Global Food Security and the Governance of New Biotechnological Tools: A Challenge to People for People

Climate Change impact on OIC Strategic Commodities: Wheat, Rice and Cassava

Implementation of Satellite and Meteorological Modelling in Agriculture

Hunger as a Weapon: Food Security Crisis and Humanitarian Failure in Gaza Under Israeli Aggression

المنظمة الإسلامية للأمن الغذائي
Islamic Organization for Food Security
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CONTENT

Dear Esteemed Readers,

Assalamu' alaikum warakhmatullahi wabaraktuh!

Welcome to the 15th Edition of the Food Security Hub, a comprehensive compendium of research and insights dedicated to addressing the pressing issues surrounding food security within the Islamic world. Each contribution provides unique insights and actionable recommendations delving into the role of meteorological modelling for agriculture in the face of climate adversities, to the governance of new biotechnological tools for food security with international collaborative strategies to combat malnutrition, humanitarian and hunger crisis along the way.

This edition emphasizes the need to responsibly utilize and regulate state-of-the-art new plant biotechnological tools (NPBTs) for safeguarding crop diversity, addressing challenges related to climate change, population growth, hidden hunger, shrinking water resources, and hunger crisis. The biotechnological interventions have the potential to end hunger while also tackling the issue of micronutrient malnutrition. The strategic transformation of food systems is recommended to address these complexities with a sustainable and resilient approach for food production and utilization. The water crisis management could be scaled up by tailoring the water smart strategies for local conditions, and enhanced capacity building through targeted training and improved water stewardship. Monitoring and predicting the climate conditions for crop dynamics is inevitable nonetheless for sustainable food security.

Furthermore, over this new quarter, IOFS hosted and participated in various events in the Kingdom of Saudi Arabia, the Islamic Republic of Mauritania, the Islamic Republic of Pakistan, and the Kingdom of Morocco, promoting sustainable food security practices while addressing the pressing challenges of hunger crisis in Gaza. Soil erosion, salinity, and pollution pose significant challenges to agricultural productivity. This edition underscores the importance of sustainable agricultural practices like biofertilizers and uni-grow soil conditioner to mitigate soil degradation, enhanced nutrient uptake and to ensure food security. However, Pakistan's efforts to enhance wheat production and contribute to food security in the OIC geography are commendable. For collective benefit, IOFS conducted a Hands-on Training session on Wheat Breeding Technologies in Pakistan as a pivotal path to food security in various OIC Member States including Tunisia, Libya, Egypt, Iraq, Kazakhstan, Tajikistan, and Uzbekistan.

Last but not least, this edition also sheds light on the dire humanitarian crisis in Gaza exacerbated by Israeli aggression and political dynamics. Underscoring the urgent need for international attention and action to alleviate suffering and tackle underlying issues effectively, it is important to address the root causes beyond mere humanitarian food support.

We extend our gratitude to all the contributors for their invaluable research and insights, and hope that the articles presented in this edition will further stimulate dialogue, inspire innovative solutions, and contribute to the collective efforts towards achieving food security for all.

We also call on our Readers to join us in our mission to promote food security and support healthier communities worldwide.

Sincerely,

Prof. Dr. Zulfiqar Ali , Director of Programs and Projects Department

GLOBAL FOOD SECURITY AND THE GOVERNANCE OF NEW BIOTECHNOLOGICAL TOOLS: A CHALLENGE TO PEOPLE FOR PEOPLE


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Background

Food and nutrition security is one of the biggest challenges being faced by humanity on the earth. It is projected that the world population will rise to 8.55 billion and 9.74 billion people in 2030 and 2050, respectively. To feed this ever-increasing human population, it is estimated that the world needs to produce about 11.56 billion tonnes and 13.17 billion tonnes of food in 2030 and 2050, respectively, which would be 15-20% higher than what will be produced by then, with current pace (Figure 1) (Ahmad et al., 2021). Meanwhile, the projections of food demand show that cereals, roots, tubers, pulses, sugar, vegetables, and oilseed crops will be more demanding by 2030 (Figure 2). Several efforts have been made for food crop improvements to cope with these challenges for a long time, but the world is still lagging far behind the targets. In 2015, the United Nations (UN) showed a great sense of responsibility and set 17 Sustainable Development Goals (SDGs) with a dream of having a better world by 2030. Undoubtedly, all SDGs directly or indirectly revolve around global food and nutrition security. Nevertheless, the second SDG "Zero Hunger" is one of those 17 SDGs that particularly aims to make sure that every single human on the globe has enough food to survive and live a happy life, which also means no home for hunger on the earth (Ahmad et al., 2021). But unfortunately, according to the 17th annual Global Report on Food Crises 2023 published by the Food Security Information Network (FSIN) and Global Network Against Food Crises (GNAFS) recently in May 2023, nearly 258 million people – up from 193 million in 2021 – are still facing acute hunger and are living at the brink of death (FSIN and Crises, 2023). These statistics validate the FAO statement given in 2020 that the world would not be able to achieve food security if the same trends in food production continue. Recently, António Guterres, Secretary-General of the UN has again stated that the current trends show that the world is heading in the wrong direction (FSIN and Crises, 2023).

Factors Affecting Global Food Security

The world is facing a lot of challenges on the way to achieve global food security. The major drivers of global hunger and food insecurity include but are not limited to severe climate change (e.g., heat, water scarcity, etc.), natural disasters (e.g., COVID-19 pandemic, Locust outbreak, etc.), national and international conflicts (e.g., Russia-Ukraine war, civil wars etc.) and mass displacement, decrease in arable land, mounting poverty, soaring prices of fertilizers, seeds and machinery, developing discriminations and inequalities, inadequate access to latest technologies, poor education, and extensive underdevelopment. For example, the current

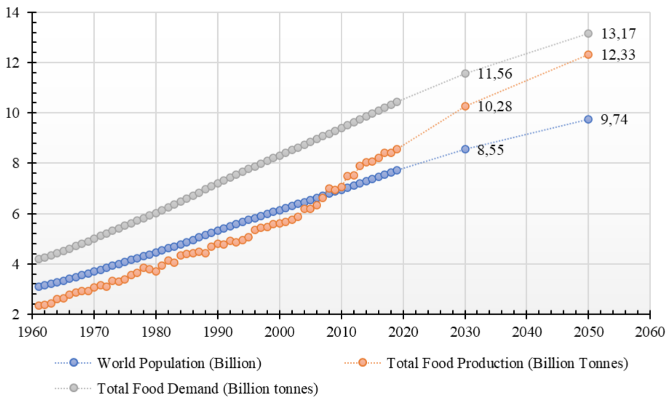

Figure 1: World population and crop-based world food production since 1961. Year-wise aggregate of cereals, roots and tubers, pulses and legumes, tree nuts, fruits and vegetables, sugar crops, and oil crops.

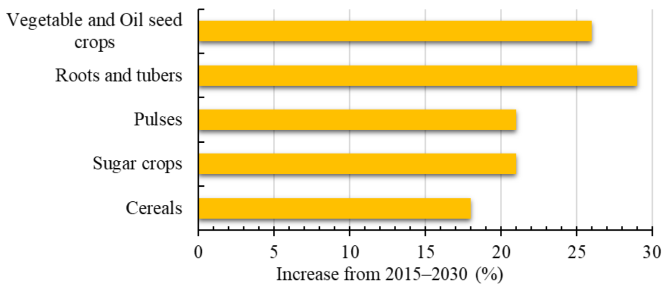

Figure 2: Projected change in the demand for food production between 2015 and 2030.

agriculture system is more prone towards changing climatic conditions such as rising temperature, drought and water scarcity, and pathogen and disease attacks (FSIN and Crises, 2023). According to temperature stats recently published by FAO in

May 2023, 1.4⁰C was the average annual temperature change in the world in 2022. However, it is predicted that the average global temperature will increase up to 3⁰C by the end of the 21st century, which is more alarming than ever, as it is reported that a 1⁰C increase in mean temperature could affect 6% to 7% grain yield of crop plants (FAO, 2023). Similarly, other abiotic and biotic stresses are also threatening and causing food insecurities by reducing crop yield. As recently it was reported by FAO on World Plant Health Day 2023 that pests and diseases are causing up to 40% yield losses in annual crop production. In recent times, Fall Armyworm attacks and desert locust outbreaks have damaged crop productivity and biodiversity significantly and remained a major concern of many crop protection organizations/departments of the world (Dwivedi, 2023). Hence, climate change and the challenges arising from it should be tackled promptly and efficiently to conserve our plant genetic resources (PGRs) for a food-secure world.

In addition to climate change and natural disasters, the world was not fully recovered yet after the shocks of the COVID-19 pandemic that the Russia-Ukraine war brought the world to another level of food shortage and crises (Abay et al., 2023). Because Ukraine and the Russian Federation contribute significantly to the production and trade of essential food commodities like wheat, barley, corn, and edible oil (especially, sunflower oil) to not only low and middle-income, microeconomies, and developing countries or territories but also the developed nations. About a quarter of the wheat supply is being made by Ukraine and Russia to the world. However, a significant hike in food prices that had never been seen by the world ever before was observed throughout the world after this conflict (FSIN and Crises, 2023). Moreover, the Russian invasion to Ukraine also impacted and hindered the efforts of researchers of Ukraine regarding the conservation of PGRs and biodiversity (Gallo-Cajiao et al., 2023).

Thus, under such circumstances, the global food security challenge demands not only the application of new plant breeding and biotechnological interventions for the conservation of PGRs (which are severely threatened by climate change and wars) and the development of new crop varieties that could withstand the global environmental issues but also fundamental, and systemic change in the world's diplomatic and science-loving policies.

Notable Ways to Achieve Global Food Security

Zero Hunger (food security), the Second Sustainability Development Goal set by the United Nations, is not impossible but to achieve this goal a significant contribution is required by the world. There are many factors and contributors that can play their pivotal role in global food security; however, crops' improvement, the development of new desirable varieties, and the conservation of crop diversity using state-of-the-art modern plant breeding and biotechnological tools could be the key players. Hence, this section highlights some ways in which food security can be achieved, worldwide.

PGRs Conservation

PGRs include newly developed crop varieties, cultivars, landraces, obsolete varieties and cultivars, and breeding and genetic material including wild plants, breeders' lines, elite lines, and mutant populations. These diverse resources are the front-line of agriculture, food, and nutrition, and vital resources for researchers and farmers to develop new desirable crop varieties for future generations (Salgotra and Chauhan, 2023). Therefore, their conservation should be given full attention by the world. In this regard, several techniques can be used, for example, gene banks, DNA banks, digital sequence information (DSI)/next generation sequencing (NGS), genetic engineering and gene editing, marker-assisted selection, tissue culture, cell culture, and cryopreservation are prominent (Qin et al., 2023; Salgotra and Chauhan, 2023). Every method has its pros and cons. Overall, recent biotechnological interventions such as gene editing and NGS can be powerful tools for preserving crop diversity by enabling the rapid development of crops that are more resistant to pests and diseases, reducing the need for chemical pesticides, and facilitating the propagation and storage of rare or endangered crop varieties.

Development of New Climate-resilient Crop Varieties

The development of climate-ready crop varieties are the need of the hour. In this regard, despite significant improvements made in crops using various plant breeding techniques starting from the selection of desirable plants to mutation and then transgenic breeding, the food production statistics are still lagging behind from the food demand (Figure 1). Hence, to fulfill the world food demand and to boost up the pace of development of new desirable and climate-smart crop varieties, utilization of new plant breeding technologies (NPBTs) such as gene editing, speed breeding, and Genomics-assisted plant breeding is needed. Among these, gene editing technology especially Nobel Prize winner CRISPR/Cas (Clustered Regularly Interspaced Short Palindromic Repeats/CRISPR-associated protein) technology has revolutionized not only agriculture but also the health and other departments of life sciences. It has significantly reduced the breeding period of food crops such as wheat, rice, and maize from 8-10 years to 4-6 years (Figure 3). It is one of the eminent technologies of the era that has generated many new and desirable transgene-free lines of various field, oil seed, vegetable, pulses, and legume crops. Nevertheless, the product developed through gene editing technology must go through the process of biosafety and regulatory processes in many countries in the world, which certainly limits or delays the full advantage of the technology (Ahmad et al., 2020). However, to benefit efficiently from new biotechnological tools, it is important that the world should have proper access to these technologies and should

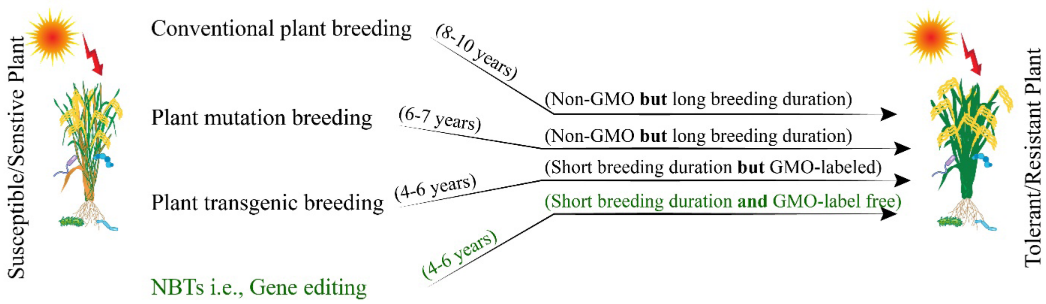

Figure 3: Development of climate-resilient crop (e.g., rice) varieties using different plant breeding tools. Figure modified from Ahmad et al. (2020).

resolve the regulatory issues, if any, as soon as possible. So the products developed through these technologies should be available in the markets for consumers.

Apart from these, harmony between the countries and territories, collaborations, and connections between the organizations/institutions/laboratories for knowledge sharing and technology transfer, implementation of best agricultural practices, and appropriate allocation of resources to develop innovative solutions can help the world to achieve SDG 2 goal: Zero Hunger.

Embrace the Power of New Biotechnological Tools to End Hunger

Safeguarding crop diversity and developing new crop varieties are our shared responsibilities to ensure a food and nutrition-secure world for future generations. In this regard, as discussed above, many old and new techniques and technologies are being used. Among all NPBTs, gene editing technology has been considered a robust, efficient, cost-effective, and promising technology for securing PGRs and generating new climate-smart resources for breeding new crop varieties. However, in various countries, genetically modified plants that have some fragment/s of foreign DNA are not legal for commercial cultivation (Figure 4). Similarly, whether gene-edited plants, especially via the CRISPR-Cas system (because it is one of the most popular systems so far among gene editing technology) should be considered as GMOs and pass through the GMO regulatory process or should not be labeled as GMO and pass on to the next level of field trials and commercialization straight away, is still a question and part of legislative discussions in many countries including European Union (EU). Besides, some countries have already finished or are near to finish their legislative framework and decided the fate of gene-edited crops. Positively, UK has recently joined the countries (i.e., Argentina, Australia, Brazil, Canada, Chile, China, Colombia, India, Israel, Japan, and USA) that have allowed GE tools for crops' improvements and exempted the CRISPR-edited plants from GMO's legislations because they possess mutations or genetic changes as similar as they can happen in conventional breeding or natural populations (Figure 4) (Caccamo, 2023; Schmidt et al., 2020). Additionally, regarding the biosafety concerns, the Ministry of Agriculture and Rural Affairs of China has also recently approved the safety of GE soybean and issued a certificate to the developers for the next five years starting from April 2023 (Mallapaty, 2022). Likewise, the UK has also recently allowed gene-edited wheat developed by the researchers of Rothamsted Research in the UK using CRISPR-based gene editing tool for field trials and commercialization, as the amount of acrylamide formed in gene-edited wheat was 45% less than the wild type (Raffan et al., 2023). However, such biosafety approvals should be granted to other food crops such as rice and maize varieties, and by other countries as well to achieve food security, globally. Positively, the European Parliament has also voted in the support of EU Commission's proposal on 7th February 2024 on new genomic techniques, released in July 2023, marking a big win for sustainable agriculture and food security in Europe. Similarly, the other countries in the world are also either working on the legislation or still preparing the proposal and having discussions about modern and precision breeding techniques i.e., the Kingdom of Saudi Arabia (KSA) has launched its National Biotechnology Strategy in 2024 under its Vision 2030, with a focus on achieving milestones in various fields of biotechnology e.g., agriculture and medicine. Under this strategy, besides product development, KSA will also be working on re-designing its biotech policies and regulatory aspects to facilitate the research and development of GMOs to ensure food security and PGR conservation not only in the kingdom but also in the region and the world. Hence, it is believed that the world can protect the PGRs and can also develop climate-resilient new crop varieties by judicious use of new biotechnological tools, which will help the researchers to fill the gap between food production and demand by 2030 and/or 2050.

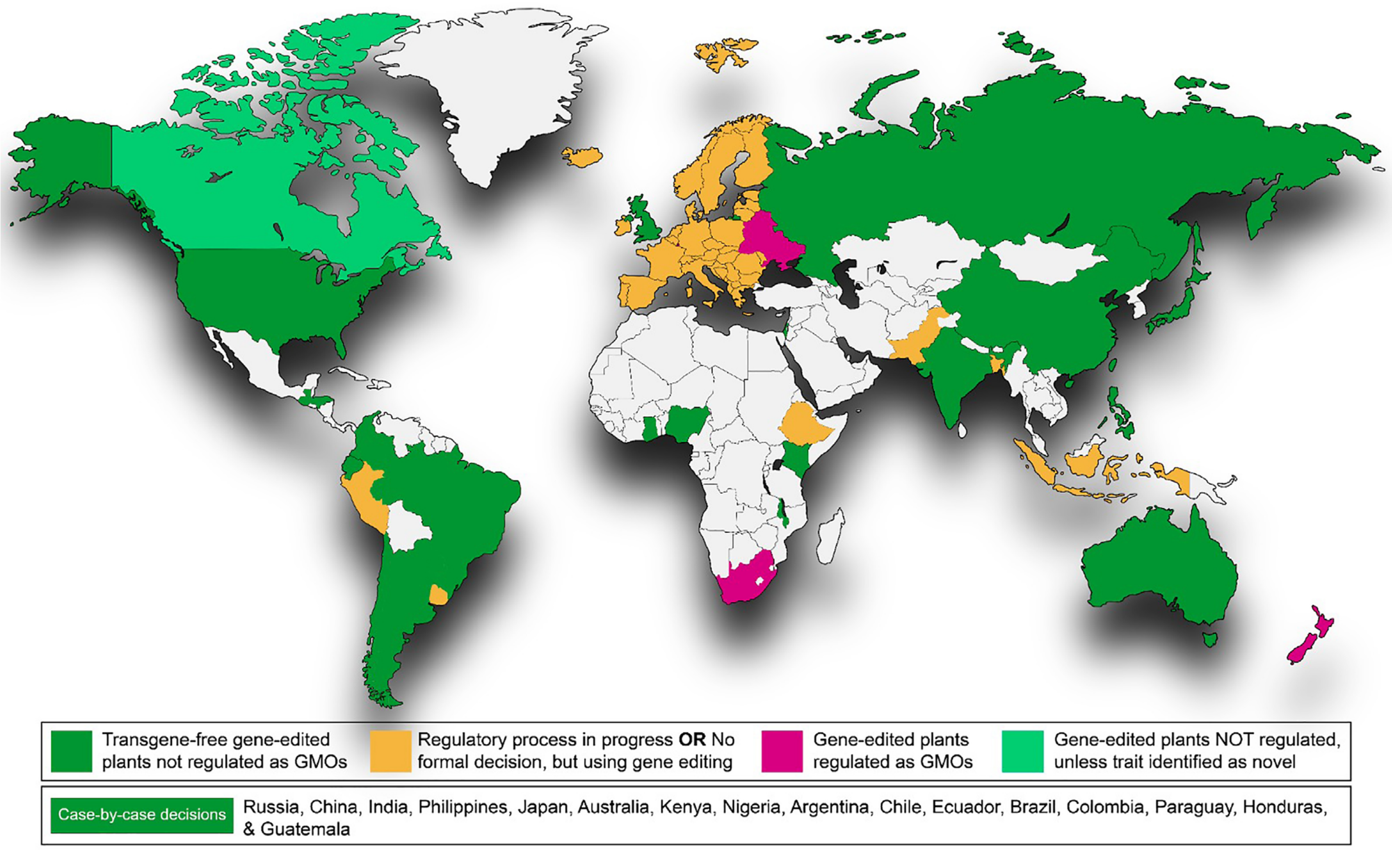

Figure 4: Global status of regulation of gene-edited plants.

Concluding remarks

Food and nutrition security are the key concerns in times of rapidly changing environmental conditions and political scenarios. Securing crops diversity and PGRs, cultivating the potential of crops' wild relatives, and improving the traits of cultivars using NPBTs such as gene editing, speed breeding, and Genomics-assisted breeding are important to achieve global food and nutrition security. As these technologies, especially gene editing technology, do not involve any foreign gene and are quite like natural breeding processes, their products should not be regulated as GMOs and should be approved for commercial cultivation through proper channels. Hence, NPBTs are robust and efficient so the world should embrace their power and utilize them rationally to get high production to meet the global food needs. Apart from biotechnological advancements, world peace, political and economic stabilities, cooperations and collaborations, and good governance are equally critical in building food secure world. Thus, with collective efforts and commitments to the Zero Hunger goal, we can ensure that every single person on the earth has access to the most basic of human needs: food and nutrition.

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EN SUMMARY

Climate change, growing human population, depleting resources, internal and external conflicts, and unstable economic and political situations are posing some serious threats to the conservation and utilization of crops diversity and plant genetic resources (PGRs) that are the main pillars of global food security. Now, safeguarding crops diversity, preserving the PGRs, and developing new high-yielding climate-smart crop varieties using state-of-the-art new plant biotechnological tools (NPBTs) are our collective responsibilities for our future generations. Hence, in this article, we have summarized the current statistics related to food production and demand, and then factors affecting the global food systems, and contributing to the food crises. Further, the role of new biotechnological tools in PGRs conservation and crop improvements has also been discussed. Furthermore, the global trend towards regulation of NPBTs has also been elaborated. Finally, it is concluded that a collective effort is needed to save biodiversity and ensure the food secure world for future generations.

FR RÉSUMÉ

Les changements climatiques, l'accroissement démographique, la raréfaction des ressources, les conflits internes et externes, ainsi que les contextes économiques et politiques volatils constituent des défis majeurs pour la préservation et l'exploitation de la diversité des cultures et des ressources phylogénétiques (RPG), qui sont essentielles à la sécurité alimentaire mondiale. Il est de notre responsabilité collective de protéger cette diversité, de conserver les RPG et de développer de nouvelles variétés de cultures adaptées au climat grâce à l'utilisation de nouvelles techniques de biotechnologie végétale (NPBT). Cet article résume les statistiques actuelles concernant la production et la demande alimentaires, explore les facteurs qui influencent les systèmes alimentaires mondiaux et contribuent aux crises alimentaires. Il aborde également le rôle des nouvelles biotechnologies dans la conservation des RPG et l'amélioration des cultures. En conclusion, un effort collectif est indispensable pour préserver la biodiversité et assurer la sécurité alimentaire pour les générations à venir.

AR ملخص

يشكل تغير المناخ، وتزايد عدد السكان، واستنزاف الموارد، والصراعات الداخلية والخارجية، والأوضاع الاقتصادية والسياسية غير المستقرة، بعض التهديدات الخطيرة لحفظ واستخدام تنوع المحاصيل والموارد الوراثية النباتية *(PGRs)* التي تشكل الركائز الأساسية للأمن الغذائي العالمي. في الحقيقة، أصبحت حماية تنوع المحاصيل، والحفاظ على الموارد الوراثية النباتية، وتطوير أصناف جديدة من المحاصيل الذكية مناخيًا عالية الإنتاجية باستخدام أحدث أدوات التكنولوجيا الحيوية النباتية الجديدة *(NPBTs)* مسؤولياتنا الجماعية تجاه أجيالنا القادمة. ومن هنا قمنا في هذا المقال بتلخيص الإحصائيات الحالية المتعلقة بإنتاج الغذاء والطلب عليه، ومن ثم العوامل المؤثرة على النظم الغذائية العالمية، والمساهمة في الأزمات الغذائية. علاوة على ذلك، تمت مناقشة دور أدوات التكنولوجيا الحيوية الجديدة في الحفاظ على الموارد الوراثية النباتية وتحسين المحاصيل. علاوة على ذلك، تم أيضًا توضيح الاتجاه العالمي نحو تنظيم *NPBTs*. وأخيراً، تم التوصل إلى أن هناك حاجة إلى جهد جماعي لإنقاذ التنوع البيولوجي وضمان عالم آمن غذائياً للأجيال القادمة.

