Table S1. Search results from Web of Science for 'digital agriculture' and 'smart farming' in MENA countries.[1]

Country/Region	Article(s) Returned
Algeria	*None*
Bahrain	*None*
Comoros	*None*
Djibouti	*None*
Egypt	*None*
Iraq	*None*
Jordan	*None*
Kuwait	*None*
Lebanon	*None*
Libya	*None*
Mauritania	*None*
Morocco	*None*
Oman	*None*
Qatar	*None*
Saudi Arabia	*None*
Somalia	*None*
Sudan	*None*
Syria	*None*
Tunisia	*None*
West Bank and Gaza [2]	*None*
United Arab Emirates	*None*
Yemen	*None*
Middle East and North Africa [3]	Ronaghi & Forouharfar (2020)

[1] Search was conducted via Web of Science on January 29, 2021, using a combination of 'country/region' + 'digital agriculture' or 'country/region' + 'smart farming' specifying both terms within the TOPIC field. The search was conducted for all years available.

[2] Search conducted for "West Bank and Gaza," "West Bank," "Gaza," and "Palestine."

[3] Search conducted for "Middle East and North Africa," "Middle East," "North Africa," and "MENA."

Table S2. Selected economic, social, environmental, and policy indicators.

Country	Agriculture as Share of GDP (2019)[1]	Agricultural Employment as Share of Total Employment (2020)[1]	Poverty Rate[3]	Rural Poverty Rate[3]	Urban Poverty Rate[3]	Prevalence of Undernourishment (2017-2019)[4]	Prevalence of Food Insecurity (2017-2019)[4]	Water Scarcity Ranking / Category[5]	Agricultural Emissions as Share of Total GHG Emissions (2017)[6]	Ag Or
Algeria	12.4%	9.7%	0.4%	N/A	N/A	2.8%	17.3%	29 - H	5.3%	
Bahrain	0.3%	1.0%	N/A	N/A	N/A	N/A	N/A	12 - EH	0.1%	
Comoros	33.1%	49.9%	19.1%	24.5%	10.9%	N/A	N/A	N/A	37.3%	
Djibouti	1.3%	32.4%	17.0%	57.4%	9.8%	N/A	N/A	36 - H	35.5%	
Egypt	11.0%	23.3%	3.8%	4.7%	2.5%	4.7%	34.2%	43 - H	10.1%	
Iraq	1.5%	17.8%	1.7%	3.7%	0.7%	23.7%	N/A	42 - H	2.7%	
Jordan	4.9%	3.0%	0.1%	0.3%	N/A	8.5%	N/A	5 - EH	4.8%	
Kuwait	0.5%	2.0%	N/A	N/A	N/A	<2.5%	12.3%	7 - EH	0.4%	
Lebanon	3.1%	13.4%	0.0%	N/A	N/A	5.7%	N/A	3 - EH	3.8%	
Libya	N/A	18.8%	N/A	N/A	N/A	N/A	N/A	6 - EH	3.4%	
Mauritania	18.7%	50.6%	6.0%	9.6%	2.0%	11.9%	44.8%	61 - MH	61.3%	
Morocco	12.2%	34.1%	0.9%	2.0%	0.2%	4.3%	25.9%	22 - H	16.4%	
Oman	2.4%	4.4%	N/A	N/A	N/A	7.8%	N/A	16 - EH	1.8%	
Qatar	0.2%	1.2%	N/A	N/A	N/A	N/A	N/A	1 - EH	0.4%	
Saudi Arabia	2.2%	2.3%	N/A	N/A	N/A	4.8%	N/A	8 - EH	0.8%	
Somalia	N/A	83.0%	N/A	N/A	N/A	N/A	N/A	100 - LM	50.6%	
Sudan	11.7%	39.7%	12.2%	14.3%	8.3%	12.4%	48.9%	47 - MH	39.8%	
Syria	N/A	10.5%	1.7%	N/A	N/A	N/A	N/A	31 - H	11.3%	
Tunisia	10.4%	12.7%	0.2%	0.7%	N/A	<2.5%	20.0%	30 - H	12.4%	
United Arab Emirates	0.7%	1.3%	N/A	N/A	N/A	3.1%	N/A	10 - EH	0.7%	
West Bank and Gaza	7.4%[2]	5.9%	0.8%	N/A	1.0%	N/A	26.3%	4 - EH	N/A	
Yemen	5.7%	28.6%	18.3%	23.4%	6.5%	N/A	N/A	20 - H	14.6%	

[1] World Bank. (2021). Databank: World Development Indicators. World Bank Group. Retrieved from https://databank.worldbank.org/source/world-development-indicators# (accessed January 26, 2021).

