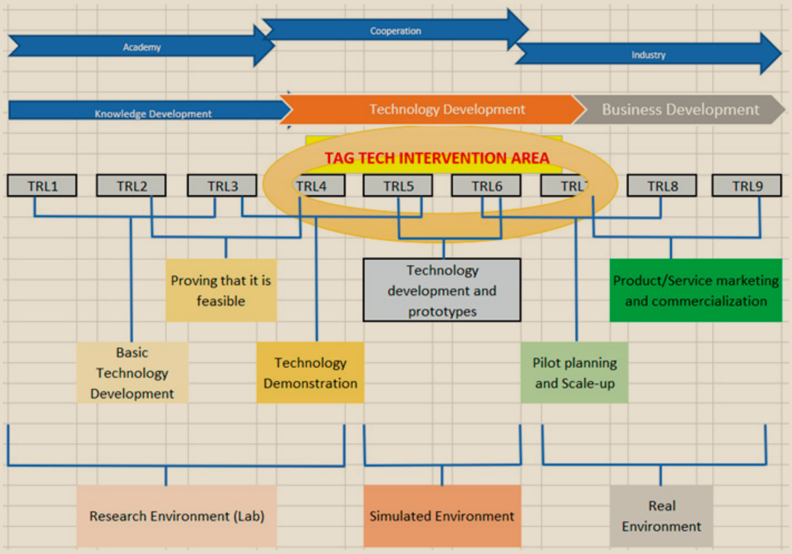
MAIN STEPS IN TAG-TECH.

	Technology Integration Steps	Agricultural Extension Steps
1	Call for proposals	Call for proposals
2	Preevaluation of applications	Preevaluation of applications
3	Site visits to eligible applicants if necessary	Site visits to eligible applicants if necessary
4	Identify needs/problems of farmers/ institutions/startups	Identify needs/problems of farmers/ institutions/startups
5	Evaluation Committee	Evaluation Committee
6	Matching	Matching
7	Implementation	Implementation

The steps in the TAG-TECH "technology readiness level (TRL)" are shown in Figure 4. The model aims to intervene in the area between TRL 4 and TRL 7. In Turkiye, some funds are provided for basic technology development but it is not easy to validate and test them in the agrifood field since the geographic area is large and scattered.

FIGURE 4

INTERVENTION AREAS IN THE TAG-TECH MODEL.



SOURCE: Adapted with permission from TUBITAK [7].

A questionnaire was conducted with experts in economic growth through an online survey [8]. The question of "which agricultural factors of production are primarily responsible for the large differences among countries in the success of the agricultural sector in contributing to economic growth?" was addressed. It was completed by 22 persons, 64% of whom indicated the choice of differences in the capabilities of farmers. This is not a surprising result in the agricultural growth literature. The Nobel Prize-winning economist Theodore W. Schultz tested this result in the 1960s [9]. He found that differences in the capabilities of farmers were more important than differences in land and in the quality of material capital in the amount and rate of increase of agricultural production. For instance, the quality of material agricultural factors employed in Japan is far better than that used in India. One of the features of Japan's agricultural growth has been the high level of farming skills and the amount of schooling [10]. This was also stressed in a recent report published by the OECD, which highlighted that the share of agricultural worker enrollment in higher education was stable or rising in Japan despite a declining share of employment in agriculture [11].

One of the commitments of OECD countries through the Committee of Agriculture is to invest in research, innovation, and extension services that can facilitate sustainable productivity growth and offer climate change mitigation and adaptation solutions. Strengthening the interconnections among research, innovation, and education is important [11]. The agricultural extension model is based on a demand-driven approach with the help of strong integration of innovation, research, and education.

Eligible Sectors and Costs

Agriculture and food, medical plants and drugs, and agricultural equipment and machinery are the sectors supported under the TAG-TECH Program. The eligible costs are laboratory use, testing/field stations, soil analysis, transportation, and mentoring/training. The ideal budget to be allocated for each matching is not more than USD20,000 and not less than USD7,000.

The program needs change on the basis of applications from potential beneficiaries, although the main topics listed in Table 3 cover the essential components of the program.

TABLE 3

PRIORITIZED AREAS UNDER THE TAG-TECH PROGRAM.