ROLE OF BIOLOGICAL INTERVENTIONS IN ENHANCING THE NUTRIENT UPTAKE AND PRODUCTIVITY OF WHEAT

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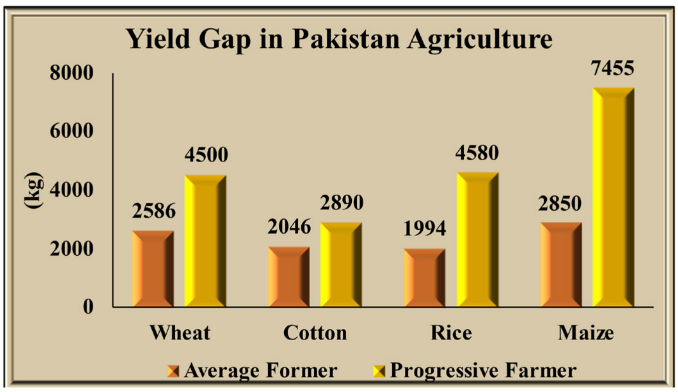
Pakistan faces multiple soil-related challenges that adversely affect its agricultural productivity and food security. Soil erosion, salinity, waterlogging, and pollution are some of the major problems caused by unsustainable land use practices, deforestation, overgrazing, industrialization, urbanization, and the use of chemical fertilizers and pesticides. These issues result in reduced fertility, crop production, soil degradation, and human health impacts. The lack of organic matter in the soil also contributes to low fertility and productivity. Proper management and sustainable agricultural practices are necessary to address these challenges and ensure food security and sustainable development in Pakistan.

Wheat (*Triticum aestivum L.*) is a major cereal crop and staple food in Pakistan, covering about 9.2 million hectares with a production of around 27.5 million tons during the 2021-2022 cropping season. It contributes 1.8% to the country's GDP and 9.2% value-added in agriculture. Despite its high productivity potential, wheat yield in Pakistan is below par due to poor crop management, lack of water resources, biotic and abiotic stresses, and the impact of climate change. Figure 1 showing the yield gap in different crops in Pakistan.



Enhancing crop nutrient availability with Fertilizer

Plants require 17 essential nutrients to grow and develop properly. While carbon, hydrogen, and oxygen come from water and the atmosphere, the soil and fertilizers provide the remaining 14 mineral nutrients. The three macronutrients needed in the largest quantities for crops such as wheat are nitrogen (N), phosphorus (P), and potassium (K), and they are typically the primary components of fertilizer applications.

The use of nitrogen fertilizers in agriculture can result in the loss of nitrogen through different pathways, including volatilization, denitrification, leaching, and runoff. This loss can lead to lower fertilizer use efficiency and reduce the availability of nitrogen for crop uptake. Managing nitrogen fertilizers carefully to minimize losses and maximize crop uptake is essential. While some fertilizers contain additives to reduce the loss of nitrogen, researchers are exploring new biologically derived sources of nitrogen that are less vulnerable to such losses.

Phosphorus is a vital macronutrient required by plants for their life cycle, but its availability in soil can be limited due to several reasons, including its binding to soil particles and reaction with other elements in the soil to form insoluble compounds. Soil pH can also affect its availability, with a pH between 6.0 and 7.5 being optimal for plant uptake. To increase phosphorus availability, farmers may need to apply phosphorus fertilizer and adjust soil pH. Developing affordable and eco-friendly farming technologies is essential to tackle these challenges and boost productivity.

Potassium (K) is an essential macronutrient for plant growth and development, but it is often tightly bound to soil particles, making it less available to crops when needed. While most soils contain sufficient amounts of K, applying K fertilizers may be necessary to ensure sufficient plant-available K is accessible when needed, similar to phosphorus (P).

To meet the crop's nutritional demands and maintain soil nutrient levels, N, P, and K fertilizers are typically applied at full rates each season. However, this can result in excess N or P accumulation in the soil, leading to unintended movement to water systems. To optimize fertilizer use efficiency, best management practices involve applying nutrients at the right rate, time, and place, striking a balance between maximizing nutrient use efficiency and enhancing crop productivity and profitability. While efficiency is crucial, it should not be pursued at the expense of fertilizer effectiveness in increasing crop yields.

New technologies known as biologicals, bio stimulants, or biocatalysts have emerged in recent years, claiming to enhance soil nutrient supply and improve fertilizer use efficiency. These technologies aim to shift the traditional fertilization approach from applying sufficient fertilizer to meet yield expectations to managing fertilizer applications to ensure the availability of applied nutrients as the crop requires them. Instead of applying all fertilizers at once, it is possible to manage nutrients to become available as the crop grows.

Biological nutrient use efficiency

Biological nutrient efficiency technologies refer to methods and techniques that increase nutrient uptake and use by crops while reducing environmental impact. Examples include biofertilizers/bioinoculants, biological nitrogen fixers and or phosphorus/potash/zinc solubilizers, crop rotation and intercropping, conservation agriculture, precision farming, and genetic engineering. With hundreds of individual products available, understanding the different categories and mechanisms of action is crucial to effectively utilizing these technologies.

Categories of biological / bio stimulant products

To face the current challenges of soil and plant growth yield requires the adoption of innovative agricultural practices based on organic or biological concepts for sustainable crop production. To achieve sustainable agriculture, new models, agricultural supplies, and biotechnologies must be incorporated to improve crop productivity. Plant biostimulants are an emerging alternative to conventional chemical plant nutrition approaches.

Biological products are types of agricultural inputs used to improve crop growth, yield, and overall soil health. Biological products consist of living organisms such as bacteria, fungi, and other microorganisms that promote plant growth and protect crops from pests and diseases. Biostimulant products, on the other hand, are non-living substances that enhance plant growth and nutrient uptake by stimulating the plant's natural processes.

Biological products can be used for a variety of purposes such as improving soil health, controlling pests and diseases, and enhancing nutrient availability. Examples of biological products include biopesticides, biofertilizers, and biostimulants.

Nutrient efficiency products/ biological products can be classified into various categories based on different criteria, such as their active ingredient, the nutrient they affect, their mechanism of action, and the method of application. Additionally, there may be other criteria used for categorizing these products, including their compatibility with other inputs, their cost-effectiveness, their target crop, and the stage of crop growth at which they are most effective.

Biofertilizers

Soil bio-activators are a type of biofertilizer that enhance soil microbial activity and suppress soil-borne pathogens, ultimately improving soil quality to support plant growth and development. Beneficial microorganisms such as bacteria and fungi inhabit the soil and promote plant growth by supplying nutrients, producing phytohormones, controlling plant pathogens, improving soil structure, accumulating inorganic compounds, and bioremediating metal-contaminated soils (Figure 2).

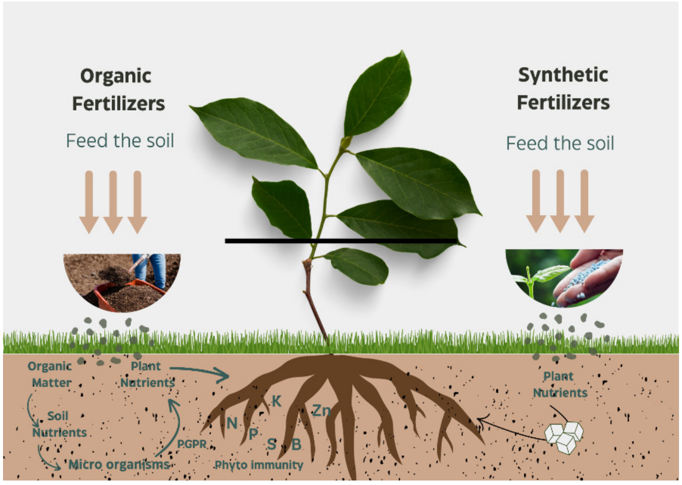


Figure 2 shows the mechanistic role of bioeffectors/biologicals in plant growth promotion and nutrient uptake.

To help farmers make informed decisions about microbial products like biofunkar, it's important to understand how they work and whether they're needed on their farm. There are many different types of microbial products on the market, but most of them can be classified into four main categories: (1) nitrogen-fixing bacteria such as *Rhizobium, Azotobacter, Azospirillum, Acetobacter, blue-green algae,* and *Azolla;* (2) phosphorus-solubilizing bacteria (PSB) like *Bacillus, Pseudomonas, Aspergillus, and vesicular arbuscular mycorrhiza (VAM);* (3) microbial soil conditioners that stimulate the rhizosphere and decompose residue; and (4) plant growth-promoting rhizobacteria (PGPR) like *Azotobacter, Azospirillum, Rhizobium (for non-legumes), Bacillus,* and *Pseudomonas*.

However, there is a significant opportunity to promote the adoption of biofertilizers in sustainable agricultural systems. At present, Pakistan is investing substantial funds (i.e., over 100 billion rupees) in the import and production of 8.41 million metric tons of chemical fertilizers. If biofertilizers could account for 10% of the total fertilizer usage, it could result in annual savings of up to 10 billion rupees in Pakistan.

The use of microbial biofertilizers in Pakistan's agriculture offers many benefits, including ease of use, low cost, and potential improvements to soil quality and crop growth, yield, and quality. Many research groups and organizations in Pakistan are currently working on developing and promoting the use of biofertilizers in agriculture. The effort of various research centers and higher learning institutes in promoting the use of biologicals to enhance crop yield and fertilizers use efficiency is well document.

Ayub Agricultural Research Institute (AARI) in Pakistan is a leading center for biological nitrogen fixation and biofertilizer research. They have developed bio-fertilizer products such as "Associative Diazotrophs" and "Fasloon ka jarasimi teeka" which can increase crop yields by up to 20% (as per claim). These inoculants are supplied to farmers in the province on a limited scale by the Soil Bacteriology Section at AARI. The institute has been conducting research since the 1920s.

National institute for biotechnology and genetic engineering (NIBGE) developed a biofertilizer called BioPower in 1992, which met 40-70% of crop plants' nitrogen requirements and resulted in a 60-80% improvement in crop yield. The technology was transferred to public and private business entrepreneurs for production, and NIBGE has a pilot production unit to upscale production to meet future demand. However, inconsistency in field results led the team to reduce the Biofertilizer Division to a small section of the Plant Microbiology Division.

The Soil Biology and Biochemistry Division in NARC developed "Biozote," a biofertilizer product in 1990, that resulted in a 20-50% increase in legume crop yield and has a benefit-cost ratio of 30:1. If applied to 50% of the legume area, the technology could add Rs. 4.0 billion to the national economy through increased production. The center has a pilot production unit called "Legume Inoculum Production Unit (LIPU)" and provides approximately 3,000 culture bags annually to the farming community for inoculating legume and cereal crops.

The Institute of Soil and Environmental Sciences at the University of Agriculture, Faisalabad focuses on soil microbiology and biochemistry research and has developed various biofertilizers containing beneficial bacteria and microbial formulations that have shown promising results in improving crop yields. They have extensively studied the effectiveness of different PGPR and found that those containing ACC-deaminase lower plant ethylene, making them more resistant to environmental stresses. The institute has created biofertilizers utilizing ACC-deaminase biotechnology that have proven effective even in stressful conditions. Additionally, they have produced "Rhizogold" and "RhizogoldPlus" formulations that increase legume productivity and minimize the negative impact of salinity stress on cereals. These products are currently under extensive evaluation at farmer's fields.

The Soil and Environmental Microbiology Lab at the Institute of Soil and Environmental Sciences, University of Agriculture Faisalabad is playing an important role in resolving issues related to Pakistani soils like, low organic matter, less soil water and fertilizer use efficiency, salinity, drought and waterlogging and severity in climate change. These include subsurface soil compaction, low availability of water and nutrient uptake, low organic matter, poor soil health, salinity/drought/waterlogging, and soil degradation. To address these issues, the lab has launched various types of biofertilizers to help farmers. Results have shown a positive response from farmers, with improved growth and yield of crops.

"The waste decomposer" (a consortium of Bacillus and Pseudomonas spp.) with following benefits in terms of better crop yield and soil health.

- enhances NPK fertilizers uptake
- enhances immunity against diseases
- improves soil structure
- improves soil environment for microbial activity
- improve seed germination
- enhance crop yield

"Uni-Grow Soil Conditioner" a soil freshener having low pH. It increases

- Water use efficiency
- fertilizer use efficiency
- Defense system in plant against diseases/insect attack
- Accelerates aeration in soil
- Breaks subsoil hard pan
- Improves drainage
- Improves crop yield

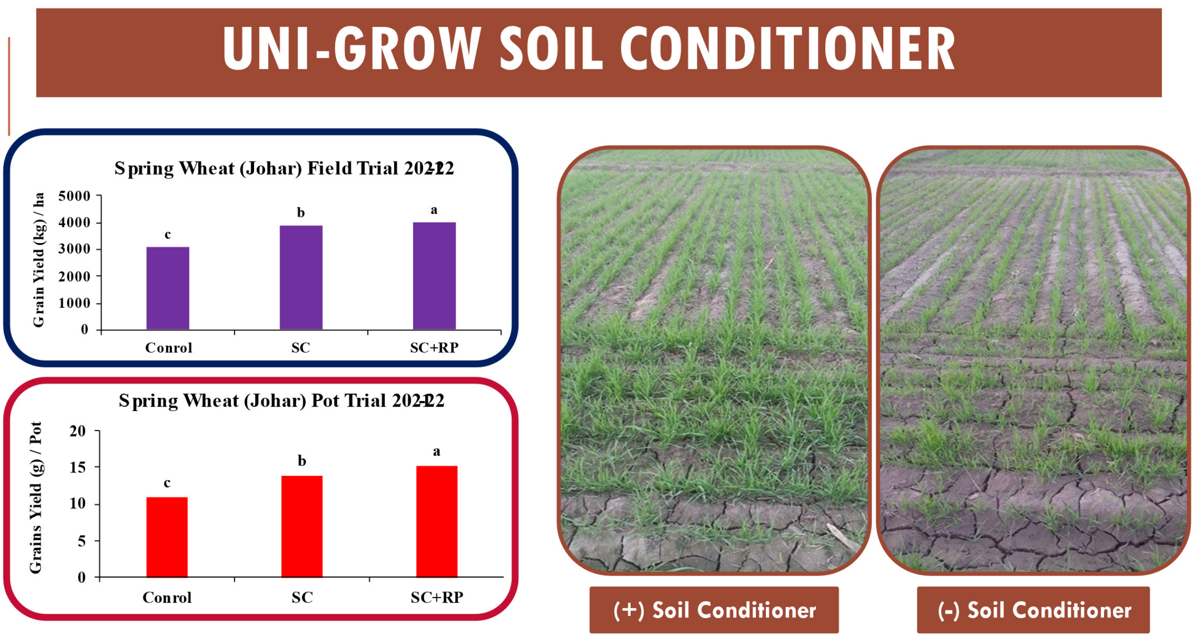


Figure 3 shows the response of Uni-grow soil conditioner on seed germination and grain yield of wheat.

Biologically augmented rock phosphate with phosphorus solubilizing bacteria (PSB)

Composting is a useful method for recycling organic waste and producing manure for crop cultivation, while also enhancing soil quality. Composts provide a rich source of nutrients, including nitrogen and phosphorus, as well as organic substrates, which can improve the physical, chemical, and biological properties of the soil. Organic acids released during composting can dissolve the rock phosphate, making it more available to plants. By adding rock phosphate to compost, it can increase the nutrient content of the resulting manure, reducing the need for chemical fertilizers and improving soil health. The use of compost enriched with rock phosphate can be a sustainable and eco-friendly solution to boost plant growth and fertility (Figure 4).

Composting rock phosphate with organic materials can be a feasible alternative to enrich manures with phosphorus, as it can produce organic acids that contribute to the dissolution of phosphorus during the decomposition process. This method is particularly promising in Pakistan, where soils are deficient in phosphorus, and phosphatic fertilizers are costly. Additionally, Pakistan has significant reserves of rock phosphate, and composting can improve crop growth.

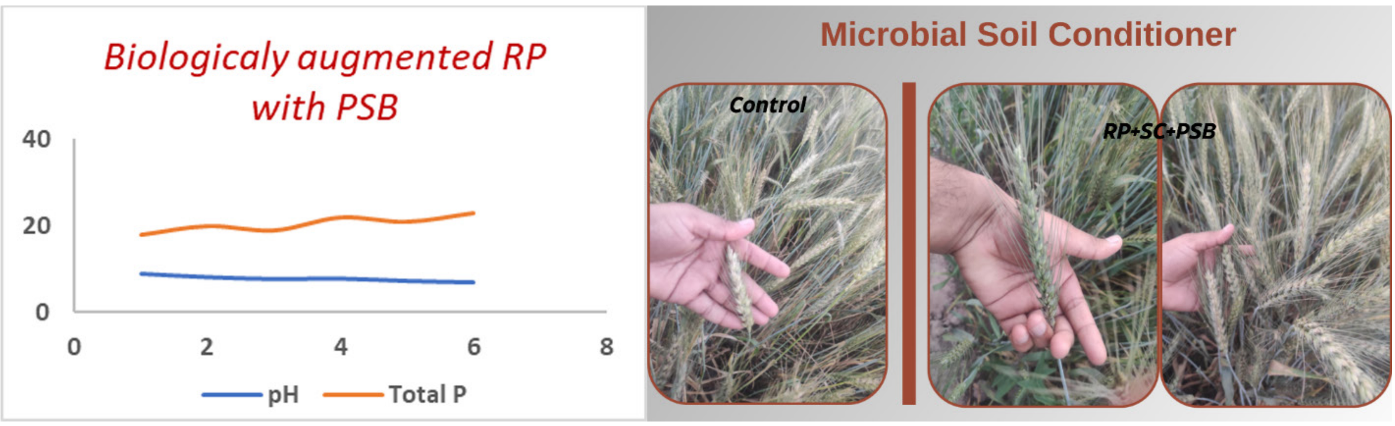


Figure 4. Effect of biologically augmented rock phosphate with P solubilizer bacteria on P release pattern and wheat growth.

Wheat production in Pakistan

The 2023/24 wheat crop yields are anticipated to increase, and overall production is expected to rise, owing to favorable weather and improved irrigation water availability. The previous year's floods raised concerns about a significant decrease in the planted area for 2023/24, as farmers faced challenges in preparing their land due to the unavailability of seeds and the lingering floodwaters, especially in Sindh.

Cumulative fertilizer nutrient offtake during the 2022/23 winter planting season (October-January) was 4.6 percent lower compared to last year. Phosphate and potash use decreased 25.5 and 69.9 percent, respectively, while nitrogen offtake was 3.9 percent higher.

The federal and Punjab provincial governments increased the wheat support price for the 2023/24 crop to Rs. 3,900 per 40 kilograms ($346 per metric ton), while Sindh government set the price at Rs. 4,000 per 40 kilograms ($354 per metric tons). Last year there was a uniform support price of Rs. 1,950 per 40 kilograms ($290 per metric ton).

Wheat production area by province is shown in Table 1.

Province	Area (Million Hectares)	Percentage of Total Area
Punjab	6.47	73
Sindh	1.19	13
KPK	0.78	8
Baluchistan	0.42	4
Total	8.86	100

The plant growth and yield are stagnant day by day because of low organic matter, deterioration of soil health and several environmental issues in Pakistan. Biological strategies such as crop rotation, cover cropping, biofertilizers, microbial composting and PGPRs can enhance soil health and reduce the need for synthetic fertilizers. These approaches support the natural microbial communities in the soil, promote nutrient cycling, and improve soil structure, resulting in better growing conditions for crops, consequently ensuring food security in the country.

EN SUMMARY

Pakistan faces multiple soil-related challenges that adversely affect its agricultural productivity and food security. Soil erosion, salinity, waterlogging, and pollution are some of the major problems caused by unsustainable land use practices, deforestation, overgrazing, industrialization, urbanization, and the use of chemical fertilizers and pesticides. These issues result in reduced fertility, crop production, soil degradation, and human health impacts. The lack of organic matter in the soil also contributes to low fertility and productivity. Proper management and sustainable agricultural practices are necessary to address these challenges and ensure food security and sustainable development in Pakistan.

FR RÉSUMÉ

Le Pakistan fait face à divers défis du sol qui compromettent sa productivité agricole et sa sécurité alimentaire. L'érosion, la salinité, l'engorgement par l'eau et la pollution du sol sont quelques-unes des principales difficultés résultant de pratiques d'utilisation des terres non durables, telles que la déforestation, le surpâturage, l'industrialisation, l'urbanisation ainsi que l'emploi d'engrais chimiques et de pesticides. Ces problématiques contribuent à une baisse de la fertilité des sols, à la réduction des rendements agricoles, à la dégradation des terres et à des effets néfastes sur la santé humaine. En outre, l'insuffisance de matière organique dans le sol diminue également la fertilité et la productivité. Il est donc impératif d'adopter une gestion adéquate et des pratiques agricoles durables pour surmonter ces obstacles et assurer la sécurité alimentaire ainsi que le développement durable au Pakistan.

AR ملخص

تواجه باكستان العديد من التحديات المتعلقة بالتربة والتي تؤثر سلباً على إنتاجيتها الزراعية وأمنها الغذائي. يعد تآكل التربة، والملوحة، والتشبع بالمياه، والتلوث من بين المشاكل الرئيسية الناجمة عن ممارسات استخدام الأراضي غير المستدامة، وإزالة الغابات، والرعي الجائر، والتصنيع، والتحضر، واستخدام الأسمدة الكيماوية والمبيدات الحشرية. وتؤدي هذه المشكلات إلى انخفاض الخصوبة وإنتاج المحاصيل وتدهور التربة وتأثيرات على صحة الإنسان. كما يساهم نقص المواد العضوية في التربة في انخفاض الخصوبة والإنتاجية. وتعد الإدارة السليمة والممارسات الزراعية المستدامة ضرورية لمواجهة هذه التحديات وضمان الأمن الغذائي والتنمية المستدامة في باكستان.

CLIMATE CHANGE IMPACT ON OIC STRATEGIC COMMODITIES: WHEAT, RICE AND CASSAVA

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Introduction

Climate change is a very important and immediate problem that affects the whole world. It's changing our planet and the basic things we need to live. Agriculture, or farming, is greatly affected by this change. The way ecosystems, plants, and how people make a living from farming are facing new and big challenges. The problems become even bigger when you think about conflicts between countries, like the war between Russia and Ukraine. These conflicts make it harder to ensure that everyone has enough food. The effect of climate change on important crops like wheat, rice, and cassava becomes a key focus. These crops are crucial in making sure people around the world have enough to eat.

The Organization of Islamic Cooperation (OIC), a collective of nations bound by shared values and challenges, finds itself at the forefront of this transformative period. The strategic commodities that have sustained these nations for centuries are now under the shadow of climate change and climate variability presenting not just an environmental hurdle but a complex nexus of economic, social, and geopolitical implications. We navigate through the nuanced vulnerabilities of Wheat, Rice, and Cassava, unravelling the intricate tapestry of how these commodities stand at the crossroads of global climate shifts. As we explore the scientific projections, socio-economic implications, and potential interferences in the agricultural landscape, one entity emerges as a beacon of hope – the Islamic Organization for Food Security (IOFS).

