Aquaculture technology using plasma fine bubble in Indonesia

Biotechnology might alleviate zinc malnutrition through biofortification of wheat

Adapt to climate change and ensure food security in OIC-MC

Global trade and use of antibiotics in food animals is increasing antimicrobial resistance

المنظمة الإسلامية للأمن الغذائي

Islamic Organization for Food Security

l'Organisation Islamique pour la Sécurité Alimentaire

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FOOD SECURITY HUB

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CONTENT

Dear Readers,
assalamu' alaikum warakhmatullahi wabarakatuh!

It is my great pleasure to present you the 13th edition of the IOFS Food Security Hub. This edition discusses general articles about agriculture and food security.

With the world's population projected to reach staggering numbers, the food demand is expected to increase. This places immense pressure on agricultural systems to produce more with depleting resources while simultaneously mitigating the negative environmental impacts of intensified production. The role of agricultural technology in ensuring food security under this scenario has never been more crucial. Against this backdrop, the articles presented here explore the ways in which cutting-edge agricultural technologies are shaping the future of food production.

Modern agricultural technologies play a vital role in ensuring food security through precision agriculture, genetic engineering, vertical farming, and controlled environment agriculture. Climate-resilient crops and post-harvest technologies address the challenges of changing conditions and reduce production losses. Technologies like drones, robotics, and AI-driven analytics optimize crop monitoring, irrigation, and management. Mobile apps, extension services, and blockchain enhance information access and supply chain transparency. Soil health management and sustainable practices underpin long-term productivity. These advancements collectively bolster crop yields, minimize losses, and promote efficient resource utilization, ultimately contributing to global food security.

The articles also explore various aspects of technology's role in addressing critical challenges such as food security, climate change adaptation, nature-friendly farming, nutritional deficiencies, and antimicrobial resistance. From the integration of digitalization, AI, and robotics to the utilization of biofortification strategies and advanced plasma fine bubble technology, the articles shed light on transformative approaches that not only enhance productivity but also emphasize environmental conservation, biodiversity, and human health. As we navigate the complexities of modern agriculture and its impact on the planet, the articles underscore the importance of holistic and interdisciplinary approaches to inspire hope and optimism for a world where technology and nature coexist to ensure food security, environmental health, and human well-being.

Sincerely,

Prof. Yerlan A. Baidaulet

IOFS Director General

AGRI-TECH FOR FOOD SECURITY

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Introduction

According to International Organization for Food Security, food security is "a condition when all people, at all times, have physical, social, economic and financial access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (1). Every ninth person (about 790 million) around the world is undernourished and 780 million people of them live in Africa and Asia. According to IOFS's Food Security Index (FSI), only 7 of 55 OIC countries can be considered food secure, 30 are marginally secure and rest are food insecure as per statistics of 2019-2020 (Figure 1). The countries were classified based on the internal food security situation based on three dimensions i.e., consumption, access, nutrition. It also indicates the readiness of the countries to fulfil the basic needs to cover internal food demand.

Increasing population and hence increasing food demand is a major driver of climate change. The intensified farming although has increased food supply in last 50 years but it also increased use of fertilizers, and pesticides. Food/agricultural production is not only driving the climate change but also affected by it. The increased flooding in recent years, temperature fluctuations, long drought periods, tropical storms, and volcano eruptions (evidently in 2023), new diseases and pests are consequences of climate change. For instance, 2010 and 2022 floods and May 2022 heat waves in Pakistan, indicate increasing frequency of climate variations and had resulted in crop failures and livestock losses. The recurrent drought in East Africa in 2011 is also a classic example of food insecurity. The comprehensive analysis of published work indicates that global warming, erratic rainfall patterns, and increased frequency of extreme climate events has reduced crop yields, decreased livestock productivity and animal growth rate. Furthermore, post green revolution, dependence on fewer crops (and varieties within these crops) has not only limited our daily nutrient supply but also is not pacing up to meet food demands, increasing water scarcity, soil erosion, pests and disease resistance against agrochemicals, and loss of biodiversity.

The United Nations introduced 17 sustainable developmental goals on 1 January 2016. These goals address diversity of tasks, from yield increment to building infrastructure for local markets and international trading. All the SDGs deal with at least one of the four dimensions of food security at global scale. Keeping all the challenges in mind, food security through all dimensions can only be achieved through exploiting new technologies and innovations across food system (few listed in Table 1).

Country	Y2019	Y2020	Country	Y2019	Y2020	Country	Y2019	Y2020
Albania	3	3	United Arab Emirates	2	2	Nigeria	2	1
Kazakhstan	3	3	Côte d'Ivoire	2	2	Mali	1	1
Kuwait	3	3	Benin	2	2	Afghanistan	1	1
Türkiye	3	3	Iran (Islamic Republic of)	2	2	Bangladesh	1	1
Uzbekistan	3	3	Maldives	2	2	Chad	1	1
Bahrain	3	3	Gabon	2	2	Comoros	1	1
Qatar	3	3	Malaysia	2	2	Djibouti	1	1
Algeria	2	2	Mauritania	2	2	Gambia	1	1
Azerbaijan	2	2	Cameroon	2	2	Guinea-Bissau	1	1
Egypt	2	2	Syrian Arab Republic	2	2	Iraq	1	1
Guyana	2	2	Lebanon	2	2	Jordan	1	1
Kyrgyzstan	2	2	Niger	2	2	Mozambique	1	1
Libya	2	2	Burkina Faso	2	2	Senegal	1	1
Morocco	2	2	Guinea	2	2	Sierra Leone	1	1
Oman	2	2	Indonesia	2	2	Suriname	1	1
Saudi Arabia	2	2	Pakistan	2	2	Togo	1	1
Tunisia	2	2	Tajikistan	2	2	Uganda	1	1
Turkmenistan	2	2	Sudan	2	2	Yemen	1	1

Figure 1: The IOFS's Food Security Index (FSI). Score 3-high food security, 2-marginal food security, 1-low food security)
Source: Agricultural production and trade complementarities among OIC Member Countries, SESRIC, OIC 2023

The modern and innovative agricultural technologies are broadly classified as Uncontrolled Environment Agriculture (UEA) and Controlled Environment Agriculture (CEA). UEA encompasses practices like open space vegetable gardens, rooftop gardens, and community gardens, which are frequently recognized for their contribution to enhancing food security in urban areas across the globe. On the other hand, CEA encompasses agricultural methods that employ environmental optimization, often in collaboration with the surrounding urban infrastructure. Examples of CEA include structures like greenhouses, indoor farming, vertical farming, and building-integrated agriculture (BIA).

While integrated efforts are being made globally, food security remains a pressing challenge for the Organization of Islamic Cooperation (OIC) countries, which face numerous hurdles, including population growth, climate change, water scarcity, and limited arable land. A study conducted to examine the impact of climate change in 14 OIC countries for three important food commodities (rice, corn, and fruits) revealed that increasing temperature in OICs will reduce the return on these products (2). Decreasing precipitation is another concern for semi-arid to arid OIC countries; 23 facing water stress, 18 suffering water scarcity and 13 of them has absolute water scarcity, according to Statistical, Economic and Social Research and Training Center for Islamic Countries (SESRIC).

Category	Sub-Category	Company or Product Name	Country	Purpose	Reference
Indoor farming	Aeroponics	Lettus Grow	United Kingdom	Design and build aeroponic technology and farm management software for indoor and vertical farms.	www.lettusgrow.com
	Hydroponic	Dekoponix	Malaysia	Indoor hydroponic kit	sciencepark.upm.edu.my
Supply Chain Technology	Vegetable processing	Releaf	Nigeria, Africa	Supply chain technology company that helps Fast Moving Consumer Goods Companies (FMCGs) in Africa get high quality inputs cheaper by localising food processing technology in farming clusters to increase quality, reduce logistic costs, and create more value for farmers, primary processors & FMCGs	www.releaf.africa
	Urban operating system	Archisen	Singapore	Designs, builds, and operates solutions to grow ultra-fresh, ultra-local produce specially vegetables indoor	www.archisen.com
Crop Improvement Technology	Microbiome technology	Novonutrients	USA	NovoNutrients fermentation platform is powered by patent pending microbes and proprietary bioreactors. The organisms transform emissions, along with hydrogen and oxygen, into complete, safe, natural single cell protein ingredients for food and feed.	www.novonutrients.com
	Breeding	PadiU Putra 1	Malaysia	High yield and blast resistant rice variety	sciencepark.upm.edu.my
	Biocontrol	Milagro Matado	Malaysia	Repel insects	sciencepark.upm.edu.my
Agri-Engineering	Agricultural machinery	Blade	Malaysia	Attached to fiber extractor machine to extract pineapple leaf fiber	sciencepark.upm.edu.my
	Agricultural machinery	Fruit dryer	Malaysia	Portable dual-pass tray dryer for drying crops	sciencepark.upm.edu.my

Category	Sub-Category	Company or Product Name	Country	Purpose	Reference
Post Harvest	Post harvest processing technology	AgroSustain	Switzerland	Developing natural and organic coatings for sustainable production and distribution	agrosustain.ch
	Post harvest processing technology	Mori	USA	Using naturally derived silk protein, a protective layer that slows down three key mechanisms that cause food to spoil	www.mori.com
Precision Agriculture	Farm designing	AgriTecture	USA	An advisory services and technology firm focused on climate-smart agriculture, particularly urban and controlled environment agriculture (CEA)	www.agritecture.com
	Satellite imagery	Fixposition AG	Switzerland	Combining high precision RTK-GNSS with inertial and visual sensors, expertise in satellite and visual navigation	www.fixposition.com
	Smart technology	Smart detector for fruit quality	Malaysia	Smart detector fruit quality	sciencepark.upm.edu.my
	Engineering	Ecorobotix	Switzwerland	Develop, manufacture and commercialise farming machines, Robotic solutions to make farmers' lives easier in producing healthy food.	ecorobotix.com
	Smart technology	G2V Optics	Canada	Proprietary variable spectra technology to maximise commercial crop value by controlling plant yield and chemical content through precision lighting and monitoring	g2voptics.com
	Smart technology	NorDetect	Denmark	Produces Lab-on-a-chip devices for environmental and agricultural analysis like on farm-water testing	www.nordetect.com
Livestock improvement	Livestock management	Livestock Profiling System	Malaysia	A Sub-Dermal RFID Based Monitor to profile ivestock health	teknologi-tawaran.mardi.gov.my
Biosafety	Contaminant detection	SwissDeCode	Switzerland	Testing kits and automated devices for the rapid, on-site detection of contaminants that may harm the quality of food products like GMO Corn, Cacao Swollen Shoot Virus, and the authentication of swissdecode.com premium products, such as A2 milk.	www.swissdecode.com

Table 1: Global examples of agricultural science and technology

Precision agriculture: optimizing farming practices

Precision agriculture (PA) is a data-driven approach that utilizes technologies like Global Positioning System (GPS), sensors, drones, and satellite imagery to make informed decisions about farming practices. It aims to increase efficiency, productivity, and sustainability by tailoring agricultural practices to specific conditions in the field. For OIC countries facing water scarcity and limited resources, this technology can significantly increase agricultural productivity and ensure sustainable farming practices. However, farmers adopt technologies based on cost/benefit ratio. In the context of PA, this primarily involves reducing production expenses or boosting productivity, resulting in decreased per unit production costs. However, the early adopters of PA gain a competitive edge over those who do not adopt it. Consequently, non-adopters may face marginalization and potential exit from the market during industry consolidation.

The PA technology was broadly introduced and adopted in developed countries during 1990s. Priorly, the smaller-scale farmers handled the field operations precisely as they knew the characteristics of their fields and livestock. For instance, they might apply manure specifically on hilltops, perceived to require more nutrients than lower, possibly richer areas of the fields. They could readily identify sick animals, as the herd was smaller. However, for large scale farming, PA might offer tremendous potential cutting off the costs and increasing productivity. For example, it would be easier to monitor livestock operations with robust monitoring practices.

The PA can be scaled on two levels; advancing the already adopted farming practices (like tractors, fertilizers, crop breeding and genetics), and computational technology (GPS, sensors, variable rate technology etc) (3). However, the PA technologies depend on the type of farm. Some practices may be independent of scale and method of operation. For instance, a small-holder farmer may benefit from applying a bag of fertilizer manually in the same way as a large-scale farmer would from a motorized application. Similarly, both can switch from conventional to genetically engineered seed regardless of application method.

Precision agriculture involves various technologies and techniques, including:

Global Positioning System (GPS) Technology

GPS is used in precision agriculture to precisely map fields and determine the exact location for input application more precisely than a steering wheel. GPS technology enables farmers to apply inputs (e.g., fertilizers, pesticides) only where needed, reducing waste, and ensuring targeted application. Moreover, the equipment can be trained too, like section controllers for input application to reduce pass to pass and end-of-field overlaps and skips, overall increasing efficiency.

Variable Rate Technology (VRT)

VRT allows farmers to adjust input application rates based on the variability within a field. For instance, different areas with varying soil types or nutrient levels can receive different amounts of fertilizers or irrigation, optimizing resource usage and crop yields.

If GPS system is equipped with the variable rate technology, it can detect and variably inputs based on heterogenous soil texture, moisture, organic matters, and many other variable factors leading to field inconsistency (Figure 2).

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Figure 2: Google Earth image from MNS University of Agriculture Multan, Punjab-Pakistan (30°08'27" N, 71°26'33" E, 133 m elevation) shows variability in agricultural fields.

Remote Sensing and Imaging

Drones, satellites, and sensors are employed to gather real-time data about crop health, soil conditions, and other environmental factors. This data is used to identify areas of concern, such as pest infestations, diseases, or nutrient deficiencies, allowing farmers to take timely actions.

Figure 3: Images of wheat field captured using unmanned aerial vehicle (UAV)

Digitalizing agriculture for food security

The digital system is known to revolutionize agriculture commonly called as Agriculture 4.0. It includes automations in dairy, livestock business and farming like Internet of Things (IoT), Big data, robots, artificial intelligence (AI), and augmented and virtual reality. Ultimately, it provides data driven cop production systems and efficient utilization of resources.

AUTOMATED MACHINERY

Farm equipment with advanced automation capabilities, such as self-driving tractors, can precisely follow predetermined paths and perform tasks with high accuracy. This reduces human errors, fuel consumption, and the time required for farming operations. For instance, FarmBots have the capability to operate in small garden beds, greenhouses, and indoor environments. However, the challenge arises when there is limited or no access to high-capacity mobile communication networks. To address this, ad-hoc systems are necessary to provide access to services, utilizing cloud-based solutions even in areas with restricted or no coverage. However, according to SESRIC, the average usage of one tractor covers over 100 hectares of arable land in OIC countries, which contrasts with developing countries and the global average of 73 hectares and 48 hectares, respectively.

Tool	Application	Website
Nutrient Expert	SSNM tool that provide soil nutrient recommendations for individual farmer fields in the absence of soil testing data in rice, maize, and wheat	research.ipni.net
Crop Manager	A web-based platform for field-specific information on rice crop	www.irri.org/crop-manager
Nutrient Decision Support System (NuDSS)	Decision support on SSNM in the irrigated lowlands for rice	ipipotash.org
Quantitative Evaluation of the Fertility of Tropical Soils	Model that can estimate crop yield from input applied information. Utilized in rice cropping systems	models.pps.wur.nl
AmaizeN	Decision support system to schedule nitrogen applications for site-specific maize crops	sciencedirect.com

Table 2: Digital apps and tools for decision making in agricultural production system

IOT, DATA ANALYTICS AND AI

The Internet of Things (IoT) connects various devices and sensors on the farm, collecting data in real-time. Sensors can monitor soil moisture, temperature, humidity, and other parameters, providing valuable insights for decision-making. It monitors flow of data using encryption methods to safeguard important datasets.

It employs AI security technologies to monitor suspicious activities and store data in blockchain to maintain integrity. Advanced data analytics and AI-driven algorithms process large datasets collected from various sources. This analysis helps identify patterns, predict crop growth, optimize resource allocation, and make informed decisions.

SMART IRRIGATION SYSTEMS AND DECISION MAKING TOOLS

Precision agriculture employs smart irrigation systems that adjust watering schedules based on real-time data, weather forecasts, and crop needs. This ensures efficient water usage and prevents over- or under-irrigation.

SITE-SPECIFIC NUTRIENT MANAGEMENT (SSNM)

The SSNM is essential for optimizing fertilizer utilization and enhancing crop productivity. It involves featured fertilizer application based on the specific requirements of the crop and the capacity of the soil to supply nutrients. Some of the tools that may help in decision making are given in Table 2. Similar tools can also be found on www.quantitative-plant.org/model

By integrating these technologies and techniques, precision agriculture offers numerous benefits, including increased crop yields, reduced input costs, minimized environmental impact, improved resource efficiency, and enhanced overall farm profitability. It plays a crucial role in addressing the challenges of a growing global population, limited arable land, and climate change, making it an essential strategy for the future of sustainable and efficient agriculture.

Conclusion

Incorporating agricultural technologies like precision agriculture supported by data-driven practices and advance tools like IoT, AI, and robotics, hold the key to addressing the pressing challenge of global food security. With undernourishment affecting millions, especially in Africa and Asia, the need for efficient resource utilization and sustainable farming methods is paramount.

The AgriTech innovations offer solutions to mitigate the impact of climate change, water scarcity, and limited arable land in OIC Member States. By optimizing input application, enhancing crop yields, and reducing waste, precision agriculture and digitalization pave the way for a more secure food future. Embracing these advancements not only ensures a stable and sufficient food supply but also underscores the role of technology in building a resilient and prosperous global food system.

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EN ABSTRACT

AgriTechs for food security

The emerging agricultural technologies have focused on sustainability and improved farming methods. These encompass digitalization, automation, and advanced concepts like Big Data, AI, robotics, IoT, and virtual/augmented reality. These innovations are profoundly influencing our lives, particularly through precision agriculture—a data-driven approach that helps efficiently grow crops on cultivable land, enabling farmers to maximize resource utilization. Utilizing geoinformation technologies minimize or eliminate downtime during personnel or equipment shortages. This approach also lowers agrotechnical operation costs per unit of cultivated area and leads to improved yield outcomes.

Keywords

Precision agriculture, digital agriculture, food security index, computation technology

FR RÉSUMÉ

Les technologies agricoles au service de la sécurité alimentaire

Les nouvelles technologies agricoles se sont concentrées sur la durabilité et l'amélioration des méthodes de culture. Celles-ci englobent la numérisation, l'automatisation et des concepts avancés tels que le Big Data, l'IA, la robotique, l'IoT et la réalité virtuelle/augmentée. Ces innovations ont une influence profonde sur nos vies, notamment par le biais de l'agriculture de précision, une approche fondée sur des données qui aide à cultiver efficacement les terres cultivables, permettant ainsi aux agriculteurs de maximiser l'utilisation des ressources. L'utilisation des technologies de la géoinformation permet de minimiser ou d'éliminer les temps d'arrêt en cas de pénurie de personnel ou d'équipement. Cette approche permet également de réduire les coûts des opérations agrotechniques par unité de surface cultivée et d'améliorer les rendements.

Keywords

Agriculture de précision, agriculture numérique, indice de sécurité alimentaire, technologie informatique

AR المُلخّص

التكنولوجيات الزراعية من أجل الأمن الغذائي

ركزت التكنولوجيات الزراعية الناشئة على الاستدامة وأساليب الزراعة المُحسّنة. وتشمل هذه التقنيات الرقمنة والأتمتة والمفاهيم المتقدمة مثل البيانات الضخمة والذكاء الاصطناعي والروبوتات وإنترنت الأشياء والواقع الافتراضي/المُعزز. وتؤثر هذه الابتكارات بعمق على حياتنا، لا سيما من خلال الزراعة الدقيقة - التي هي عبارة عن نهج قائم على البيانات يُساعد على زراعة المحاصيل بكفاءة على الأراضي الصالحة للزراعة، مما يمكّن المزارعين من تعظيم الاستفادة من الموارد. ويؤدي استخدام تكنولوجيات المعلومات الجغرافية إلى تقليل فترات التعطّل أو إزالتها عندما يكون هناك نقص الموظفين أو المعدات. كما يُقلل هذا النهج أيضًا من تكاليف العمليات الزراعية لكل وحدة من المساحة المزروعة ويُؤدي إلى تحسين نتائج الغلة.

الكلمات الرئيسية: الزراعة الدقيقة، الزراعة الرقمية، مؤشر الأمن الغذائي، تكنولوجيا الحوسبة

TECHNOLOGY MUST HELP FARMERS WORK WITH NATURE

Helen Browning OBE is an organic farmer and chief executive of the Soil Association. As well as leading the charity, she runs a mixed farm in Wiltshire, England, with arable crops, pigs, cattle and some fruit crops from agroforestry.