Agricultural Technologies	Food Technologies	Drug Technologies
Precise agricultural practices	Alternative food ingredients	Traditional herbal medicinal plants
Robotic vehicles and practices	Food safety and security	Medicinal and aromatic plants
Irrigation technologies	Alternative proteins	Biotechnology

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Agricultural Technologies	Food Technologies	Drug Technologies
Product and soil technologies	Waste technologies	Alternative active ingredients
Fertilizer technologies	Fortified food	Smart customized drugs
Pest control	e-Trade of food	Phytotherapy
Vertical agriculture	Sustainable packaging	
Soiless agriculture		
Smart agricultural equipment and machinery		
Animal health and farm management		
Big data management		
Climate change		
Traceability of agricultural products		
B2B digital marketing		

Case Study 1

A medicinal plant grower applied to the TAG-TECH Program in order to grow crops according to standards. He asked for mentoring in both growing products and laboratory testing. Through the Evaluation Committee, two mentors were allocated, one from the Department of Field Crops and the other from the Department of Pharmacy, who provided a total of 24 hours of mentoring including oil and soil analysis. At the end of the mentoring, it was found that the fungus propazine active ingredient level was high and manganese, zinc, and iron levels were deficient, resulting in poor cumin growth. It was suggested that the soil needed to be fertilized with rich microelements. The pharmacy mentor also tested and informed the beneficiary of the results. The grower started to prepare the soil and used the suggested techniques in his field. Following the program, the grower set up a new business and started to extract oil from cumin.

Case Study 2

A poultry firm applied to the program with a request for mentoring to prevent performance losses in broiler breeding due to diseases. The Evaluation

Committee selected two mentors from the Faculty of Veterinary Medicine, who provided 66 hours of mentoring and training to the beneficiary. Field testing was conducted with the suggested probiotic. Positive results of the probiotic were observed at the end of the program.

Lessons Learned from the Pilot Program

The bottom-up approach is important in defining the precise needs of beneficiaries. Among startups, multidisciplinary actions are essential for developing advanced tools in the agrifood sector. Farmers, particularly traditional ones, might not know their precise needs. Mentoring is of the utmost importance in identifying those needs. There are institutions serving as headquarters and regional offices, but more functional bodies are necessary to transfer technology or act as intervening brokers. Financing technology firms with the right tools would give more effective results, and therefore diversifying the financing tools available would be important for ecosystem development in the agrifood sector.

Venture capital funds need to be integrated with startup ecosystems to encourage their involvement in solving the main problems of the agrifood sector. Emphasizing agricultural extension is a key issue in raising agricultural productivity. There is knowledge transfer from technology companies to farmers or traditional food firms, but a systematic structure for transfer from farmers to farmers or from startup to startup is lacking. Tacit knowledge also needs to be transferred from traditional farmers. Finally, design-thinking training should be conducted for traditional farmers and firms.

A MODEL SUGGESTED FOR APO MEMBERS

Statistics show that the agrifood sector plays a vital role in the economies of most APO members. The lack of technology use and low productivity in many members are the most common findings from the statistics. APO members could start to prioritize their subdomains in agrifood through innovation strategies. The efficient use of limited natural and financial resources can only be achieved through prioritization. For example, climate-smart agricultural solutions could be a key priority area because there are significant numbers of small-scale farmers within the APO membership who need to adopt these solutions to overcome their main barriers and gain knowledge of new technologies. Other APO members could assign flexible institutions to act as interfaces, similar to the development agencies in Turkiye. Those willing to conduct joint activities could design tailor-made programs for technology firms and subsequently create databases for startups in the agrifood sector (Table 4).

TABLE 4

POTENTIAL MATCHES FOR JOINT PROGRAMS AMONG APO MEMBERS.

Farmer Mentor	Adviser Mentor
Farmer startups	Farmer–farmer
Food company startups	Food company mentor
Farmer–startup mentor	Food company startup mentor
Agricultural machinery firm startup	Agricultural machinery firm mentor
Agricultural machinery firm–startup mentor	Startup mentor, startup–startup mentor

CONCLUSIONS

Least developed and developing countries have not yet benefited enough from mechanization or the Green Revolution. World Bank Statistics show that the rate of agricultural machinery use in APO members remains low, noting that, "The new technology was introduced into traditional societies long before the so-called green revolution. However, their social and institutional structures did not permit the benefits of technology to spread widely throughout these societies" [1]. Furthermore, many countries suffered from insufficient land reform policies that are considered by many experts as a first step in agricultural reforms.