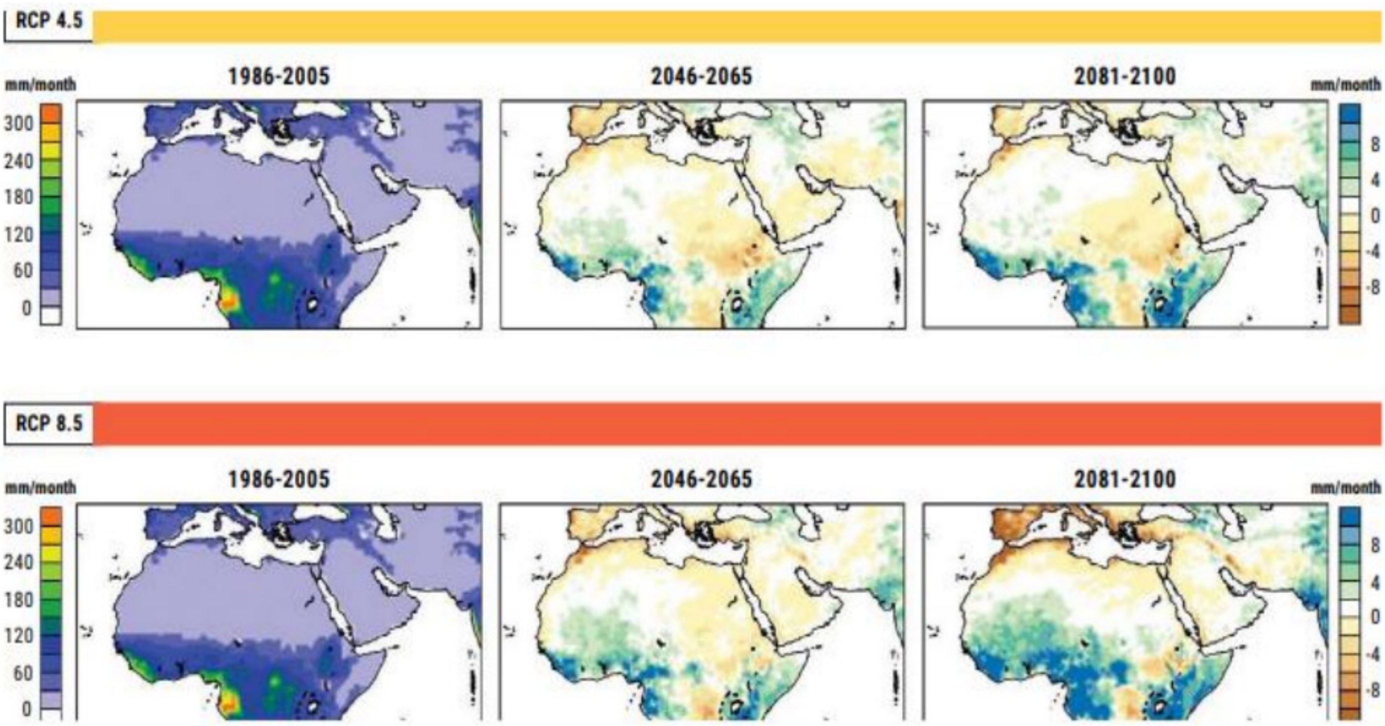

Figure 1. Average change in annual precipitation (mm/month) for RCP 4.5 and RCP 8.5, ESCWA et al. 2017

In the face of such challenges, IOFS stands as a testament to collective resilience and proactive adaptation to develop climate resilient ecosystem and society. Established with the explicit mandate to enhance food security and foster agricultural cooperation among OIC member countries. Drought conditions will prevail in future under both RCPs till end of this century that is threat for food security in this region. Through collaborative initiatives, adaptive strategies, and international partnerships, IOFS not only addresses the imminent threats of climate change but lays the groundwork for a sustainable, climate-resilient future.

Understanding the Agricultural Landscape in OIC member countries

Agriculture, commanding a substantial 40% of the OIC land and voraciously consuming an alarming 70% of available water resources, emerges as the cornerstone of human survival. This vast sector, however, finds itself entangled in the complex web of climate change, where disruptions transcend mere environmental concerns, reaching deep into the socio-economic fabric of nations.

The far-reaching impact of climate change manifests through a myriad of alterations in established patterns. Shifts in precipitation regimes and unpredictable temperature fluctuations pose significant challenges, not only to the immediate productivity of crops but also to the overarching economic dynamics of countries heavily dependent on agriculture. The intricate balance that sustains global food systems becomes increasingly precarious under the influence of these climatic shifts and climate variability.

At the heart of this challenge lies the complex interplay between climate change and food security, a relationship that knows no borders. Over 2.5 billion people in developing countries, a substantial portion of which comprises OIC nations and more than 3.1 billion people - or 42% of the world's population did not have the means to eat healthily, an overall increase of 134 million compared to 2019, and 148 million children (five years old) continue to suffer from malnutrition and 37 million (5.6%) were overweight. This vast demographic not only engages in agricultural activities for sustenance but also contributes significantly to the global agricultural supply chain. The consequences of this interdependence are further magnified by the reliance on the export of key commodities, transforming climate change from a regional concern to a pervasive global threat to food security.

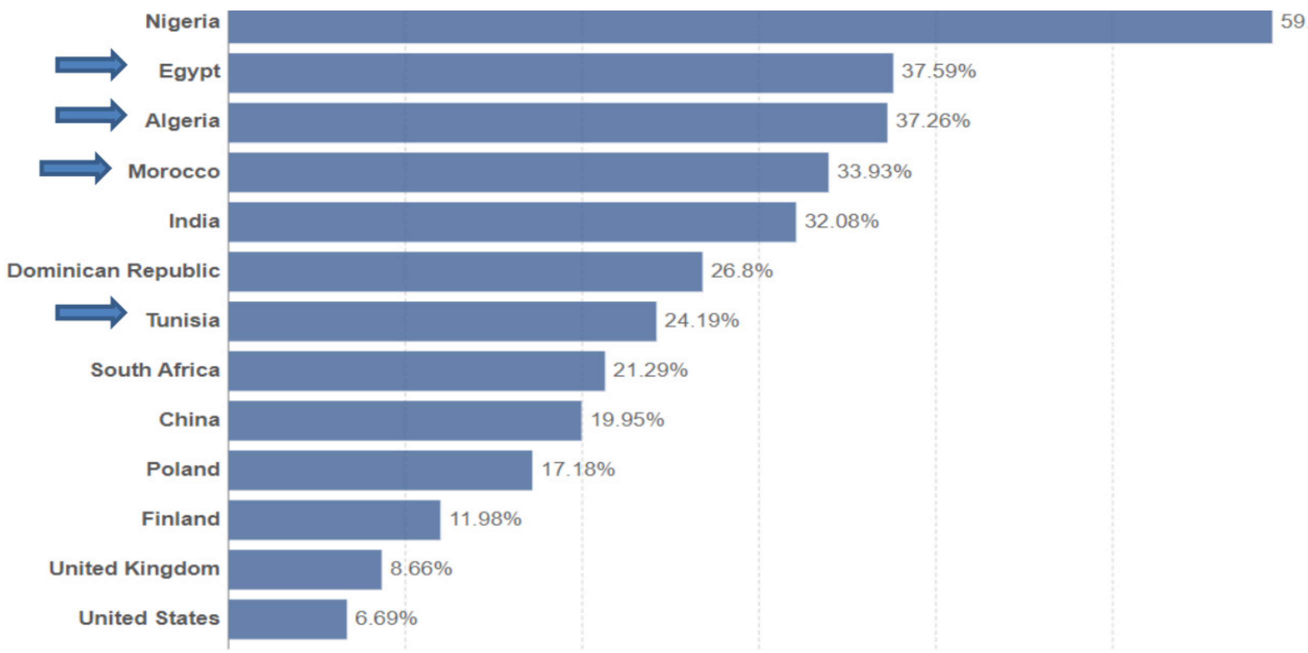

Figure 2. Share of consumer expenditure spent on food (FAO, 2021)
Food expenditure only includes food consumed at home, and does not include alcoholic or Tobacco

To really get the big picture of this worldwide problem, we need to look closely at how countries are dealing with the complicated relationship between climate change and farming. These countries rely a lot on selling goods to other countries, which makes them vulnerable to the changing prices and demands in the world market. This can make their money situation very unstable. For countries in the OIC (Organization of Islamic Cooperation), their money often depends a lot on certain important crops like wheat, rice, and cassava.

Data reveals the magnitude of this vulnerability. A substantial portion of OIC member countries heavily relies on agricultural exports, with key commodities serving as economic cornerstones. For instance, in MENA region, wheat and rice play pivotal roles not only in ensuring food security but also in contributing significantly to foreign exchange earnings. The intricate web of global agricultural trade, however, becomes a double-edged sword in the face of climate change. While these nations contribute substantially to the global food supply, they are simultaneously exposed to the volatility induced by climatic shifts.

The interconnection of climate change, agriculture, and global markets underscores the need for a comprehensive and collaborative approach to address this multifaceted challenge. The repercussions of a disrupted agricultural landscape extend beyond immediate food shortages, encompassing broader socio-economic implications. As the world grapples with the complexities of climate change, finding sustainable solutions that safeguard not only crop productivity but also the livelihoods of millions becomes an imperative shared by nations across the globe.

OIC Strategic Commodities: Vulnerabilities and Challenges

Wheat: The Staple Grain Under Threat

Wheat, serving as a dietary staple for millions, confronts escalating challenges in the Islamic region due to the impacts of climate change. Scientific projections suggest an impending decrease in wheat productivity, attributed to the shifting temperature norms and altered precipitation patterns. This ominous trend not only poses a threat to sustainable wheat production but also has broader implications for the economies of OIC nations heavily reliant on wheat exports. The potential reduction in wheat yields not only strains these nations economically due to fluctuating global demand but also poses a critical threat to their foreign exchange earnings. As climate change continues, the implications for the agricultural landscape in the Islamic region are increasingly pressing, necessitating proactive measures to ensure food security and economic resilience.

Previous studies from around the world have thoroughly investigated how changes in climate affect the production of wheat crops. Most studies focusing on the Islamic region have primarily examined the interplay between climate change and wheat production at national and regional levels. Some research has explored into specific regions, recognized for its highest wheat yield. However, the impacts of climate change on food production exhibit variability across regions with diverse climate conditions. Studies evaluate the enduring consequences of climate change on wheat production in the top three provinces of the northern Islamic region and aim to comprehensively analyse the heterogeneous influence of changing climate on wheat production, propose targeted measures for adapting to climate change in the primary grain-producing areas of the Islamic region, and contribute to enhancing food security strategies. Refer to the Figure below for a visual representation of the dynamic interconnections between climatic factors, other determinants, and wheat production in the region.

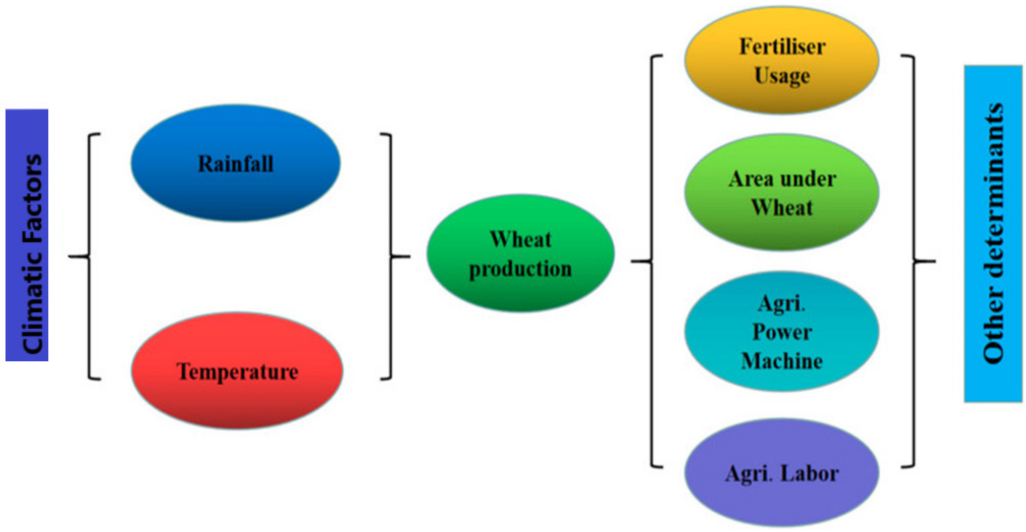

Figure 3. Dynamic nexus between climatic factors, other determinants, and wheat production (Huaquan et al., 2022).

Visible changes in temperature and rainfall, both at a global and regional scale, have been recognized as a climate change phenomenon within the Islamic region. These changes, characterized by shifts in both the amount and timing of occurrences, have exerted diverse impacts on agricultural inputs and production, particularly affecting the Islamic region's ecological systems.

In the Islamic region, the rise in gases like CO_2 (carbon dioxide), CH_4 (methane), and N_2O (nitrous oxide) is the main reason behind the greenhouse effect, which is majorly caused by human actions. These gases are crucial because they trap solar energy, affecting the region's climate.

To delve deeper, greenhouse gases (GHGs) come from various human-induced sources across different sectors, including energy, transportation, and agriculture. In energy, burning fossil fuels for electricity and heat is a significant source of CO_2. In transportation, vehicles emit CO_2 and other GHGs, contributing to the overall emissions.

Agriculture is a noteworthy sector, especially in the context of this discussion. It releases various greenhouse gases like methane from livestock and rice paddies and nitrous oxide from fertilizer usage. In the Islamic region, agricultural practices, including the cultivation of staple crops and livestock farming, emit these gases, impacting the climate.

While certain areas within the Islamic region, particularly those above 55° northern latitude, may experience positive effects on agricultural production due to climate change, there is a heightened concern for severe negative impacts in hot and dry areas. Developing countries within the Islamic region are anticipated to face more pronounced rises in temperature and reduced rainfall, accentuating the vulnerability of these regions. Particularly the frequency and intensity of extremes climatic events has increased in these regions due to climate change as reported by 6th Assessment report of IPCC in 2023. In the Islamic region, the frequency and intensity of rare climatic phenomena, including drought, heatwaves, cold spells, and floods, are expected to escalate. Developing countries in the Islamic region will likely bear the effect of these changes, posing significant challenges to agricultural production systems.

Even though many of the world's most arid and semiarid areas are situated in developing Islamic countries, there is a notable scarcity of research and scientific studies addressing the impacts of climate change in these regions. This knowledge gap calls for increased attention to understand and mitigate the specific challenges faced.

Studies conducted in NENA, a significant part of the Islamic region, confirm the occurrence of climate change. Notably, predictions for NENA region indicate a reduction in wheat yield by an average of 14% to 21%, highlighting the urgency for tailored strategies to safeguard agricultural production in the face of changing climatic conditions. As we look at the available data, the trends align with these predictions, emphasizing the pressing need for adaptive measures.

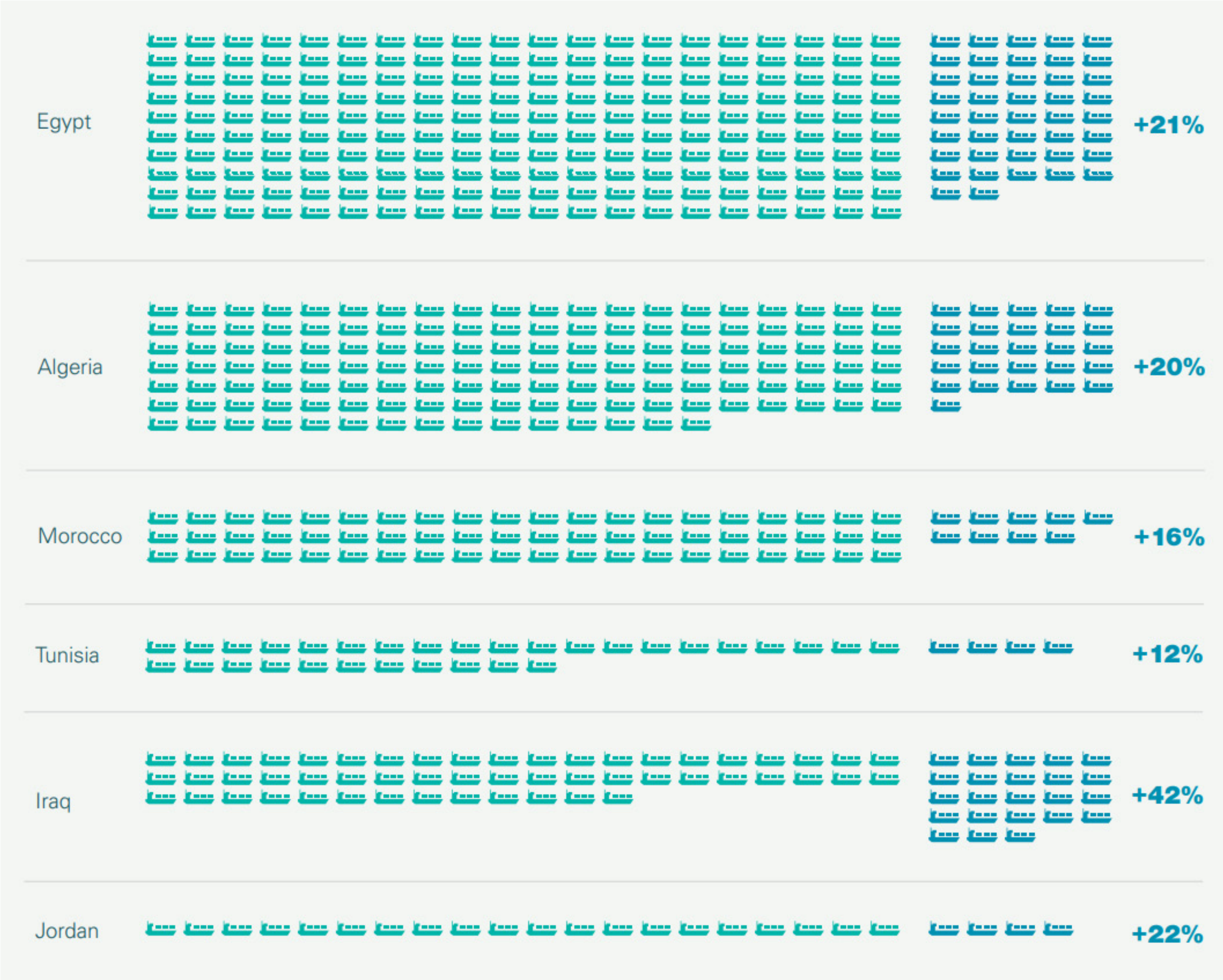

Figure 4. Country Panamaxes currently required Additional number of panamaxes needed to supply wheat.

This figure shows how many Panamax-sized ships would be needed to deliver wheat imports to each country now and in 2030. Each ship represents a Panamax-sized vessel carrying 55,000 tonnes of wheat, and the numbers shown are estimated from reported import volumes not the actual number of ships arriving. Demand in 2030 is calculated based on populations growing at UN-estimated rates, and each country's food import dependency remaining at current levels.

Rice: A Precarious Future

The Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC_AR5) underscores a global increase in the average surface temperature by approximately 0.85°C from 1880 to 2012, with continuous upward trends over the past decade. Recognizing the implications of climate change on global food production, particularly the potential risks to future crop yields, is crucial. Within the Islamic region, where rice serves as the main ration crop for over 65% of the population, understanding the impact of climate change on rice production is dominant.

The Islamic region, being a significant global player in rice production, faces a critical challenge in maintaining high rice yields to ensure food security for a substantial portion of its population. The region's sensitivity to global climate change is underscored by a 1.6°C increase in the annual average surface temperature from 1951 to 2017, exceeding the global average. The Islamic region has also experienced more frequent extreme weather phenomena, heightening concerns about the potential impact of global warming on rice production.

Recent data from the Islamic region further highlight the urgency of addressing climate change impacts. Observations indicate not only a rise in average surface temperature but also an increase in the frequency of extreme weather events. These events, including high and low-temperature extremes, pose direct threats to rice production systems in the Islamic region. As it is projected from future climate change scenarios that precipitation frequency and intensity will also reduced in many these regions; low irrigation water will also be among main challenges for rice sustainable production other than GHGs contribution like CH4 emission from paddy field (current traditional production technologies).

Rice, serving as a dietary cornerstone in many OIC countries, is susceptible to the changing climate, particularly in regions where it serves as a primary food source. The intricate water management systems crucial for rice cultivation face disruption due to altered precipitation patterns. This not only threatens food security but also jeopardizes the socio-economic stability of nations heavily reliant on rice exports.

The vast and diverse rice-growing regions in the Islamic region, ranging from plateaus to coastal deltas, exhibit significant temporal and spatial differences in the impact of climate warming on rice production. Various rice-growing patterns and systems, such as dual cropping rice, medium-cultivation rice, and single cropping rice, further contribute to the complexity of the situation.

While global studies have clarified the response characteristics of food production to climate warming, the focus on the Islamic region's specific conditions remains limited. Most existing research relies on model analysis and historical data mining, contributing to uncertainties about the impact of climate change on specific countries and seasonal crops. Recent experimental research and long-term field observations on the response and adaptation of crop growth to climate warming offer valuable empirical data for comprehensive analysis. In recent past the state of the art technologies being implemented like modelling, GHGs emission, big data, and sensing technologies for reliable and accurate findings related to climate change. But still the current rice production systems are vulnerable and crucial adaptation and imitation strategies are required to develop climate resilient agriculture and agro ecosystems for food security.

Cassava: Resilience Amidst Uncertainty

Cassava, a key source of carbohydrates in many OIC countries, exhibits a degree of resilience to climate change. Scientific insights reveal that while cassava shows adaptability to shifting conditions, alterations in precipitation patterns and an increased frequency of extreme weather events pose substantial challenges. Given the crucial role of cassava in ensuring food security, adaptive strategies and sustainable practices are imperative.

In regions with a significant Islamic presence, such as parts of Africa and Southeast Asia, cassava production plays a crucial role in ensuring food security and contributing to economic development. While the global cassava production in 1961 amounted to 78.5 million tons, with Africa contributing around 44%, by 2017, the worldwide production had surged to 322 million tons. Despite Africa's substantial share, accounting for over 58% of cassava production and more than 75% of cultivated land, the average fresh root yield per hectare in the region is 8.9 tons, significantly lower than the global average of 11.9 tons per hectare and the Asian average of 13.3 tons per hectare.

Major cassava-producing countries with Islamic populations include Nigeria, the Democratic Republic of the Congo and Indonesia. In smallholder farmer conditions, fresh root yields are estimated to range from 1 to 10 tons per hectare. However, with the adoption of high-yielding cultivars and improved crop management practices, yields can potentially reach 75–80 tons per hectare.

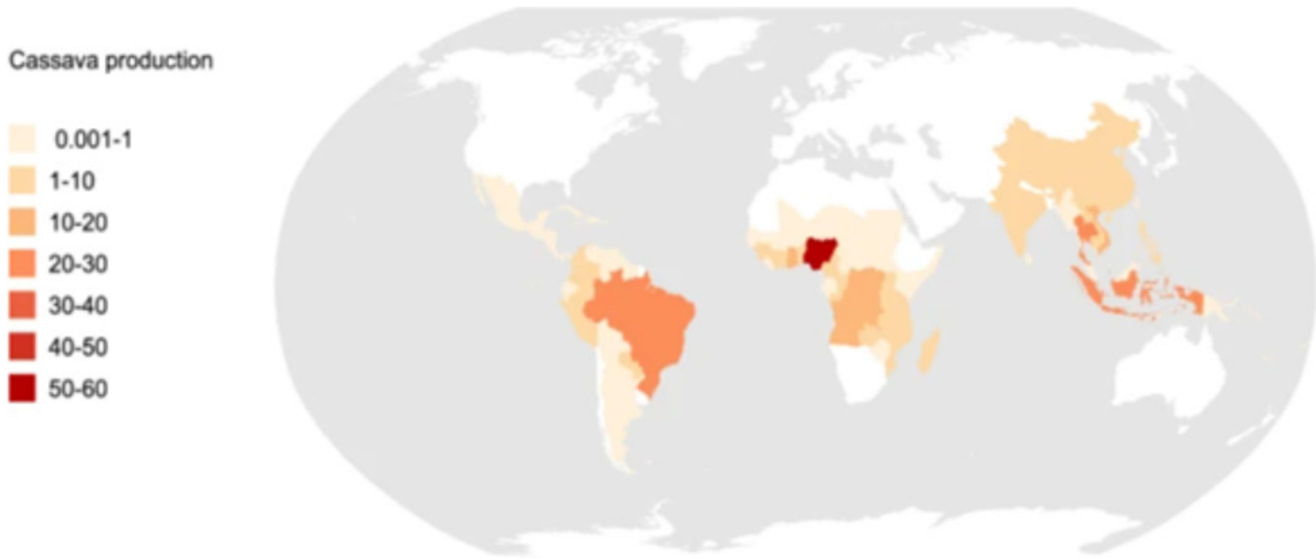

Figure 5. Cassava production statistics by country (Mt/year), based on data from FAOSTAT

Over the past six decades, cassava production has experienced consistent growth, with the most significant increases observed in Africa and Asia, especially from 1996 to 2017. This growth is attributed in part to the expansion of the harvested area in Africa as farmers recognize the economic significance of the crop. Additionally, substantial yield gains in Asia resulted from the adoption of new improved cultivars and enhanced agronomic practices.