HELEN BROWNING

Introduction

Agricultural technology (AgriTech) has received a high degree of promotion from businesses and government. While new technologies are potentially exciting and should be approached with an open mind, we must be clear about the pros and cons of these emerging approaches alongside other innovations in our farming and food systems.

In the face of the climate and nature emergencies, the key question is, will modern technologies accelerate or distract from the fundamental transformation needed in our farming systems?

We must identify the technologies to support organic and agroecological farming practices, as well as being aware of those that lead to intensive farming and may stop farmers from shifting to nature-friendly systems.

What is agricultural technology all about?

In recent decades, food and farming systems in the UK and worldwide have become very tech-intensive, mostly through engineering and chemical approaches such as combine harvesters, tractors, pesticides, artificial fertilisers and 'ultra' food processing. These technologies have emphasised high yields and less labour and encouraged standardisation. Meanwhile, biology and ecology have been less of a focus.

The result has been a shift from the type of mixed farm that we see in children's books, with a diverse mix of animals and crops, to farm businesses that are specialised in one aspect, with standardised methods of production.

Supply chains have become more centralised, focussed on mass-produced key products, like wheat and soya. Many seasonal and exotic foods are available all year round. A shift to new ways of mass production, processing, and preservation has turned a narrow range of crops into a diverse array of mass-produced food products.

Technology has changed farming in the UK and around the world, and the food that ends up on our plates. But tech didn't so much adapt to meet the needs of our food systems. Largely, our food systems adapted to meet the development of the tech. So new problems have been created as others have been solved.

We've ended up with the production and consumption of too much of the wrong foods, which has increased obesity rates, food inequality, food waste, environmental pollution, use of antibiotics in farm animals, soil degradation, and extensive greenhouse gas emissions, to name a few.With the connected crises in our climate, nature, and health, we now need to develop and promote new agricultural and food technologies that are designed to tackle these issues. And we need to be careful about harnessing new technologies that, despite good intentions, work to simply maintain the status quo.

Until recently, technology has not supported nature-friendly farming

There is a huge untapped potential for new technologies to aid a transition to agroecology. Agroecology applies the scientific principle of ecology. Rather than a sole focus on production and high yields, it aims to meet broader environmental and societal needs. A key priority is to make the most of the benefits you get from having diversity in our farming systems and our diets. So far, this has clashed with what has been a technological push towards input-intensive, rather than biology-intensive, farming.

For example, in agroecological systems, such as organic farmers look at how to fertilise crops while considering nutrient pollution, soil carbon, soil degradation, and crop pests and diseases. The solution becomes complex and context-specific – using leguminous plants like clover that naturally put nitrogen into the soil, grazing livestock, deep-rooting crops, and more. It makes farming more diverse, less standardised, which can be more labour-intensive. Yields are not always lower, though, as studies suggest yield gaps can be closed with the right investment, and the benefits for nature, climate, and human health are substantial.

There is, therefore, an urgent need to ensure that new and emerging technologies support this more complex, holistic system of farming, as well as help farmers to grow crops that support healthier, less ultra-processed diets.

Figure 1: Mixed farming system including animals and crops

Is agricultural technology safe and ethical?

To avoid repeating mistakes, we need to develop and promote agricultural technologies that are designed to fit our desired food system, not the other way round. So, we must be clear about the goals we are aiming for and the relative merits of different ways of achieving them.

We need to consider the control by fewer companies in our food system and its effect on how technology is rolled out. And we need to ensure that technology supports agroecological aims.

It is tempting to say we need all the tools in the toolbox, but we must be careful not to support approaches that will squeeze out other solutions and consume all available investment. Some tech can lead to 'lock-in' to unsustainable systems, despite the best of intentions.

For example, biogas digestors that break down waste materials can create revenue streams for large-scale indoor dairy, pig, and poultry farming and drive the expansion of maize farming, which can be damaging to soil and biodiversity. So how they are used and the support they are given needs to be carefully considered.

Genetic modification, including new gene-editing techniques, is another example. These techniques have a whole range of concerns attached, as well as a great deal of speculation as to their potential benefits. So far, these technologies have tended to exacerbate currently unsustainable food systems rather than help us steer a new course.

Figure 2: Farmer inspects hops with hand held microscope-organic hops variety field lab

Is agritech the answer to our food and farming crisis?

We need to move towards a food system that facilitates the production of less but better meat, more fruit and veg, soil and wildlife regeneration, more trees, and healthier diets for all. Emerging technologies have the potential to support a diverse and resilient future.

Engineering technologies such as robotics may allow us to move away from ever larger machinery that damages soils by compacting and driving field expansion. Robotics for weeding and picking could help us manage more complex and diverse farms. It would be great to see more trees on farms producing fruits, nuts, and timber, growing among smaller fruit bushes and herbs and alongside grazed grassland or crops – and little machines that could navigate through this diverse array could help make this more financially viable.

In the biological sphere, algae and insect farming could also have a role to play. These developments hold great potential to reduce our reliance on imported soy for animal feed – which drives deforestation and habitat destruction abroad. Reducing demand for grain-fed industrial livestock products as part of a shift to healthier, more humane, and sustainable diets remains of paramount importance.

But Innovation is not all about tech. It is also about building knowledge and trialling new farming systems whilst utilising existing practices that can be rapidly scaled up by farmers. Diversity is the key to innovation. It gives greater resilience in the face of climate and disease risks and underpins greater nutritional diversity, which we need for healthier diets. As agroecological farms produce a greater variety of foods, we need processing and supply chains to evolve, too, to enable these products to reach the end consumer in optimal form with reduced wastage.

Figure 3: Farmer using a quadrant

Figure 4: Farmers led research

We need more support for farmer-led research into sustainable solutions.

Many of the best ideas in farming come from farmers themselves. Field labs led by farmers in partnership with scientists have a key role to play. The Soil Association's Innovative Farmers network, which enables such trials, has put farmers in the driving seat of agricultural research for the last decade. The network has connected with 12,000 UK farmers across 120 field labs. Among these, half of the surveyed farmers said they changed their farming practices because of field labs, and the majority said they had learned something new. Farmer-led research is crucial to sustainable farming.

And it needs to gear towards securing innovation in low-input farming. We must reduce our reliance on pesticides, fertilisers, and antibiotics to secure a sustainable future. Crop and animal breeding programs should therefore prioritise varieties that are effective in lower input systems. Currently, this is not happening to a great degree, and varieties are not often evaluated in organic conditions, so it is an unclear picture for anyone looking to avoid chemicals. Most investments into research, flows of high tech, with patentable products that drive profits, rather than furthering the knowledge farmers need to produce food using the natural world as a friend and ally. The era of chemical agriculture is ending, and the focus now shifts to biology, ecology, and the complexity of natural systems. Let us hope we can reap the benefits and learn the lessons of the last 60 years.

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EN ABSTRACT

Technology must help farmers work with nature

Food and farming systems in the UK and worldwide have become very tech-intensive, mostly through engineering and chemical approaches such as combine harvesters, tractors, pesticides, artificial fertilizers and 'ultra' food processing. These technologies have emphasized high yields and less labor and encouraged standardization. Meanwhile, biology and ecology have been less of a focus.

In the face of climate and nature emergencies, the key question for the Soil Association is, will modern technologies accelerate or distract from the fundamental transformation needed in our farming systems? We must identify the technologies to support nature-friendly farming practices like those followed by organic and agroecological farms. We also need to be aware of when technologies lead to intensive farming and may stop farmers from shifting to nature-friendly systems.

There is a huge untapped potential for new technologies to aid a transition to agroecology. Agroecology applies the scientific principle of ecology. Rather than a sole focus on production and high yields, it aims to meet broader environmental and societal needs. A key priority is to make the most of the benefits you get from having diversity in our farming systems and diets. Technology needs to help us shift to this mindset and away from the intensive practices that have dominated in recent decades.

To avoid repeating mistakes, we need to develop and promote agricultural technologies that are designed to fit our desired food system, not the other way round. And innovation is not all about tech. It is also about building knowledge and trialing new farming systems whilst utilizing existing practices that can be rapidly scaled up by farmers. So, we must be clear about the goals we are aiming for and then consider the relative merits of different ways of achieving them. Diversity is the key to innovation. It gives greater resilience in the face of climate and disease risks and underpins greater nutritional diversity, which we need for healthier

FR RÉSUMÉ

La technologie doit aider les agriculteurs à travailler avec la nature

Les systèmes alimentaires et agricoles au Royaume-Uni et dans le monde entier sont devenus très intensifs en technologie, principalement par le biais d'approches techniques et chimiques telles que les moissonneuses-batteuses, les tracteurs, les pesticides, les engrais artificiels et l'ultra-transformation alimentaire. Ces technologies ont mis l'accent sur des rendements élevés et une main-d'œuvre réduite et ont encouragé la normalisation. Dans le même temps, la biologie et l'écologie ont été moins mises en avant.

Face aux urgences climatiques et naturelles, la question clé pour l'Association des sols est la suivante : est-ce que les technologies modernes accéléreront ou détourneront la transformation fondamentale nécessaire de nos systèmes agricoles ? Nous devons identifier les technologies qui soutiennent les pratiques agricoles respectueuses de la nature, telles que celles des exploitations biologiques et agroécologiques. Nous devons également savoir quand les technologies mènent à une agriculture intensive et peuvent empêcher les agriculteurs de passer à des systèmes respectueux de la nature. Il existe un énorme potentiel inexploité de nouvelles technologies pour faciliter la transition vers l'agroécologie. L'agroécologie applique le principe scientifique de l'écologie. Plutôt que de se concentrer uniquement sur la production et les rendements élevés, elle vise à répondre à des besoins environnementaux et sociétaux plus larges. L'une des principales priorités est de tirer le meilleur parti des avantages liés à la diversité de nos systèmes agricoles et de nos régimes alimentaires. La technologie doit nous aider à adopter cet état d'esprit et à nous éloigner des pratiques intensives qui ont dominé ces dernières décennies.

Pour éviter de répéter les mêmes erreurs, nous devons développer et promouvoir des technologies agricoles conçues pour s'adapter à notre système alimentaire souhaité, et non l'inverse. Par ailleurs, l'innovation ne se résume pas à la technologie. Elle consiste également à développer les connaissances et à tester de nouveaux systèmes agricoles tout en utilisant les pratiques existantes qui peuvent être rapidement transposées à plus grande échelle par les agriculteurs. Nous devons donc définir clairement les objectifs que nous visons, puis examiner les mérites relatifs des différentes manières de les atteindre. La diversité est la clé de l'innovation. Elle apporte une plus grande résilience face aux risques climatiques et aux maladies et sous-tend une plus grande diversité nutritionnelle, dont nous avons besoin pour une alimentation plus saine.

المُلخص AR

يجب أن تساعد التكنولوجيا المزارعين على العمل مع الطبيعة

لقد أصبحت أنظمة الأغذية والزراعة في المملكة المتحدة وفي جميع أنحاء العالم كثيفة الاستخدام للتكنولوجيا، ومعظمها من خلال الأساليب الهندسية والكيميائية مثل الجمع بين الحصادات والجرارات والمبيدات الحشرية والأسمدة الاصطناعية ومعالجة الأغذية "الفائقة". ولقد أكدّت هذه التكنولوجيات على العوائد العالية والعمالة الأقل وشجّعت على التوحيد القياسي. وفي الوقت نفسه، كانت البيولوجيا والبيئة أقل تركيزًا.

وفي ظل مواجهة حالات الطوارئ المناخية والطبيعية، فإن السؤال الرئيسي لجمعية التربة هو: هل ستُسرّع التكنولوجيات الحديثة أو تُصرف الانتباه عن التحوّل الأساسي المطلوب في أنظمتنا الزراعية؟ ويجب علينا تحديد التكنولوجيات المناسبة لدعم ممارسات الزراعة الصديقة للطبيعة مثل تلك التي تتبعها المزارع العضوية والزراعية البيئية. كما علينا أيضًا أن نكون على دراية بالوقت الذي تؤدي فيه التكنولوجيات إلى الزراعة المكثفة التي من شأنها أن تمنع المزارعين من التحوّل إلى أنظمة صديقة للطبيعة.

هناك إمكانات هائلة غير مستغلة للتكنولوجيات الجديدة للمساعدة في الانتقال إلى الزراعة الإيكولوجية. حيث تطبق الإيكولوجيا الزراعية المبدأ العلمي للبيئة. وبدلاً من التركيز فقط على الإنتاج والعوائد العالية، فإنها تهدف إلى تلبية الاحتياجات البيئية والمجتمعية الأوسع. وتتمثل الأولوية الرئيسية في تحقيق أقصى استفادة ممكنة من الفوائد التي نحصل عليها من التنوع في أنظمتنا الزراعية ووجباتنا الغذائية. ويجب أن تساعدنا التكنولوجيا على التحوّل إلى هذه العقلية والابتعاد عن الممارسات المكثفة التي ظلّت سائدة خلال العقود الأخيرة.

يجب علينا أن نطوّر ونُعزز التكنولوجيات الزراعية المصممة لتناسب نظامنا الغذائي المطلوب، وليس العكس، من أجل تجنب تكرار الأخطاء. فالابتكار لا يتعلق التكنولوجيا لوحدها، بل يتعلق أيضًا ببناء المعرفة وتجربة أنظمة زراعية جديدة مع استخدام الممارسات الحالية التي يمكن للمزارعين توسيع نطاقها بسرعة. وهكذا، يجب أن نكون صريحين بشأن الأهداف التي نرمي إليها ومن ثم النظر في المزايا النسبية للطرق المختلفة لتحقيقها. فالتنوع هو مفتاح الابتكار. إذ أنه يوفر قدرًا أكبر من المرونة في مواجهة مخاطر المناخ والأمراض ويدعم المزيد من التنوع الغذائي، الذي نحتاجه للحصول على أنظمة غذائية صحية.

BIOTECHNOLOGY MIGHT ALLEVIATE ZINC MALNUTRITION THROUGH BIOFORTIFICATION OF WHEAT

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Malnutrition or hidden hunger

One of the major challenges of 21st century is to feed ever increasing human population with sufficient yet nutritious food. Micronutrient malnutrition rightly referred as "hidden hunger" is more widely prevalent than the chronic hunger and affecting over 2 billion people particularly in developing world. Recently, WHO reported that one third of the human population is suffering from deficiency of one or more essential micronutrients such as zinc and iron. This is mainly caused by reduced dietary intake of micronutrients. Staple foods such as cereal based foods represent major source of daily caloric intake in developing countries; but these foods are inherently very low in concentration and bioavailability of micronutrients. Monotonous consumption of staple foods induces micronutrient deficiencies (i.e., hidden hunger) in human populations resulting in severe health complications such as retarded physical growth, gastrointestinal issues, immunity breakdowns, impaired intellectual ability, and reduced work efficiency. Hidden hunger is also responsible for a significant economic burden on health care systems of the developing countries. Published results show that up to 5 % of the GDP is lost due to hidden hunger problem in many low-income countries

Zn deficiency in humans

Of the micronutrients, zinc (Zn) is significant due to its physiological and biochemical effects in biological systems. It is estimated that about 17% of human population is affected by Zn deficiency which is responsible for various human health concerns including increased risk of premature delivery, reduced growth and weight gain in infants and children, high risk for infections, DNA damage causing cancer. Adequate Zn intake is, therefore, essential to maintain better immunity response and function against virulent pathogens. Recent studies have shown higher mortality rate of Covid-19 patients having lower blood serum Zn compared to patients with sufficient Zn in the blood.

Zinc deficiency in humans is mostly prevalent (Figure 1 A) in countries having Zn deficient soils especially Afro-Asian countries (Figure 1 B). Indeed, cultivated soils are rich in total amount of Zn. However, due to several soil chemical and physical problems (such as high levels of soil pH and clay minerals and low amounts of organic matter and moisture), soil Zn is not chemically available for root uptake.

Low amount of soluble Zn for root uptake represents a major reason for the widespread occurrence of Zn deficiency in food crops and consequently for the low amounts of Zn in the harvested parts of plants such as grains. It is estimated that about 50 % of cereal cultivated soils have low amount of plant available Zn. It is therefore not surprising why Zn deficiency incidence in human populations is very common in the regions where soil deficiency of soluble Zn is prevalent (Figure 1). Moreover, marked increases in grain yield started with the green revolution during early 60th years also resulted in decreased Zn concentration of cereal grains caused by "dilution effect" over time.

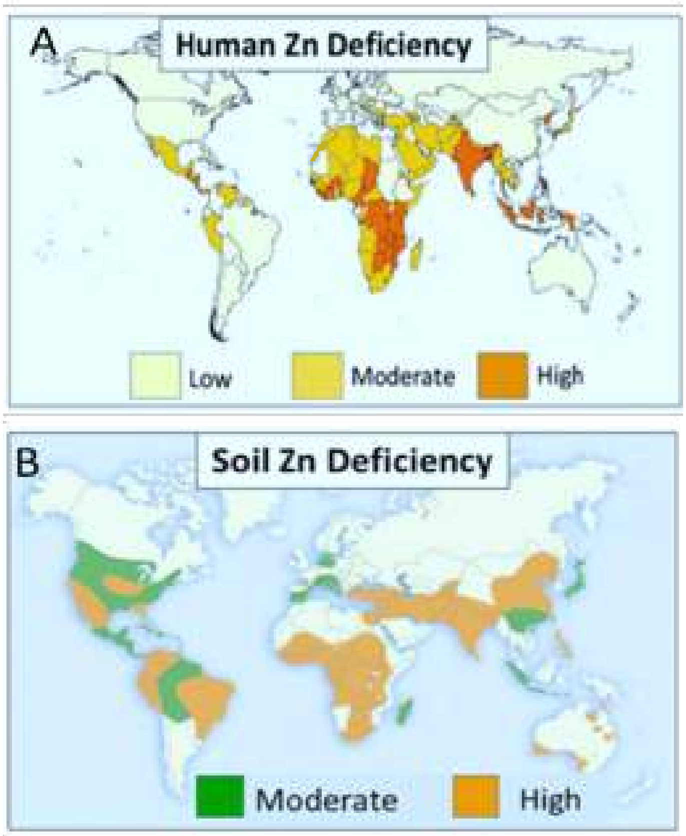

Figure 1: Prevalence of Zn deficiency in humans (A) and soils (B). (Adopted from Cakmak et al. 2017, Plant Soil 411: 1-4)

Elevating CO_2 and Zn deficiency disorder

As discussed below, elevated atmospheric CO_2 represents an important potential factor that can worsen Zn deficiency problem in human populations. With the onset of industrialization, atmospheric CO_2 concentration started to increase at an unprecedented rates. Currently, atmospheric CO_2 has attained the level of 420 µmol mol^{-1} and is predicted to reach up to the level of 700 µmol mol^{-1} by the end of this century. Being a basic driver of climate change, elevated CO_2 concentration coupled with increasing temperature, drought conditions and soil salinity, is increasing soil fertility problems and threatening root uptake of mineral nutrients including Zn. In addition to these indirect effects, recent studies have shown that elevated CO_2 concentrations without causing changes in air temperature pose a further threat to human nutrition through depleting vital nutrients such as Zn in soils along with others. It is known that current CO_2 concentration is not sufficient enough for photosynthetic enzyme (Rubisco) to work at its optimum capacity. Therefore, increasing CO_2 would result in strong enhancements in photosynthetic efficiency of rubisco and thus photosynthesis activity, leading to higher biomass and grain yield and, hence dilution of vital nutrients. Several published reports are available showing that enhancements in atmospheric CO_2 concentrations result in large increases in grain yield of C_3 crops and consequently dilution of micronutrients in grains. Among different factors assigned to deterioration of nutritional quality (lower Zn concentration) of grains under elevated CO_2, "dilution effect" seems to be a very relevant factor.

Biofortification of wheat might be a twilight

Wheat (*Triticum Aestivum* L.) is staple food crop for population of some 2.5 billion humans in 89 countries, cultivated on 215 million hectares throughout the globe, and is the main source of calories, protein, vitamins, dietary fiber, and other nutrients especially in developing countries. However, wheat is inherently low in Zn concentrations and the problem is even aggravated when wheat is grown on soils deficient in Zn. Zinc concentration of wheat grain ranges between 5-12 mg kg^{-1} and 20-30 mg kg^{-1} for low and adequate Zn soils, respectively. This content is too low to suffice the requirement of adequate Zn nutrition, especially for those living on a higher proportion of cereal-based diets. Moreover, a major portion of Zn in wheat grains is stored in embryo and aleurone layer which are generally removed during milling process, further deteriorating the nutritional quality of the wheat flour. Considering these circumstances, there is a dire need of devising strategies to enrich wheat grains with Zn, and contribute in resolving the issue of Zn malnutrition in humans.