[2] Data are from 2018 (latest available).

[3] Data are for $1.90 PPP/day poverty line, and are latest available per country. World Bank. (2021). Databank: Poverty and Equity. Retrieved from https://databank.worldbank.org/source/poverty-and-equity (accessed January 26, 2021).

[4] FAO, IFAD, UNICEF, WFP, & WHO. (2020). *The State of Food Security and Nutrition in the World: Transforming Food Systems for Affordable Healthy Diets*. Rome: FAO. Retrieved from http://www.fao.org/publications/sofi/2020/en/ (accessed January 26, 2021).

[5] Ranking is among 163 countries, with higher rank reflecting higher baseline water stress. Classifications are as follows: Extremely High Water Stress (EH), High Water Stress (H), Medium-High Water Stress (MH), Low-Medium Water Stress (LM), Low Water Stress (L). World Resources Institute (WRI). (2019). "17 Countries, Home to One-Quarter of the World's Population, Face Extremely High Water Stress." Retrieved from https://www.wri.org/blog/2019/08/17-countries-home-one-quarter-world-population-face-extremely-high-water-stress (accessed January 26, 2021).

[6] Data refer to emissions from agriculture, including agricultural land use. FAO. (2020). FAOStat: Emissions Shares – Agriculture total – Share of total emissions (CO_2 eq) (AR5). Retrieved from http://www.fao.org/faostat/en/#data/EM (accessed January 26, 2021).

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Table S3. Evidence of digital agriculture across MENA countries.

Digital Agriculture Technology	Examples by Geography
Access to Land	• **Morocco:** The National Land Registry incorporates digital technologies to execute its functions [1].
Access to Machinery & Services	*No examples identified.*
Precision Agriculture	• **Egypt:** Tomatiki is a start-up in the area of precision agriculture applying smart irrigation solutions [1,2]. Solarise has developed smart aeroponics systems incorporating IoT, embedded controls, and sensors for improved growth monitoring and automatic adjustment. AbuErdan delivers improved management for the chicken value chain through a combination of IoT, AI, cloud, and blockchain technologies, offering a full traceability system, monitoring and prediction of farm performance, and slaughterhouse management. Innovation is a start-up proudcing large-scale, automated fish feeders for the fishery sector [2]. • **GCC:** ICARDA has developed digital technologies for precision management of date palm plantations [2]. • **Iraq:** Digital technologies have been adopted to support zero tillage and conservation agriculture techniques, as well as drip irrigation [2]. • **Jordan:** Digital technologies have been adopted to estimate evapotranspiration and monitor agricultural water use, including within irrigation systems. Digital technologies also feature within the control systems for soilless agriculture production in multiple locations across the country [2]. • **Lebanon:** The wine industry has adopted digital technologies including drone- and sensor-based IoT to assess growing conditions, water stress, vine performance, and disease. Potato producers have also invested in precision agriculture technologies [2].

Digital Agriculture Technology	Examples by Geography
	• **Morocco:** AGROAM is a business-to-business start-up offering services including for precision agriculture; these include an integrated system for IoT-based data collection, cloud-based data processing, and an application for improved farm management [2]. • **Saudi Arabia:** The public Sustainable Agriculture Research Centre conducts applied research on innovative techniques for protected agriculture, including water use efficiency and pest management [2]. • **Sudan:** The DAL dairy farming operation employs electronic necklaces to track livestock performance and allow for improved analysis and management [3]. • **Tunisia:** Start-up companies including I-Farming, Ezzayra, and IT Grapes/Seabex offer precision agriculture technologies [1,2]. Ezzayra is a private company offering management solutions in the form of sensors to monitor and regulate soil conditions (including irrigation and fertilization), as well as control irrigation leaks. MooMe offers precision agriculture solutions for dairy cow production, using animal-level sensors to assess rumination, movements, disease, and fertility and generate data via an online platform [4]. • **UAE:** Responsive Drip Irrigation is a start-up company developing self-regulating irrigation technologies [5].
IoT	• **Morocco:** COSUMAR Group designed Attaisir, a farmer-focused online management platform that aims to ensure sugar production for the domestic market [2]. The Moroccan Agricultural Development Agency has since 2020 expanded the functionality of Attaisir to enable remote monitoring of a fleet of 2,000 GPS-linked agricultural machines, with a goal to ensure continuous supply while minimizing contamination risk [6].
Remote Sensing / Control	• **GCC:** ICARDA has established more than 2,000 plots for soilless agriculture using digital applications for remote monitoring and control across the GCC sub-region [7]. • **Sudan:** Al Waha farm employs electronically controlled fertigation for crop production [3]. • **Syria:** Academic researchers have used remote sensing data to estimate crop yields [8] and to assess the impact of conflict on irrigated agriculture [9]. • **West Bank and Gaza:** Researchers at the Palestine Polytechnic University have developed software solutions for insect monitoring and for detection and estimation of plant foliage diseases [10]. • **Yemen:** The National Research Corporation with the support of the World Bank announced the launch of GIS- and GPS-supported agricultural, soil, and water maps [11]. Recent analysis published in 2020 has used remote sensing data to estimate the impacts of conflict on agriculture in the country [12].