The growth in cassava production is expected to continue in Islamic regions, driven by the crop's resilience to drought and its ability to yield well on marginal and low-fertility soils. Many countries within these regions recognize the economic potential of cassava as a versatile crop for food, feed, and industrial purposes. In Africa, the demand is primarily food-driven, while in Asia, the industrial applications for starch, livestock feed, and biofuel production contribute to the increasing demand for cassava. This aligns with the economic and agricultural needs of diverse communities within Islamic regions, emphasizing the role of cassava in sustainable agriculture and economic development.

Based on the individual farmer's agricultural objectives, climate adaptation practices can serve economic and/or non-economic purposes. According to the random utility theory, an economic agent will opt for climate change adaptation methods based on the values associated with qualities and alternatives that offer higher utility. In the context of cassava farming, a rational farmer is expected to choose a set of adaptation strategies with lower costs and greater productivity potentials, aiming to maximize the economic gains from adapting to climate change, even if these activities have adverse environmental effects. When deciding on adaptation, it would be impractical for a smallholder farmer to prioritize soil preservation and fertility enhancement over the objective of profit maximization. However, if a farmer emphasizes both improving crop productivity and environmental benefits when selecting adaptation practices, it becomes feasible to achieve increased farming rewards. This approach enhances the likelihood of choosing multiple adaptation practices to optimize farming profits.

The evaluation of cassava farmers' decisions to adopt specific climate change adaptation strategies is based on relative productivity. The study speculates that farmers consider not only socio-economic attributes but also factors like farm capacity, farming systems, and climate variables when choosing adaptation strategies. These drivers of adaptation choices can directly impact both farm productivity (an economic goal of adaptation) and environmental health (a non-economic goal of adaptation). The expectation is that the farmers' selection of climate change adaptation practices will also indirectly influence the environmental conditions and cassava productivity of their farms. Therefore, this article is centred on identifying the factors that influence the choice of climate change adaptation practices and pinpointing the most effective climate adaptation techniques. The goal is to sustainably enhance IOFS's cassava productivity and support climate-smart agriculture.

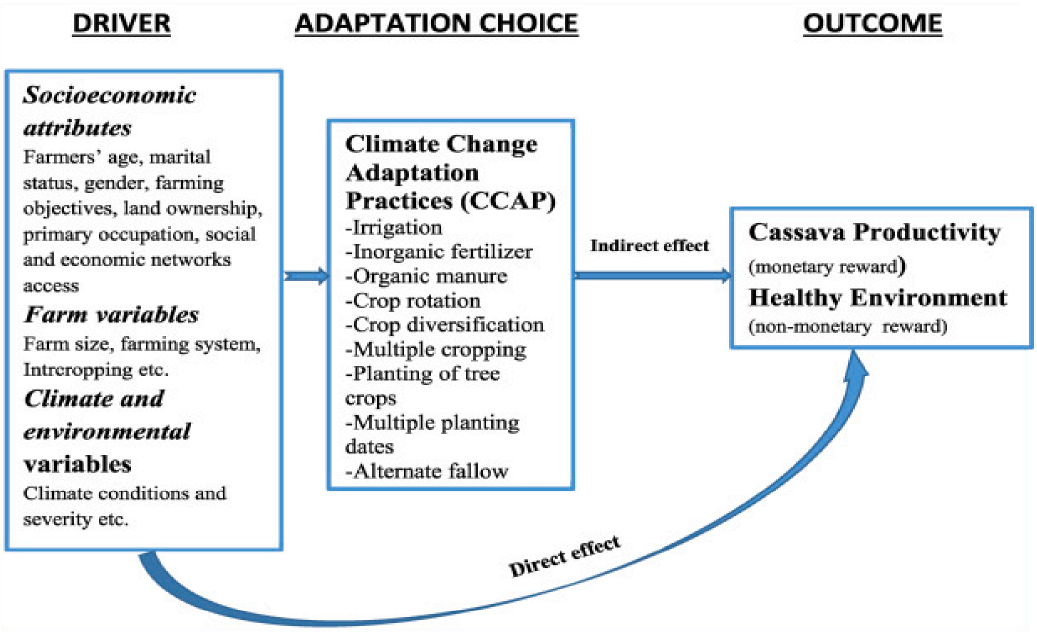

Figure 6. Conceptual framework for the choice of climate change adaptation practices in cassava farming and its effect on productivity (Olabisi et al. 2023).

Amidst the challenges posed by climate change on the strategic commodities of the OIC member countries, the IOFS emerges as a crucial player. Endowed with the mandate to enhance food security and agricultural cooperation, the IOFS plays a pivotal role in formulating adaptive strategies, fostering resilience, and promoting sustainable practices to effectively navigate the impending crises.

Collaborating closely with OIC member countries, the IOFS spearheads adaptive strategies to mitigate the impact of climate change on strategic commodities. Immediate measures such as intercropping, biodiversity enhancement, leguminous based crop rotation, and the use of drought-tolerant crop varieties, soil health, agro-forestry take precedence. The IOFS-led initiatives also emphasize promoting sustainable production practices, including integrated pest management and targeted precision irrigation and fertilization, ensuring the development of climate-resilient agricultural systems

Functioning as a platform for collaborative initiatives within the OIC framework, the IOFS facilitates knowledge exchange, resource sharing, and joint research endeavours. These collaborative efforts enable OIC nations to collectively build adaptive capacity, pool expertise, and develop region-specific strategies to tackle climate-induced challenges effectively. The shared vulnerabilities faced by OIC member countries underscore the importance of collaborative resilience-building.

Recognizing that the impact of climate change on OIC strategic commodities necessitates international support, the IOFS acts as a bridge between OIC member countries and the global community. Actively engaging with international organizations and developed nations, the IOFS highlights the unique challenges faced by OIC countries and garners support for implementing adaptive measures, capacity building, and technology transfer to tackle climate change and ensure food security.

Conclusion and Recommendations

In conclusion, the reverberations of climate change on OIC strategic commodities demand not just attention but concerted action. Wheat, rice and cassava, integral to OIC nations, face unprecedented challenges that transcend mere environmental concerns. The IOFS emerges as a linchpin in this endeavor, offering not just strategies but a framework for collective resilience. Through adaptive measures, collaborative initiatives, and international partnerships, the IOFS lays the foundation for a future where OIC nations not only tackle the storm of climate change but also develop climate resilient food production systems for food security in OIC nations.

In response to the intricate challenges facing food security, a set of comprehensive recommendations has been proposed with a particular emphasis on transforming food systems along the entire value chain for wheat, rice, and cassava. This entails initiatives covering production, processing, supply chains, and consumption, tailored to the unique challenges associated with these staple crops. The strategic transformation of food systems is considered pivotal for addressing the specific complexities within the wheat, rice, and cassava sectors, ensuring a sustainable and resilient approach to their production and utilization.

Simultaneously, there is a strong advocacy for the reassessment and reinforcement of food security policies, with a targeted focus on the nuances of wheat, rice, and cassava production. This includes a keen emphasis on investment, support, trade, and the reduction of losses and waste, guided by accurate and reliable data specific to these crops. Furthermore, addressing climate change is paramount in the context of wheat, rice, and cassava production. Recommendations underscore the integration of climate change considerations into overarching strategies, policies, and programs to fortify the resilience of these crops against evolving climatic challenges Sustainability perspectives, particularly in the judicious use of water resources, are deemed crucial for the wheat, rice, and cassava sectors. To navigate the uncertainties associated with climate change, the development of risk management strategies tailored to these crops is strongly advised.

Collaborative efforts are deemed essential, with a specific focus on regional and international cooperation for wheat, rice, and cassava. This collaborative approach aims to collectively tackle challenges and enhance the effectiveness of food security initiatives, with targeted responses to the aftermath of the Covid-19 crisis on wheat, rice, and cassava value chains. Initiatives are proposed to specifically strengthen the role of Small and Medium-Sized Enterprises (SMSAs) in the resilience of wheat, rice, and cassava value chains during the post-COVID-19 economic recovery.

EN SUMMARY

This article examines the impact of climate change on agriculture in Organization of Islamic Cooperation member countries, focusing on strategic crops like wheat, rice, and cassava. Agriculture is critical in these nations, using substantial land and water resources. The article highlights the challenges posed by climate variability, including shifts in temperature and precipitation, which affect crop productivity and economic stability. It also delves into greenhouse gas emissions from various sectors, emphasizing agriculture's role in the Islamic region. The Islamic Organization for Food Security is presented as a key entity in promoting adaptive strategies and sustainable practices to combat climate-related threats and a collaborative approach to ensure the sustainability of agricultural systems and the well-being of Islamic countries amidst global environmental challenges.

FR RÉSUMÉ

Cet article examine l'impact du changement climatique sur l'agriculture dans les pays membres de l'Organisation de Coopération Islamique, en se concentrant sur les cultures stratégiques comme le blé, le riz et le manioc. L'agriculture est essentielle dans ces pays, car elle utilise d'importantes ressources en terres et en eau. Le texte met en évidence les défis posés par la variabilité climatique, notamment les changements de température et de précipitations, qui affectent la productivité des cultures et la stabilité économique. Il se penche également sur les émissions de gaz à effet de serre de divers secteurs, mettant l'accent sur le rôle de l'agriculture dans la région islamique. L'Organisation Islamique pour la Sécurité Alimentaire est présentée comme une entité clé dans la promotion de stratégies adaptatives et de pratiques durables pour lutter contre les menaces liées au climat et d'une approche collaborative pour assurer la durabilité des systèmes agricoles et le bien-être des pays Islamiques dans un contexte environnemental mondial.

AR ملخص

تتناول هذه المقالة تأثير تغير المناخ على الزراعة في البلدان الأعضاء في منظمة التعاون الإسلامي، مع التركيز على المحاصيل الاستراتيجية مثل القمح والأرز والكسافا. تعتبر الزراعة أمرا بالغ الأهمية في هذه الدول، وذلك باستخدام موارد كبيرة من الأراضي والمياه. ويسلط النص الضوء على التحديات التي تفرضها تقلبات المناخ، بما في ذلك التغيرات في درجات الحرارة وهطول الأمطار، والتي تؤثر على إنتاجية المحاصيل والاستقرار الاقتصادي. كما يتناول التقرير انبعاثات الغازات الدفيئة من مختلف القطاعات، مع التركيز على دور الزراعة في المنطقة الإسلامية. تلعب المنظمة الإسلامية للأمن الغذائي دور رئيسي في تعزيز الاستراتيجيات التكيفية والممارسات المستدامة لمكافحة التهديدات المتعلقة بالمناخ ونهج تعاوني لضمان استدامة النظم الزراعية ورفاهية دول منظمة التعاون الإسلامي وسط تحديات البيئة العالمية.

IMPLEMENTATION OF SATELLITE AND METEOROLOGICAL MODELLING IN AGRICULTURE

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Introduction

The development of the space industry creates notable preconditions for the implementation of methods for assessing the state of the vegetation cover on the Earth's surface. Today, on the basis of images from space, a large number of different indicators characterizing the growth and development of plants are calculated. One such popular measure of active biomass is undoubtedly the NDVI index, commonly referred to simply as the vegetation index. This indicator is used to monitor the condition and productivity of crops in many countries around the world.

Firstly, much attention has been paid to the development of a software and information component that allows processing and visualizing satellite information, and in particular, the development of mathematical models (AI/ML models) for monitoring and predicting the state of crops. Modeling the dynamics of vegetation indices in this regard is a significant task of practical importance.

Secondly, weather forecasting plays an important role in agriculture, which is a determining factor in helping farmers get healthy and abundant crops. Predicted rainfall and temperatures, together with historical data, are key weather parameters for agriculture to plan field work from planting to harvest, with fertilization and herbicides in between. While some chemicals need to be sprayed in dry weather, others require moisture to activate. In addition, each crop requires a certain soil temperature for planting. Thus, farmers cannot achieve the best effect without a reliable agricultural weather report that saves costs and minimizes risks.

During the last 3 years the team of "Acash Systems" company developed the "Agrogen" project which gathered scientific and technical data in order to give solutions to solve issues of the farming community in Kazakhstan using IT instruments.

Satellite and meteorological monitoring service for agricultural purposes

Service of Satellite Monitoring of Crops is designed to automate the processing and analysis of data received as a result of monitoring measurements of satellite images, elevation maps and meteorological data and transfer them to agricultural clients. Microservice provides processing of results of monitoring measurements in the automated mode.

This microservice uses satellite monitoring technologies that allow you to collect data on the state of soil, vegetation, moisture, yield and other parameters in real time. This information is used to analyze and predict the condition of crops, as well as to optimize agricultural production.

This tool can be integrated into various software systems such as farm management systems, decision programs, monitoring systems, etc. It can also be used in conjunction with other microservices such as weather forecasting, pest monitoring, etc.

The use of service allows to improve the efficiency of agricultural production, optimize the costs of its production and increase productivity.

A microservice consists of two main modules:

- module for processing and analyzing satellite data
- meteorological data transmission module;

From satellite data, you can extract such indices as NDVI, GNDVI, CIGreen and NDMI and others. Based on meteorological data, you can get information about air temperature and humidity, wind speed and direction, pressure and precipitation, as well as a weather forecast for 14 - 16 days.

Agricultural focus: vegetation indices

Vegetation indices are designed to determine the health status of plants throughout the growing season. They can indicate the state of soil fertility (lack of nitrogen), provision of plants with moisture, chlorophyll content in plants, plant density. The following are some of the more common vegetation indices that can be calculated from Sentinel-2 data:

- NDVI (Normalized Relative Vegetation Index) is a remote sensing index that is used to assess the health, density and productivity of vegetation. It is calculated by subtracting the near-infrared (NIR) reflectance from the red reflectance and then dividing the result by the sum of the two reflectances. NDVI values range from -1 to 1, where values close to 1 indicate dense, healthy vegetation, and values close to -1 indicate bare soil or water.
- GNDVI (Green Normalized Relative Vegetation Index) is a variant of NDVI that is used to assess the health, density and productivity of vegetation. GNDVI values range from

-1 to 1, where higher positive values indicate healthier and more abundant vegetation, and lower values indicate less healthy or sparse vegetation. Compared to NDVI, GNDVI is more sensitive to changes in green vegetation. Therefore, GNDVI can be particularly useful in applications where the focus is on monitoring changes in green canopy, such as assessing the condition and density of pastures or evaluating the productivity of certain crops.

- CIGreen (Chlorophyll Index) is a measure of the amount of chlorophyll in vegetation. It is calculated using the reflectance values of different wavelengths of light and is used to evaluate the health and productivity of vegetation. Several different chlorophyll indices have been developed, each using different combinations of reflectance values for different wavelengths.
- NDMI (Normalized Difference Moisture Index) is a vegetation index used to assess moisture content and water stress in vegetation. NDMI is sensitive to changes in the water content of the canopy and can give an indication of the state of the water in the plants. NDMI values range from -1 to 1, where higher positive values indicate higher moisture content and healthier vegetation, and lower values indicate lower moisture content and potential water stress. Therefore, NDMI is especially valuable for drought monitoring, irrigation management and environmental studies.
- SAVI (Soil Adjusted Vegetation Index) is a variant of NDVI that is used to assess the health, density and productivity of vegetation. It is calculated by adjusting the NDVI for the effect of soil brightness on vegetation reflectivity. SAVI typically uses a soil correction factor (L) to reduce the effect of soil reflectivity on the NDVI value. It is usually used in areas with sparse vegetation or with a high proportion of bare soil.
- MSAVI (Modified Soil Corrected Vegetation Index) is a widely used vegetation index in remote sensing and agriculture. It is designed to assess and monitor the health and strength of vegetation. The index takes into account the effect of soil reflectivity, which can interfere with vegetation assessment. By including a soil correction factor, MSAVI compensates for differences in soil reflectance and provides a more accurate measure of vegetation condition. This is especially useful in areas where there is significant soil background influence, such as agricultural fields.
- NDRE (Normalized Red Edge Difference Index) is a vegetation index commonly used in remote sensing and agriculture to assess plant health, especially in relation to chlorophyll content and vegetation load. The main difference between NDRE and NDVI lies in the bands used for comparison. NDVI compares near-infrared reflectance to red, and NDRE compares near-infrared to red edge. NDVI primarily indicates the overall strength and density of vegetation, while NDRE focuses on chlorophyll content and vegetation stress. The NDRE is particularly useful for assessing specific aspects of plant health such as nitrogen content, leaf area index, and vegetation stress caused by factors such as water stress, disease, or nutrient deficiencies. It provides a more accurate assessment of the physiological state of plants compared to NDVI.
- Relative NDVI (RNDVI) is not a constant value of certain factors, but the ratio of the actual NDVI taken from the field to the NDVI of a certain value. The last value is laid down from the goal for which the RNDVI is calculated.

Index	Formula	
NDVI	$\frac{B8 - B4}{B8 + B4}$	
GNDVI	$\frac{B8 - B3}{B8 + B3}$	
CIGreen	$\frac{B8}{B3} - 1$	
NDMI	$\frac{B8 - B11}{B8 + B11}$	
SAVI	$\frac{(1 + L) \times (B8 - B4)}{B8 + B4 + L}$	где L = 0.33
MSAVI	$\frac{2*B8 + 1 - \sqrt{(2*B8 + 1)^2 - 8*(B8 - B4)}}{2}$	
NDRE	$\frac{B8 - B5}{B8 + B5}$	
$RNDVI_{last}$	$\frac{NDVI}{NDVI_{last}}$	*where NDVI is the last actual NDVI value of the entire field, NDVI_last is the average NDVI value of the three previous images.*
$RNDVI_{max}$	$\frac{NDVI}{NDVI_{max}}$	*where NDVI is the last actual NDVI value of the entire field, NDVI_max is the maximum value of the actual NDVI from the section of the field under consideration.*

Objectives of the service

Service solves the following production tasks:

- Observation of changes in vegetation indices obtained using high-resolution satellite images and allows you to track the dynamics of plant development. The difference in vegetation indices indicates differences in the development of crops in the fields, and will signal the need for certain agricultural work in specified areas
- Observation of meteorological data (the sum of active / effective temperatures from the date of sowing, air temperature, daily precipitation, snow depth, wind speed, weather forecast and timely notification, saving the history of meteorological conditions)
- Storage and analysis of data on the state of the soil: surface temperature, soil moisture (up to 1 meter);
- Reconstruction of distorted or missing data (cloud scattering).
- At the same time, the service ensures the creation of a structured database of information and data with the ability to search by various query parameters.

Service functionality

Service provides three sorts of data:

1. *Vegetation indices for specified fields based on Sentinel-2 satellite optical imagery.*
2. *Meteorological data for the specified fields based on the NOAA GFS model.*
3. *Height map based on ALOS data.*

GIS monitoring

The data provided by the geographic information system (GIS) is based on the images of the Sentinel l/2 satellite. The frequency of satellite images is 3-4 days. The resolution of one pixel from the images of this satellite is 10x10 m. The data from the satellite is downloaded in the form of RGB and NIR color models, which are used to calculate vegetation indices: CIGreen, GNDVI, MSAVI, NDMI, NDVI, NDRE, RNDVI and SAVI.

Based on GIS data, the service receives data for calculating vegetation indices throughout the entire field season. With the help of the Whittaker Smoother mathematical model, it restores distorted pixels (for example, pixels of a field covered with clouds) based on past data. Vegetation indices and meteorological data as they accumulate can be presented in analytical illustrations by means of maps and graphs with statistical calculations for vegetation indices and the sums of precipitation, temperatures and other accumulated data.

Data Source on GIS monitoring: Sentinel-2

Sentinel-2 is a family of satellites owned by the European Space Agency. The task of satellites is to monitor the use of land, forest and water resources, and can be used to eliminate the consequences of natural disasters.

The Sentinel 2A/2B are equipped with a Multispectral Imager (MSI) optoelectronic multispectral sensor for imaging at 10m (four visible and near infrared), 20m (six red edge and shortwave infrared) and 60m (three bands of atmospheric correction)) in the visible, near infrared (VNIR) and shortwave infrared (SWIR) regions of the spectrum, including 13 spectral bands, which guarantees the display of differences in the state of vegetation, including temporal changes, and also minimizes the impact on the quality of atmospheric imaging. Orbit with an average height of 785 km.

The Sentinel-2 satellites provide global coverage of the earth's surface every 10 days from one satellite and 5 days from 2 satellites, making the images and data valuable for use in ongoing research.

For the required geometry, the so-called Sentinel-2 product is loaded, which is an ortho image of 100x100 km2 in the UTM/WGS84 projection. Each such product contains the following bands:

Band name	Band number
Coastal aerosol	B1
Blue	B2
Green	B3
Red	B4
Vegetation Red Edge	B5
Vegetation Red Edge	B6
Vegetation Red Edge	B7
NIR	B8
Narrow NIR	B9
Water vapour	B10
SWIR – Cirrus	B11
SWIR	B12
SWIR	B13

Classification map (Sentinel 2)

In addition, Sentinel 2 supports a classification map that is generated for each Sentinel-2 level 1C product at a resolution of 60m, and the byte values of the classification map are organized as shown below:

Label (byte number)	Classification
0	No data
1	Saturated or Defective
2	Cast shadows
3	Cloud shadows
4	Vegetation
5	Not vegetated
6	Water
7	Unclassified
8	Cloud medium probability
9	Cloud high probability
10	Thin cirrus
11	Snow or Ice

Meteorological monitoring

Meteorological monitoring includes the provision of data on meteorological conditions in the specified fields. The data provided is based on the American NOAA GFS model, which provides both historical weather data from January 1, 2015, and weather forecast for 14-16 days ahead with a maximum frequency of 3 hours.

It should be noted that NOAA GFS divides the world map into cells with a maximum resolution of 0.25x0.25 square degrees (approximately 19 x 28 sq. km. in Kazakhstan) and provides data on points located at the intersection of these cells. Meteorological parameters of the specified field are calculated as follows:

1. *The latitude and longitude of the field centroid is determined.*
2. *The 4 closest points to this centroid are determined for which there are data from NOAA GFS.*
3. *Meteorological parameters per centroid are calculated using linear interpolation.*
4. *These calculated meteorological parameters per centroid are considered universal throughout the field.*

Data Source on meteorological monitoring: NOAA GFS

Weather data is provided by NOAA GFS. The Global Forecasting System (GFS) is a weather forecasting model developed by the National Centers for Environmental Prediction (NCEP) that generates data for dozens of atmospheric and soil variables, including temperature, wind, precipitation, soil moisture, and atmospheric ozone. The system combines four separate models (atmosphere, ocean, land/soil and sea ice) that work together to accurately display weather conditions.

GFS runs four times a day, providing up to 16 days of forecasts. The forecast component uses a cubed finite volume (FV3) model with ~13 km resolution, with an atmosphere coupled to the NCEP global wave model. Vertically, the model is divided into 127 vertical layers. It gives an hourly forecast for the first 120 hours, then 3 hours for days 5-16.

Forecasts are available to the public through various channels such as the NOAA website, weather apps, and other services. The GFS model also provides input to other models such as regional forecast models and storm surge models. These models use information provided by GFS to make more detailed predictions for specific regions or weather events.