Various strategies suggested to cope with Zn deficiency related malnutrition in human include Zn supplementation, utilizing Zn fortified foods or biofortification of staple foods with Zn. Among these, biofortification of staple foods is widely recognized as the most sustainable, viable and practical approach to provide nutritious food to the masses. Biofortification approaches involve conventional and molecular breeding, genetic engineering and agronomic interventions including targeted fertilization strategies to enhance Zn density in wheat grains.

Molecular, genetic and breeding strategies

Breeding strategy involves exploitation of genetic variation for micronutrient concentrations in the germplasms to enhance micronutrient densities in the edible portion of food crops, reduce antinutrients' levels and increase the nutrient absorption from source. Exploring existing germplasm for selection of mineral dense genotypes is pre-requisite for this strategy. The promising genotypes are then included in the breeding programs and utilized for the development of biofortified crop varieties. Although it is a most sustainable solution to malnutrition, but it requires a long-term hybridization and selection procedures lasting up to 10-12 years to develop a variety. HarvestPlus (www.harvestplus.org) is a CGIAR based organization working on biofortification of various staple crops worldwide. After long-term successful efforts, HarvestestPlus program was able to release very promising Zn biofortified varieties for general cultivation in wheat producing countries including Pakistan and India. However, the performance of these varieties in terms of grain Zn contents under varied Zn availability and diverse environmental and soil conditions is yet to be determined. For example, the soils cultivated with wheat has usually diverse physical and chemical properties restricting the availability of Zn for root uptake by wheat plants and might limit the Zn uptake efficiency of biofortified wheat cultivars. In addition, higher Zn uptake by biofortified cultivars in the absence of exogenous Zn fertilization might result in further depletion of Zn in already Zn deficient soils and render them unable to sustain crop production in near future.
Considering different factors, creating wheat cultivars with efficient Zn uptake capacity through genetic approaches must be augmented with optimized agronomic techniques as given below. Increasing evidence is now available showing that breeding and agronomy are synergistic approaches as discussed below:

Agronomic practices

Although there are certain successful stories regrading breeding, genetic and molecular techniques to develop crop cultivars with better nutrient uptake, transport and grain deposition efficiency. But, the upgraded transport and storage system is bound to fail anyway if the minerals to be transported and stored are in short supply. There are two major sources of Zn for deposition in grains including 1) rhizosphere providing continuous supply of Zn through roots 2) and Zn deposited in foliage and translocated to grains during reproductive growth stage. Soil and plant factors such as availability of water and Zn during grain filling, senesce rate, time span of grain filling phase and N nutritional status of plants play a decisive role in relative contribution of these two sources in depositing Zn in grains.Therefore, in order to enhance Zn deposition in grains, it is essential to maintain adequate Zn supply either through rhizosphere or through resorption from vegetative tissues or both. Fertilizer strategy represents a short-term solution of low Zn contents of wheat grains. For getting efficient results of fertilizer strategy, knowledge of different sources of Zn and timing of application are very crucial. Zn application through soils is generally considered less efficient in increasing grain Zn concentrations, instead it significantly improves grain yield. In contrast to soil, foliar Zn application during grain filling period substantially improves grain Zn concentration.

Therefore, higher yields of wheat grains with sufficient Zn content could be achieved by integrative application of Zn through soil at early growth stages and in the form of foliar sprays during later growth stages. Several studies have revealed a satisfactory enhancement in grain Zn concentration through foliar Zn fertilization of wheat plants.

In addition to Zn, application of an adequate dose of nitrogen (N) fertilization also play crucial role in grain Zn concentration of wheat plants because of positive correlation between the two essential nutrients. Increased phosphorus (P) fertilization exhibits an antagonistic effect on Zn uptake of plants and hence grains with lower Zn density would be the outcome of unattended P fertilization.

Microbial Strategy

In addition to crop genotype and fertilization status, the diversity and activity of rhizospheric microbiomes play a critical role in phytoavailability of different nutrients. Microorganisms are crucial for uptake, translocation and accumulation of these nutrients into grains through different mechanisms. These microorganisms can be exploited to enhance the level of vital micronutrient in wheat grains. Several studies have revealed that the activity of different rhizospheric microorganisms significantly improve nutrient uptake by plants. For example, arbuscular mycorrhiza (AM) have been found to provide up to 50% of Zn nutrition to plants and hence might be exploited to enhance grain Zn concentration. Moreover, efficient AM fungal activity also contribute significantly in rhizostabilization of Cd and thus in production of Cd safe wheat grains. Similarly, a range of bacterial species from Bacillus, Serratia, Pseudomonas genera have been found to increase bioavailability of Zn and hence enhance grain Zn concentration of wheat.

Figure 2: Foliar spray of nutrient solution. Created in BioRender.com

The roles biotechnology can play

Currently, breeding efforts are focusing on identifying genes responsible for Zn uptake and deposition into grains from spelt, dicoccon based synthetics, land races into high yielding elite lines. The molecular and genetic studies to elucidate the mechanisms of Zn uptake, transport and deposition in grains are critical for understanding the physiology of these phenomena. Application of biotechnology might not only hasten the process of cultivar development through screening the germplasm for genes of interest but also help in transforming the genes from unrelated plant species into wheat. However, biotechnology also comes along with its demerits.

For example, the genetically engineered plants are often tested in controlled laboratory or glasshouse environments provided with continuous supply of micronutrients thus might not always represent a successful outcome when grown under limited Zn availability in the natural field conditions. Moreover, public acceptance of genetically modified food crops is another unignorable matter.

In addition to cultivar development, Biotechnology may also help in isolation, multiplication, and formation of microbial (including bacteria and AM fungi) consortium, efficient in developing mutualistic relationship with plant roots and dissolving soil-bound Zn according to the soil/genotype preferences.

Solution lies in integrating different strategies to produce Zn biofortified wheat

Integrated strategy to enhance Zn concentration of wheat represents application of combined strategies prioritized based on outcomes in a sustainable manner. For example, breeding and/or molecular techniques might be exploited to enhance resorption of Zn or other nutrients from foliage into grains when the soil conditions do not favor soil Zn uptake due to any reasons. Moreover, cultivars having better affinity for AM fungal symbiosis might be developed to sustainably enhance Zn exploration capacity of plants in the wider range of the rhizosphere.Optimum doses of P and N fertilization should be applied to gain better results from cultivation of Zn biofortified varieties along with suitable Zn fertilization strategy.

From the above discussion, it is concluded that different strategies might play an important role in Zn biofortification of wheat plants. However, each strategy has its strengths and weaknesses and when applied in an integrated manner would result in better outcome. Therefore, integrated application of all these strategies as and when required seem the only sustainable way forward to produce Zn biofortified wheat.

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EN ABSTRACT

Biotechnology might alleviate zinc malnutrition through biofortification of wheat

Over 2 billion people, particularly residents of developing world, are suffering from micronutrient malnutrition generally referred as hidden hunger. The human micronutrient deficiencies are mainly caused by monotonous consumptions of cereal based foods inherently low in vital micronutrients such as zinc. In addition to severe health complications, micronutrient deficiencies also cause a significant economic burden on health care system of poor resource countries. Zinc (Zn) is an important micronutrient responsible for several vital physiochemical processes yet deficient in a substantial proportion (17%) of human population. Risks of health complications such as premature delivery, reduced growth and weight gain in infants and children, viral/bacterial infections and cancer are often enhanced in individuals suffering from Zn deficiency.

Human Zn deficiency is generally prevalent in the inhabitants of regions with soils deficient in plant available Zn resulting into a lower Zn content in edible plant parts. Almost 50% of lands under cereal cultivation are deficient in Zn and hence grains harvested from these soils also contains lower Zn concentrations. Moreover, yield oriented breeding after green revolution resulted into further dilution of Zinc in grains. Furthermore, increasing atmospheric CO_2 is also foreseen as a potential threat to human Zn nutrition due to fertilization effect of elevated CO_2 concentrations. Therefore, it is essential to devise the strategies to cope with Zn nutritional disorder in humans in a sustainable way.

Biofortification of food crops such as wheat represents a viable and sustainable strategy to cope with Zn malnutrition. Biofortification involves breeding, genetic manipulations, agronomic interventions and targeted fertilization to enhance the concentration of micronutrients in the grains.

Under genetic biofortification strategy, the genetic variation among the germplasm is exploited to develop biofortified cultivars with enhanced nutrient densities, reduced antinutrient concentrations and increased nutrient absorption. Several Zn biofortified wheat cultivars with higher grain Zn concentrations have been developed by CGIAR based HarvestPlus program and are recommended for general cultivation in wheat growing countries like Pakistan. However, the efficiency of these cultivars might be hindered by several physical and chemical properties of soil such as pH, Zn availability, water availability and soil organic matter. Therefore, agronomic interventions such as targeted fertilization to enhance plant Zn availability, foliar Zn sprays and amendments to enhance soil organic matter must be applied to complement the impact of biofortified cultivars.

Moreover, microorganisms such as arbuscular fungi and several bacterial species play a critical role in Zn availability for plants and soil conservation practices such as reduced tillage, judicious use of fertilizer must be practiced to enhance activity of these microbes. In addition to breeding and agronomic practices, biotechnology might also be exploited to speed up the process of germplasm screening, cultivar development and transformation of genes of interest from unrelated species into wheat. Moreover, biotechnology might also be helpful for screening and multiplication of microbial strains with better efficiency in developing symbiotic relations with wheat.

Integrating breeding strategy with agronomic and microbial approaches augmented with biotechnology seems a sustainable way forward to achieve the benefits of biofortification and cope with Zn malnutrition in masses especially those residing in the developing world.

FR RÉSUMÉ

La biotechnologie pourrait atténuer la malnutrition due au zinc grâce à la biofortification du blé

Plus de 2 milliards de personnes, en particulier les habitants des pays en développement, souffrent de malnutrition par carence en micronutriments, généralement appelée "faim cachée". Les carences en micronutriments chez l'homme sont principalement causées par la consommation monotone d'aliments à base de céréales, par nature pauvres en micronutriments essentiels tels que le zinc. Outre les graves complications pour la santé, les carences en micronutriments font peser une lourde charge économique sur le système de soins de santé des pays pauvres en ressources. Le zinc (Zn) est un micronutriment important, responsable de plusieurs processus physiochimiques vitaux, mais déficient dans une proportion substantielle (17%) de la population humaine. Les risques de complications de santé tels que l'accouchement prématuré, la réduction de la croissance et de la prise de poids chez les nourrissons et les enfants, les infections virales/bactériennes et le cancer sont souvent accrus chez les personnes souffrant d'une carence en zinc.

La carence humaine en Zn est généralement répandue chez les habitants des régions où les sols sont déficients en Zn disponible pour les plantes, ce qui entraîne une baisse de la teneur en Zn dans les parties comestibles des plantes. Près de 50 % des terres céréalières sont déficientes en Zn, de sorte que les céréales récoltées dans ces sols contiennent également de faibles concentrations de Zn. De plus, la sélection axée sur le rendement après la révolution verte a entraîné une nouvelle dilution du zinc dans les grains. En outre, l'augmentation du CO 2 atmosphérique est également prévue comme une menace potentielle pour la nutrition humaine en raison de l'effet fertilisant des concentrations élevées de CO 2. Il est donc essentiel de concevoir des stratégies pour faire face de manière durable au désordre nutritionnel en Zn chez l'homme.La biofortification des cultures vivrières telles que le blé représente une stratégie viable et durable pour faire face à la malnutrition due au zinc. La biofortification implique la sélection, les manipulations génétiques, les interventions agronomiques et la fertilisation ciblée pour améliorer la concentration de micronutriments dans les grains.

Dans le cadre de la stratégie de biofortification génétique, la variation génétique du matériel génétique est exploitée pour développer des cultivars biofortifiés présentant des densités nutritionnelles accrues, des concentrations d'antinutriments réduites et une absorption accrue des nutriments.

Plusieurs cultivars de blé biofortifiés en zinc présentant des concentrations plus élevées de zinc dans le grain ont été développés par le programme HarvestPlus du CGIAR et sont recommandés pour la culture générale dans les pays producteurs de blé tels que le Pakistan. Cependant, l'efficacité de ces cultivars peut être entravée par plusieurs propriétés physiques et chimiques du sol telles que le pH, la disponibilité du Zn, la disponibilité de l'eau et la matière organique du sol. Par conséquent, des interventions agronomiques telles que la fertilisation ciblée pour améliorer la disponibilité du zinc des plantes, les pulvérisations foliaires de zinc et les amendements pour améliorer la matière organique du sol doivent être appliquées pour compléter l'impact des cultivars biofortifiés.

En outre, les micro-organismes tels que les champignons arbusculaires et plusieurs espèces bactériennes jouent un rôle critique dans la disponibilité du zinc pour les plantes et les pratiques de conservation du sol telles que le travail réduit du sol, l'utilisation judicieuse d'engrais doivent être pratiquées pour améliorer l'activité de ces microbes. Outre les pratiques de sélection et d'agronomie, la biotechnologie pourrait également être exploitée pour accélérer le processus de sélection du matériel génétique, le développement de cultivars et la transformation de gènes d'intérêt provenant d'espèces non apparentées dans le blé. De plus, la biotechnologie pourrait également être utile pour le criblage et la multiplication de souches microbiennes plus efficaces dans le développement de relations symbiotiques avec le blé.

L'intégration d'une stratégie de sélection reposant sur des approches agronomiques et microbiennes renforcées par la biotechnologie semble être une solution durable pour obtenir les avantages de la biofortification et faire face à la malnutrition due au zinc chez les populations, en particulier celles qui vivent dans les pays en voie de développement.

المُلخص AR

إمكانية تخفيف التكنولوجيا الحيوية من سوء التغذية بالزنك من خلال التحصين الحيوي للقمح

يعاني أكثر من ملياري شخص، لا سيما سكان العالم النامي، من سوء التغذية بالمغذيات الدقيقة الذي يشار إليه عمومًا بالجوع الخفي. ويعود سبب نقص المغذيات الدقيقة البشرية بشكل رئيسي إلى الاستهلاك الرتيب للأغذية القائمة على الحبوب المنخفضة بطبيعتها في المغذيات الدقيقة الحيوية مثل الزنك. وبالإضافة إلى المضاعفات الصحية الشديدة، فإن نقص المغذيات الدقيقة يتسبب أيضًا في عبء اقتصادي كبير على نظام الرعاية الصحية في البلدان ذات الموارد الفقيرة. إذ يعتبر الزنك (Zn) عنصرًا غذائيًا دقيقًا مهمًا مسؤولاً عن العديد من العمليات الفيزيائية والكيميائية الحيوية غير أن نسبة كبيرة (17٪) من السكان تعاني من نقص الزنك. وغالبًا ما تزداد مخاطر المضاعفات الصحية مثل الولادة المبكرة وانخفاض النمو وزيادة الوزن عند الرضع والأطفال والالتهابات الفيروسية/البكتيرية والسرطان لدى الأفراد الذين يعانون من نقص الزنك.
ينتشر نقص الزنك البشري بشكل عام في سكان المناطق التي تعاني من افتقار التربة للزنك المتاح للنبات مما يؤدي إلى انخفاض محتوى الزنك في أجزاء النبات الصالحة للأكل. وما يعاني ما يقرب من 50٪ من الأراضي المزروعة بالحبوب من نقص في الزنك، وبالتالي تحتوي الحبوب المحصودة من هذه التربة أيضًا على تركيزات منخفضة من الزنك. وعلاوة على ذلك، فلقد أدى التكاثر المُوجّه نحو المحصول بعد الثورة الخضراء إلى مزيد من التخفيف للزنك في الحبوب. ومن المتوقع أيضًا أن تُشكل زيادة ثاني أكسيد الكربون في الغلاف الجوي تهديدًا محتملاً لتغذية الإنسان بالزنك بسبب تأثير التسميد لتركيزات ثاني أكسيد الكربون المرتفعة. وبالتالي، فمن الضروري وضع استراتيجيات للتعامل مع اضطراب التغذية بالزنك لدى البشر بطريقة مستدامة.

تُمثل التقوية الحيوية للمحاصيل الغذائية مثل القمح استراتيجية قابلة للتطبيق ومستدامة للتعامل مع سوء التغذية بالزنك. وتشمل التقوية الحيوية التكاثر والتحوير الجيني والتدخلات الزراعية والتخصيب المستهدف لتعزيز تركيز المغذيات الدقيقة في الحبوب. ويتم في إطار استراتيجية التقوية الحيوية الجينية استغلال التباين الجيني بين الأصول الوراثية لتطوير أصناف مدعمة بيولوجيًا ذات كثافة مغذية محسنة وتركيزات منخفضة لمضادات المغذيات وزيادة امتصاص المغذيات. ولقد تم تطوير العديد من أصناف القمح المدعمة بيولوجيًا ذات التركيزات العالية من الزنك بواسطة برنامج HarvestPlusالقائم على الفريق الاستشاري المعني بالبحوث الزراعية الدولية (CGIAR) ويوصى بها للزراعة العامة في البلدان التي تزرع القمح مثل باكستان. ومع ذلك، فقد تتعطل كفاءة هذه الأصناف بسبب العديد من الخصائص الفيزيائية والكيميائية للتربة مثل درجة الحموضة وتوافر الزنك وتوافر المياه والمواد العضوية في التربة. ولذلك، يجب تطبيق التدخلات الزراعية مثل التسميد المستهدف لتعزيز توافر الزنك في النبات وبخاخات الزنك الورقية والتعديلات لتعزيز المواد العضوية في التربة لتكملة تأثير الأصناف المدعمة بيولوجيًا. وفضلاً عن ذلك، تلعب الكائنات الحيّة الدقيقة مثل الفطريات الشظية والعديد من الأنواع البكتيرية دورًا مهمًا في توافر الزنك للنباتات وممارسات الحفاظ على التربة مثل تقليل الحرث، ويجب ممارسة الاستخدام الحكيم للأسمدة لتعزيز نشاط هذه الميكروبات. وبالإضافة إلى ممارسات التربية والزراعة، فإنه يمكن أيضًا استغلال التكنولوجيا الحيوية لتسريع عملية فحص الأصول الوراثية وتطوير الأصناف وتحويل الجينات ذات الأهمية من الأنواع غير ذات الصلة إلى قمح. وعلاوة على ذلك، فقد تكون التكنولوجيا الحيوية مفيدة أيضًا في فحص ومضاعفة السلالات الميكروبية بكفاءة أفضل في تطوير علاقات متآلفة مع القمح.
يبدو أن دمج استراتيجية التربية مع الأساليب الزراعية والميكروبية المعززة بالتكنولوجيا الحيوية طريقة مستدامة للمضي قدمًا لتحقيق فوائد التقوية الحيوية والتعامل مع سوء التغذية بالزنك لدى الجماهير وخاصة أولئك المقيمين في العالم النامي.

RECENT DEVELOPMENTS IN AGRICULTURE AND AQUACULTURE TECHNOLOGY USING PLASMA FINE BUBBLE IN INDONESIA

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One of the sectors capable of being the key to facing the global crisis is the food industry. The availability of food that can be accessed by various parties is considered capable of helping to maintain national economic stability. Therefore, food security needs to be a focus for improvement by realizing food sovereignty and self-sufficiency (food resilience). The Indonesian government is also making efforts to promote food security through various strategic and policy initiatives.

Recently, a novel green technology called non-thermal plasma (NTP) has been developed to contribute to agricultural and aquaculture applications [1, 2]. NTP is electrically energized matter in a gaseous state and can be generated by passing gases through electric fields.

Plasma created in gas/liquid form causes various chemical and physical reactions, such as UV light, shockwaves, active species and thermal effects. Some research studies have demonstrated significant efficiency improvement in seedling development when NTP is applied to activated water or directly to seeds, implying a low environmental impact. These effects are attributed to the stimulation of sources and changes in their absorption properties, generated by the production of reactive oxygen species (ROS) and reactive nitrogen species (RNS), which benefit water use efficiency [1]. Additionally, a protective effect associated with the inactivation of microorganisms has been detected, without causing any damage to the organic structures or altering the physicochemical and organoleptic properties of food.