Digital Agriculture Technology	Examples by Geography
Digital Knowledge Dissemination / Extension Services	• **Egypt:** FAO has launched a pilot mobile application for delivery of advisory and extension services under its "Inclusive Rural Information and Communication Services for Agricultural Innovation and Resilient Family Farming in the NENA Region" initiative. The Knowledge Economy Foundation operates Bashaier, a digital platform linking farmers to a range of extension services as well as markets [2]. • **Iraq:** The public Directorate of Agricultural Extension and Training has launched a mobile application to communicate with farmers on recommended dates for agricultural production, the use of chemical inputs, and productivity-enhancing techniques, and market price information. The Directorate of Veterinary Services is developing a system for geospatial surveillance and monitoring [2]. • **Jordan:** Private start-up TWIG offers services including smart software solutions to support home gardening, with plans to introduce automation and other innovations [13]. • **Lebanon:** The public National Center for Remote Sensing offers ICT activities to generate publicly accessible information that may be of use of farmers to inform planting, pest management, and fertilization. The public Lebanese Agriculture Research Institute offers an Arabic-language weather information and alert system via internet, SMS broadcast, and smartphone application. The private AgVisor digital application provides farmers notifications on pest and disease management [2]. Through the *Izraa* Facebook group, agricultural engineers provide agricultural advice, tutorials, and questions-and-answers to more than 100,000 members across a range of agricultural contexts. • **Morocco:** AGRIDATA is a private firm providing agricultural extension services via mobile phone, adapted to the needs of small producers. Fertimap is a public partnership using an online GIS-platform to provide information on soil fertility and cost-effective fertilization recommendations based on soil fertility maps and soil sampling [1,2]. • **Oman:** The Ministry of Agriculture and Fisheries offers an application to deliver advisory services to farmers. The private Oman Agriculture application offers information on farming requirements for selected major crops [2]. • **Saudi Arabia:** The Ministry of Environment, Water and Agriculture operates a mobile and web application to facilitate the delivery of advisory services [2]. • **Syria:** An e-learning pilot course on soilless cultivation systems allowed academics in exile to deliver training to learners inside Syria, overcoming conflict-related barriers [14]. • **Tunisia:** Plantix is a mobile application offering crop advisory services [1], produced via a public-private partnership. PlantMed, a recently established network of plant doctors, has established an Arabic-language online forum for exchange [2].