The Global Forecast System (GFS) uses a large amount of observational data from various sources to initialize the model and improve the accuracy of forecasts. Some of the key sources of observational data used by the GFS include:

- Weather Stations: The GFS model uses data from weather stations around the world to provide information on temperature, humidity, wind speed and direction, pressure, and precipitation.
- Satellites: The GFS model uses data from various satellite instruments such as microwave radiometers, infrared sounders, and laser radars (lidars) to provide information on temperature, humidity, wind speed and direction, and precipitation at different levels of the atmosphere.
- Radiosonde: The GFS model uses data from radiosondes, instruments mounted on weather balloons that measure temperature, humidity, pressure, and other parameters as they rise through the atmosphere.
- Buoys: The GFS model uses data from ocean buoys that provide information on ocean temperature, salinity, wave height, and other oceanographic parameters.
- Aircraft: The GFS model uses data from aircraft that fly through the atmosphere and collects data on temperature, humidity, wind speed and direction, and other parameters.

The GFS model also uses data from other sources such as radar, lightning networks, and ground-based lidar to improve the accuracy of forecasts. The model uses these observations to initialize the model, which means providing initial conditions for the model to run. The model then uses equations to simulate the movement and behavior of the atmosphere, given observations, to make weather forecasts.

It is important to note that while the GFS model provides valuable information, it is not perfect and forecasts should be considered as a guide and not as final forecasts as weather is a complex system and there are always uncertainties that can affect forecast results.

Data Source on relief: ALOS

The Digital Elevation Model (DEM) project is a technical implementation of obtaining a height map on the territory of Kazakhstan. The elevation map was obtained from the Advanced Land Observing Satellite (ALOS) project, a satellite developed and operated by JAXA (Japan Aerospace Exploration Agency) that was used to observe and collect data on the Earth's surface.

The "ALOS 3D World Map" is a digital elevation model (DEM) created by JAXA using data collected by ALOS. The map is a high-resolution, global 3D image of the Earth's surface and covers approximately 80% of the Earth's land area. The map has a resolution of 30 meters and is available both in digital raster format and as a triangulated irregular network (TIN-triangulated irregular network) dataset.

The 3D map can be used for various applications such as terrain analysis, land use planning, resource management and disaster management. In addition, it is also used as the base data for creating other geospatial data such as ortho images and 3D city models.

- Measurement scale: Altitude

- Integer (16-bit signed) bitmap data (little trailing sign)

Fig. 1 shows 30 sectors covering the territory of Kazakhstan. Each sector contains 25 cells of 1x1 degrees longitude/latitude.

Note: The free version of the height map from ALOS (which we use) has a resolution of 30 meters/pixel. The paid version is provided at a resolution of 5 meters/pixel.

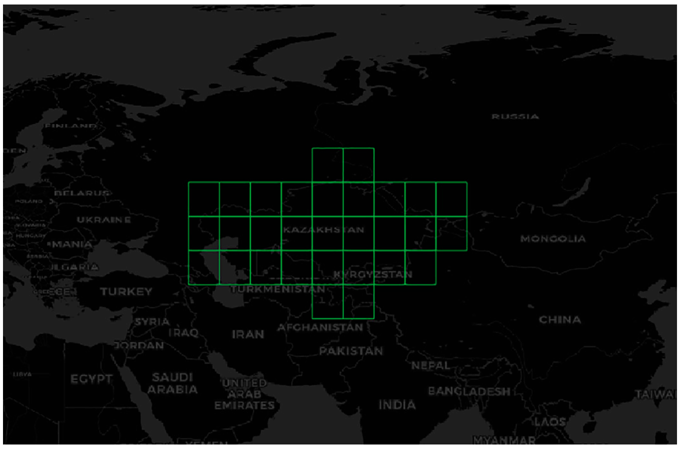

Figure 1. The territory of Kazakhstan is divided into 30 sectors (700 ALOS tiles).

Conclusions and recommendations

Our service has a number of advantages when it comes to implementation of data analytical tools, satellite and meteorological modelling for agricultural needs which was evidenced on the use of more than 450,000 Ha.

However, we recommend to IT teams, interested organizations and other parties a number of amendments to improve the functionality of such agri-tech IT services:

- Cloud dispersal using SAR images from the Sentinel 1C satellite (to be launched into Earth orbit in 2023) and neural network processing of previous satellite images will restore the lost pixels.
- Use of data from weather stations. Use of local weather stations in combination with NOAA GFS models for more accurate forecasting.
- Creation of recommender systems based on data analysis and use of vegetation indices for plant health monitoring. The received meteorological data and satellite images allow developing an individual system of recommendations (action calendar) for each field, taking into account the sown crop and soil and climatic features for fertilization and pest control.
- Get access to NDVI images for the last 30-35 years. The microservice can be enhanced by obtaining information on NDVI over the past decades, for example, to analyze long-term trends in plant health and productivity.
- Image quality improvement using deep learning models (DLM). At the moment, the resolution of images allows you to fit an area of 10x10 m in one pixel. If the client wants to get even higher resolution of satellite images, you can use DLM, which will increase the resolution of images up to 5x5 m per pixel.

EN SUMMARY

Much attention has been paid to the development of a software and information component that allows processing and visualizing satellite and meteorological information, and in particular, the development of mathematical models (AI/ML models) for monitoring and predicting the state of crops. Modeling the dynamics of vegetation indices in this regard is a significant task of practical importance. An example of implementation of such IT practices is “Agrogen” project which gathered scientific and technical data in order to give solutions to solve issues of the farming community in Kazakhstan using IT instruments.

FR RÉSUMÉ

Une attention particulière a été portée au développement d’un système logiciel et informatique conçu pour le traitement et la visualisation des données satellitaires et météorologiques, avec un accent spécifique sur la création de modèles mathématiques (modèles IA/ML) dédiés à la surveillance et à la prévision de l’état des cultures. La modélisation de la dynamique des indices de végétation représente une tâche pratique de grande importance dans ce contexte. Un exemple concret de cette application technologique est le projet «Agrogen», qui a collecté des informations scientifiques et techniques pour développer des solutions adressant les enjeux de la communauté agricole au Kazakhstan à travers des outils informatiques.

AR ملخص

وقد تم إيلاء الكثير من الاهتمام لتطوير مكون برمجي ومعلوماتي يسمح بمعالجة وتصور معلومات الأقمار الصناعية والأرصاد الجوية، وعلى وجه الخصوص، تطوير النماذج الرياضية (نماذج الذكاء الاصطناعي/التعلم الآلي) لرصد حالة المحاصيل والتنبؤ بها. تعد نمذجة ديناميكيات مؤشرات الغطاء النباتي في هذا الصدد مهمة كبيرة ذات أهمية عملية. ومن الأمثلة على تنفيذ ممارسات تكنولوجيا المعلومات هذه مشروع «Agrogen» الذي جمع البيانات العلمية والتقنية من أجل تقديم حلول لحل قضايا المجتمع الزراعي في كازاخستان باستخدام أدوات تكنولوجيا المعلومات.

SECURING SUSTAINABLE WATER: ACTION PLANS FOR THE OIC ARAB COUNTRIES IN TIMES OF CRISIS AND BEYOND

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Introduction

The Arab region is confronted with the daunting task of securing water and food in the face of severe climate conditions, unequal distribution of resources, and persistent conflicts. A comprehensive strategy is indispensable to navigate these challenges. As endorsed by the United Nations Development Program, integrating water management strategies with broader developmental objectives, including health, education, and the alleviation of poverty, is imperative to ensure equitable water usage among various sectors. Furthermore, it is crucial to acknowledge the multifaceted value of water—encompassing social, environmental, and economic aspects—to steer effective governance and policy-making.

Climate change adds a layer of complexity, diminishing water availability and increasing the frequency of extreme weather patterns. It is imperative to embrace sustainable water management practices and pivot towards eco-friendlier development paradigms. Innovative solutions rooted in technology, such as advanced data collection and risk monitoring tools, are pivotal. These would provide a clearer understanding of water use and management, facilitating informed decision-making. Additionally, fostering collaboration across governmental, scientific, and local community spheres can enhance policy coherence and accountability[1].

The need for financial innovation cannot be overstated; thus, public-private partnerships should be encouraged to broaden the scope of climate financing. This is vital for implementing water management solutions that can reach and benefit all segments of society, including the most vulnerable. Moreover, the successful scaling of pilot projects must be informed by local conditions and resource assessments to ensure their effectiveness in diverse settings.

In concert with these measures, targeted capacity building and training initiatives are necessary to bridge skill gaps and bolster technical proficiency in water management. International cooperation and community engagement are also key to navigating these multifaceted challenges.[2]

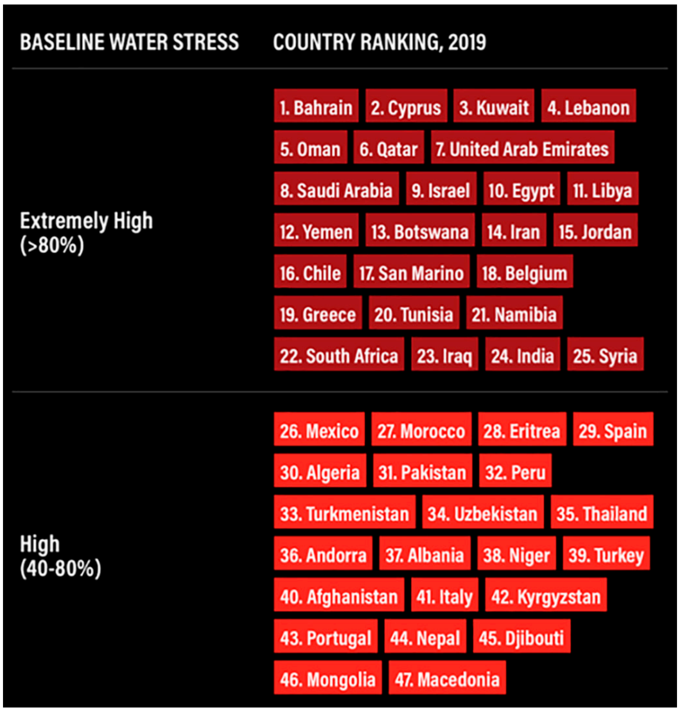

Figure 1. Baseline water stress, (World Resources Institute)

1 https://www.undp.org/arab-states/press-releases/policy-roundtable-water-scarcity-arab-region-calls-urgent-climate-action-build-resilience

2 https://www.worldbank.org/en/topic/water/publication/beyond-scarcity-water-security-in-the-middle-east-and-north-africa

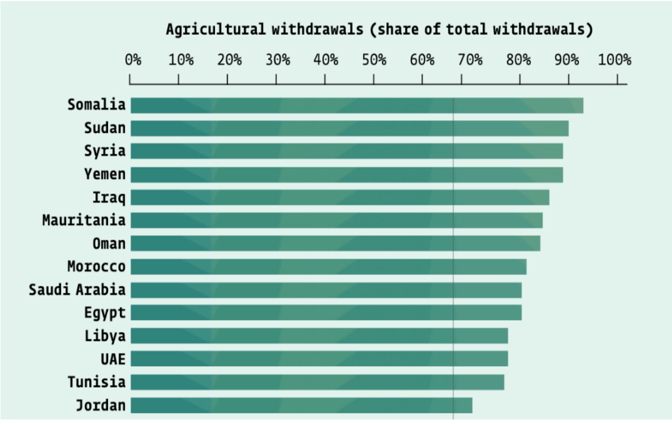

Figure 2. Agricultural withdrawals in Arab countries, (FAO AQUASTAT)

Current State of Water Security in the Arab region

The Middle East and North Africa (MENA) region stands as one of the most water-stressed regions globally, with extreme water stress denoting the use of over 80% of the available water supply. This is largely due to the region's geographic and climatic conditions which have historically led to limited water availability. Approximately 83% of the population in the MENA region is exposed to extremely high levels of water stress, reflecting the acute challenge of ensuring an adequate water supply for the region's inhabitants.

It is estimated that global water demand will increase by 20-25% by 2050. This increase will likely intensify the water scarcity challenges in the MENA region, placing additional pressure on its already limited water resources.[3]

> Agricultural water use in the most Arab countries is greater than global averages.

Bahrain, Kuwait, Lebanon, Oman, and Qatar are among the countries most vulnerable to water stress in the region, significantly affected by the scarcity of water resources which impacts various aspects of life and development. Egypt, Jordan, Libya, the UAE, Palestine, Yemen, Algeria, Morocco, Saudi Arabia, Tunisia, and Iraq are also among the top 25 countries globally that are exposed to water stress. This widespread prevalence of water stress underscores a shared regional challenge.[4]

In the Arab region, around 85% of water resources are allocated to irrigation, significantly higher than the global average of 70%. This substantial allocation to agriculture indicates the looming challenge of intensified competition for water resources among various sectors.

The Arab region could face significant economic consequences due to water scarcity, exacerbated by climate change. Projections suggest potential losses ranging from 6 to 14 percent of GDP by 2050, emphasizing the critical need for effective water management strategies.[5,]

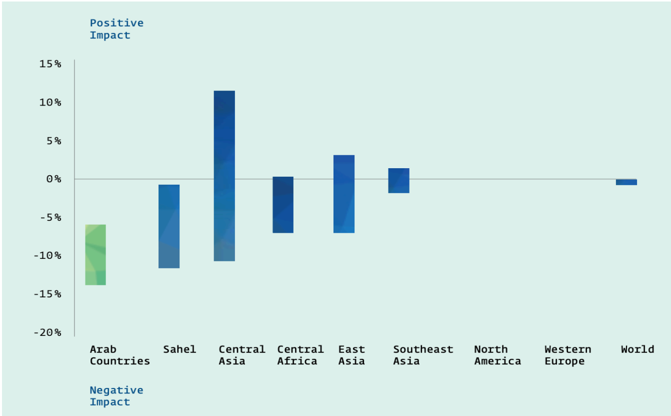

Figure 3. GDP losses due to water scarcity caused by climate change, World Bank

More than 60% of the MENA region's water supply is found in transboundary rivers like the Euphrates, Jordan, and Nile. These shared resources are essential for domestic water and energy needs but are complicated by historical and political tensions, which challenge cooperative water management.[6]

Urbanization and industrialization in the region are changing its economic structure, influencing water security. Agriculture, being the largest consumer of freshwater resources, often uses water sub-optimally, with water-intensive crops and inefficient irrigation practices further taxing the limited water supplies.[7]

The MENA region faces simultaneous crises of water scarcity, climate change, and security, which are interlinked and exacerbate each other. Water scarcity is both influenced by and contributes to climate change and regional conflicts, while authoritarian governance in some MENA countries complicates the situation by repressing public discourse on these crises.[8, 9]

Challenges of Water Management in the Arab countries

The Arab region, encompassing a diverse range of countries in the MENA, faces a unique set of challenges in water management, largely influenced by its geographical and climatic conditions. This region, known for its arid environment and extreme water scarcity, grapples with issues that span from inefficient agricultural water use and the profound impacts of climate change, to the complexities of rapid urbanization and policy governance. Each of these factors plays a critical role in shaping the water security landscape of the Arab world, demanding a comprehensive understanding and strategic action to ensure sustainable water resource management and equitable access.

3 https://www.unwater.org/news/water-security-middle-east-and-north-africa
4 https://www.stimson.org/2021/water-crisis-in-the-mena-region/
5 https://climateandsecurity.org/2021/04/drought-is-leading-to-instability-and-water-weaponization-in-the-middle-east-and-north-africa/
6 https://openknowledge.worldbank.org/entities/publication/62f75eb4-5488-50dc-9bb5-b54b12a32ac0
7 https://ecfr.eu/publication/how_water_scarcity_could_destabilise_the_middle_east_and_north_africa/
8 https://www.sipri.org/publications/2019/sipri-insights-peace-and-security/confluence-crises-water-climate-and-security-middle-east-and-north-africa
9 https://www.mei.edu/events/2023-world-water-day-future-water-security-middle-east-and-north-africa

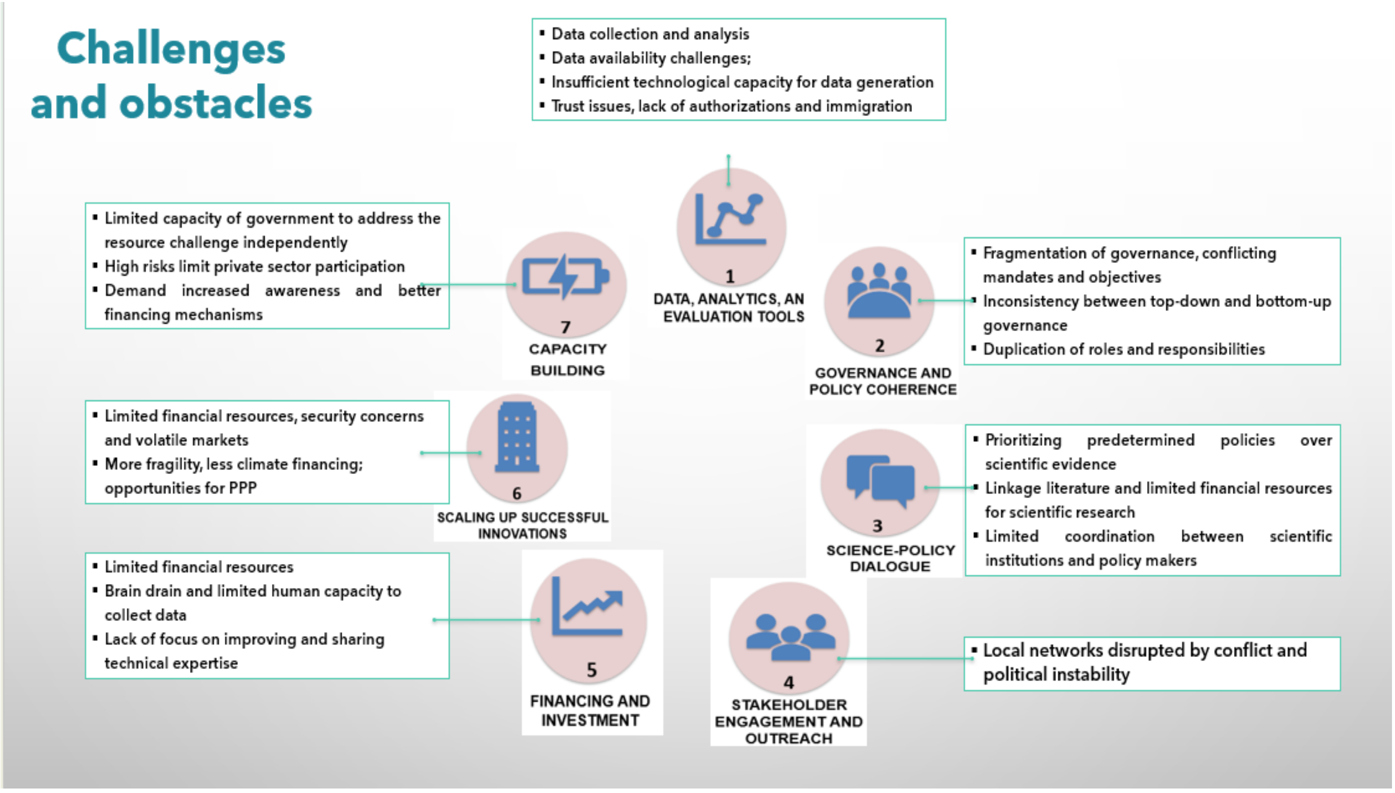

Figure 4. Systemic Challenges in Water Management for Sustainable Agriculture

Managing water for farming involves many problems that touch on technology, money, rules, and community relations. It's important to really understand these problems to make good plans for keeping farming going strong.

Using Data to Make Choices

One big issue is that we don't have enough good data to help make decisions about water in farming. Collecting data isn't easy because of outdated tech and red tape, which leaves us with big gaps in our knowledge. Without good data, it's hard to know how much water crops need and if we're using water in the best way. We need to get better at collecting and using data to make smart choices about water.

Making Rules Work Together

Different groups making their own rules about water can lead to confusion and overlap, which isn't helpful for farmers. There's a need for a clear and united approach that gets everyone—government, farmers, and communities—working towards the same goals for using water wisely.

Science and Rules Talking to Each Other

There's also a gap between what scientists know about water and what the rules say. Sometimes, old policies get in the way of new scientific discoveries. With not enough money for research, we can't find new and better ways to use water. It's key to make sure that the latest science helps shape the rules about water in farming.

Getting Everyone Involved

When communities face conflicts or instability, it's harder for them to work together on water problems. Everyone's involvement is key because it brings local know-how and support for using water better. Efforts to repair and build these community networks are important for joint water management.

Money and Investments

Not having enough money is a big roadblock to trying new things and investing in better water management for farming. We need more money for things like improved irrigation systems that save water. When experts leave the area or country for better jobs, it's even tougher to handle these problems. Bringing in more experts and getting more funding, maybe through partnerships between public and private groups, are ways to overcome these money challenges.

Innovating and Building Skills

Last, we need to take the good ideas that work for managing water and use them more widely. It's also important to teach governments and local people more about these issues. If private companies are scared to get involved because of the risks, we need to find ways to make it less risky for them. Teaching everyone more about water and how to manage it can lead to better decisions.

Opportunities and Strategies for Food Security in the Arab Region

The Arab region, characterized by diverse climatic and geographic conditions, faces significant challenges in agricultural water management. These challenges are exacerbated by factors like climate change, population growth, and land degradation. To ensure food security and sustainable water use, the region requires innovative strategies and policies that address these complex issues. The integration of sustainable agricultural practices and efficient water management strategies is key to overcoming these challenges and ensuring the long-term viability of agriculture in the region.

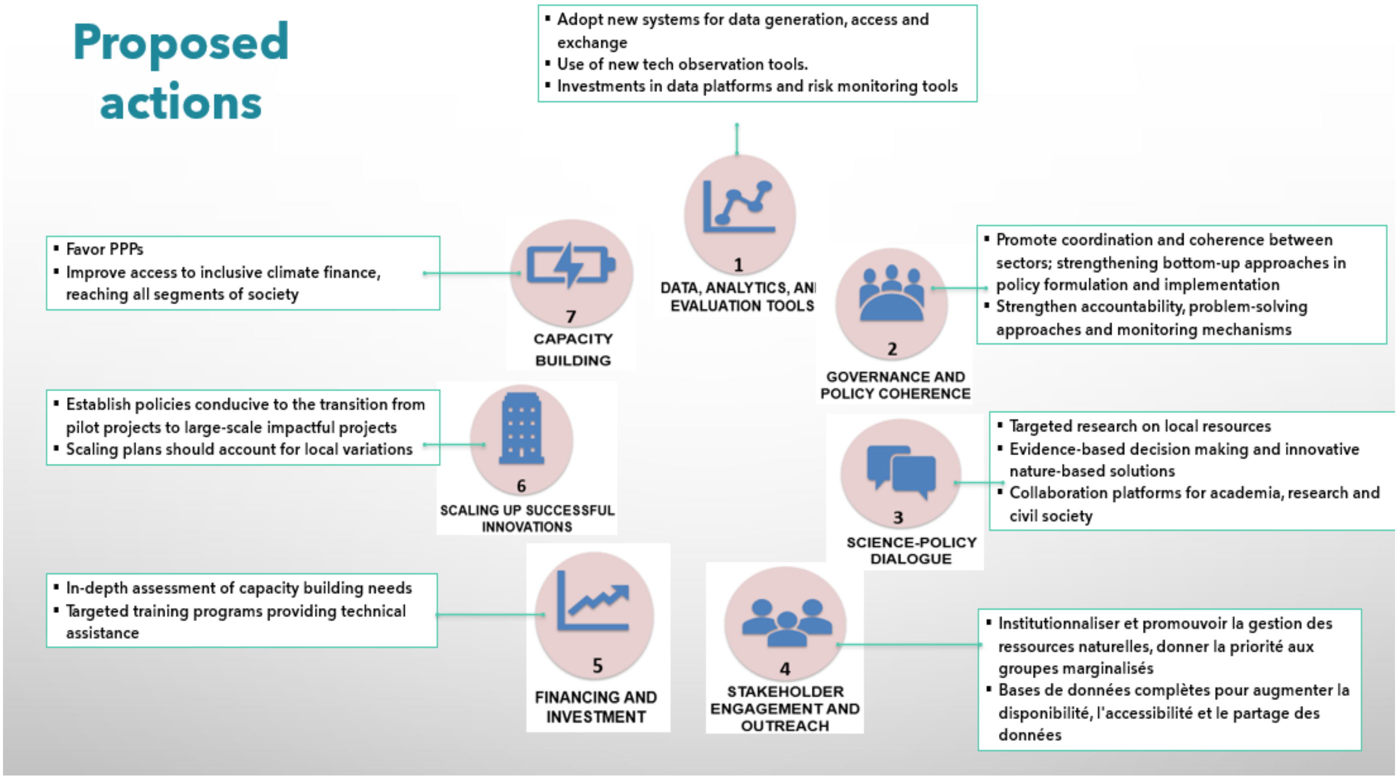

Figure 5. Practical Steps for Improving Water Management in Agriculture

Water is essential for agriculture but managing it can be challenging. The following actions are proposed to tackle these challenges and make water use in agriculture more efficient and sustainable.