Figure 1. Potential utilization of plasma fine bubble technology from growth to food

Meanwhile, fine bubble technology is a technology for producing very small bubbles with diameters under 100 micrometers, including nanometer-sized bubbles in water or solutions. Fine bubbles have begun to be adopted as a technology to ensure dissolved oxygen availability, which is important in agriculture and aquaculture [3]. Fine bubbles consist of microbubbles and nanobubbles, with nanobubbles being highly stable and durable. Due to their ability to carry gases and various substances on their surfaces, their stability and long lifespan offer great potential for use in agriculture. Applications such as irrigation, fertilization, spraying and disease prevention, suggest that fine bubbles could significantly improve food security and environmentally friendly agricultural techniques. The technological innovation that we have developed in recent years is the Plasma fine bubble (PFB). PFB is a technology that combines NTP and fine bubble technologies. PFB technology is an advanced method that utilizes free radicals ROS and RNS produced by NTP and fine bubbles to activate water [4]. The activated water containing ROS and RNS has enhanced abilities for use in agriculture and aquaculture industries. Figure 1 shows the potential utilization of PFB in agriculture and aquaculture from growth to food service on table.

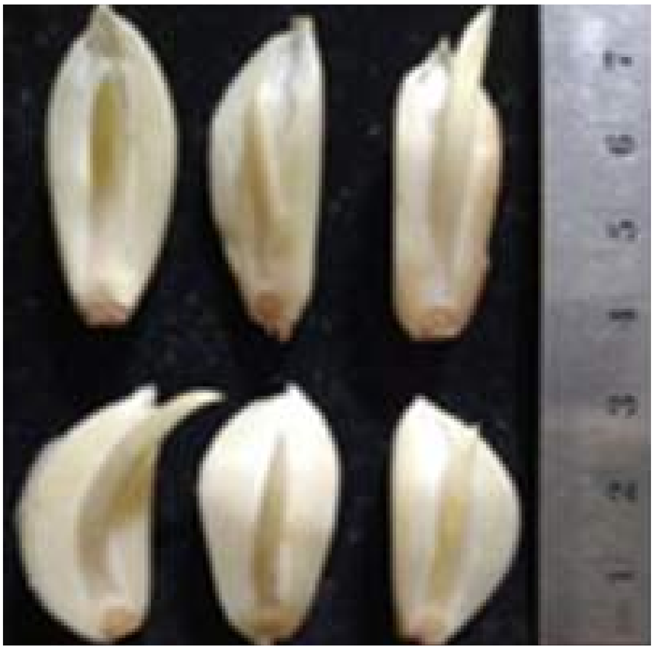

Figure 2 (a): Garlic blubs treated by UFB;

Figure 2 (b): Garlic blubs demonstration plot harvest

Various research and development efforts for the use of PFB in plant growth, post-harvest processes, product storage and Recirculating Aquaculture Systems (RAS) have been carried out. Some research activities have focused on the effects of fine bubbles on seed treatment. The application of ultrafine bubbles water for breaking dormancy and seed germination has shown positive results. This suggests that ultrafine buble (UFBs) water enhances the dormancy-breaking of garlic bulbs and positively influences the germination rate of seeds [5,6]. The ROS caused by UFBs might play an important role in growth by facilitating the cell walls needed for cell extension. Other treated seeds include soybean, rice, lettuce, Acacia crassicarpa and Gmelina arborea.

PFB is also used in post-harvest processing. The advantages of ROS as oxidizing agents are strengthened by the ability of nanobubbles to dissolve ROS in water. This makes activated nanobubble water an effective solution for post-harvest processing. A pilot plant PFB generator has been used in the chili washing process to remove pesticide residues from chilies (less than 0.01 ppm) and extend shelf life (up to 27 days in 15°C).

Figure 3. Chili washing process using plasma fine bubble

In the aquaculture sector, shrimp farming is a priority for aquaculture development in Indonesia. Large-scale shrimp farming has the potential to create waste issues that pollute coastal waters. In our study, the PFB method was used to treat wastewater from shrimp ponds. This method produces active species such as ozone and hydroxyl radicals, which act as oxidizing agents to oxidize pollutants in the wastewater. This research was conducted at a shrimp hatchery by placing a fine bubble plasma unit in a waste pond before releasing water into the aquatic environment. The results of this study show that pollutant content in wastewater, such as suspended solids (79%), ammonia (88%), nitrite (92.5%) and phosphate (68.5%) can be significantly reduced. This indicates that the plasma fine bubble method can be applied to treat shrimp pond wastewater, and the processed water has the potential to be recirculated in ponds to reduce water usage in Recirculating Aquaculture System (RAS) and minimize chemical usage.

Figure 4. Shrimp farming wastewater treatment using Plasma Fine Bubble (PFB)

The development of fine bubble plasma technology continues to be carried out in various studies. It is necessary to understand the advantages of fine bubble plasma properties based on the actual use of fine bubbles containing active species in various potentially effective industries. Moreover, it is necessary to develop a versatile use of fine bubble plasma by identifying system configurations for use in agriculture and aquaculture.

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EN ABSTRACT

Recent developments in agriculture and aquaculture technology using plasma fine bubble in Indonesia

In the pursuit of enhancing food security in Indonesia, several technologies are continuously being developed. Among the most promising emerging technologies is plasma fine bubble (PFB). PFB integrates Non-Thermal Plasma (NTP) and fine bubble technologies. This advanced method utilizes NTP-generated free radicals ROS and RNS, infused as fine bubbles into water, thereby activating it. The ROS and RNS-enriched water exhibited enhanced efficacy in the agriculture and aquaculture industries. Various research and development efforts have explored PFB's utility in plant growth, post-harvest processes, product storage and Recirculating Aquaculture Systems (RAS).

The application of PFB in plant growth for preventing dormancy and seed germination has shown positive results.PFB enhances dormancy-breaking in garlic bulbs and positively influences seed germination rate. The oxidative potential of ROS is strengthened by nanobubbles' capacity to dissolve ROS in water. This makes PFB an effective solution for post-harvest processing. Moreover, PFB has proven effective in removing pesticide residues and extending shelf life during chilli washing process. Additionally, the application of PFB can be extended to treating shrimp pond wastewater, and the treated water can potentially be recirculated into ponds to minimize water supply consumption within the Recirculating Aquaculture System (RAS) and reduce the reliance on chemical inputs.

FR RÉSUMÉ

Développements récents dans les technologies de l'agriculture et de l'aquaculture utilisant le plasma à fines bulles en Indonésie

Dans le but d'améliorer la sécurité alimentaire en Indonésie, plusieurs technologies sont continuellement développées. Parmi les technologies émergentes les plus prometteuses figure le plasma à fines bulles (PFB). Le PFB intègre les technologies de plasma non thermique (NTP) et de fines bulles. Cette méthode avancée utilise les radicaux libres ROS et RNS générés par le NTP, infusés sous forme de fines bulles dans l'eau, l'activant ainsi. L'eau enrichie en ROS et en RNS a montré une efficacité accrue dans les industries de l'agriculture et de l'aquaculture. Divers efforts de recherche et de développement ont exploré l'utilité des PFB dans la croissance des plantes, les processus post-récolte, le stockage des produits et les systèmes d'aquaculture en recirculation (RAS).

L'application du PFB dans la croissance des plantes pour prévenir la dormance et la germination des graines a donné des résultats positifs. Les PFB améliorent la levée de la dormance dans les bulbes d'ail et influencent positivement le taux de germination des graines. Le potentiel oxydatif des ROS est renforcé par la capacité des nanobulles à dissoudre les ROS dans l'eau. Cela fait du PFB une solution efficace pour le traitement après récolte. En outre, le PFB s'est avéré efficace pour éliminer les résidus de pesticides et prolonger la durée de conservation pendant le processus de lavage des piments. De plus, l'application du PFB peut être étendue au traitement des eaux usées des bassins de crevettes, et l'eau traitée peut potentiellement être recirculée dans les bassins pour minimiser la consommation d'eau dans le système d'aquaculture en recirculation (RAS) et réduire la dépendance à l'égard des intrants chimiques.

المُلخص AR

التطورات الأخيرة في تكنولوجيا الزراعة وتربية الأحياء المائية باستخدام فقاعة البلازما الدقيقة في إندونيسيا

يتم تطوير العديد من التكنولوجيات باستمرار في إندونيسيا في بغرض تعزيز الأمن الغذائي. وتعتبر فقاعة البلازما الدقيقة (PFB) من بين أكثر التكنولوجيات الناشئة الواعدة. حيث تدمج فقاعة البلازما الدقيقة تكنولوجيات البلازما غير الحرارية (NTP) والفقاعات الدقيقة. تستخدم هذه الطريقة المتقدمة الجذور الحرة الناتجة عن البلازما غير الحرارية وأنواع الأكسجين التفاعلية (ROS) وأنواع النيتروجين التفاعلية (RNS)، والتي يتم غرسها في شكل فقاعات دقيقة في الماء، وبالتالي تنشيطها. ولقد أظهرت المياه المخصبة بأنواع الأكسجين التفاعلية (ROS) وأنواع النيتروجين التفاعلية (RNS) فعالية معززة في صناعات الزراعة وتربية الأحياء المائية. ولقد استكشفت جهود البحث والتطوير المختلفة فائدة فقاعة البلازما الدقيقة (PFB) في نمو النبات وعمليات ما بعد الحصاد وتخزين المنتجات وأنظمة إعادة تدوير تربية الأحياء المائية (RAS

). ولقد أظهر تطبيق فقاعة البلازما الدقيقة (PFB) في نمو النبات لمنع السكون وإنبات البذور نتائج إيجابية. تُعزز فقاعة البلازما الدقيقة (PFB) كسر السكون في بصيلات الثوم وتُؤثر بشكل إيجابي على معدل إنبات البذور. ويتم تعزيز إمكانات الأكسدة لأنواع الأكسجين التفاعلية (ROS) من خلال قدرة الفقاعات النانوية على إذابتها في الماء. وهوما يجعل من فقاعة البلازما الدقيقة (PFB) حلاً فعالاً لمعالجة ما بعد الحصاد. وعلاوة على ذلك، فلقد أثبتت فقاعة البلازما الدقيقة (PFB) فعاليتها في إزالة بقايا المبيدات وإطالة مدة الصلاحية أثناء عملية غسل الفلفل الحار. وبالإضافة إلى ذلك، يمكن توسيع تطبيق فقاعة البلازما الدقيقة (PFB) لمعالجة مياه الصرف الصحي في أحواض الجمبري، ويمكن إعادة تدوير المياه المعالجة في الأحواض لتقليل استهلاك إمدادات المياه داخل نظام إعادة تدوير تربية الأحياء المائية (RAS) وتقليل الاعتماد على المدخلات الكيميائية.

GLOBAL TRADE AND USE OF ANTIBIOTICS IN FOOD ANIMALS IS INCREASING ANTIMICROBIAL RESISTANCE

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The potential consequences of antimicrobial resistance (AMR) include reduced food production, reduced food security, greater food safety concerns and high economic burden to farmers. Reduction of antimicrobial use in animal husbandry is a key strategic objective indicated in many global and regional action plans to address problem of antimicrobial resistance (AMR). Colistin often called as last-resort antibiotic belongs to polymyxins group of antibiotics and is included in the World Health Organization (WHO) list of critically important antimicrobials for human medicine. Colistin disrupt the bacterial cell membrane through a detergent like mechanism thus leading to the bacterial cell death. However, the last-resort antibiotic colistin, is still being traded and widely used for growth promotion and disease prevention in food-producing animals in some low- and middle-income countries. This may provoke public health crisis making highly infectious diseases (pneumonia, diarrhoea etc) treatment impossible in human.

However, this study found that many countries such as China, Viet Nam, Belgium, Netherland, Germany, South Korea, and Spain still export colistin to OIC member countries such as Pakistan, Nigeria and Bangladesh. This study showed that China is the major manufacturer of colistin and exported 666·2 tonnes/year of pharmaceutical grade and 642 tonnes/year of feed additive colistin.

This study published in The Lancet Microbes, one of the world's leading medical journals, provided evidence on colistin trade, manufacturing, consumption, and socioeconomic factors linked to colistin resistance and was carried out by researchers at the University of Agriculture, Faisalabad-Pakistan, Ahmadu Bello University, Zaria-Nigeria, Dhaka Medical College Hospital, Dhaka-Bangladesh and University of Oxford, Oxford-UK. Dr Mashkoor Mohsin, an Associate Professor at the University of Agriculture, Faisalabad and lead author of the study said that colistin is extremely important antibiotic for humans and its use in animal farming as growth promoter has been banned by the WHO, FAO, WOAH and many high-income countries in a bid to halt the spread of its resistance among deadly superbugs. Pakistan imported 68 tonnes of colistin and 175 tonnes of feed additive colistin which is much higher compared to Nigeria and Bangladesh. Registration data from the Drug Regulatory Authority of Pakistan showed that about 566 veterinary drugs containing colistin were registered.

Furthermore, the study found high level resistance to drug colistin due to a gene called mcr-1 which was frequently present in bacteria from human, animals and the environment. Wild birds and commercial broiler carried highest frequency of colistin resistant mcr-1 positive bacteria. Worryingly, these bacteria were also resistant to other antimicrobial drugs amoxicillin-clavulanic acid, sulfamethoxazole–trimethoprim, ciprofloxacin, levofloxacin, and gentamicin.

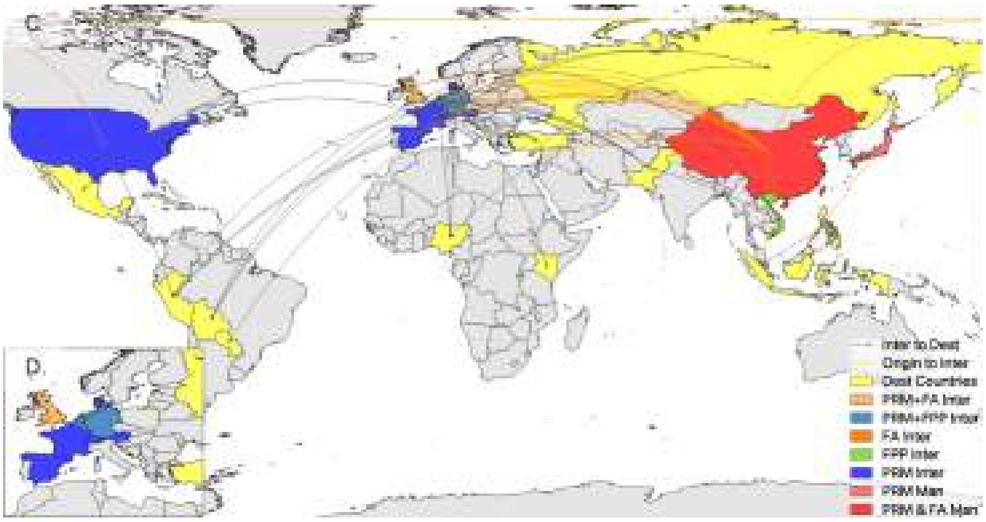

Figure 1: Global trade of colistin
PRM=pharmaceutical raw material. FPP=finished pharmaceutical product. FA=feed additive.

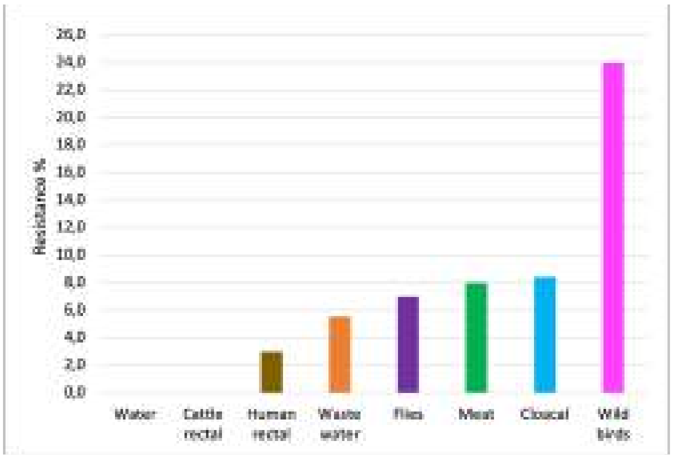

Figure 2: Prevalence of mcr-1 among different sources in Pakistan

It was also observed that farmers in these countries have limited understanding of the public health consequences of colistin use which highlights the importance of better hygiene farming practices. These findings highlight the need for strong regulation and political commitment regarding reducing colistin import, manufacturing and use in the animals to avoid a health crisis.

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EN ABSTRACT

Global trade and use of antibiotics in food animals is increasing antimicrobial resistance

Antimicrobial resistance has become one of the major health threats of 21st century. The global expansion of intensive farming has led to an increase reliance on antimicrobial use including use of medically important antimicrobials such as colistin. In this study we investigate community-based One Health surveillance and molecular epidemiology of colistin resistance bacteria in Pakistan with samples from humans, poultry, cattle and buffalo, meat, flies, wild birds, and fresh and wastewater. We critically discuss the global scenario of colistin manufacturing and its export, especially to low-income and middle-income countries.

We found high rates of colistin resistant E. coli from wild birds, poultry, flies and sewage water. Genotypically these bacteria were unrelated however colistin resistance gene mcr-1 was present on a single plasmid IncI2. Global import and export data revealed that many countries such as China, Viet Nam, Belgium, Netherland, Germany, South Korea, and Spain export large quantitates of colistin to low-income and middle-income countries such as Pakistan, Nigeria and Bangladesh. Strict laws should be internationally and locally implemented to curb widespread resistance to Critically Important Antimicrobials for Human Medicine such as colistin.

FR RÉSUMÉ

Le commerce mondial et l'utilisation d'antibiotiques chez les animaux destinés à l'alimentation augmentent la résistance aux antimicrobiens

La résistance aux antimicrobiens est devenue l'une des principales menaces sanitaires du 21e siècle. L'expansion mondiale de l'agriculture intensive a entraîné une dépendance accrue à l'égard des antimicrobiens, y compris des antimicrobiens d'importance médicale tels que la colistine. Dans cette étude, nous étudions la surveillance communautaire One Health et l'épidémiologie moléculaire des bactéries résistantes à la colistine au Pakistan à l'aide d'échantillons prélevés sur des humains, de la volaille, du bétail et des buffles, de la viande, des mouches, des oiseaux sauvages, des eaux douces et des eaux usées. Nous discutons de manière critique du scénario mondial de la fabrication de colistine et de son exportation, en particulier vers les pays à faible revenu et à revenu intermédiaire.

Nous avons constaté des taux élevés d'E. coli résistant à la colistine provenant d'oiseaux sauvages, de volailles, de mouches et d'eaux usées. Génotypiquement, ces bactéries n'étaient pas apparentées, mais le gène de résistance à la colistine mcr-1 était présent sur un seul plasmide InCI2. Les données mondiales sur les importations et les exportations ont révélé que de nombreux pays tels que la Chine, le Vietnam, la Belgique, les Pays-Bas, l'Allemagne, la Corée du Sud et l'Espagne exportent de grandes quantités de colistine vers des pays à faible revenu ou à revenu intermédiaire tels que le Pakistan, le Nigeria et le Bangladesh. Ainsi, des lois strictes devraient être mises en œuvre au niveau international et local afin d'enrayer la résistance généralisée aux antimicrobiens d'importance critique pour la médecine humaine, tels que la colistine.

AR المُلخص

تؤدي التجارة العالمية واستخدام المضادات الحيوية في أغذية الحيوانات إلى زيادة مقاومة مضادات الميكروبات

أصبحت مقاومة مضادات الميكروبات واحدة من التهديدات الصحيّة الرئيسية في القرن الحادي والعشرين. ولقد أدى التوسع العالمي للزراعة المكثفة إلى زيادة الاعتماد على استخدام مضادات الميكروبات، بما فيه استخدام مضادات الميكروبات المهمة طبيًا مثل الكوليستين. ولقد قمنا في هذه الدراسة بالتحقيق في مراقبة One Health المجتمعية وعلم الأوبئة الجزيئي للبكتيريا المقاومة للكوليستين في باكستان مع عينات من البشر والدواجن والأبقار والجاموس واللحوم والذباب والطيور البرية والمياه العذبة ومياه الصرف الصحي. ونناقش بشكل نقدي السيناريو العالمي لتصنيع الكوليستين وتصديره، خاصة إلى البلدان ذات الدخل المنخفض والمتوسط.