Digital Agriculture Technology	Examples by Geography
Farm Management & Decision-Making	• **Morocco:** Crop Growth Monitoring System (CGMS), Fertimap, Market Information System [1] • **Tunisia:** The *Institut National des Grandes Cultures* uses digital technologies to forecast yields [1].
Access to Finance	• **Jordan:** Digital payment systems exist and are widely used, including within the agriculture sector [2]. • **Lebanon:** Two mobile wallet solutions were introduced in the second half of 2020: Areeba has introduce Zaky, while Bank Audi has introduced Hawele. While both are already commercially available, the latter is being updated to include additional services (M. Bou Nassar, personal communication, 2021, February 2). • **Morocco:** *Crédit Agricole du Maroc* (CAM) offers a smartphone application for online banking operations, and a *relais digitaux* service to deliver visually connected financial and advisory services to rural areas. CAM is exploring advances in interoperable e-payment systems and weather index-based insurance schemes [2]. • **Somalia:** Ari.farm is a mobile application allowing anyone – regardless of location – to buy livestock in Somalia, which is then cared for by nomadic herders; users earn a share of the profits when animals are sold or produce offspring [15]. • **Tunisia:** Enda/Tamweel provides loans via a digital platform. Elsewhere, AHMINI targets rural women's inclusion in social protections by facilitating remote registration and payment by mobile phone; participating women can benefit from insurance against work accidents, health insurance, and retirement income [2]. • **West Bank and Gaza:** The private Bank of Palestine owns PalPay, a company providing e-payment solutions that reach some 50% of the population [16].
Market Access & Information / Digital Marketplaces & E-Commerce	• **Egypt:** Freshsource is an e-commerce, business-to-business platform linking horticulture producers to vendors in Cairo [1,2]. Freshfarm is a start-up working as an intermediary between farmers and consumers, facilitating direct purchases to raise farmer incomes and reduce consumer prices [2]. E-commerce technologies connecting farmers to modern markets and supporting sustainable agriculture practices have enhanced their efforts to tackle food loss and empower farmers during the COVID-19 pandemic [17]. • **Jordan:** Websites operated by large wholesale and producer associations (Wholesale and Vegetable Market of Greater Amman Municipality, Jordanian Exporters and Producers Association for Vegetables and Fruits) share market price information, as well as export standards, to support both farmer incomes and export performance [2]. • **Lebanon:** The AgVisor application allows farmers to compare crop market prices, and to access a director of actors across value chains [2]. • **Morocco:** E-commerce is at the earliest stages, led by companies including Jumia and Hmizate [2].

Digital Agriculture Technology	Examples by Geography
	• **Oman:** In partnership with the Oman Technology Fund, the government of Oman introduced the Behar digital auction platform as an alternative to traditional, in-person market operations during the COVID-19 pandemic. The platform also facilitates electronic payments for registered accounts. The platform has sustained market activity during COVID-19, while ensuring proper health and safety measures are respected [18]. • **Tunisia:** Herundo delivers e-commerce services to the National Olive Oil Exporter Association. Its business-to-consumer platform seeks to expand access to export markets, reduce transaction costs, capture economies of scale, and improve branding [1,2].
Transparency & Traceability	• **Egypt:** Verumcode applies blockchain and QR codes to tackle counterfeit products and improve food traceability and safety [2]. • **Iraq:** Electronic certificates have been used to facilitate field inspection of seeds for strategic crops [2].
Data Collection & Dissemination	• **Qatar:** Qatar's Ministry of Commerce and Industry maintains a website sharing daily price information for major food commodities (fish, fruit, vegetables) [19], and has operated a multi-channel consumer complaints line as a means to monitor and control price hikes linked to both trade embargoes as well as the COVID-19 pandemic [20].
Monitoring & Evaluation	• **Lebanon:** The National Center for Remote Sensing has used high-resolution satellite imagery to generate a wheat production map, which the Ministry of Economy and Trade uses in verifying production plots to implement its wheat subsidy program for farmers [21].
Digital Identification, Subsidy Distribution & Social Safety Nets	• **Egypt:** E-Finance is a public-sector initiative applying digital solutions, which has established AgriMisr, an online platform to connect farmers, agro-input dealers, and banks to facilitate the delivery of subsidized inputs. The creation of a farmer digital smart card has been used to facilitate the distribution, as well as to gather information on land holdings and crop production to inform agricultural planning [2]. • **Jordan:** A partnership between Making Cents International and BanQu has applied blockchain to deliver digital identification to vulnerable populations for facilitate delivery of social, financial, and health services [2]. The World Food Programme has introduced biometric beneficiary registration and verification in its interventions to support Syrian refugees living in Jordan. • **Lebanon:** A partnership between Making Cents International and BanQu has applied blockchain to deliver digital identification to vulnerable populations for facilitate delivery of social, financial, and health services [2]. • **Sudan:** The privately-organized Nafeer network, which was established in 2013 following Nile floods, has used a range of digital technologies (social media platforms, smartphone applications, GIS location

Digital Agriculture Technology	Examples by Geography
	mapping) to match volunteers, NGOs, and support to meet community needs including food security assistance [22].
E-Government	• **Egypt:** E-Finance is a public-sector initiative applying digital solutions, which has established the country's first government financial payment hub [2]. • **Qatar:** Public authorities in Qatar offer several e-government solutions to facilitate agricultural service delivery, including veterinary health certificates, inspection of agricultural products, and additional farmer-government transactions [2].

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