Data and Technology Improvements

New systems for collecting, sharing, and analyzing water-related data can lead to better management decisions. Investing in technology that helps observe water use and tracks risks can prevent shortages and reduce waste.

Governance and Policy Enhancement

Stronger cooperation between various sectors and the implementation of community-driven policies are key. Enhancing accountability and setting up effective monitoring can ensure policies work as intended.

Science-Policy Integration

Research focused on local water resources can inform policies. Decisions based on scientific evidence, especially those that consider the environment, can lead to sustainable water use. Collaborations between researchers and policymakers can support this integration.

Community and Stakeholder Engagement

Involving local communities and ensuring that all voices, especially those often overlooked, are heard is vital. Sharing data widely can improve water availability and access for all.

Financial Strategies

Encouraging public-private partnerships and widening access to climate financing can help fund necessary improvements in water management.

Scaling Successful Practices

Policies should support the expansion of successful small projects to have a broader impact. Adapting these policies to fit local conditions can help ensure their success.

Capacity Building and Training

Understanding the specific training needs for better water management and providing targeted technical assistance can empower those responsible for managing water resources.

In light of the connection between sustainable water management and agricultural practices, enhancing the agricultural sector's performance becomes pivotal in **achieving food security and sustainable water use.**

Therefore, the success in one area — either water management or food security — will inherently contribute to advancements in the other, underscoring the need for **integrated and well-coordinated strategies in the Arab region.**

Agricultural water innovation trends in the Arab region: Success stories

1. Renewable-Energy Irrigation Pumps. The Arab region, including countries like Egypt, Yemen, Morocco, and Gulf countries, has seen a significant expansion in solar irrigation. This shift towards renewable energy sources for irrigation is a positive step in water management, especially in Upper Egypt. The benefits of this transition include cost-effectiveness and a low carbon footprint, aligning with global efforts towards sustainable development. Solar-powered irrigation systems present an opportunity to move away from non-sustainable and unreliable fossil fuel-powered generators, thereby contributing to both economic and environmental sustainability in the region.[10]

2. Water Governance Innovations. Innovations in water governance, such as water accounting, data acquisition, and analytics, have enhanced the real-time operation and administration of water infrastructure in the Arab region. These advancements play a crucial role in managing water resources more effectively and sustainably. The adoption of advanced technologies for water governance ensures better management and distribution of water resources, especially critical in regions facing severe water scarcity.

3. Advanced Sensing and Monitoring Platforms. The use of fixed and drone-based sensors for agricultural monitoring has emerged as a key innovation in the Arab region. These advanced sensing and monitoring platforms enable precise and efficient agricultural practices, contributing to improved water productivity and sustainable land use. Remote sensing technologies, in particular, have become instrumental in monitoring water productivity, offering valuable data for informed decision-making in agriculture.[11]

4. Controlled Environment Agricultural Technologies. Hydroponics and other controlled environment agricultural technologies have been implemented to enhance food security, especially in conflict-impacted areas. These technologies allow for the cultivation of crops with minimal water usage, optimizing water resources and contributing to sustainable agricultural practices in the region.[12]

5. Importance of Extension Systems. Extension systems are crucial for integrating emerging technologies and fostering innovation in agricultural practices. These systems support the adoption and effective implementation of new agricultural technologies, ensuring that farmers and agricultural stakeholders are well-equipped to utilize these advancements for sustainable agriculture.[13]

Recommendations

1. Enhance Investment in Water Management R&D: Investing in research and development for water management is crucial. This includes the development of smart irrigation systems, efficient water recycling methods, and drought-resistant crops. Such innovations can provide sustainable solutions to water scarcity, aiding in the advancement of water management technologies and practices that are vital for the region's agricultural sustainability.

2. Implement and Enforce Regulatory Reforms: Regulatory reforms are essential for efficient water management. This includes establishing water rights, setting appropriate pricing mechanisms to discourage wasteful use, and ensuring a fair distribution of water resources. Regulatory reforms help in managing water resources more effectively, ensuring equitable access and sustainable utilization.

3. Encourage Public-Private Collaborations: Public-private partnerships (PPPs) play a significant role in the development and implementation of innovative water management technologies. These collaborations can help scale successful practices and bring in private sector expertise and investment, contributing to the advancement of sustainable water management solutions in the region.

4. Encourage Community Involvement and Education: Engaging local communities is critical in ensuring that water management practices are well-suited to local needs. Community involvement and education can enhance the effectiveness and sustainability of water management practices. This approach helps in building awareness about water conservation and ensuring that the local population is an active participant in water management strategies.

5. Increase International Cooperation: International cooperation, including joint initiatives and data sharing, is key to managing shared water resources effectively. Collaborative projects can address common water management challenges in the OIC region, promoting shared knowledge and resources that are vital for tackling regional water scarcity.

6. Develop Comprehensive Water Management Policies: Member states should develop and execute comprehensive water management policies that incorporate technological advancements, regulatory frameworks, and socio-economic considerations. These policies should aim to balance water conservation needs with economic growth and social equity, ensuring sustainable water management in the region.

Conclusion

The technical paper presents a compelling argument for the adoption of integrated and sustainable strategies to address the pressing challenges of water and food security in the Arab region. It identifies the critical need for a holistic approach that leverages technological innovation, policy reform, and collaborative efforts to combat the adverse effects of water scarcity, climate change, and socio-economic dynamics. The implementation of renewable-energy powered irrigation, advanced water governance, and controlled environment agricultural technologies are highlighted as key measures for advancing the agricultural sector's sustainability. Moreover, the paper stresses the significance of public-private partnerships in catalyzing innovation and investments in water management. It advocates for comprehensive water management policies that effectively integrate technological solutions, regulatory frameworks, and socio-economic factors to harmonize water conservation with economic and social objectives. The call for a united front among government bodies, private sector stakeholders, communities, and international organizations underscores the imperative for collective action. Through such collaborative endeavors, the Arab region can secure sustainable water and food security, contributing not only to its own resilience and prosperity but also to the broader global agenda for sustainable development and environmental stewardship.

10 https://www.egypttoday.com/Article/3/66436/The-solar-powered-irrigation-scene-in-Egypt
11 https://www.mdpi.com/2504-446X/5/3/84
12 https://www.mdpi.com/journal/water/special_issues/hydroponics_agriculture
13 https://pdf.usaid.gov/pdf_docs/PA00ZX79.pdf

EN SUMMARY

This paper outlines a concise action plan to improve water management in agriculture, responding to challenges such as limited data, inconsistent policies, and financial shortages. We propose the adoption of advanced data systems and stronger coordination between governance and grassroots efforts. Highlighting the need for evidence-based policies, we recommend fostering partnerships between scientists, policymakers, and local communities. Financially, we advocate for public-private partnerships and broadened climate finance access. We also call for scaling successful water management innovations, tailored to local conditions, and enhanced capacity building through targeted training. These actions aim to ensure sustainable agricultural practices through improved water stewardship.

FR RÉSUMÉ

Ce document présente un plan d'action concis pour améliorer la gestion de l'eau dans l'agriculture, en répondant à des défis tels que des données limitées, des politiques incohérentes et des pénuries financières. Nous proposons l'adoption de systèmes de données avancés et une coordination plus forte entre la gouvernance et les efforts locaux. Soulignant la nécessité de politiques fondées sur des données probantes, nous recommandons de favoriser les partenariats entre les scientifiques, les décideurs politiques et les communautés locales. Sur le plan financier, nous plaidons en faveur de partenariats public-privé et d'un accès élargi au financement climatique. Nous appelons également à généraliser les innovations réussies en matière de gestion de l'eau, adaptées aux conditions locales, et à renforcer les capacités grâce à une formation ciblée. Ces actions visent à garantir des pratiques agricoles durables grâce à une meilleure gestion de l'eau.

AR ملخص

تحدد هذه الورقة خطة عمل موجزة لتحسين إدارة المياه في الزراعة، والاستجابة للتحديات مثل البيانات المحدودة، والسياسات غير المتسقة، والنقص المالي. ونقترح اعتماد أنظمة بيانات متقدمة وتنسيق أقوى بين جهود الحوكمة والجهود الشعبية. ومن خلال تسليط الضوء على الحاجة إلى سياسات قائمة على الأدلة، نوصي بتعزيز الشراكات بين العلماء وصناع السياسات والمجتمعات المحلية. ومن الناحية المالية، ندعو إلى إقامة شراكات بين القطاعين العام والخاص وتوسيع نطاق الوصول إلى التمويل المناخي. وندعو أيضًا إلى توسيع نطاق الابتكارات الناجحة في إدارة المياه، والمصممة خصيصًا لتتناسب مع الظروف المحلية، وتعزيز بناء القدرات من خلال التدريب الموجه. وتهدف هذه الإجراءات إلى ضمان ممارسات زراعية مستدامة من خلال تحسين إدارة المياه.

ASSESSING FOOD SECURITY CHALLENGES IN OIC MEMBER STATES

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Food security stands as one of the most pressing global concerns, impacting millions of individuals daily. Defined by the World Food Summit of 1996, it denotes universal access to safe, nutritious, and adequate food, essential for leading a healthy and active life. This article delves into assessing the state of food and nutrition in member states of the Organization of Islamic Cooperation (OIC), a pivotal aspect of global food security.

The article underscores the formidable challenges presented by recent shocks, including the disruptive effects of the COVID-19 pandemic and escalating costs. To comprehensively gauge the food security landscape in OIC MS, IOFS has developed the Food and Nutrition Index (FNI). This index offers a thorough evaluation encompassing food consumption, accessibility, and nutritional value, facilitating targeted policy formulations, and fostering international collaborations to tackle food security hurdles. Moreover, it scrutinizes the dynamics of imports and exports, stressing the significance of trade negotiations and regional cooperation to bolster food security and ensure the affordability of wholesome diets across OIC member states.

Tackling food security issues within OIC nations demands a multifaceted approach. Prioritizing enhancements in agricultural productivity, endorsing sustainable practices, and implementing tailored policies are imperative steps for the OIC to make substantial strides toward achieving food security. Furthermore, fostering trade cooperation and enacting reforms are essential to mitigate import risks, while investments in infrastructure and research can amplify food production and accessibility. The article accentuates the imperative for collaborative endeavors in addressing the root causes contributing to food insecurity, thereby safeguarding the well-being of populations within the OIC.

The period from 2020 to 2022 has underscored the systemic deficiencies within the global food system, heightening apprehensions surrounding food security. These recurring and extensive shocks, encompassing the COVID-19 pandemic, conflicts, climatic anomalies, and surging costs, exacerbate underlying issues fueling food insecurity and compromise the system's resilience, particularly in OIC MS, where there exists a considerable reliance on agrifood imports.

According to the Global Report on Food Crisis (GRFC) 2022, an estimated 42 million individuals across 37 countries confront the specter of malnutrition, necessitating urgent interventions. The food security landscape in numerous OIC member states continues to deteriorate, with Afghanistan, Nigeria, Somalia, and Yemen confronting the highest alert levels as their populations grapple with or face imminent starvation. This alert extends to the Syrian Arab Republic, Sudan, and Pakistan, given the uncertainties stemming from climatic extremities and other factors such as food inflation and elevated fuel prices, compounded by the repercussions of disruptions in major cereal supply chains.

OIC member countries, comprising 57 states with a collective populace of approximately 1.8 billion, confront formidable food security challenges. These challenges are compounded by a confluence of factors, including poverty, conflicts, natural calamities, and the impacts of climate change. Additionally, the influx and movements of refugees significantly influence the regional and national food security landscapes within the OIC, with eight of the top ten refugee-hosting nations worldwide being OIC member states.

Comprehending the complex relationship between access, availability, and utilization regarding food resources is crucial for defining the Food Security Index (FSI).. Serving as a standardized mechanism, the FSI facilitates the evaluation of food security status, identifies prevalent areas of food insecurity, and elucidates the contributory factors such as poverty, natural disasters, or political instability. Such insights are important in devising and implementing effective food security interventions and policies, crucial for combatting hunger, and malnutrition, and advancing sustainable development objectives. Nonetheless, the compilation of data for constructing a food security index presents formidable challenges, given the varied measurement methods and data requirements across different indices and survey levels.

Various scholars have proposed diverse FSI indicators that transcend mere availability, access, utilization, and stability metrics. These encompass household-level calorie adequacy, and dietary diversity measures such as Household Diet Diversity Score (HDDS), Women's Diet Diversity Score (WDDS), Individual Diet Diversity Score (IDDS), and Food Consumption Score (FCS). While each indicator encapsulates specific dimensions and components, they diverge in terms of measurement methodologies, intended uses, and data . However, it's noteworthy that certain drawbacks exist, particularly regarding dietary diversity measures, which may overlook the nutritional value of consumed foods. Consequently, IOFS propose the Food and Nutrition Index (FNI) at the country level, offering a holistic assessment of food security premised on food consumption score and dietary diversity. This model amalgamates methodologies from the Food and Agriculture Organization (FAO) and the World Food Programme (WFP), providing member states with a lucid understanding of their food and nutrition landscapes, enabling targeted policy interventions, and fostering international collaborations to bolster food security[1].

The FNI encompasses three core dimensions: food consumption, food access, and nutritional value. Drawing upon secondary data from the UN FAOSTAT, FNI scores for OIC member states are depicted on a scale of 1 to 3 in Figure 1, with 3 indicating high performance, 2 denoting marginal performance, and 1 signifying low performance. The calculation of FNI scores entails the aggregation of weighted values assigned to each country's food items, derived from the Food Balance Sheet data provided by the UN FAOSTAT. These weights are formulated based on the significance of various food items for food security, with specific reference to the weights utilized by the World Food Programme (WFP), aimed at gauging survey data that may be challenging to collect. Figure 1.

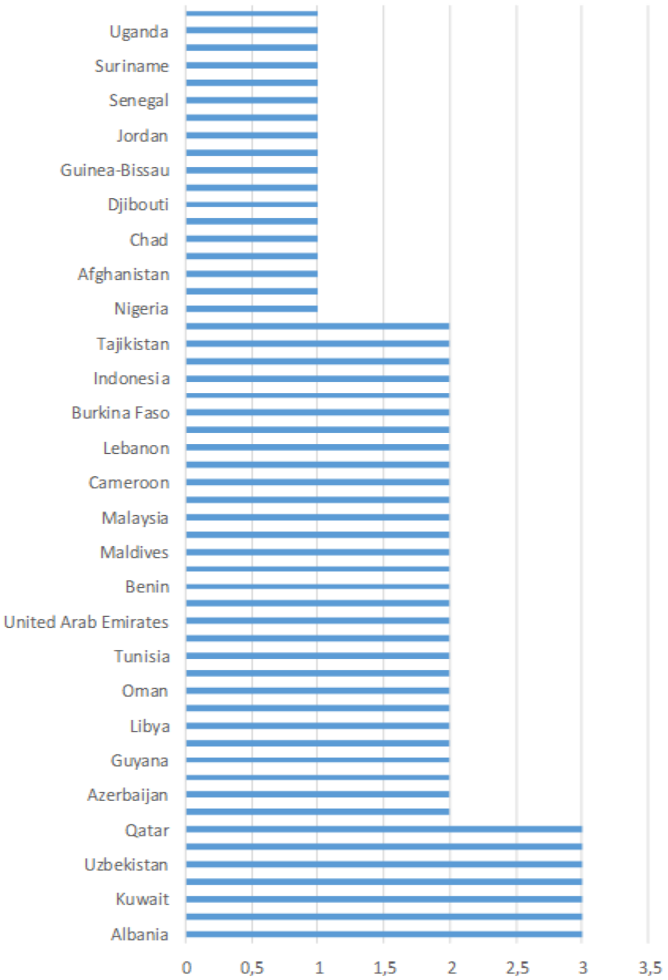

Figure 1. IOFS Food and Nutrition Index in OIC member countries in 2020
Source: IOFS staff calculations based on UN FAO, 2023

Emphasizing the importance of data quality over calculation complexity, the IOFS FNI endeavors to furnish a transparent and comprehensible classification of food availability that incorporates population data from diverse countries. In crafting this classification, three factors were considered:

- Comparative Analysis: The index is tailored to facilitate comparisons among different OIC state . By focusing on internal comparisons, statistical outliers are minimized, ensuring that numerical differences remain contextually relevant within the OIC.
- Comprehensive Evaluation: Unlike indices solely reliant on calorie measurements, the FNI encompasses a broader spectrum of food products and nutritional aspects, elevating the evaluation's accuracy and relevance.
- Simplified Interpretation: While many indices feature decimal values for precision, the FNI opts for a simplified approach, employing basic values generated statistically to enable straightforward comparisons within the OIC, without undue focus on minute differences.

Recognizing the variegated eating habits and dietary predilections among OIC member states is paramount, shaped by diverse factors encompassing cultural traditions, economic development, and resource availability. While generalizations pose challenges given this diversity, discernible patterns and commonalities exist. The influences of globalization, urbanization, and evolving lifestyles, including the proliferation of Western diets and processed foods, underscore the burgeoning significance of balanced diets and nutritional literacy across the OIC. Nonetheless, the formulation of an FNI presents formidable challenges, particularly in low-income nations where periodic surveys and data collection entail logistical hurdles. Frequently, data about food and nutrition security may be fragmented, inconsistent, or outdated, impeding accurate evaluations.

Recognizing the diversity in eating habits and dietary preferences among countries within the OIC MS is crucial, as these variations are shaped by a myriad of factors such as cultural traditions, economic development, and resource availability. While it's challenging to generalize about the entire OIC, notable patterns and similarities emerge. The influences of globalization, urbanization, and changing lifestyles, including the adoption of Western diets, fast food, and processed foods, have underscored the importance of balanced diets and nutritional awareness across the OIC. Nevertheless, developing an FNI can be formidable, particularly in low-income countries where conducting surveys and gathering data periodically poses significant challenges. Often, the data required to assess food and nutrition security may be incomplete, inconsistent, or outdated, impeding the ability to obtain an accurate evaluation.

This index ranks countries focus on consumption, access, and nutrition andserve as indicators of a country's capacity to fulfill basic needs and internal demands for food. While there may be varying opinions regarding the dimensions included in the index, it nonetheless provides valuable insights into a country's internal resources. A higher index value indicates challenges related

[1] Ahn S, Norwood FB. Measuring food insecurity during the COVID-19 pandemic of spring 2020. Appl Econ Perspect Policy. 2021;43(1):162–8.
Cafiero C, Melgar-Quiñonez HR, Ballard TJ, Kepple AW. Validity and reliability of food security measures. Ann N Y Acad Sci. 2014;1331:230–48.
Carletto C, Zezza A, Banerjee R. Towards better measurement of household food security: harmonizing indicators and the role of household surveys. Glob Food Sec. 2013;2:30–40.
Bawadi HA, Tayyem RF, Dwairy AN, Al-Akour N. Prevalence of food insecurity among women in northern Jordan. J Health Popul Nutr. 2012;30(1):49.
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Manikas, I., Ali, B.M. & Sundarakani, B. A systematic literature review of indicators measuring food security. Agric & Food Secur 12, 10 (2023). https://doi.org/10.1186/s40066-023-00415-7
https://www.fao.org/fileadmin/user_upload/food-security-capacity-building/docs/Nutrition/NairobiWorkshop/5.WFP_IndicatorsFSandNutIntegration.pdf
https://www.wfp.org/publications/food-security-indicators

to the sufficiency of the food supply, shedding light on the intricate relationship between food intake, nutrition, and access to food.

Influenced by factors such as COVID-19, political and environmental instability, and market shocks, some countries have bolstered their food security positions through effective policies and socioeconomic programs. However, for others, these uncertainties have resulted in a decline in overall access to healthy food. Achieving high performance in food and nutrition necessitates adequate food access, backed by agricultural, land, and financial resources, as well as intentional policies. Unfortunately, these favorable conditions are not widespread. High-income countries are better positioned to mitigate fluctuations in food prices, while low-income countries remain more vulnerable to changes in the global market.

Disrupted food supply chains, dependence on food imports, increased cereal prices in the global market, food price inflation prevalent in many low- and middle-income countries, and a lack of social protection programs are among the root causes of these challenges. Moreover, rising food and oil prices, along with adverse climatic conditions, have further compounded the challenges concerning food access and availability in these countries, with many falling below the minimum nutrition standards in terms of per capita caloric intake.

Several countries are grappling with severe food shortages, and this predicament is anticipated to exacerbate. For instance, the cereal market in Chad is experiencing an unprecedented decline due to elevated transportation costs and diminished production, leading to a surge in reported prices amid pressure on grain markets. Rampant inflation further restricts access to food, particularly for the most vulnerable households and populations affected by conflicts.

The MS in the MENA (Middle East and North Africa) region remains heavily reliant on imported food, with approximately 50% of its food originating from other countries. While strides have been made in agri-food technology in countries like the UAE, ongoing conflicts in Yemen and Syria, coupled with the economic repercussions of COVID-19 and soaring international food and energy prices, are poised to precipitate significant increases in poverty and food insecurity. In Sudan, economic challenges compounded by rising commodity prices and political stalemate are expected to exacerbate food insecurity in the foreseeable future.

In 2020, 18 out of 54 OIC MS (observed in the survey) received a low performance score of 1.Afghanistan, Mali, and Yemen require special attention to address issues related to accessibility, consumption, and nutrition at the national level.

To elucidate the proposed methodology of IOFS for calculating the index and evaluate the precision of FNI, a comparative analysis was undertaken between FNI and FAO's PoU (Percentage of Undernourishment) index. Standardizing the PoU index values on a scale of 1 to 3 for comparison, IOFS computed a 3-year average to synchronize with its index. The findings from these comparative analyses are depicted in the bar graphs presented in Figure 2.