لقد وجدنا معدلات عالية من بكتيريا E. coli المقاومة للكوليستين من الطيور البرية والدواجن والذباب ومياه الصرف الصحي. ومن الناحية الجينية، فلقد كانت هذه البكتيريا غير مرتبطة ولكن كان جين مقاومة الكوليستين mcr-1 موجودًا على بلازميد واحد في InCi2. ولقد كشفت بيانات الاستيراد والتصدير العالمية أن العديد من البلدان مثل الصين وفيتنام وبلجيكا وهولندا وألمانيا وكوريا الجنوبية وإسبانيا تصدّر كميات كبيرة من الكوليستين إلى البلدان ذات الدخل المنخفض والمتوسط مثل باكستان ونيجيريا وبنغلاديش. وفي هذا الصدد، يجب تنفيذ قوانين صارمة دوليًا ومحليًا للحد من المقاومة الواسعة النطاق لمضادات الميكروبات ذات الأهمية الحاسمة للطب البشري مثل الكوليستين.

PRECISION FARMING TECHNOLOGIES IN OIC-MC TO ADAPT TO CLIMATE CHANGE AND ENSURE FOOD SECURITY

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Introduction

Agriculture can play an important role in reducing greenhouse gas emissions through the sequestration and storage of carbon in soils and crops, including trees. Climate is the most important environmental factor influencing agricultural production. There will never be food security on the planet without a healthy climate and sustainable agriculture. This is why the Islamic Organization for Food Security (IOFS) encourages programs related to climate change and the rational management of resources to reduce poverty and hunger in the member countries of the Organisation for Islamic Cooperation (OIC-MC).

Agriculture in the OIC-MC will face several challenges in the coming years including rapid population growth, climate change, water shortage, increased energy demand, scarcity of resources, accelerated urbanization, changing diets and increased competition in global markets. The need to direct agricultural policies and strategies towards smart agriculture adaptive to climate change, judicious use of natural resources and introduce new technologies for precision agriculture.

Agricultural plots have always displayed natural heterogeneity, with varying soil characteristics, topography, and vegetation. Precision agriculture acknowledges and addresses this intra-plot variability, enabling farmers to tailor interventions accordingly. While experienced farmers and agronomists have long understood this heterogeneity, it has often been treated uniformly or approximately. In precision agriculture, advanced technologies like satellite imagery, GPS, and soil sensors are utilized to map and analyze intra-plot differences. This data-driven approach allows for targeted strategies such as variable rate seeding, fertilization, and irrigation, optimizing resource usage and enhancing crop yield while promoting sustainability. Embracing precision agriculture not only benefits individual farmers but also fosters a more efficient and environmentally responsible agriculture industry, ensuring a stable food supply for future generations.

Precision agriculture is a transformative approach that leverages geospatial information from satellites and digital technologies to enhance and optimize agricultural production processes. Instead of employing blanket approaches like uniform pest control, uniform fertilizer application, or equal feeding for all animals in a field or herd, precision agriculture focuses on measuring and analyzing variations within agricultural plots. It can tailor fertilization, harvesting strategies, and animal feed to match the specific conditions of each section of the field or the individual needs of each animal. This data-driven methodology allows for more efficient resource usage, reduced environmental impact, and improved overall productivity. With precision agriculture, farmers can make informed decisions, adapt to the unique characteristics of their land and livestock, and pave the way for a sustainable and technologically advanced future in agriculture.

Precision farming methods promise to increase the quantity and quality of agricultural production while using fewer inputs (water, energy, fertilizers, pesticides, etc.). The goal is to save costs, reduce environmental impact and produce more and better food. Precision farming methods rely primarily on a combination of new sensing technologies, satellite navigation and tracking technologies, and the Internet of Things.

Challenges of climate change in agriculture in OIC-MC

Most of the OIC-MC face significant vulnerability to the impacts of climate change, with particular emphasis on African countries and the near east regions, primarily due to their geographical location. These regions already grapple with challenging climatic conditions, such as soaring temperatures (Figure 1), limited groundwater, low precipitation, and a scarcity of agricultural and arable land. This combination of factors makes them highly susceptible to the adverse effects of climate change. Of particular concern is the prevailing water scarcity and limited precipitation, which exacerbates the challenges these regions face. Moreover, the high population growth and geographic concentration of people in these areas contribute to making the OIC-MC the most water-stressed region in the world. As climate change intensifies, the agricultural sector within the OIC-MC is likely to confront even greater pressures, endangering food security, livelihoods, and exacerbating existing socio-economic challenges in the affected countries. Urgent and coordinated efforts are essential to bolster resilience and implement adaptive measures to address the detrimental impacts of climate change on agriculture in the OIC-MC region.

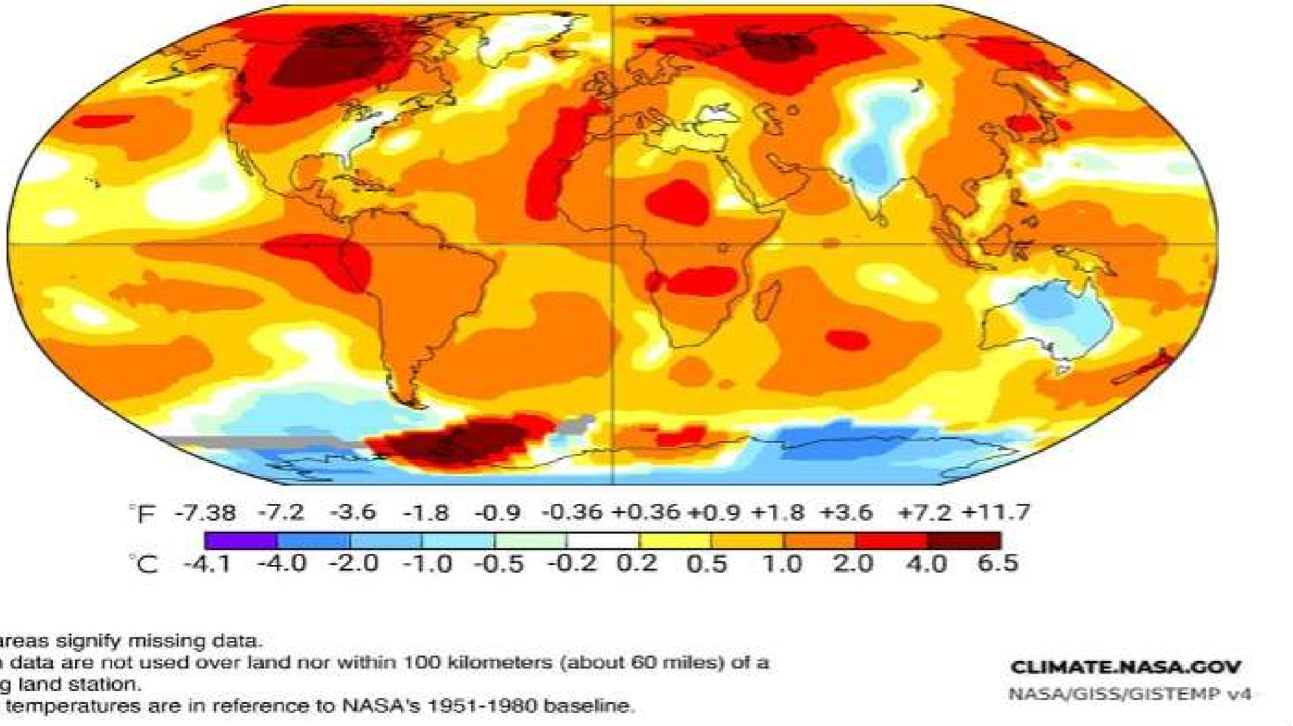

Figure 1 : Global Average Temperature Changes (May 2023) : 0.94°C/1.69°F

Challenges of climate change in agriculture in OIC-MC

In sub-Saharan Africa, drought has caused a 45.6% increase in the number of undernourished people since 2012, according to the Food and Agriculture Organization of the United Nations. The increase in temperatures and the modification of precipitation will also have significant repercussions on human health in Africa. Indeed, sucking biting insects, especially mosquitoes, proliferate in such conditions. Areas of transmission of diseases such as malaria, dengue fever and yellow fever will therefore expand.

Climate change is already affecting the Near East region disastrously. This will spread the intense heat over more land for longer periods of time, making some areas uninhabitable and reducing the cultivable areas. Rising temperatures will put severe stress on already scarce crops and water resources, potentially increasing migration, and the risk of conflict.

Precision farming to combat desertification and mitigate the effects of drought in OIC- MC

Desertification, as defined by the United Nations Convention to Combat Desertification (UNCCD), refers to land degradation in arid, semi-arid, and dry sub-humid areas caused by various factors, including climatic variations and human activities. One of the significant consequences of desertification is the increased frequency and intensity of droughts, which exacerbates land degradation and poses substantial challenges to sustainable development. This phenomenon poses a grave threat, particularly in developing countries, and is increasingly affecting developed countries as well.

According to forecasts, by 2050, droughts could impact more than three quarters of the world's population including Africa. Therefore, addressing desertification is crucial not only for combating land degradation but also for mitigating the adverse effects of drought and ensuring the resilience of agricultural systems in the IOFS-MC region.

The integration of precision farming methods can play a crucial role in ensuring food security and economic stability in the OIC-MC, where agriculture remains a vital component of livelihood and development. Farmers in these regions can optimize their water usage and resource allocation, ensuring that limited water resources are efficiently directed to areas with the greatest need. Tailoring irrigation schedules and fertilization based on precise data helps minimize water wastage and maximizes crop yields even under challenging environmental conditions. Additionally, precision farming empowers farmers to make informed decisions about crop selection and management strategies, considering the specific environmental conditions of their fields (Figure 2).

In Morocco, precision farming has emerged as a vital solution to tackle the challenges of water scarcity and optimize agricultural productivity. Farmers are adopting techniques like drip irrigation, soil moisture monitoring, and remote sensing to efficiently use water resources and monitor crop health.

Precision farming practices are gaining momentum in Egypt, particularly in the fertile Nile Delta region. With the help of advanced technologies such as satellite imagery and drones, Egyptian farmers can closely monitor their crops and detect potential issues early on. This enables targeted interventions, leading to improved resource efficiency and increased yields. Precision agriculture plays a crucial role in optimizing irrigation schedules and fertilizer applications, ensuring that agricultural inputs are used effectively while minimizing environmental impacts.

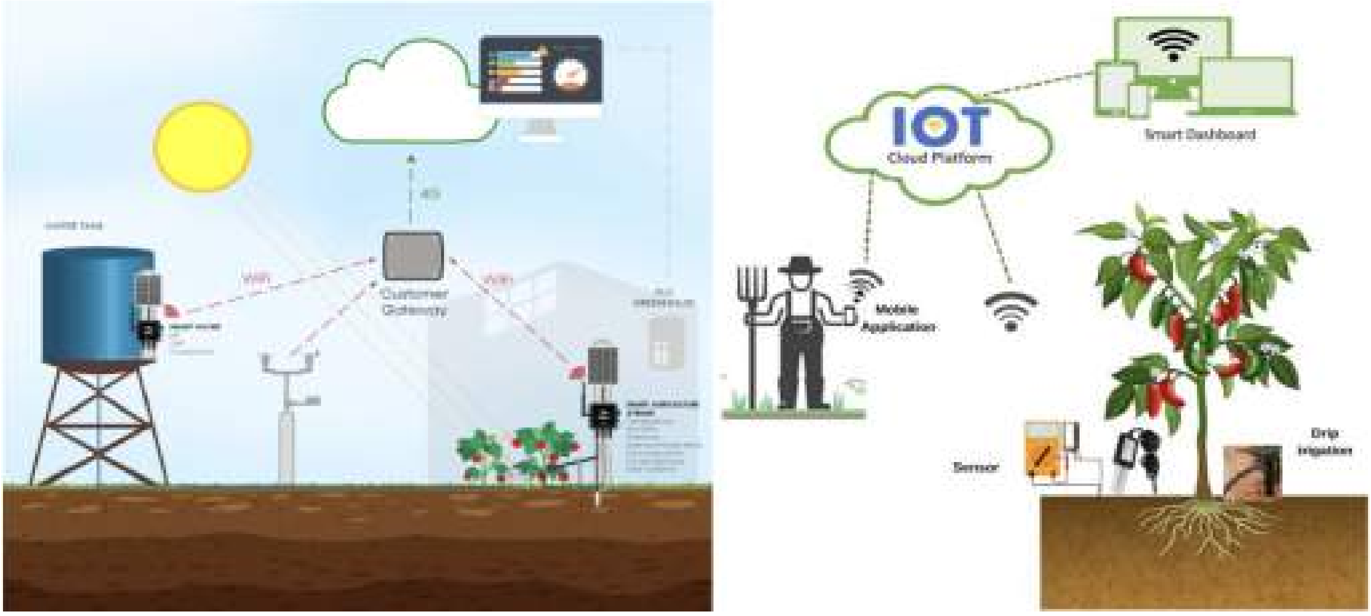

Figure 2: Digital Agri-technologies for weather monitoring to mitigate the effects of drought (IMRCN&IA)

In Nigeria, precision farming is transforming smallholder agriculture, offering new opportunities for improved productivity and livelihoods. Mobile-based platforms and data-driven insights are empowering farmers with tailored agronomic advice, weather forecasts, and market information.

In Malaysia and Indonesia, precision farming is becoming increasingly integrated into modern agriculture practices. Using precision technologies, such as GPS-guided machinery and remote sensing, Malaysian farmers can optimize land use, reduce chemical inputs, and improve crop quality. The implementation of precision agriculture practices in Malaysia and Indonesia contribute to sustainable farming, increased productivity, and better environmental stewardship, supporting the nation's agricultural growth and development goals.

Due to variations in farms and localities, even experts find it impossible to calculate where agricultural stress will occur. The only way to check if a culture is suffering is to measure what is happening on the ground.

Farmers must obtain images of their farms, stitch them together and analyze them using drone image analysis to make an informed decision. Images must be taken at high resolution for the entire farm. Farmers can achieve this by using a camera mounted on a drone and Smart Machineries (Figure 3). Many drone operators offer their services, and they can be found with an online search. Several farmers decide to purchase a drone for the frequent application of precision farming. Also, a map of the whole farm should be made by putting together pictures of different parts of a field. Online software companies provide a solution for assembling farm images. Finally, image analysis should be performed using software.

Precision farming for reservation of agricultural ecosystem and valorization of natural resources

One of the main challenges for the future of agriculture is to produce enough food with minimal impact on the environment. However, to date, there is a lack of appropriate methods and tools to assess, preserve, design, and monitor the multifunctionality and sustainability of agricultural production.

Also, one of the most important factors affecting the biodiversity of the agroecosystem in the OIC-MC is the mode of agricultural management and land use. The farming systems in the Islamic Countries used in modern agriculture can affect the environment, including biodiversity. Intensive agriculture is the main reason for the decrease in diversity and abundance of flora and fauna species in agroecosystems.

Government policy decisions and private sector actions should think about the agricultural ecosystem through the reduction of the pressures that agriculture places on ecosystem services and think about ecosystem-friendly agriculture as the promotion of agricultural systems diversified, control and regulation of the pesticides use, and support for alternative protection measures.

By 2050, we will have to feed more than 4 billion people in the OIC region, and the world has become aware of the consequences on environment and health of previous agricultural revolutions (factory farming, deforestation and methane emissions from livestock, pollution of the oceans, overfishing and problems of genetic modification of both crops and animals) and importance of preserving the ecosystem for our agriculture. The appearance of artificial intelligence and intelligent logistics will be the key to meeting this challenge using precision farming.

Figure 3: The use of the Smart Machineries as precision farming in intensive agriculture

All farms in the future must relate to precision agriculture, as well as location intelligence, mobile devices will be associated with smart maps. Sensors are incorporated into equipment and fields, and pickers are equipped with smart tracking devices so the farm manager can know where the picker is and when they picked that product. This can help isolate potential contamination issues so the food is not destroyed and can also help farmers identify their best product to replicate if successful. Soon, robots equipped with artificial intelligence (AI) and spatial awareness will be able to move across a field to pick a product. Some companies fly over their fields at the end of the growing season to analyze the vegetation index and get prediction of upcoming harvests.

Precision farming emerges as a crucial solution for addressing the challenges related to the preservation of the agricultural ecosystem and the valorization of natural resources in the OIC-MC region. With the goal of producing enough food to feed the growing population while minimizing environmental impact, precision farming leverages advanced technologies and data-driven approaches to optimize agricultural practices. Moreover, precision farming empowers farmers with real-time insights into their fields' health and productivity. Employing smart maps and intelligent logistics, farmers can monitor crop growth, identify areas of concern, and detect potential issues early on. This proactive approach allows for swift interventions, preventing the spread of diseases and minimizing crop losses.

Additionally, the integration of artificial intelligence and robotics in precision farming further revolutionizes the sector. AI-powered robots can perform tasks like harvesting, minimizing the need for manual labor and reducing the risk of yield losses due to inefficient harvesting practices (Figure 4).

Water and soil are two fundamental resources essential for agriculture and sustaining life. The quality of natural resources, including water, soil, biodiversity, forests, and landscapes, directly impacts our well-being and the attractiveness of a region. These resources play a vital role in the economy and contribute to the identity of a community.

To tackle challenges related to natural resources, the IOFS has included intensified efforts to work on the development and promotion of natural resources in its growth objectives. This will help preserve the environment and contribute to the sustainable development of the present and future generation of the OIC-MC.

As the IOFS emphasizes the development and promotion of natural resources for the region's sustainable growth, precision farming stands out as a vital tool to achieve these objectives, paving the way for a more resilient and environmentally conscious agricultural future in the OIC-MC. With the adoption of precision farming practices, the OIC-MC region can optimize resource use, preserve the ecosystem's health, and maximize crop yields, contributing to food security and economic growth. Precision farming, with its data-driven and tech-savvy approach, holds tremendous potential for sustainable agricultural development in the region.

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Precision organic farming as smart agriculture

Organic agriculture consists of a low-input agro-ecosystem in which crop productivity is based on the natural availability of plant nutrients, the use of green manures and the biological control of pathogens. These practices are regulated by international and national institutional bodies that certify organic products at all stages of the supply chain

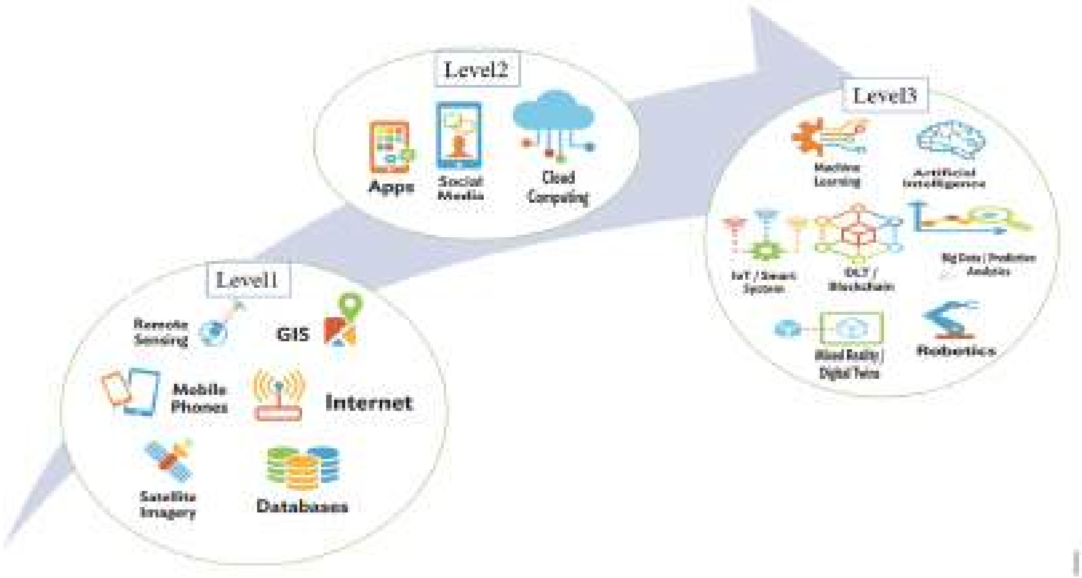

Figure 4: Levels of the digital technologies using in the Smart Agriculture

Precision farming is one of the key pillars of smart agriculture, integrating the three main dimensions of sustainable development: economic, social adaptation, and environmental preservation. Through precision farming practices, the agricultural sector in the OIC-MC can achieve economic sustainability by efficiently increasing production to meet the demands of a growing population.

The precision farming also contributes to social adaptation to enhance the resilience of agriculture to the impacts of climate change. With real-time insights into weather patterns, soil conditions, and crop health, farmers can make informed decisions to mitigate the adverse effects of extreme weather events.