The gaps between small and large farms are widening. Land and/or labor productivity is still weak in least developed countries. Despite the fact that the cooperative movement has developed in many advanced countries, least developed countries suffer from a lack of institutions and cannot overcome constraints within food systems in terms of dealing with climate change. Although it is not feasible to buy a tractor that cannot be used year round, many tractors are not used economically without land reform since the level of cooperation required is not developed.

One of the important points observed from least developed countries is that prioritization is neglected in agriculture in terms of the share of R&D and innovation in GDP, lack of enrollment of farmers' children in schools, and lack of public awareness of the importance of agriculture. The limited financial resources cannot be used for the highest-priority areas that are not identified on the basis of reliable datasets. The smaller sizes of farms in least developed countries show that small-scale farmers face obstacles in accessing credit mechanisms since they might not have land to offer as guarantees. Under the UN SDGs, one of the main instruments to transform food systems is built on equity, participation, and democracy while not excluding vulnerable groups such as farmers and immigrants [12].

Smart agriculture or climate-smart agriculture differs from mechanization since it can be widely adopted by farmers, even traditional small-scale ones. However, labor and skill shortages are a serious problem in the agrifood sector as there is a declining contribution of agriculture to GDP as well as negative public perceptions of the sector as having relatively low wages and limited career prospects [13]. Agricultural extension services in many developing countries should therefore be redesigned based on public–private partnerships.

The main barriers that small-scale farmers face in agrifood value chains must be overcome through innovative approaches. The interactive networking approach aims to transform traditional agriculture and the food sector by including new actors such as startups and new interfaces like regional development agencies through a demand-driven approach. With technology integration, linear models implemented pre-2000 have begun to give way to the interactive networking model since mechanization and former institutions were insufficient to solve the chronic problems of the developing world completely.

Startups could be a promising area for overcoming unresolved issues in the agrifood sector. New interfaces that are flexible on a regional scale such as development agencies are important in transferring technology. The interactive approach does not exclude top-down approaches but focuses more on bottom-up ones. It also replaces the “one-size-fits-all” policies of the past with multisectoral approaches, particularly strengthening connections with advanced sectors including IT. As a result, APO members could create networking arrangements in the agrifood sector and design joint policies for transferring advanced technologies to increase productivity and raise the standards of living of their rural populations.

REFERENCES

[1] World Bank. World Bank Statistics, 2022. https://data.worldbank.org/indicator/AG.LND.TRAC.ZS (accessed 29 November 2022).

[2] Rostow W.W. The Stages of Economic Growth, A Non Communist Manifesto. Cambridge, UK: Cambridge University Press; 1960.

[3] World Bank. https://data.worldbank.org/indicator/NV.AGR.TOTL.ZS.

[4] Ministry of Agriculture and Forestry, Turkiye. Towards Sustainable Food Systems, National Pathway of Türkiye. Ankara: Government of Turkiye; 2021.

[5] Asian Productivity Organization. https://www.youtube.com/watch?v=FgKvp454joo (accessed 14 January 2023).

[6] Hayami Y., Ruttan V.W. Agricultural Development: An International Perspective, Baltimore: Johns Hopkins Press; 1991.

[7] TÜBİTAK. https://tubitak.gov.tr/tr/kurumsal/politikalar/icerik-tubitak-teknoloji-hazirlik-seviyesi-belirleme-metodolojisi (accessed 10 February 2023).

[8] Serefoglu C. Online survey through LinkedIn. https://www.linkedin.com/feed/update/urn:li:activity:6995043790134628352/ (accessed 12 January 2022).

[9] Schultz W.T. Economic Crisis in World Agriculture. Ann Arbor, MI: University of Michigan Press; 1966.

[10] Schultz W.T. Transforming Traditional Agriculture. New Haven, CT: Yale University Press; 1964.

[11] OECD. Labour and skills shortages in the agro-food sector. OECD Food, Agriculture and Fisheries Paper, January 2023, No. 189.

[12] United Nations. United Nations Food Systems Summit 2021. https://www.un.org/en/food-systems-summit/action-tracks/ (accessed 20 February 2023).

[13] Dorner P. Land Reform & Economic Development. Great Britain by S. Nicholls Company Ltd; Penguin Modern Economics Texts; 1972.

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