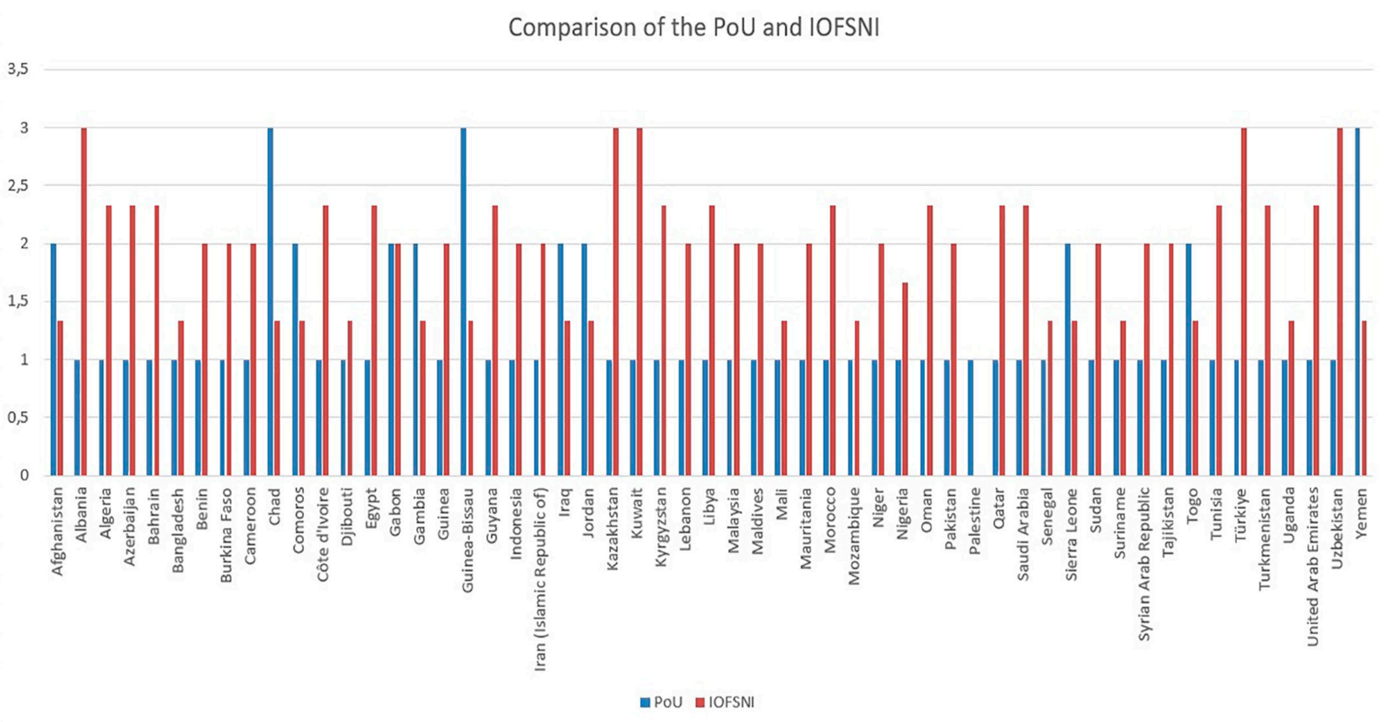


Figure 2. Comparison of Percentage of Undernourishment and IOFS Food Nutrition Index, 2020
Source: IOFS staff calculations based on UN FAO, 2023

Figure 2 demonstrates a close alignment between the FNI and the PoU index. It's important to recognize that while they are related, the PoU index serves a different purpose than the FNI. The PoU index represents the percentage of a country's population experiencing inadequate nutrition, while the FNI considers total calorie levels and the significance of various food types based on the WFP's criteria. Consequently, it is not reasonable to expect a country with a low FNI ranking to have a high PoU value. Nevertheless, FNI can serve as a useful reference point when considering the PoU index's value.

According to the UN FAO, the average cost of a healthy diet per day (CoAHD) in 2020 amounted to USD 3.54. Unfortunately, in certain OIC countries, daily earnings fall below USD 1.90, leaving them more susceptible to acute food insecurity due to limited financial access to nutritious food (Figure 3).

To enhance the accessibility and affordability of nutritious food in OIC, addressing underlying issues such as poverty, income inequality, agricultural productivity, trade policies, and nutrition education are essential. Implementing sustainable farming practices, investing in infrastructure, supporting local food production, and establishing social safety programs are all key strategies that can bolster food security and increase the affordability of healthy diets for OIC MS.

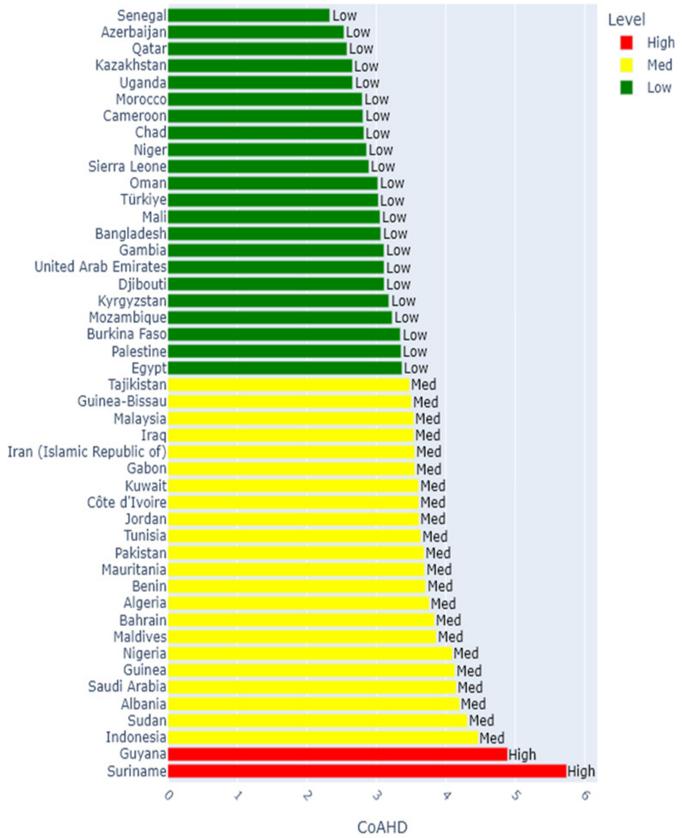


Figure 3. Costs of a healthy diet
(PPP dollar per person per day) in OIC MS in 2020
Source: IOFS staff calculations based on UN FAO STAT, 2023

Food Price Indexes

One of the sets of food security indicators relates to the changes in world markets, such as the potential to meet food shortfalls: food price stability and its levels. These affect both the ability to finance imports via export earnings and changes in the food import bill, themselves potential indicators of changes in the food security situation.

Given that most of the member states are net importers of food commodities, they become the ones most seriously affected by rising prices. Especially, where net agricultural imports account for more than 5% of their GDP as well as low GDP per capita making their consumers very sensitive to food price shocks (e.g., Syria, The State of Palestine, Yemen, and Algeria, Mauritania, Jordan, and Lebanon). Only a few countries, either large oil exporters and/or more developed with higher GDP per capita, seem to be able to cope with price shocks in world agricultural markets (Kuwait, Qatar, Saudi Arabia, Türkiye).

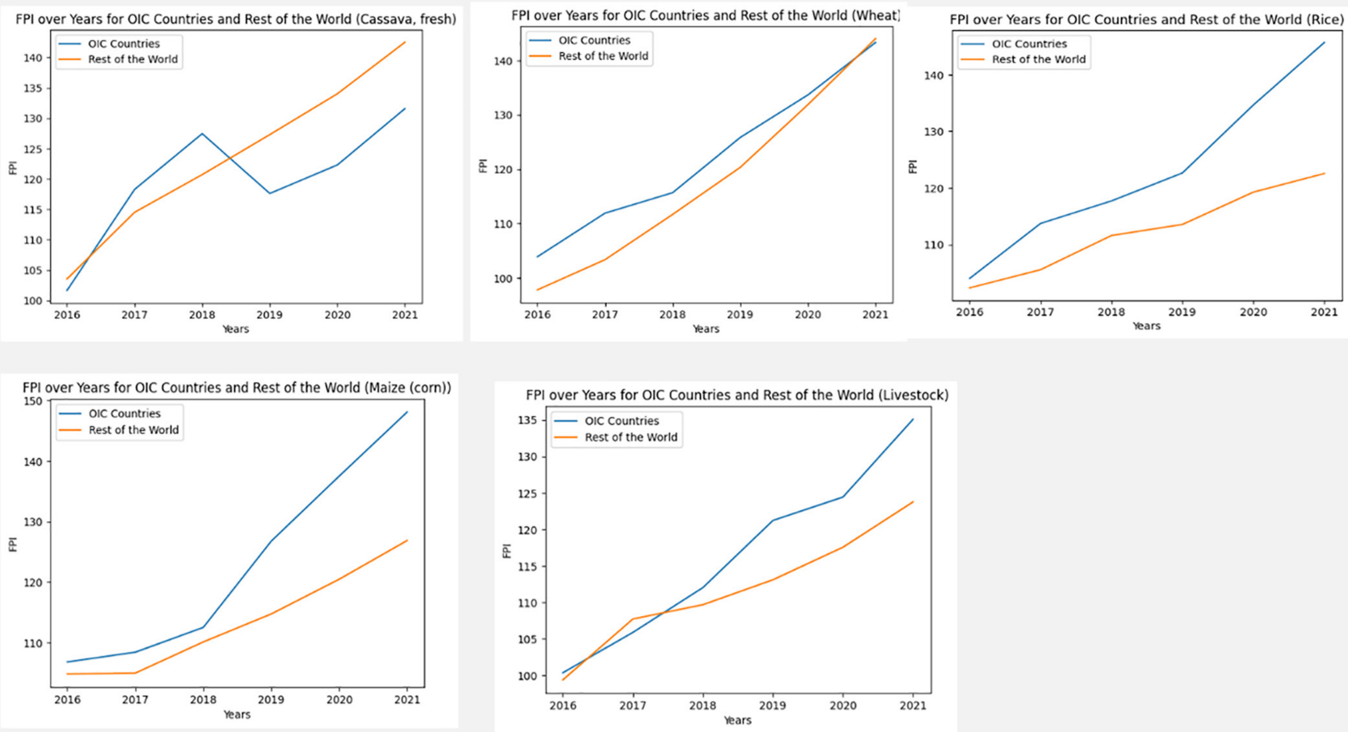
Such a tendency is the result that most OIC MS are unable to produce enough volume, due to different circumstances, as extremely dependent on imports of food, especially wheat, rice, and other staple grains. As a result, people suffer from the double burden of malnutrition: stunting and obesity.

In the Sahel, the Republic of Burkina Faso, the Republic of Chad, the Republic of Mali, the Islamic Republic of Mauritania, and the Republic of the Niger with climatic shocks (high rivers and flash floods) and some uncertainties driven by regional and international markets, the food prices are likely to remain at very high levels. The prices of basic staples in Mali and Sudan in 2020 doubled, and up to 80 percent above the five-year average, caused by embargoes applied by Economic Community of West African States (ECOWAS) and adverse weather reflected in the harvesting.

Influence on the prices for strategic commodities such as rice, maize, and livestock remain high in the OIC compared to the rest of the world and on average in 2021. The situation differs (lower) only in cassava (fresh), as it is the result of local usage and unpopularity in the rest of the world. The highest retreat was observed in maize indexation in 2020 (Figure 4). At the same time, the price index of wheat was at the same level as in the rest of the world, even lower at the level of -0.7 ppt in 2021. The main concern of such differences is that most of the countries in OIC are chronic importers of the commodities and the slight changes in world agri-food markets, are reflected primarily in the pricing policy within the countries and contribute to the aggravation of food availability among the population, especially in countries with a high risk of food security.

Some countries are taking steps to minimize the effects of higher prices, through taking the easy options of restricting food exports, setting limits on food prices, or both (for example banning exports, reducing imports, and others). Some OIC member states have responded to the soaring food prices following different approaches, depending on each country's specifics. However, most countries are generally characterized by subsidies dominating the policy response, a high share of staples in consumption, high dependence on imported food, and relatively

high malnutrition rates (for income levels). Destruction of the international food supply chains due to the impact of COVID-19 promoted many countries to delocalize production or seek a better balance between imported and locally produced food, which was a sound of the strategies for robustness and resilience.



* Change

Source: IOFS staff calculations based on UN FAO, 2023 access March 2023

Note: The graphs elaborated based on the FPI data e

Figure 4 Food Price Indexes (FPI) for main agri-food commodities in OIC compared to the world FPIs, 2021

Given the high dependence of the people, especially the marginalized groups of the population, on agricultural resources, improving agricultural productivity will enhance food security by making food available in the hopes that this shall improve the livelihoods of the impoverished strata of the population, which remains to be an important objective of agriculture in the future.

As per the recommendations on price control policy, the following areas should be included in the internal policies to regulate food prices:(1) comprehensive food and nutrition initiatives to diversify the diet, and meet short/medium-term needs (2) investment in agriculture, particularly in agricultural science and technology and in market access, at a national and global scale to address the long-term problem of boosting supply; and (3) trade policy reforms, in which developing countries would revise their agricultural trade policies.

Conclusion

The Food and Nutrition Index (FNI) developed by the IOFS emerges as a crucial tool for understanding and evaluating food security situations comprehensively, encompassing dimensions such as consumption, access, and nutritional value. Collaborative efforts among OIC member countries are paramount for addressing the root causes of food insecurity and achieving sustainable development goals.

Against the backdrop of formidable challenges, a multifaceted approach to address food security within OIC member countries should be considered, which underscores the importance of enhancing agricultural productivity, investing in infrastructure, and promoting trade policy reforms to ensure the availability and affordability of nutritious food. Additionally, the significance of collaborative endeavors and international partnerships in addressing underlying factors contributing to food insecurity and advancing sustainable development objectives.

The review emphasizes the disparities in food access and affordability among OIC member countries, exacerbated by external factors such as global market fluctuations and climatic shocks. To mitigate these challenges, policies must focus on diversifying diets, investing in agricultural technology, and reforming trade policies to promote resilience and robustness in the face of disruptions. Also, a critical need for concerted action at national and international levels to address food security challenges within the OIC, recognizing the diverse contexts and specificities of member countries. By prioritizing collaboration, innovation, and equitable access to resources, OIC member countries can work towards a future where all individuals have access to safe, nutritious, and affordable food, thereby advancing the well-being and prosperity of their populations.

EN SUMMARY

Food security remains a pressing global concern, particularly in Organization of Islamic Cooperation (OIC) member states (MS), where millions of people face challenges accessing safe and nutritious food. This article presents an in-depth assessment of food and nutrition security within OIC MS, highlighting the impact of various factors such as the COVID-19 pandemic, conflicts, rising costs, and environmental instability. The Islamic Organization for Food Security (IOFS) has developed the Food and Nutrition Index (FNI) to measure and understand the food security situation comprehensively. The FNI provides valuable insights into food consumption, access, and nutrition, enabling targeted policies and international partnerships to address food security challenges. Strategies to improve agricultural productivity, enhance infrastructure, and promote trade policy reforms are essential for ensuring food security and the affordability of healthy diets. Despite challenges, collaborative efforts among OIC member countries are crucial for addressing underlying factors contributing to food insecurity and achieving sustainable development goals.

FR RÉSUMÉ

La sécurité alimentaire demeure une préoccupation urgente à l'échelle mondiale, particulièrement dans les États membres (EM) de l'Organisation de la coopération islamique (OCI), où des millions d'individus luttent pour accéder à une alimentation sûre et nutritive. Cet article fournit une évaluation détaillée de la situation de la sécurité alimentaire et nutritionnelle au sein des EM de l'OCI, soulignant l'impact de facteurs variés tels que la pandémie de COVID-19, les conflits, la hausse des coûts et les instabilités environnementales. Pour une compréhension globale de la sécurité alimentaire, l'Organisation islamique pour la sécurité alimentaire (IOFS) a élaboré l'Indice de sécurité alimentaire et nutritionnelle (ISAN), un outil mesurant de manière exhaustive la sécurité alimentaire. L'ISAN apporte des données essentielles sur la consommation, l'accès à l'alimentation et la nutrition, favorisant l'élaboration de politiques spécifiques et la formation de partenariats internationaux pour répondre aux défis alimentaires. Des initiatives visant à augmenter la productivité agricole, à améliorer les infrastructures et à encourager des réformes des politiques commerciales sont vitales pour assurer la sécurité alimentaire et faciliter l'accès à des régimes alimentaires équilibrés. En dépit des obstacles, une collaboration renforcée entre les pays membres de l'OCI est essentielle pour surmonter les causes profondes de l'insécurité alimentaire et atteindre les objectifs de développement durable.

AR ملخص

لا يزال الأمن الغذائي مصدر قلق عالمي ملح، لا سيما في الدول الأعضاء في منظمة التعاون الإسلامي، حيث يواجه ملايين الأشخاص تحديات في الوصول إلى طعام آمن ومغذي. تقدم هذه المقالة تقييمًا متعمقًا للأمن الغذائي والتغذوي داخل الدول الأعضاء في منظمة التعاون الإسلامي، مع تسليط الضوء على تأثير عوامل مختلفة مثل جائحة كوفيد-19، والصراعات، وارتفاع التكاليف، وعدم الاستقرار البيئي. قامت المنظمة الإسلامية للأمن الغذائي بتطوير مؤشر الغذاء والتغذية (FNI) لقياس وفهم حالة الأمن الغذائي بشكل شامل. يوفر المؤشر رؤى قيمة حول استهلاك الغذاء، والوصول إليه، والتغذية، مما يتيح للسياسات المستهدفة والشراكات الدولية مواجهة تحديات الأمن الغذائي. وتعد استراتيجيات تحسين الإنتاجية الزراعية، وتعزيز البنية التحتية، وتشجيع إصلاحات السياسة التجارية ضرورية لضمان الأمن الغذائي والقدرة على تحمل تكاليف النظم الغذائية الصحية. وعلى الرغم من التحديات، فإن الجهود التعاونية بين الدول الأعضاء في منظمة التعاون الإسلامي تعتبر حاسمة لمعالجة العوامل الأساسية التي تساهم في انعدام الأمن الغذائي وتحقيق أهداف التنمية المستدامة.

HUNGER AS A WEAPON: FOOD SECURITY CRISIS AND HUMANITARIAN FAILURE IN GAZA UNDER ISRAELI AGGRESSION

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Since October 7, 2023, Gaza has been exposed to the harshest Israeli aggression in decades, pushing its food system to the brink of collapse, paving the way for a potential famine. According to the World Food Program (WFP) and Office for the Coordination of Humanitarian Affairs (OCHA), dire situation is unfolding in northern Gaza where food shortages are imminent. While the relief efforts are underway, access limitations undermine their effectiveness. Food security experts warn of a looming agricultural collapse in northern Gaza, with significant damage to croplands and infrastructure, exacerbated by evacuation orders and displacement. The conflict has ravaged agricultural resources, with 46.2% of cropland damaged. Over one quarter of wells have been destroyed, and 339 hectares of greenhouses, most severely in Gaza City, north Gaza, and Khan Younis, have suffered extensive destruction. Additionally, the harvest of olives and citrus fruits, dairy farms, and livestock which crucial income and nutrition resources, has been heavily impacted.[1]

The situation is catastrophic, with heavy damage to water infrastructure and dwindling food supplies. Urgent humanitarian aid is needed to address the crisis, with calls for restoring basic services like health, electricity, and sanitation. Without significant intervention, Gaza faces the looming spectre of famine. The recent report[2] by the Palestine Food Security Cluster delineates a concerning reality. Approximately 2.2 million individuals are presently confronting food Crisis phase of food insecurity (Integrated Food Security Phase Classification-IPC Phase 3 or above), while 1.17 million people are grappling with Emergency levels of IPC Phase 4. Moreover, over half a million individuals are confronting Catastrophic levels of food insecurity (IPC Phase 5). This grim picture underscores the urgent necessity for uninterrupted and secure humanitarian corridors to facilitate the delivery of critical aid across Gaza. Despite the normative expectation of approximately 39,000 trucks entering Gaza since October 7 under ordinary circumstances, as of January 18, only 8,572 aid trucks have been recorded entering Gaza since the onset of the conflict, representing a mere 17% of the anticipated traffic. Notably, a portion of these trucks is dedicated to the transportation of human food items, amounting to around 5,256 units. However, this quantity remains insufficient to adequately address the basic nutritional requirements of the 2.2 million individuals in need, particularly in light of the disruption and non-operational state of food markets, compounded by the doubling of the population in need[3]. As the worst to come, according to World Health Organisation (WHO) in northern Gaza, approximately 300,000 residents endure severe malnutrition, exacerbated by critical shortages of fuel, food, and medical supplies, and tragically, over 20 children have lost their lives due to hunger signalling the existential threat to the rest of the residents[4]. This scenario exemplifies yet another tragic instance of starvation being employed as a tactic of warfare, echoing a recurring war crime documented throughout diverse epochs of global history.

From this particular case, it is crucial to underline the political dimension inherent in deliberately induced famines. The criminalization of institutions like The United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNRWA), through unfounded accusations aimed at undermining the foundations of aid structures supporting Palestinians[5], or what is sometimes referred to as "aid washing"—the practice of pretending to provide genuine humanitarian aid while merely making symbolic gestures— involves Western states, including the US and UK, providing costly but merely symbolic air dropping of food aid[6] instead of pressuring the occupying state to facilitate the Rafah border crossings. This tactic serves to obscure the harsh realities perpetuated by the Israeli occupation and control system. These aggressive attacks on civilians not only obstruct the truth but also transform it into a logistical challenge, thereby diluting the severity of the crisis. This approach risks relegating the plight of Palestinians to the realm of other conflicts, such as civil wars and governance failures in different countries, thereby diminishing its urgency and international attention on the reality of aggression and occupation.

In examining the crisis in Gaza, it is pertinent to contextualize it within the conceptual frameworks of famine, which inherently entail politicization and are intertwined with power dynamics. According to Devereux[7], "old famine" theories have several limitations including i) depersonalizing and depoliticizing famines" describing it as

1 UN News Brief, https://news.un.org/en/story/2024/02/1146997
2 Palestine Food Cluster Situation Report, 13 https://fscluster.org/sites/default/files/documents/GAZA_UPDATE_%2313_0.pdf
3 ibid., p.3
4 https://www.bbc.com/news/world-middle-east-68471572
5 https://www.hrw.org/news/2024/02/12/unrwas-demise-would-be-catastrophic-gaza
6 https://www.bbc.com/news/world-middle-east-68478831
7 Devereux, Stephen. The new famines: why famines persist in an era of globalization . Routledge, 2006. p.7

"acts of God" making them unscientific, ii) only focusing disrupted availability of food (crop failure) and failing to look at failure of access to food, and mechanisms for response to shortage and limited food availability, of iii) also failing to see social segmentation of access to food from political dimensions (some people are more vulnerable than the others, for instance). The "new famines" on the other hand, are not result of natural disasters or population growth, yet they are manmade political action or inaction and even the disruptions of production and market famines are preventable through internal public transfers and international aid system. This new generation famines transform the political priority regimes to act intentionally which makes famines avoidable. Another influential scholar, Howe introduces "priority regimes" points to the political preferences and trade-offs that create and/or prevent famine situations, with the layers of immediate action to denial, and points out wider choices and priorities from decision makers to create the dynamics of famine over time.[8] Howe mentions three general tendencies for famine response: First, regimes externalize the famine process limiting them in a certain area. Giving a distance somehow relates the role of aid actors. Secondly, some of them isolate the famine situations that creates the ruptures from the systemic problems of the global environment and this ad-hoc attention creates a false uniqueness. Finally, other approaches "negativize" the cases with a reductionist view that highlight simple trigger events of climate or conflict ignoring complexity. He summarizes the various interactions of the priorities and gives a relationship figure based on the ends and means citing "neglect, byproduct, trade-off, means, famicide and response"[9]. Both international actors and states can use famine as a weapon for intervention or a short cut political instrument to reach political ends. As we see here in the table, the spectrum changes from the absolute criminality (famicide) to righteous humanitarianism (famine response) and these choices are embedded with political aims.