Remote sensing for agriculture monitoring, especially when adopted for biological pest control, further enhances the effectiveness of precision farming practices (Figure 5). Utilizing remote sensing data, farmers can detect pest outbreaks at an early stage, allowing for timely and targeted interventions.

The ability to identify pest hotspots and monitor their spread helps in optimizing the application of biological control agents, reducing the reliance on chemical pesticides, and minimizing the ecological impact.

Moreover, precision farming plays a crucial role in environmental sustainability by reducing and, in some cases, eliminating greenhouse gas emissions. In conventional farming systems, precision farming techniques have already proven effective in increasing yields while reducing runoff and contamination caused by excessive use of chemical inputs. The ability to apply organic fertilizers and pesticides in variable rates to specific field points maximizes yields while minimizing environmental impact. This approach can be extended to organic farming systems, where precision organic farming offers partial solutions to the challenges caused by intensive chemical farming.

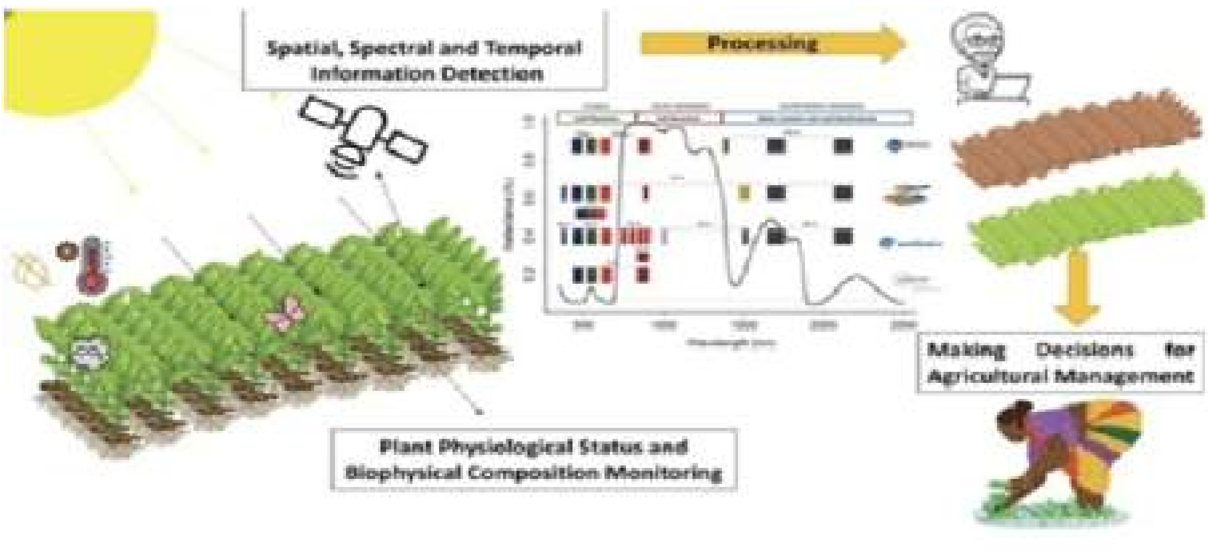

Figure 5: Remote sensing for agriculture monitoring for Biological Pest control

Conclusion

Precision farming is not a singular system or model but rather encompasses a range of practices that can enhance yields at the plant or animal level. While it may not directly lead to a transformation of the current agricultural model into a fully agro-ecological one, it does offer valuable approaches to developing agricultural strategies for ensuring sustainable food security in the face of climate change.

To effectively implement the climate vision of the IOFS, it requires comprehensive cooperation on multiple levels. The public sector, including public institutions, ministries, and government representatives, holds the responsibility for formulating and implementing public policies at the national level. Their collaboration is essential in devising climate action plans that foster sustainable agricultural practices and food security.

The private sector, as one of the significant contributors to greenhouse gas emissions, must commit to reducing its environmental footprint. Prioritizing measures such as altering production patterns, transitioning to sustainable energy sources, and adopting eco-friendly production and distribution systems can make a substantial impact on climate action.

Local governments play a pivotal role in implementing climate action plans that align with regional realities and conditions. Their decisions on sustainable practices and resource management contribute to the overall success of climate initiatives.

The university sector provides invaluable knowledge and insights that inform evidence-based decision-making in climate action. Their scientific contributions help refine strategies and foster innovation for sustainable agriculture.
Civil society, represented by non-governmental organizations and civil society groups, contributes to the decision-making processes by offering feedback, opinions, and suggestions based on their diverse expertise, including local, scientific, traditional, and technical knowledge. Their involvement adds depth and inclusivity to climate action initiatives.

In collective collaboration, these actors can drive meaningful change towards a more sustainable and climate-resilient agricultural sector. Precision farming, combined with a comprehensive and integrated approach involving all stakeholders, holds promise in addressing the global challenge of feeding a growing population while safeguarding the environment for future generations.

EN ABSTRACT

Agriculture is one of the sectors most vulnerable to climate variations in the Member Countries of the Organisation of Islamic Cooperation. Climate change can affect the entire agricultural system, from production and commercialization to processing and consumption of agricultural products. The technological revolution in recent years is pushing farmers to direct their strategies towards climate-smart agriculture in order to ensure food security.

Precision farming is one of the new farming management strategies that use advanced technologies to optimize agricultural production by adapting management practices specified for each plot of farm. This may include the use of drones, GPS mapping, sensors, precision mapping, navigation systems and data analysis to monitor and manage crops and animals. It may also optimize the use of agricultural resources and to reduce the environmental impacts of agriculture, minimizing greenhouse gas emissions and preserving soil quality.

FR RÉSUMÉ

Le changement climatique a un impact significatif sur l'agriculture dans les pays membres de l'Organisation de la Coopération Islamique, qui est l'un des secteurs les plus vulnérables aux variations du climat. Les effets du changement climatique peuvent affecter l'ensemble du système agricole, de la production à la commercialisation en passant par la transformation et la consommation des produits agricoles. La révolution technologique dans les dernières années pousse les agriculteurs à orienter leurs stratégies vers une agriculture intelligente face au climat afin d'assurer la sécurité alimentaire.

L'agriculture de précision est l'une de ces nouvelles stratégies de gestion agricole qui vise à utiliser des technologies de pointe pour optimiser la production agricole en adaptant les pratiques agricoles aux conditions spécifiques de chaque parcelle de terrain. Cela peut inclure l'utilisation de drones, de GPS mapping, de capteurs, de cartographie de précision, de systèmes de navigation et d'analyse de données pour surveiller et gérer les cultures et les animaux afin d'optimiser l'utilisation des ressources agricoles et de réduire les impacts environnementaux de l'agriculture, en minimisant les émissions de gaz à effet de serre et en préservant la qualité des sols.

AR المُلخص

لتغير المناخ تأثير كبير على الزراعة في دول منظمة التعاون الاسلامي، التي تعد واحدة من أكثر القطاعات عرضة لتقلبات المناخ. يمكن أن تؤثر آثار تغير المناخ على النظام الزراعي بأكمله، من الإنتاج والتسويق إلى معالجة واستهلاك المنتجات الزراعية. دفعت الثورة التكنولوجية في السنوات الأخيرة المزارعين إلى توجيه استراتيجياتهم نحو الزراعة الذكية مناخيًا من أجل ضمان الأمن الغذائي. تعد الزراعة الدقيقة إحدى استراتيجيات إدارة الزراعة الجديدة التي تهدف إلى استخدام التقنيات المتقدمة لتحسين الإنتاج الزراعي من خلال تكييف الممارسات الزراعية مع الظروف المحددة لكل قطعة أرض. قد يشمل ذلك استخدام الطائرات بدون طيار ورسم خرائط GPS وأجهزة الاستشعار ورسم الخرائط الدقيقة وأنظمة الملاحة وتحليل البيانات لرصد وإدارة المحاصيل والحيوانات لتحسين استخدام الموارد الزراعية وتقليل الآثار البيئية للزراعة، عن طريق تقليل انبعاثات غازات الاحتباس الحراري والحفاظ على جودة التربة.

SECURING A RESILIENT AGRICULTURAL FUTURE IN AFGHANISTAN: LIGHT MECHANIZATION AND IMPROVED SEED TRANSFER IN CEREAL PRODUCTION

Manager on Humanitarian Operations at Islamic Organization for Food Security

MR. EMRE YUKSEK

In Afghanistan, the looming crisis of food insecurity poses a significant threat to the lives of millions. According to a recent report from the World Food Programme (WFP),[1] a staggering 15.3 million people are expected to experience severe food shortages between May and October 2023. This dire situation includes 2.8 million people facing extreme food scarcity, and a concerning 4 million Afghans suffering from acute malnutrition, including 3.2 million children under the age of 5. These statistics paint a grim picture of the nutritional crisis gripping the nation. In light of these alarming numbers, it is evident that Afghanistan's food crisis has reached critical levels, with approximately 29.2 million people, or over two-thirds of the population, requiring urgent humanitarian assistance in 2023. The increased reliance on food aid underscores the need to find sustainable solutions to this crisis.

Afghanistan's economy heavily relies on agriculture, contributing 22% to the national GDP and serving as a vital source of income for 70% of the rural population. However, Afghan farmers face various challenges, including extreme weather events, limited resources, underdeveloped markets, and the dominance of low productivity in agriculture. Additionally, climate change with rising temperatures and reduced rainfall threatens future crop yields. Over the past four decades, Afghanistan has struggled with constraints on agricultural production due to factors such as ongoing conflict and water scarcity. The literature highlights that these trends along with the climate change exacerbates the overall agricultural productivity and import dependency.[2]

According to the data of National Statistic and Information Authority (NSIA) of Afghanistan, the core of Afghan agriculture lies in grain production, particularly wheat, which is grown annually on irrigated and rain-fed land. In 2021, wheat production reached 4 million tons, while rice, barley, and maize production were at 0.42 million tons, 0.07 million tons, and 0.26 million tons, respectively.[3] Despite these numbers, the average wheat yield remains below the targeted levels, primarily due to the lack of mechanization, irrigation issues, and poor-quality seed and access to fertilizers. This article will delve into critical aspects concerning mechanization, genetic enhancement, and project design in the context of cereal cultivation.

Firstly, to address these challenges and ensure food security, it is crucial to improve access to farm machinery, especially for marginalized and economically disadvantaged farmers. Farm mechanization plays a pivotal role in agricultural growth, alleviating labor shortages during peak seasons and enhancing agricultural productivity. Tractors and water pumps are widely used farm machinery, followed by threshers, harvesters, and power tillers.[4] While ownership rates are low, the need of farm machinery remains high, emphasizing the importance of access to this equipment requires either use of joint service centers, private providers or cooperative structures which is limited in Afghanistan case within the disrupted market and governance context. To address this gap and to promote the adoption of farm machinery, technology supply and innovation must be prioritized. Given the smaller size of Afghan farms, large-scale machinery may not be practical. Instead, investments in light agricultural mechanization can help increase cereal particularly wheat production yields, and the distribution of medium and small-scale machinery is a more feasible approach to agricultural mechanization in Afghanistan in that stage. The ongoing trend of agricultural mechanization in South Asia[5] can potentially include Afghanistan, where rapid growth in the adoption of agricultural machinery is being observed, driven by intrinsic factors such as knowledge, attitudes, and perceptions. This growth can be achieved by utilization of suitable agricultural machinery for cereal cultivation and other agricultural activities in Afghanistan.

However, mechanization alone is insufficient. Genetic support through improved crop varieties is also crucial. Afghanistan currently relies heavily on international breeding material due to the limited local wheat breeding activities. Challenges persist in registering new crop varieties, seed multiplication, and aligning technologies like irrigation and fertilization with market demand. To create sustainable systems, collaboration between the public sector, farmer-assisted research and development, regulation, and commercial seed distribution is essential. Multi-stakeholder engagement, technology demonstrations, seed production, capacity strengthening, and field-based extension activities for increasing production and productivity are disrupted over the years of conflict and political turmoil recently which have suspended international development interventions.[6] Towards this end previous activities of International Maize and Wheat Improvement Center (CIMMYT) are crucial for these change and need to be backed up regardless of the political deadlock as the trials, registration and commercialization and marketing requires time and resources to keep up the nation which relies on bread wheat as the main staple.

Finally to achieve all these ends, participatory approaches are vital for strategizing sustainable intervention frameworks based on local capacities and learning needs. International institutions should expand their roles beyond knowledge production and training, fostering closer collaboration with innovation stakeholders and generating fresh insights into innovation mechanisms and technology transfer.[7] Participatory approaches should also prioritize building strong partnerships between farmers, researchers, and policymakers to ensure the effective co-design and implementation of innovative solutions in agriculture, fostering sustainable development and food security.

In this context, IOFS is actively involved in driving agricultural change in Afghanistan through its Afghanistan Food Security Program (AFSP). The IOFS conducts field visits, engages with local stakeholders, and gathers information to strengthen the resilience and self-sufficiency of Afghanistan's agricultural sector. As part of that initiative a fact-finding mission of IOFS to Afghanistan in August visited Central and Western Afghanistan, and engaged in informative meetings and consultations. These visits focused on discussions regarding agricultural mechanization interventions, and the IOFS actively collaborated with local stakeholders, including Agriculture, Livestock, and Irrigation Offices in in Herat, Badghis, Nimrouz, Farah, Kabul and Logar provinces along with the farmer groups, NGOs, other development actors such as Turkish Cooperation and Coordination Agency (TIKA) and local researchers. The insights gained from these visits are being translated into practical project designs aimed at harnessing modern technologies to increase yields for farmers and establish sustainable cereal production models that can be replicated across Afghanistan. Feedback from farmers has highlighted challenges related to access to quality seeds, fertilizers, and cost-effective mechanization solutions, as the use of fuel-intensive machinery in previous projects has failed them.

On the other hand, renowned research institutions in Afghanistan, such as the UrdoKhan Research Institute in Herat and the Agricultural Research Institute of Afghanistan (ARIA) in Badambagh Kabul, have played crucial roles in sustaining efforts to introduce new wheat varieties to the country. These institutions were also visited by IOFS to acquire the latest information on wheat genetic research and plant protection. As mentioned in the previous issue of the Food Security Hub [8], there is a strict ban on poppy cultivation in Afghanistan that the researchers on the ground also verifies the ongoing positive trend. The stricter control offers a timely opportunity for a shift to alternative crops particularly wheat. However, this transition requires the right mechanization models and the supply of improved germplasm.

IOFS is firmly committed to tackling these challenges through a participatory approach, engaging stakeholders to gather essential insights for the design and implementation of replicable model interventions. In summary, Afghanistan's path to agricultural transformation critically depends on the seamless integration of mechanization, genetic support, and collaborative efforts. In the face of food security challenges, these strategies provide optimism for a more resilient and self-sustaining agricultural sector, poised to nourish the population and reduce dependence on external aid. Together, we can cultivate a brighter future for Afghanistan's agricultural landscape.

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8. Food Security Hub Issue 12 p. 24 'Gaps in Humanitarian Assistance in Afghanistan and IOFS Food Crisis Response through Afghanistan Food Security Program (AFSP)' https://www.iofs.org.kz/bulletin/food-security-hub-%E2%84%96-12

EN ABSTRACT

Afghanistan teeters on the brink of a severe food crisis. This alarming situation, highlighted in a recent report by the World Food Programme, underscores the urgent need for humanitarian assistance, as over two-thirds of the population, approximately 29.2 million people, require immediate help. The country's agricultural sector, a cornerstone of its economy, faces formidable challenges such as climate change, conflict, and water scarcity. Addressing these issues is contingent upon three critical pillars: enhancing access to light mechanization to boost productivity, harnessing genetic support to improve crop varieties, and adopting participatory approaches to engage local stakeholders.

Islamic Organization for Food Security (IOFS) recently conducted a fact-finding mission in Afghanistan in August 2023 under its Afghanistan Food Security Program (AFSP), collaborating with local stakeholders to formulate practical project designs aimed at leveraging modern technologies to increase yields and establish sustainable cereal production models. These comprehensive strategies offer a glimmer of hope for a more resilient and self-sustaining agricultural sector in Afghanistan, ultimately reducing its dependence on external aid.

FR RÉSUMÉ

L'Afghanistan vacille au bord d'une grave crise alimentaire. Cette situation alarmante, mise en évidence dans un récent rapport du Programme alimentaire mondial, souligne le besoin urgent d'une assistance humanitaire, car plus des deux tiers de la population, soit environ 29,2 millions de personnes, ont besoin d'une aide immédiate. Le secteur agricole du pays, pilier de son économie, est confronté à d'énormes défis tels que le changement climatique, les conflits et la pénurie d'eau. Pour faire face à ces problèmes, trois piliers critiques sont nécessaires : améliorer l'accès à la mécanisation légère pour augmenter la productivité, exploiter le potentien génétique pour améliorer les variétés de cultures, et adopter des approches participatives pour impliquer les acteurs locaux.

L'Organisation islamique pour la sécurité alimentaire (IOFS) a récemment mené une mission de recherche en Afghanistan en août 2023, dans le cadre de son Programme de sécurité alimentaire en Afghanistan (AFSP), en collaboration avec les acteurs locaux pour formuler des projets pratiques visant à exploiter les technologies modernes afin d'augmenter les rendements et d'établir des modèles durables de production céréalière. Ces stratégies globales offrent un rayon d'espoir pour un secteur agricole plus résilient et autosuffisant en Afghanistan, rréduisant à terme sa dépendance à l'égard de l'aide extérieure.

AR المُلخص

تتأرجح أفغانستان على حافةأزمة غذائية حادة. ويؤكد هذا الوضع المثير للقلق، والذي تم تسليط الضوء عليه في تقرير حديث لبرنامج الأغذية العالمي، على الحاجة الملحة للمساعدات الإنسانية، حيث يحتاج أكثر من ثلثي السكان، أي حوالي 29.2 مليون شخص، إلى مساعدات فورية. ويواجه القطاع الزراعي في البلاد، وهو حجر الزاوية في اقتصادها، تحديات هائلة مثل تغير المناخ والصراعات وندرة المياه. وتتوقف معالجة هذه القضايا على ثلاث ركائز أساسية، وهي: تعزيز الوصول إلى الميكنة الزراعية الخفيفة لرفع الإنتاجية، وتسخير الدعم الجيني لتحسين أصناف المحاصيل، واعتماد مناهج تشاركية لإشراك أصحاب المصلحة المحليين.

كما قامت المنظمة الإسلامية للأمن الغذائي (IOFS) مؤخرًا بمهمة استقصائية للإطلاع على حقيقة الوضع في أفغانستان في أغسطس 2023 في إطار برنامج الأمن الغذائي في أفغانستان (AFSP)، بالتعاون مع أصحاب المصلحة المحليين لإرساء مشاريع عملية تهدف إلى الاستفادة من التقنيات الحديثة لزيادة المحاصيل وإنتاج أصناف حبوب مستدامة. وتوفر هذه الاستراتيجيات الشاملة شعاعا من الأمل لقطاع زراعي أكثر مرونة وقدرة على الاكتفاء الذاتي في أفغانستان، الأمر الذي يؤدي في نهاية المطاف إلى الحد من اعتماده على المساعدات الخارجية.

IOFS ANNOUNCMENTS

الجمعية العامة السادسة
للمنظمة الاسلامية للأمن الغذائي
6TH GENERAL DOHA 2023
ASSEMBLY OF THE IOFS
TOGETHER COMMITTED TO ACTION

2ND IOFS HIGH-LEVEL FORUM ON FOOD SECURITY
2 ÈME FORUM DE HAUT NIVEAU DE L'IOFS SUR LA SÉCURITÉ ALIMENTAIRE

2nd IOFS High-Level Forum on Food Security

In accordance with the Strategic Vision 2031 of the Islamic Organization for Food Security (IOFS), we are delighted to announce the upcoming 2nd IOFS High-Level Forum on Food Security, scheduled to take place from October 1 to October 3, 2023, in the vibrant city of Doha, State of Qatar. This event will feature three dynamic Sub-Forums dedicated to advancing food security across OIC Member States:

SUB-FORUM 1: ENGAGING CIVIL SOCIETY AGAINST FOOD INSECURITY

DATE: OCTOBER 1, 2023

LOCATION: DOHA, QATAR

In a world where millions still go hungry, we believe that collective action is the key to change. Join us as we gather experts, advocates, and civil society leaders to address the pressing issue of food insecurity and find innovative solutions. Potentially, the Sub-Forum would be a platform for engaging discussions, collaborative workshops, networking opportunities, and inspiring speakers. Together, we can create a world where no one goes to bed hungry!

SUB-FORUM 2: ADVANCING AGRI-TECH FOR SUSTAINABLE FOOD SECURITY

DATE: OCTOBER 2, 2023

LOCATION: DOHA, QATAR

Join us on October 2, 2023, in Doha, Qatar, as IOFS presents the groundbreaking Advanced Agri-Tech Forum. This exceptional event is designed to foster multi-stakeholder dynamic dialogue, facilitating the exchange of cutting-edge agricultural technologies, fostering innovation, and forging strategic partnerships. By prioritizing practical, affordable solutions, the Forum seeks to empower OIC Member States to revolutionize food security through widespread implementation of best practices. Don't miss this opportunity to be part of shaping sustainable food systems for the future.

SUB-FORUM 3: IFPA - ENHANCING INTRA-OIC FOOD MARKETS

DATE: OCTOBER 3, 2023

LOCATION: DOHA, QATAR

Delve into a transformative dialogue on food security and sustainability at the IFPA Sub-Forum! Hosted by the Islamic Organization for Food Security (IOFS) in collaboration with the International Islamic Food Processing Association (IFPA) and the Qatar Ministry of Municipality, this sub-forum casts a spotlight on the vibrant future of intra-OIC food markets. Forum Highlights include insightful exploration of Qatar's food sector development, understanding the challenges and prospects of the national food sector across OIC countries, networking with leaders from various OIC member states, and participating in dynamic discussions to reshape the future of food.

This is a golden opportunity to be part of a global movement – come, let's reshape the future of food together!

For more details and registration for the Sub-Forums, please contact HLF@iofs.org.kz

Stay tuned for further updates! #IOFSHighLevelForum #FoodSecurity2023 #InnovationInAgriTech #EngageAgainstHunger #IFPASustainability

IOFS NEWS OVER JUNE-JULY-AUGUST

FOOD SECURITY MONITORING AND FOOD BALANCE SHEET MANAGEMENT IN FOCUS OF IOFS-ORGANIZED ONLINE SEMINAR

On 14 June, 2023, the Islamic Organization for Food Security started a two-day virtual seminar on “Monitoring and forecasting of food security, and food balance sheet management”. The event gathered 87 representatives of government agencies, research institutions and international experts of 23 Member States. The event was opened by the Director General of IOFS, Prof. Yerlan Baidaulet, and the Guest of Honor included the Deputy-Minister of Agriculture of the Republic of Kazakhstan, Mr. Yerbol Taszhurekov.

THE DIRECTOR GENERAL OF IOFS AND THE MINISTER OF AGRICULTURE OF THE REPUBLIC OF KAZAKHSTAN HOLD A REGULAR MEETING

On 16 June 2023, a regular working meeting was held between the Director General of the Islamic Organization for Food Security, His Excellency Prof. Yerlan Alimzhanuly Baidaulet, and the Minister of Agriculture of the Republic of Kazakhstan, His Excellency Mr. Yerbol Sh. Karashukeyev. The IOFS Director General informed the Minister about the results of the work accomplished by the Secretariat, during the time period since their last meeting in early 2023, as well as upcoming events of the IOFS. The parties also discussed furthering strategic plans for the implementation of the initiatives and programs of the IOFS.

IOFS PROVIDES A PRESENTATION FOR THE STUDENTS OF AGRICULTURAL SCIENCE AT THE UNIVERSITY OF PUNJAB, PAKISTAN

On 20 June 2023, the Islamic Organization for Food Security (IOFS), took the opportunity to address the students of the Agricultural Science at the University of Punjab on the various initiatives of the Organization, to inspire them to actively contribute to the advancement of agricultural practices in Pakistan and beyond.

IOFS CONTINUES SECOND HUMANITARIAN FOOD ASSISTANCE CONVOY TO AFGHANISTAN AND JOINS EFFORTS TO FIGHT AGAINST DRUG USE

On June 20, 2023, the IOFS delegation participated in the second phase of the Flour for Humanity program in Kabul, Afghanistan. The program, supported by private sector members of the IOFS Subsidiary (IFPA), Kondiz, and Amar Group, involved the distribution of 70 tonnes of fortified wheat flour as part of IOFS's Humanitarian Food Assistance Initiative in collaboration with UNAMA, UNODC, and local institutions. The focus was on targeting Drug Treatment Centers (DTCs) in Afghanistan.

WORKSHOP ON "DEVELOPMENT OF CURRICULUM & INTRODUCTION OF EDUCATION PROGRAM ON FOOD SECURITY"

The Islamic Organization for Food Security organized a two-day Workshop on "Development of Curriculum & Introduction of Education Program on Food Security" on 21-22 June 2023 in a hybrid format. The workshop aimed to raise awareness and build capacity among university staff and experts on teaching food security and sharing international best practices.The Workshop brought together 20 representatives of the Kazakh Agrotechnical Research University attending physically, and 15 participants online to share knowledge, experiences, and best practices in teaching food security. The workshop featured expert speakers from renowned institutions such as Hamad Bin Khalifa University of Qatar, UAE University, University of Agriculture in Faisalabad of Pakistan, Sustainable Food Systems of Ireland, the American University in Beirut of Lebanon, Gulu and Makerere Universities of Uganda.

IOFS CONDUCTS WORKSHOP ON "SUKUK FOR INVESTMENTS IN AGRICULTURE" IN COLLABORATION WITH THE MINISTRY OF FOREIGN AFFAIRS OF THE REPUBLIC OF KAZAKHSTAN

On 22 June 2023, the Islamic Organization for Food Security launched the "Sukuk for Investments in Agriculture" workshop in coordination with the Ministry of Foreign Affairs of the Republic of Kazakhstan. The workshop featured esteemed speakers and experts that delved into various aspects of Sukuk and its relevance to the agricultural sector. The opening speech was delivered by the Minister of Agriculture of the Republic of Kazakhstan, HE Mr. Yerbol Karashukeev, and the Deputy Minister of Foreign Affairs of the Republic of Kazakhstan, HE Mr. Kanat Tumysh, followed by the welcoming remarks of the Director General of IOFS, HE Prof. Yerlan Baidaulet.

11TH IOFS EXECUTIVE BOARD MEETING CONVENES IN KAZAKHSTAN

On 23 June 2023, the 11th Executive Board Meeting of the Islamic Organization for Food Security convened in Astana, Kazakhstan with the participation of the Director General of the IOFS, HE Prof. Yerlan Alimzhanuly Baidaulet and the esteemed Executive Board Members from: the State of Qatar (Chairman), the United Arab Emirates (UAE), the Republic of Tajikistan, the Islamic Republic of Pakistan, the Republic of Cameroon, the Republic of the Gambia, the Republic of Kazakhstan, and the Kingdom of Saudi Arabia (KSA, Honorary Chairman). The Director General reported on the activities of the Organization for the working year of 2022, and updated the Board on the implementation of the 5th General Assembly Resolutions.

IOFS AND AL MUKARRAMAH SOLIDIFY THEIR PARTNERSHIP WITH AN MOU

On 23 June 2023, the Islamic Organization for Food Security and Al Mukarramah signed an MoU on partnership to further efforts in achieving a shared objective: to foster a strategically curated ecosystem that generates tangible outcomes, propelling OIC Member States towards sustainable food security. Al Mukarramah, as a strategic implementation partner, sealed its commitment to enhancing IOFS food security programs in the agricultural sectors and related industries in all OIC Member States.

IOFS DELEGATION CONDUCTS FRUITFUL WORKING MEETINGS IN KYRGYZSTAN

On June 27, 2023 a delegation from the Islamic Organization for Food Security concluded a successful working visit to Bishkek, Kyrgyzstan aimed at strengthening bilateral cooperation. The delegation engaged in three productive meetings with representatives of the Ministry of Agriculture, the AgroLead" Public Association, a leading advisory organization contributing to the agribusiness sector in the Kyrgyz Republic, and the Association of Sheep Breeders of the Kyrgyz Republic.

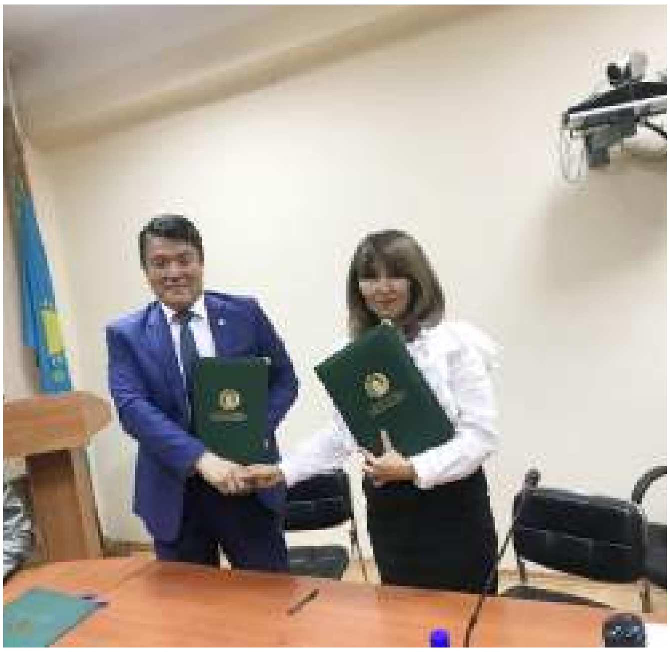
IOFS ATTENDS THE MEETING OF THE PRESIDIUM OF KAZAKHSTAN'S AGRICULTURE ACADEMY AND HIGHLIGHTS STRENGTHENING AGRI-SCIENCE IN OIC GEOGRAPHY AND PRIVATE SECTOR COLLABORATION

On 30 June 2023, the IOFS delegation led by the Director General of the Islamic Organization for Food Security, His Excellency Prof. Yerlan Alimzhanuly Baidaulet attends the meeting of the Presidium of Kazakhstan's Agriculture Academy in Almaty, Kazakhstan that aimed at fostering cooperation and partnership in the field of agricultural science and private sector collaboration.

The first and foremost, the Director General of IOFS was received by the esteemed President of the Kazakhstan's Academy of Agricultural Sciences, His Excellency Academician Tlektes Issabaiuly Yespolov for the meeting with the Presidium of Members of the Academy.The Director General of IOFS expressed appreciation and noted in leveraging the Academy's vast knowledge base and collaborative platform to enhance agricultural development within the OIC Member States. Furthermore, H.E. Yerlan Baidaulet delivered a speech emphasizing the significance of agricultural science and importance of active participation from the scientific community in OIC Member States in implementing agricultural projects. In addition, considering the importance of a platform for scientific collaboration between OIC Member States and its potential for innovation, research, and development in the field of agriculture, the IOFS shared commitment to establishing the Association of Agricultural Academies (AAA) among OIC Member States, with the Kazakhstan's Academy playing a crucial role as the coordinating body.

IOFS SIGNS MOU WITH THE KAZAKH SCIENTIFIC RESEARCH INSTITUTE OF PROCESSING FOOD

The Director General of IOFS, HE Prof. Yerlan Baidaulet conducted another meeting with the President and representatives of the Kazakh Research Institute of Processing and Food Industry. The meeting focused on exploring opportunities for collaboration within the framework of the IOFS subsidiary, the International Islamic Food Processing Association (IFPA). Discussions centered around fostering mutually beneficial partnerships and leveraging the expertise and resources of both institutions to enhance the agricultural and food processing sectors within OIC member states.IOFS also signed an MOU with the Kazakh Scientific Research Institute of Processing Food, focusing on the Institute's close engagement with the IOFS subsidiary, the International Islamic Food Processing Association (IFPA), on the Bakery Supply Chain (BSC) project



IOFS LAUNCHES 2ND INTERNATIONAL FORUM FOR AGRI-BIOTECHNOLOGY IN KAZAKHSTAN

The Islamic Organization for Food Security launched the 2nd International Forum for Agri-Biotechnology on 4 July 2023, under the patronage of the Ministry of Education and Science of the Republic of Kazakhstan, with the support of the Ministerial Standing Committee on Scientific and Technological Cooperation of the Organization of Islamic Cooperation (COMSTECH), COMSATS University Islamabad, as well as the National Center for Biotechnology (Kazakhstan). The forum aimed to stimulate the desire to collaborate and change the world of agricultural biotechnology, allowing the research community to discuss latest developments in the rapidly advancing field and find ways to respond to the increasing demands of professionals and communities across the world.Throughout the event, 47 presentations were shared - 31 physical, 12 online, and 4 videos, by speakers from over 15 countries.

During the first day, after the opening ceremony, the conference featured two technical sessions. The first session, focused on Green Biotechnology, covered topics such as cutting-edge biotechnologies, RNA interference-based technology, CRISPR/Cas technology, and more. Meanwhile, panel discussions explored the practical implementation and social acceptance of these technologies. The second technical session, centered on Breeding Tools, elaborating on genomic selection strategies, the role of wild wheat relatives, high-throughput molecular assays, and other breeding techniques. The panel discussions focused on partnership and knowledge sharing among OIC member states.Simultaneously, a parallel session on Microbial Biotechnology explored interventions to control transboundary pests and diseases, bioconversion of keratin wastes, plant-based insecticides, and the use of microbiome technologies.

THE LAST DAY OF THE INTERNATIONAL FORUM FOR AGRI-BIOTECHNOLOGY

The second day of the 2nd International Forum for Agri-Biotechnology on 5th July 2023, encompassed two technical sessions on Food Biotechnology and Animal Biotechnology. The sessions were followed by a tour of the National Center for Biotechnology, leading then to a round table on the outcomes of the forum on the various realms of biotechnology and the final closing session with the participation of government representatives of the Republic of Kazakhstan and the Republic of Niger and various international organizations.

During the Food Biotechnology session, participants from Kazakhstan, Pakistan, Egypt, and Türkiye addressed malnutrition in the Organization of Islamic Cooperation geography through functional foods, and raised issues of quality standards. The session concluded with a panel discussion and the exchange of innovative ideas and solutions to pressing challenges in the sphere of Food Biotechnology.

The Animal Biotechnology session elaborated on presentations and a panel discussion on the key challenges and potential solutions to integrating traditional breeding methods with modern biotechnology practices. Participants from Pakistan, Kazakhstan, and Malaysia elaborated on the most significant technical advancements in animal biotechnology that could contribute to bridging the gap between developed and developing countries in animal genetic resources management and conservation. The second half of the session included panel discussions with representatives from the African Union-Interafrican Bureau for Animal Resources (AU-IBAR), Pakistan, the International Livestock Research Institute, and INAT Tunisia.

After the technical sessions , the participants gathered with eminent speakers from 15 countries, in a hybrid format, to discuss recommendations and the outcomes of each session. The Director General of IOFS H.E. Prof. Yerlan Baidaulet then closed the Forum with the Minister of Livestock of the Republic of Niger, H.E. Mr. Tidjani, Abdoul Kadri; the Vice Minister of Agriculture of the Republic of Kazakhstan H.E. Mr. Tamabek Abulkhair; and the Coordinator General of COMSTECH - OIC Standing Committee on Scientific and Technological Cooperation H.E. Prof. M. Iqbal Choudhary.
The participants were then invited to tour the "Scientific and Production Center of Grain Farming named after A. I. Barayev," a leading institution in the Republic of Kazakhstan engaged in applied research on the development of technologies for the cultivation of grain, legumes, oilseeds, forage crops and the creation of new varieties.

TRANSNATIONAL COLLABORATION TO ADVANCE VETERINARY SYSTEMS AND FOOD SECURITY

Mr. Laouali Ali, the Director of Studies and Programming at the Ministry of Livestock and a delegate from the Republic of Niger, arrived to Astana to participate in the 2nd International Forum for Agri-Biotechnology. On July 4, 2023, Dr. Laouali Ali had the opportunity to explore Asyl Tulik, the largest breeding enterprise in the Asian region of the former USSR and the strategic partner of the IOFS. During a meeting on July 5, 2023, the representatives of the IOFS, the Ministry of Animal Husbandry of the Republic of Niger, and the Committee for Veterinary Control and Supervision of Kazakhstan, discussed opportunities for cooperation and knowledge sharing in the veterinary service development.

KAZAKHSTAN AND TAJIKISTAN LAUNCH AGRICULTURAL PARTNERSHIP UNDER THE ISLAMIC ORGANIZATION FOR FOOD SECURITY

During the 2nd International Biotechnology Forum, the Association of Agricultural Academies was founded within the framework of the Islamic Food Security Organisation. The founding countries include Kazakhstan and Tajikistan. The Memorandum of Understanding signed between the parties focuses on partnership in the development and application of scientific methods in agriculture.

IOFS FURTHERS EFFORTS IN STRENGTHENING LOGISTICS BETWEEN OIC MEMBER STATES

On 12 July 2023, the Headquarters of the Islamic Organization for Food Security (IOFS) hosted a meeting between the Assistant on Strategic Issues to the President of the Republic of Kazakhstan, HE Mr. Asset Issekeshev and his technical team with an extensive delegation of the Islamic Republic of Pakistan, that included esteemed businessmen, state and embassy officials. During the meeting, the dialogue was centered around developing translogistic routes between Central and South Asia.

CENTRAL ASIAN SECURITY AND COOPERATION FORUM DISCUSSES THE IOFS MANDATE IN AFGHANISTAN

The Director General of the Islamic Organization for Food Security, HE Prof. Yerlan Baidaulet was invited to join vital discussions on Asia in the Changing World: Agenda for the Future, at the Central Asian Security and Cooperation Forum (CAF) hosted in Astana, Kazakhstan on 14 July 2023. The Forum, launched by the Kazakhstan Institute for Strategic Studies (KazISS) under the President of Kazakhstan and co-organized with the Kazakh Ministry of Foreign Affairs, brought together scholars from 25 different countries in the region.

During the Panel Session on Asia's Global Security: Future Perspectives, the Director General delivered his remarks on the matter from food security and agricultural development perspectives.

THE IOFS DELEGATION PAYS A FRUITFUL VISIT TO NIGER FOR BILATERAL DISCUSSIONS ON AGRICULTURAL DEVELOPMENT PARTNERSHIPS

Niamey, Niger, from 12 - 15 July 2023, a delegation from the Islamic Organization for Food Security recently embarked on a working visit to Niger as a follow-up to the successful trip and bilateral discussion with the Government of Niger made by H.E. Director General Prof. Yerlan Baidaulet in May 2023. The delegation engaged in bilateral and technical meetings with representatives of the Government of Niger to discuss key areas for the country's agricultural development, including wheat production, plant genetic resources, water management, and livestock.

IOFS DELEGATION CONTINUES ITS MISSION IN NIGER BY MEETING WITH REGIONAL OFFICES OF THE PARTNERING INSTITUTIONS

On 14-15 July 2023, the IOFS delegation held several meetings with both strategic and potential partners based in Niger, in order to share vision of the IOFS , promoting partnerships and coordination among various stakeholders, with the aim of maximizing the impact of agricultural projects, as well as proposals for initiatives in the areas of livestock, wheat and gene bank development. Meetings were held with the Regional Office of the African Development Bank (AfDB); Regional Office of the Islamic Development bank (IsDB); Turkish Cooperation and Coordination Agency (TIKA). International Crops Research Institute for the Semi-Arid Tropics (ICRISAT); Permanent Interstate Committee for drought control in the Sahel (CILSS).

IOFS DIRECTOR GENERAL VISITS THE KAZAKHSTAN INSTITUTE FOR STRATEGIC STUDIES (KISI)

On 19 July 2023, HE Prof. Yerlan Baidaulet, the Director General of the Islamic Organization of Food Security, was received at Office of His Excellency Ambassador Yerkin Tukumov, Director of the Kazakhstan Institute for Strategic Studies Under the President of the Republic of Kazakhstan (KISI) to discuss ways and means to establish a result-oriented cooperation between the two Institutions. The parties agreed that KISI would define the manner in which it would cooperate with the IOFS in the implementation of Afghanistan Food Security Program (AFSP). It was further agreed that the IOFS would have a prominent role at the convening of the Central Asian Security and Cooperation Forum that is now expected to be held annually in the month of July in Astana, after the successful holding of the 1st Edition on 13-14 of the current mont

DJIBOUTI AGREES TO HOST THE AGRIBUSINESS FORUM

On 19 July 2023, the IOFS team conducted a Zoom meeting with Ambassador Said Dya Bamakhrama, Ambassador of the Republic of Djibouti to Saudi Arabia, to discuss the organization of the Agribusiness Forum themed "Africa Agricultural Prospectives within OIC Member States" scheduled for 2-3 November 2023 in Djibouti. The essence of the Forum is to bring together potential investors, international and OIC agencies, and businesses to explore projects in the food and agriculture sector, with an emphasis on East Africa and especially the African Horn region. After approval from the Djibouti Government, the parties agreed to establish a joint technical committee related to the Forum organization and join efforts towards the successful holding of the event. In addition, the idea of transforming Djibouti into a meat hub for the eastern region of Africa was raised by the IOFS, which was supported by the HE Ambassador and will be elaborated further in due course.

THE PRESIDENT OF KAZAKHSTAN HIGHLIGHTS THE NEED TO UTILIZE THE POTENTIAL OF THE IOFS TO ENSURE GLOBAL FOOD SECURITY

On 20 July 2023, the President of Kazakhstan HE Mr. Kassym-Jomart Tokayev, during the proceedings of the Central Asian Gulf Cooperation Council Summit in Jeddah, Kingdom of Saudi Arabia, emphasized the importance of ensuring food security and underscored the role of the Islamic Organization for Food Security.

“Food security remains a top priority. Kazakhstan is interested in increasing the volume and diversifying the structure of export deliveries of agricultural products to the Arab countries. Our country is one of the ten largest producers of wheat and flour in the world. The experience and capacity of our Arab partners in the production, processing and certification of organic and halal products are in high demand. In this context, we consider it necessary to continue work on the synchronization of standards, the system of technical regulation and certification. We can effectively implement all these tasks by utilizing the potential of the Islamic Organization for Food Security.”

The President continued by adding, “We are sincerely grateful to the leadership of Qatar for their active efforts as the Chair of the Islamic Organization for Food Security. Separately, I would like to note the significant contribution of the Kingdom of Saudi Arabia (KSA) in supporting the activities of the Organization. In order to strengthen global food security, I propose creating a Mechanism of meetings of Ministers of Agriculture in order to expand cooperation in this field."

GCC-CENTRAL ASIA SUMMIT ISSUES JOINT STATEMENT AND CALLS ON MEMBERS TO SUPPORT THE IOFS

The joint statement issued at the GCC-Central Asia Summit in Jeddah on July 19, 2023, marks a significant milestone in the relationship between the Gulf Cooperation Council (GCC) countries and Central Asia. The leaders of both regions reaffirmed their commitment to enhancing political and strategic ties at both collective and bilateral levels. One of the points of the GCC-Central Asia Summit Joint Statement included:

The leaders stressed the importance of strengthening cooperation between the Organisation of Islamic Cooperation and its institutions and bodies. They noted that many parts of the Islamic world are facing increasing food insecurity, primarily due to the challenging geopolitical and geo-economic situation as well as climate change. In this context, the leaders emphasised the necessity of cooperation and support for the efforts of the Islamic Organisation for Food Security and utilising its capacities to ensure the delivery of food supplies to needy countries.

IOFS VISITS OIC HEADQUARTERS AND ISF PERMANENT COUNCIL TO REVIEW BILATERAL COOPERATION IN THE HUMANITARIAN FIELD

During the 5th Consultative Meeting of the Islamic Committee of the International Crescent in Jeddah on July 24, 2023, the Islamic Organization of Food Security (IOFS) delegation engaged in discussions with the Organisation for Islamic Cooperation (OIC) and the Islamic Solidarity Fund (ISF). The focus of these meetings was to enhance coordination and engagement within OIC institutions, particularly regarding the IOFS's humanitarian efforts in Afghanistan and Africa.

During their visit to the OIC headquarters, the IOFS delegation met with key representatives, including Ambassador Tarig Ali Bakheet, Assistant Secretary-General for Humanitarian, Cultural, and Social Affairs. They exchanged views on self-sustainable agricultural projects and the organization's support for the development of the private sector in agribusiness engagements. In addition to the OIC meetings, the IOFS delegation paid a courtesy call to Ambassador Musa Kulaklıkaya, Assistant Secretary-General for Administration and Finance, to discuss the recent status of IOFS memberships from the OIC Member States.

IOFS CONSULTS WITH ISLAMIC DEVELOPMENT BANK ON AFGHANISTAN AND BILATERAL COOPERATION

On July 23, 2023, the Islamic Organization of Food Security delegation visited the Islamic Development Bank (IsDB) headquarters in Jeddah, Saudi Arabia, to discuss and advance the Afghanistan Food Security Program (AFSP) and other joint initiatives within the bilateral cooperation of the two sister institutions of the Organization of Islamic Cooperation (OIC). During the meeting with Eng. Mohammad Jamal Alsaati, Special Advisor to the IsDB President and Head of the Afghanistan Humanitarian Trust Fund (AHTF), the delegation exchanged views on the progress of the AFSP. In a separate meeting, the IOFS delegation engaged with the IsDB Team responsible for food security and agriculture-related projects, led by Dr Nizar Zaied, Lead Global Water Specialist. The two sides explored potential joint initiatives, with a particular focus on projects to benefit OIC member states in Africa. Notably, they discussed initiatives related to the development of the cassava value chain, which was identified as one of the strategic commodities by OIC member states.

IOFS ADVANCES ITS HUMANITARIAN AGENDA AT THE ICIC MEETING IN JEDDAH

The IOFS delegation, led by Mr Abdula Manafi Mutualo and Mr Emre Yuksek, actively participated in the 5th Consultative Meeting of the Islamic Committee of the International Crescent (ICIC) in Jeddah, Saudi Arabia, under the guidance of Prof. Yerlan Baidaulet, Director General of the IOFS. The meeting brought together representatives from 56 National Societies and senior officials of the International Federation of Red Cross and Red Crescent Societies to discuss collaborative humanitarian actions and promote international solidarity in addressing pressing humanitarian challenges.

IOFS DELEGATION ATTENDS THE UNITED NATIONS FOOD SYSTEMS SUMMIT +2

On June 24, 2023, the Director General of the Islamic Organization for Food Security, HE Prof. Yerlan Baidaulet actively led the delegation of the IOFS at the United Nations Food Systems Summit +2 (UNFSS+2) Stocktaking Moment, which was held in Rome, Italy from 24 – 26 July 2023. The crucial event unfolded at the premises of the Food and Agriculture Organization of the United Nations (FAO) graciously facilitated by Italy in collaboration with Rome-based UN Agencies (FAO, IFAD, WFP), the UN Food Systems Coordination Hub, and the wider UN system. To note, Prof. Baidaulet's participation came upon the personal invitation from Mr. Stefanos Fotiou, Director of the UN Food Systems Coordination Hub, underscoring IOFS's significant role at the summit.

Prof. Yerlan A. Baidaulet also had the opportunity to meet and engage in meaningful discussions with several high-profile figures on the sidelines of the Summit, including with Ms. Agnes Kalibata, the current President of AGRA and former UN Food Systems Coordinator and Ms. Ismahane Elouafi, Chief Scientiest of FAO. The working program of the IOFS was then followed by high level meetings with the Chairman of the IOFS HE Dr.Masoud Al-Marri and the Minister of Agriculture of the Republic of Kazakhstan, HE Mr. Yerbol Karashukeyev.

IOFS CONTINUES HIGH LEVEL MEETINGS ON THE SIDELINES OF UNFSS+2

On the second day of the UNFSS+2 Stocktaking Moment, the Director General of IOFS, Prof. Yerlan A. Baidaulet had the opportunity to meet and engage in meaningful discussions with several high-profile figures. These interactions fostered stronger partnerships and collaborative action in achieving food systems sustainability within OIC region. Notably, the Director General held meetings with: Abdoulkader Kamil Mohamed, Prime Minister of Djibouti & Mohamed Ahmed AWALEH, Minister of Agriculture of Djibouti; Aziz Botirovich Voitov, The Minister of Agriculture of Uzbekistan; Qu Dongyu, Director General of FAO (Food and Agriculture Organization of the United Nations) & Kairat Nazhmidenov, Representative of FAO; The Delegation of Mozambique; Yerbol Karashukeyev, Minister of Agricutire of Kazakhstan & Abdelmonem Belati, Minister of Agriculture of Tunisia and Respective Delegations; Ms. Ameenah Gurib-Fakim, Former President of the Republic of Mauritius, Biodiversity Scientist.

IOFS PARTICIPATES IN KAZAKHSTAN-AFGHANISTAN BUSINESS FORUM

On 2nd August, 2023, the IOFS team participated in the Kazakhstan – Afghanistan Business Forum held in Astana, Kazakhstan. The primary objective of this forum was to strengthen the economic ties between the two countries, which have been underperforming despite Afghanistan being one of the major trading partners of Kazakhstan in the Central Asian region.

THE DIRECTOR GENERAL OF IOFS CONCLUDES THE LAST DAY OF THE UNFSS+2 WITH STRATEGIC MEETINGS

On the last day of the UNFSS+2 , the Director General of IOFS had the opportunity to conduct a number of meetings with high-profile officials. An official meeting was arranged with the delegation of The Gambia led by the Minister of Agriculture, Mr. Demba Sabally to discuss prospects for cooperation in achieving common objectives.This was followed by a meeting with Mr. Fotiou Stefanos, Head of the UN Food Systems Hub. The Director General then continued discussions on strengthening bilateral cooperation with the Vice Minister of Agriculture of Mozambique, Mr. Olegário Banze.

IOFS DELIVERS KEYNOTE SPEECH AT THE INTERNATIONAL SCIENTIFIC EXPERIENCE CONFERENCE

On August 3, the Director of the Programs and Projects Department Prof. Dr. Zulfiqar Ali, participated at the International Scientific Experience Conference in Turkestan, under the theme "Improving the ecological situation through the development of greenery and problems in the development of agriculture". The Conference was dedicated to the 5th anniversary of the Turkestan region and the opening of the center of the Academy of Agricultural Sciences of the Republic of Kazakhstan. The event was also attended by the deputy akim of Turkestan region Mr. Ermek Kenjehanuly, in addition to esteemed scientists from Kazakhstan, Uzbekistan, Kyrgyzstan, India and Pakistan.

ISLAMIC ORGANIZATION FOR FOOD SECURITY SUPPORTS KATRU-RUDN CONFERENCE ON FOOD SAFETY & FOOD QUALITY

The Islamic Organization for Food Security (IOFS) has vowed to support an International Food Safety and Food Quality Conference due to be held at S. Seifullin Kazakh Agrotechnical University (KATRU) in Astana on September 20-22, 2023.The Event is jointly organized by KATRU and Russia's People's Friendship University (RUDN).

Over 40 eminent food scientists, including Nobel Laureates, from many countries as well as food quality experts and business leaders from around the world will participate in the conference. Ministers and representatives of Russian and Kazakhstan ministries of agriculture, ambassadors, university rectors, and professionals will attend the conference. The advisor to the KATRU Rector Prof. Kanat M.Tireuov, on strategy, global engagement, and communications, Mr. Muhammad Sheraz, visited the IOFS office in Astana on 10 August 2023, to officially invite the IOFS Director General H.E Prof. Yerlan Alimzhanuly Baidaulet and his team to the conference.

MINISTER OF ENVIRONMENT, WATER, AND AGRICULTURE OF SAUDI ARABIA EMPHASIZES FOOD SAFETY AND EXTENDS SUPPORT TO IOFS

On 7 August 2023, the Minister of Environment, Water, and Agriculture of the Kingdom of Saudi Arabia, His Excellency Mr. Abdulrahman Al-Fadhli, arrived in Astana, Kazakhstan for a working visit. The delegation also consisted of H.E. Sulaiman AlRumaih, CEO of Saudi Agricultural and Livestock Investment Company (SALIC); H.E. Eng. Ahmed Al Fares, Governor of the General Food Security Authority; H.E. Mr. Faisal bin Hanif Al-Qahtani the Ambassador of KSA to Kazakhstan; H.E. Eng. Ahmed Saleh Aiadh AlKhamshi, Deputy Minister; H.E. Eng. Abdulaziz Al-Huwaish Director General of International Cooperation, Honorary Chairman of the Executive Board of the IOFS. This visit aims to strengthen multifaceted cooperation between the Kingdom of Saudi Arabia and Kazakhstan.

During his visit, Minister Al-Fadhli had the privilege of meeting with the President of Kazakhstan, His Excellency Mr. Kassym-Jomart Tokayev. Following the high-level meeting, the Kingdom of Saudi Arabia delegation was warmly welcomed by the Director General of the Islamic Organization for Food Security (IOFS), His Excellency Prof. Yerlan Baidaulet, at the headquarters of the organization.

IOFS EXPLORES AGRICULTURAL OPPORTUNITIES IN WEST AFGHANISTAN

On 18 August, 2023, a delegation of the Islamic Organization for Food Security (IOFS) concluded a comprehensive fact-finding mission across the rich agricultural landscapes of four provinces in West Afghanistan within the framework of implementing the Afghanistan Food Security Program. In partnership with the Turkish Cooperation and Coordination Agency (TIKA) Herat Program Coordination Office, this mission was meticulously orchestrated to delve into the untapped potential of wheat and palm date development within the region.

THE IOFS KICKS OFF TRAINING ON MODERN RICE PRODUCTION TECHNOLOGIES IN BANGLADESH

On August 20, 2023, the Director General of the Islamic Organization for Food Security, Prof. Yerlan Baidaulet launched the Training on Modern Rice Production Technologies for IOFS Member States in Gazipur, Bangladesh in partnership with the Bangladesh Rice Research Institute. The objective of the capacity building training program is to leverage the expertise and experience of the successful rice sector of Bangladesh in order to strengthen the capabilities of rice experts in OIC Member States and contribute to sustainable rice production in OIC Geography.

IOFS PURSUES CONSULTATIONS ON THE SIDELINES OF TRAINING ON MODERN RICE PRODUCTION TECHNOLOGIES IN BANGLADESH

On the sidelines of the Training on Modern Rice production Technologies for IOFS Member States, the Director General confided with Dr. Md. Shahjahan Kabir, BRRI Director General (Grade-1), and Mr. Md. Momtaz Uddin, Director General of the Food Planning Monitoring Unit (FPMU) and Additional Secretary, Ministry of Food. Separately, the IOFS Director General was warmly received at the campus of the Islamic University of Technology by its Vice-Chancellor, Prof. Dr. M. Rafiul Islam. The IOFS Director General also had a bilateral meeting with the Director General of the Bangladesh Institute of Nuclear Agriculture (BINA) scientist and eminent plant breeder, Dr Mirza Mofazzal Islam.

FBCCI JOINS THE INTERNATIONAL ISLAMIC FOOD PROCESSING ASSOCIATION

Continuing his visit to Bangladesh, His Excellency Prof. Yerlan Alimzhanuly Baidaulet , the Director General of the Islamic Organization of Food Security (IOFS), accompanied by Mr. Abdula Manafi Mutualo, Advisor at Coordination & Cooperation Department, was received by His Excellency Mr. Mahbubul Alam, President of the Federation of Bangladesh Chambers of Commerce and Industry (FBCCI) on 21 August 2023 at their Secretariat to discuss the involvement of local private sector with food security business and issues through the important work of the International Islamic Food Processing Association (IFPA), an IOFS subsidiary. The highlight of the working visit of the IOFS delegation to FBCCI of was the signing of the Membership Agreement for the Bangladeshi entity to adhere to IFPA with immediate effect.

BANGLADESH VISIT ENDS WITH MEETINGS WITH MINISTERS OF FOOD AND AGRICULTURE

The final day of the visit to Bangladesh by His Excellency Prof. Yerlan Alimzhanuly Baidaulet, the Director General of the Islamic Organization of Food Security on, 22 August 2023, was marked with productive bilateral meetings with Honorable Ministers of Food, Mr. Sadhan Chandra Majumder and of Agriculture, Mr. Mohammad Abdur Razzaque, held at their respective offices in Dhaka. Separately, the IOFS Director General exchanged views and appreciated high quality of the important work by the Bangladesh Food Safety Authority (BFSA) when its Chairman, Md. Abdul Kayowm Sarker, welcomed him at their headquarters.

On the sidelines of the Training on Modern Rice production Technologies for IOFS Member States, the Director General confided with Dr. Md. Shahjahan Kabir, BRRI Director General (Grade-1), and Mr. Md. Momtaz Uddin, Director General of the Food Planning Monitoring Unit (FPMU) and Additional Secretary, Ministry of Food. Separately, the IOFS Director General was warmly received at the campus of the Islamic University of Technology by its Vice-Chancellor, Prof. Dr. M. Rafiul Islam. The IOFS Director General also had a bilateral meeting with the Director General of the Bangladesh Institute of Nuclear Agriculture (BINA) scientist and eminent plant breeder, Dr Mirza Mofazzal Islam.

IOFS ADVANCES AGRICULTURAL RESILIENCE IN AFGHANISTAN: PRODUCTIVE ENGAGEMENTS IN KABUL AND LOGAR

The Islamic Organization for Food Security continues to drive impactful change in Afghanistan's agricultural landscape. After the enlightening field visits to Herat and Western Afghanistan, the IOFS delegation continued its journey, participating in informative meetings and consultations in Kabul and Logar provinces.

IOFS HOLDS HIGH LEVEL MEETINGS IN PAKISTAN

The Director General IOFS, H.E Prof. Yerlan Alimzhanuly Baidaulet, accompanied by Prof. Dr. Zulfiqar Ali , Director of Programs and Projects Department of the Islamic Organization for Food Security (IOFS) visited Pakistan for a working visit and held a meeting with Mr Tabbasum Habib, Director General of the Special Investment Facilitation Council (SIFC), Prime Minister Secretariate Islamabad and his team. H.E. Prof. Yerlan A Baidaulet also held a meeting with Dr Akmal Hussain, Acting Minister for National Food Security and Research in Islamabad.

FIRST EVER EVENT ORGANIZED BY IOFS IN MOZAMBIQUE

Upon directives of His Excellency Prof. Yerlan Alimzhanuly Baidaulet, the Director General of the Islamic Organization of Food Security (IOFS), Mr. Abdula Manafi Mutualo, Advisor at Coordination & Cooperation Department, led the Organization's delegation to conduct Advanced Training on "Agronomic Methods on Cassava in Mozambique", on 28-29 August 2023 in Maputo, Republic of Mozambique, the first ever event convened by the IOFS in that Southern African country.

History was in fact made also because it is the first in-person cassava event within the mandate the IOFS has to implement relevant initiatives to advance to agenda of strategic commodities for Member States of the Organization of Islamic Cooperation (OIC). The IOFS counted with the close cooperation of the Ministry of Agriculture and Rural Development of Republic of Mozambique through the generous hosting of the event by the Agrarian Research Institute of Mozambique (IIAM).

The cassava capacity building that brought together about 25 participants across Mozambique with representatives of national research Institute, researchers and private sector working in cassava sub-sector counted with the special participation from the Islamic Development Bank (IsDB), which was represented by Momodou Ceesay, its Lead Community Driven Development and Rural Institution Specialist.

IOFS AND ISDB DISCUSS WITH MOZAMBICAN MINISTRY OF AGRICULTURE IMPROVEMENT OF CASSAVA PROGRAM IN THE COUNTRY

On 29 August 2023, on the sidelines of Advanced Training on "Agronomic Methods on Cassava in Mozambique", a tripartite meeting was held between the Ministry of Agriculture & Rural Development of the Republic of Mozambique (represented also by Agrarian Research Institute of Mozambique – IIAM) , the Islamic Organization for Food Security (IOFS), and the Islamic Development Bank (IsDB) to exchange views on how the local government would be supported to achieve sustainable food security through cassava value chain.

MOZAMBIQUE CHAMBER OF COMMERCE JOINES IFPA TO BOOST AGRI-FOOD BUSINESS AND INTRA-OIC TRADE

In a landmark move, on August 30, 2023 the Mozambique Chamber of Commerce has formally entered into a Membership Agreement with the International Islamic Food Processing Association (IFPA) , a prominent subsidiary of the Islamic Organization for Food Security (IOFS). This significant step not only welcomes Mozambique as the 23rd member of IFPA but also paves the way for transformative advancements in the nation's agri-food sector.

IOFS DELEGATION ADDRESSES CRITICAL FOOD SECURITY ISSUES AT INTERNATIONAL CONFERENCE IN CAPE TOWN

On 31 August 2023, the Islamic Organization for Food Security (IOFS) delegation, led by H.E. Director General Prof. Yerlan A. Baidaulet, took part in the One-Day International Conference themed "Food Security: Global, Continental, And Regional."The conference, hosted in Cape Town, Republic of South Africa, was organized by Awqaf SA and the International Peace College of South Africa (IPSA) in collaboration with the IOFS. The One-Day Food Security Conference gathered a diverse range of speakers from various sectors who shared their insights on the multifaceted aspects of food security. Engaging in panel discussions and Q&A sessions, these experts offered a comprehensive overview of the challenges and potential solutions in the realm of food security.

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