In the specific instance of famicide creation in Gaza, the apparent lack of significant action by humanitarian actors for response draws attention to another pressing issue of the priority regime: the enduring challenge of occupation and Israel's persistent disregard and non-adherence to international law and UN Resolutions[10]. Despite recent efforts by the International Criminal Court, whose decisions hold symbolic and rights-based significance, their practical impact on relief efforts and humanitarian access remains limited[11]. This context is closely associated with what Scott-Smith calls the tragedy of modern bureaucratic humanitarianism. First, this entails the conversion of compassion into a standardized procedure, prioritizing physical over social needs, and reducing humanitarians to mere technocrats implementing uniform relief efforts. Secondly, this approach is founded on a flawed notion: the belief that by adopting a technocratic stance, politics can be kept separate from humanitarian endeavours.[12] However, Scott-Smith contends this to be a fallacy, as politics permeates not only through the effects of aid but also in the micro-level practices involved[13]. Despite the acknowledgment that hunger is politically charged and starvation stems from various factors with social implications, the urgency of emergencies often sidelines addressing root causes and promoting long-term solutions for challenging the various aspects of the occupation. In the case of Gaza, Israeli produced famine overlaps with the findings of other authors whom they point out mass starvation is a strategy, often driven by political,

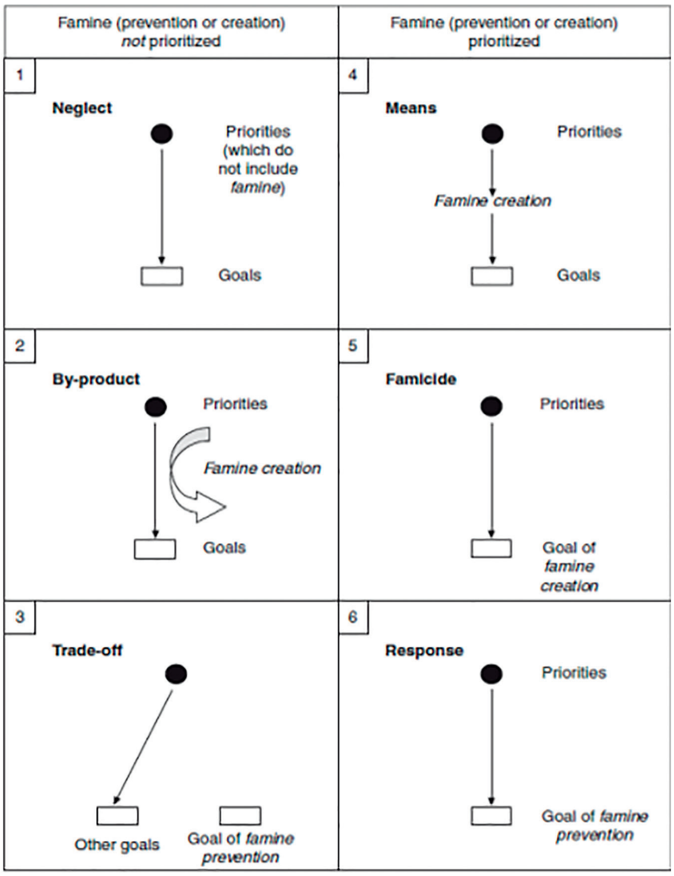

Figure 1: Relationships of priority regimes to famine (Howe, 2006:347)

economic, or military motives, and can result from deliberate acts or neglect, such as the obstruction of relief aid. Aid manipulation frequently occurs in conflict settings, where access is restricted and resources diverted, often influenced by geopolitical considerations[14].

In response to the humanitarian catastrophe in Gaza, the Islamic Organization for Food Security (IOFS) is taking proactive measures in line with its mandate. As outlined in Article 4 of its statute, the IOFS is mandated to engage in humanitarian programs upon the relevant requests of the Organization of Islamic Cooperation (OIC). This includes establishing regional mechanisms to aid during food emergencies, natural disasters, and similar crises, tailored to the unique circumstances of each member state. The IOFS Secretariat is planning to address the urgent humanitarian crisis by initiating the distribution of 1000 tonnes of wheat flour as an initial step, as part of Flour for Humanity program with potential for further action based on needs. This endeavour underscores the IOFS's commitment to alleviating the suffering of vulnerable populations in Gaza and draws inspiration from past successful humanitarian interventions, such as the Afghanistan Food Security Program last year. Such initiatives are vital in enabling the IOFS to fulfil its mission of providing immediate assistance to those in need in Palestine, reflecting the core purpose of the OIC and countering this intentional famicide efforts of the occupier state and accomplices.

8 Howe, Paul. "Priority regimes and famine." The new famines. Routledge, 2006. p.340
9 ibid., p.347
10 Imseis, Ardi. "Negotiating the illegal: On the United Nations and the illegal occupation of Palestine, 1967–2020." European Journal of International Law 31.3 (2020).
11 https://www.amnesty.org/en/latest/news/2024/02/israel-defying-icj-ruling-to-prevent-genocide-by-failing-to-allow-adequate-humanitarian-aid-to-reach-gaza/
12 Scott-Smith, Tom. Defining hunger, redefining food: humanitarianism in the twentieth century. Dissertation, University of Oxford, 2014.p. 329
13 ibid., p.345
14 Devereux, Stephen, Lewis Sida, and Tina Nelis. "Famine: lessons learned." (2017). Institute of Development Studies Report

EN SUMMARY

Gaza grapples with a dire humanitarian crisis, marked by severe food shortages and infrastructure damage exacerbated by heightened Israeli aggression since October 7, 2023. The looming threat of famine for over 2.2 million residents underscores the urgent need for international attention and action. However, relief efforts are hindered by complex political dynamics, emphasizing the necessity for concerted action to alleviate suffering and tackle underlying issues effectively. The crisis in Gaza epitomizes "new famines," politically induced and rooted in political factors like the ongoing occupation. Belonging to this new genre Gaza case underscore the deliberate manipulation of food resources for political gain, highlighting the imperative of addressing the root causes of conflict and occupation in Palestine, beyond mere humanitarian food support.

FR RÉSUMÉ

Gaza fait face à une crise humanitaire critique, caractérisée par de sévères pénuries alimentaires et des dégâts aux infrastructures aggravés par une intensification de l'agression israélienne depuis le 7 octobre 2023. Plus de 2,2 millions d'habitants sont menacés de famine, ce qui met en lumière l'urgence d'une mobilisation et d'une intervention internationales. Toutefois, les efforts de secours sont compliqués par des dynamiques politiques complexes, ce qui appelle à une action coordonnée pour atténuer la souffrance et aborder efficacement les causes profondes du problème. La situation à Gaza incarne les «nouvelles famines», où la faim est politiquement induite et ancrée dans des situations politiques telles que l'occupation prolongée. Ce cas, illustrant une manipulation délibérée des ressources alimentaires à des fins politiques, souligne la nécessité de s'attaquer aux racines des conflits et de l'occupation en Palestine, au-delà de l'aide alimentaire humanitaire.

AR ملخص

تواجه غزة أزمة إنسانية حادة، تتميز بنقص حاد في الغذاء وأضرار في البنية التحتية تفاقمت بسبب العدوان الإسرائيلي المتزايد منذ 7 أكتوبر/تشرين الأول 2023. ويؤكد التهديد الوشيك بحدوث مجاعة لأكثر من 2.2 مليون ساكن الحاجة الملحة إلى الاهتمام والعمل الدوليين. ومع ذلك، فإن جهود الإغاثة تعرقلها ديناميكيات سياسية معقدة، مما يؤكد ضرورة العمل المتضافر لتخفيف المعاناة ومعالجة القضايا الأساسية بشكل فعال. إن الأزمة في غزة تلخص «المجاعات الجديدة»، الناجمة سياسياً والتي تمتد جذورها إلى عوامل سياسية مثل الاحتلال المستمر. إن الانتماء إلى هذا النوع الجديد من حالة غزة يسلط الضوء على التلاعب المتعمد بالموارد الغذائية لتحقيق مكاسب سياسية، ويسلط الضوء على ضرورة معالجة الأسباب الجذرية للصراع والاحتلال في فلسطين، بما يتجاوز مجرد الدعم الغذائي الإنساني.

WHEAT LANDSCAPE OF PAKISTAN TO BENEFIT FOOD SECURITY IN THE OIC GEOGRAPHY

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Background

Food systems basically shape lives, meet basic needs of life including human and environmental health, and help to overcome some of the most pressing global challenges of our time. Global interventions helped to transform food systems from unsustainable and inequitable trajectories to a sustainable, equitable and resilient one. Indus-basin is one of the Agri food systems which is under continuous transformation and providing calories to the fast-growing population. Wheat is a predominantly food crop in this system. Historically, Indus-basin is part of the Indian sub-continent food system, where history witnessed 50+ million deaths during 10 famines from 1769-70 to 1943-44. Initiation of Agricultural technological intervention especially wheat breeding in 1907 resulted in release of 10 wheat varieties from 1911-1965 and helped to overcome food shortage and famines. History shows only one famine in 1943-44 with casualty of 1.5 million people. After "Green Revolution", no famine witnessed in Indo-Pak subcontinent.

Since its domestication around 10,000 years ago, wheat has played a crucial role in global food security. Wheat now supplies a fifth of food calories and protein to the world's population. It is the most widely cultivated crop in the world, cultivated on 219 million ha annually with an annual production of 785 million tonnes of grains. Wheat is the mainstay of agriculture across the major wheat producing OIC member countries. The relative share of wheat used for food in total production varies greatly across the major producers and consumers of wheat in OIC countries. Among the top-20 consumers of wheat, food use of wheat is higher than the local production in 12 member countries. In other words, the majority of these countries depend on imports to satisfy the local demand for wheat. The relative share of OIC countries in global wheat exports and imports was recorded at 2% and 42.2%, respectively. Wheat consumption is expected to be 11% higher in 2032 than in the base period. Four countries account for two-fifths of this increase: India, Pakistan, Egypt, and China. Globally, the projected increase in consumption of wheat for food is more than three times larger than that for feed, especially in Asia where there is increasing demand for processed products, such as pastries and noodles. These products call for higher quality, protein rich wheat, produced in the United States, Canada, Australia and, to a lesser extent, in the European Union. Countries in the North Africa and Western Asia, such as Egypt, Türkiye, and the Islamic Republic of Iran, will remain major consumers of wheat with high levels of per capita consumption.

Pakistan is leading wheat producer in the OIC geography while ranked at 8th position globally. There were technological interventions which helped Pakistan to increase wheat production through horizontal and vertical expansion. The story of the development of high yielding varieties (HYVs) in Mexico is inextricably linked to their introduction in Pakistan and several other Third World countries.

Among the agricultural interventions, training of human resource, new genetics and varieties, nutritional (fertilizer) and mechanical interventions are prominent which contributed significantly. There is still room for improvement to enhance the productivity of this Agri Food System at least two times. The productivity enhancement started once Borlaug came in 1960, when he toured the country as a member of a FAO Rockefeller Foundation team studying wheat production problems in North Africa, the Middle East and South Asia. The first Pakistani scientists had contact with him and resulted in "Green Revolution" in South Asia. Pakistan national wheat production increased from 4 million tons in 1965-66 to over 7 million tons by 1968-69, making Pakistan the first developing country in Asia to achieve self-sufficiency in wheat production. The achievement was primarily due to new genetics "semi-dwarf wheat – Mexi-Pak 65" bred through crossing of Pakistani and Mexican wheat varieties which was an outcome of training program of four Pakistani scientists at CIMMYT. Subsequently, with the collaboration of CIMMYT, Pakistan continuously improved its productivity to the current level of 27+ million tonnes annually.

Since 2010, the weather patterns in Pakistan have been in a constant flux. Shifting monsoons, delayed winters, early spring heat shocks, intense heatwaves in summer, droughts and floods in different parts of the country in different years keep adding to the uncertainty. The implications of unpredictable weather for agriculture and food security are serious. Among the strategies to address climate change and elevate wheat yields, hybridization stands out as offering significant potential for substantial yield boosts and breeding innovations. Yet, realizing this potential requires a foundation of technological advancements to support wheat programs effectively. Most recently, Pakistan collaborated with University of Sydney Australia in partnership with Australian Center for International Agricultural Research, and Washington State University USA to introduce new genetics to overcome the challenges of drought and heat waves and for productivity and resilience enhancement of the wheat system.

The Islamic Organization for Food Security (IOFS) acknowledges wheat's pivotal role and is actively promoting initiatives to enhance its production within member states. To benefit from the strengths of Pakistan, IOFS has concluded a comprehensive Hands-on Training session on Wheat Breeding Technologies in Pakistan, in collaboration with the University of Sydney Plant Breeding Institute, University of Agriculture Faisalabad and the MNS University of Agriculture Multan. Participants, hailing from various OIC Member States Tunisia, Libya, Egypt, Iraq, Kazakhstan, Tajikistan, and Uzbekistan, were given a unique chance to evaluate innovative genetic solutions such as hybrid wheat production, including an extensive commercial hybrid seed production at farmers and private seed producer farms across diverse scales.

Experimental farm University of Agriculture Faisalabad in Pakistan

IOFS and Sydney University experts visited field at University of Agriculture Faisalabad (UAF), Pakistan and observed drought, heat and salinity tolerant wheat genotypes. Wheat breeding team at UAF maintains a working germplasm collection of 5000+ accessions. Drought tolerant wheat genotypes also included self-irrigated types having novel leaf traits to capture gaseous water for self-irrigation. The genotypes were well with only one supplemented irrigation after 25 days of sowing. Heterotic pool development at micro, mini and macro scale, and limited commercial scale production were of significant interest of the visiting team.

Field visits at experimental farm University of Agriculture Faisalabad in Pakistan

Large scale hybrid wheat seed production (commercial) in parallelly drilled long strips of male and female parents at experimental farm University of Agriculture Faisalabad in Pakistan. The University has distributed hybrid wheat seed among 350+ farmers across the country to test its suitability and performance on farmers' fields.

Capacity building of wheat seed producers

Hybrid wheat breeders are building the capacity of farmers and public and private wheat seed producers to produce and test hybrid seed at their own farms. Some of Farms were visited by the IOFS and Sydney University experts.

Rana Iqbal Siraj Farm, Luddan, Mailsi, Pakistan

Prof. Dr. Richard Trethowan, Dr. Rebecca Thistlethwaite and The Islamic Organization for Food Security (IOFS) delegate witnessed a hybrid wheat production plot of 4 ha and hybrid wheat plot of 40 ha at Rana Iqbal Siraj Farm, a progressive wheat grower in the South Punjab of Pakistan. The hybrid wheat crop was vigorous and significantly better than to OPV best cultivar.

LCI Research and Development Farm Multan, Pakistan

LCI is a seed company, engaged in developing and testing wheat hybrids. They are observing different phenotypic traits of the hybrid wheat such as height, uniformity, synchronization of anthesis of male and pollination time of female. They are testing their hybrids at multilocation.

Fatima AG Farm Pirowal, Pakistan

Fatima AG is an agriculture enterprise and engaged in developing and testing wheat hybrids. They are observing different phenotypic traits of the hybrid wheat such as height, uniformity, synchronization of anthesis of male and pollination time of female. They are testing their hybrids at multilocation.

Experimental farm MNS University of Agriculture Multan in Pakistan

The hybrid wheat is involved in developing wheat hybrids that are resistant to biotic and abiotic stresses, have high yield potential, and are well-suited for the local agro-climatic conditions. Heterotic pool and hybrid trial was in well shape and attractive.

Overall, Pakistani two universities have developed 2000+ locally produced hybrids and tested in multilocational trials. More than 10 hybrids showed 20% or more yield gain (over best OPV cultivar) with all national traits of disease resistance, yield and quality which have the potential to be scaled up. Australia has developed and tested 5000+ hybrids across 58 environments and 7 years, 1119 hybrids performed > than SUNTOP (wheat cultivar). Prof. Richard Trethowan appreciated the efforts of Pakistani team and mentioned that Pakistan is ahead of Australia in commercialization of wheat hybrids. The practical insights into the adaptation of drought and heat tolerant wheat and climate resilient hybrid wheat in varied agroecological conditions, along with advanced techniques in agricultural mechanization and precise sowing methods for male and female plants, aiming to boost seed production were very valuable and has the potential to benefit other Member States having similar agroecological conditions.

EN SUMMARY

Food systems meet basic needs of life where wheat is mostly a predominantly food crop. Wheat consumption is expected to be 11% higher in 2032 than in the base period. Four countries account for two-fifths of this increase: India, Pakistan, Egypt, and China. Pakistan is leading wheat producer in the OIC geography while ranked at 8th position globally. Training of human resource, new genetics and varieties, nutritional (fertilizer) and mechanical interventions are prominent which contributed significantly and helped Pakistan to increase wheat production from 4 million tons in 1965-66 to 27+ million tonnes in 2022-23. Improvement in the Indus-basin Agri Food System has the potential to double its productivity. Most recently, Pakistan collaborated with University of Sydney Australia in partnership with Australian Center for International Agricultural Research, and Washington State University USA to introduce new genetics to overcome the challenges of drought and heat waves and for productivity and resilience enhancement of the wheat system. To benefit from the strengths of Pakistan, IOFS has concluded a comprehensive Hands-on Training session on Wheat Breeding Technologies in Pakistan providing mobility to the participants hailing from various OIC Member States Tunisia, Libya, Egypt, Iraq, Kazakhstan, Tajikistan, and Uzbekistan.

FR RÉSUMÉ

Les systèmes alimentaires satisfont des besoins vitaux, avec le blé comme culture alimentaire essentielle. On projette une augmentation de la consommation de blé de 11% d'ici 2032 par rapport à la période de référence, principalement attribuable à l'Inde, le Pakistan, l'Égypte, et la Chine, qui ensemble représentent près de deux cinquièmes de cette croissance. Parmi les pays de l'Organisation de la coopération islamique (OCI), le Pakistan est le plus grand producteur de blé, occupant la huitième position au niveau mondial. Des avancées importantes dans la formation des ressources humaines, le développement de nouvelles variétés génétiques, ainsi que des interventions nutritionnelles et mécaniques ont permis au Pakistan d'augmenter sa production de blé de 4 millions de tonnes en 1965-66 à plus de 27 millions de tonnes en 2022-23. L'amélioration du système agroalimentaire dans le bassin de l'Indus pourrait potentiellement doubler cette productivité. Récemment, le Pakistan a collaboré avec l'Université de Sydney en Australie, le Centre australien de recherche agricole internationale, et l'Université d'État de Washington aux États-Unis pour introduire de nouvelles variétés génétiques visant à surmonter les défis liés à la sécheresse et aux vagues de chaleur, et pour améliorer la productivité et la résilience du système céréalier. En reconnaissance des capacités du Pakistan, l'IOFS a organisé une session de formation approfondie sur les technologies de sélection du blé au Pakistan, avec la participation de membres de divers pays de l'OCI tels que la Tunisie, la Libye, l'Égypte, l'Irak, le Kazakhstan, le Tadjikistan et l'Ouzbékistan.

AR ملخص

تلبي النظم الغذائية الاحتياجات الأساسية للحياة حيث يكون القمح في الغالب محصولًا غذائيًا. ومن المتوقع أن يرتفع استهلاك القمح بنسبة 11% في عام 2032 عما كان عليه في فترة الأساس. وتمثل أربع دول خمسي هذه الزيادة: الهند، وباكستان، ومصر، والصين. تعد باكستان منتجًا رائدًا للقمح في جغرافية منظمة التعاون الإسلامي بينما تحتل المرتبة الثامنة عالميًا. يعد تدريب الموارد البشرية وعلم الوراثة والأصناف الجديدة والتدخلات الغذائية (الأسمدة) والميكانيكية أمرًا بارزًا مما ساهم بشكل كبير وساعد باكستان على زيادة إنتاج القمح من 4 ملايين طن في 1965-1966 إلى +27 مليون طن في 2022-2023. ومن شأن تحسين نظام الأغذية الزراعية في حوض السند أن يؤدي إلى مضاعفة إنتاجيته. وفي الآونة الأخيرة، تعاونت باكستان مع جامعة سيدني بأستراليا بالشراكة مع المركز الأسترالي للبحوث الزراعية الدولية، وجامعة ولاية واشنطن بالولايات المتحدة الأمريكية لإدخال علم الوراثة الجديد للتغلب على تحديات الجفاف وموجات الحرارة ولتعزيز الإنتاجية والمرونة في نظام القمح. للاستفادة من نقاط القوة في باكستان، اختتمت المنظمة الإسلامية للأمن الغذائي جلسة تدريبية عملية شاملة حول تقنيات تربية القمح في باكستان مما أتاح إمكانية التنقل للمشاركين القادمين من مختلف الدول الأعضاء في منظمة التعاون الإسلامي تونس وليبيا ومصر والعراق وكازاخستان وطاجيكستان وأوزبكستان.

IOFS NEWS OVER JANUARY-FEBRUARY-MARCH

New Director General Assumes Office at the Islamic Organization for Food Security

By the decision of the 6th IOFS General Assembly, held in Doha, Qatar on 03 October 2023, Ambassador Askar Mussinov has been elected the Director General of the Islamic Organization for Food Security (IOFS), as of 01 January 2024.

IOFS Strengthens Collaborative Ties with OIC Islamic Universities

On 16 January 2024 at the Headquarters of the Organization of Islamic Cooperation (OIC) in Jeddah, Kingdom of Saudi Arabia, the delegation of the Islamic Organization for Food Security (IOFS), attended the First Coordination Meeting of OIC Islamic Universities and relevant OIC Institutions, an initiative of H.E. Hissein Brahim Taha, Secretary General of the OIC. The IOFS, represented by Prof. Dr. Zulfiqar Ali, Director of Programs & Projects Department shared food security insights, perspectives and potential areas of collaboration and cooperation with OIC Universities in partnership with other OIC Institutions. The IOFS emphasized its intentions to continue and strengthen its active engagement with OIC Universities and Institutions in the implementation of its ongoing initiatives in the field of food security, particularly in the context of different mandates emanated from relevant OIC Meetings, including the 9th Ministerial Conference on Food Security & Agricultural Development, held on 03 October 2023 in Doha State of Qatar.

IOFS Director General Holds Strategic Meetings with SESRIC

On 17 January 2024, H.E. Ambassador Askar Mussinov, the Director General of the Islamic Organization for Food Security (IOFS), continued to engage in strategic discussions during the 7th Annual Coordination Meeting of OIC Institutions (ACMOI), including meetings with the Director General of the Statistical, Economic and Social Research and Training Centre for Islamic Countries (SESRIC), H.E Mrs. Zehra Zümrüt Selçuk.

IOFS Director General Holds Meeting with SMIIC Secretary General at ACMOI Sidelines

On 17 January 2024, the Director General of the Islamic Organization for Food Security (IOFS) Ambassador Askar Mussinov held a meeting with H.E Mr. Ihsan Ovut, Secretary General of the Standards and Metrology Institute for Islamic Countries (SMIIC), during the Annual Coordination Meeting of OIC Institutions (ACMOI), in Jeddah, Kingdom of Saudi Arabia.

Kazakhstan's President Highlights Commitment to IOFS during FAO Meeting

On 19 January 2024 in Rome, Italy, during a meeting with Qu Dongyu, Director-General of the Food and Agriculture Organizaiton (FAO), Kazakh President H.E. Kassym-Jomart Tokayev underscored the country's dedication to the Islamic Organization for Food Security, as Kazakhstan assumes the chairmanship for the current year. The Head of State spoke about the priorities of the country as it chairs the International Fund for Saving the Aral Sea and the Islamic Organization for Food Security.

IOFS signs Memorandum of Understanding and Action Plan with WDO

On 17 January 2024, the Director General of the Islamic Organization for Food Security (IOFS) Ambassador Askar Mussinov and the Executive Director of the Women Development Organization (WDO) Dr. Afnan Alshuaiby officially signed a Memorandum of Understanding (MoU) and Action Plan between the two institutions in Jeddah, Kingdom of Saudi Arabia. The MoU outlines possible ways of cooperation between two OIC institutions aimed at protection, leadership, and empowerment, education, entrepreneurship, and economic empowerment of women.

IOFS Enriches its 2024 Workplan at the 7th Annual Coordination Meeting of OIC Institutions (ACMOI)

On 17-18 January 2024, a delegation of the Islamic Organization for Food Security (IOFS), headed by Director General Amb. Askar Mussinov attended the proceedings of the 7th Annual Coordination Meeting of OIC Institutions (ACMOI), which was held at the General Secretariat of the Organization of Islamic Cooperation (OIC). Considering the relevance and variety of the subjects under IOFS Agenda, Prof. Zulfiqar Ali, Director of Programmes & Projects Department, participated at the Science & Technology Committee, while Mr. Abdula Manafi Mutualo, Advisor at Coordination & Cooperation Department was at the Economic Affairs Committee. Both IOFS representatives were vocal in calling for strengthened coordination among all Institutions towards agreeing on suitable activities in the field of food security and agricultural development.

On the sidelines of the referenced gathering, the IOFS Director General had some bilateral meetings, including with Their Excellencies Prof. Dr. Mohammad Rafiqul Islam, Vice-Chancellor of the Islamic University of Technology (IUT), Mrs. Latifa El Bouabdellaoui, Director General of the Islamic Centre for Development of Trade (ICDT), and Dr. Mansur Muhtar, Vice President of the Islamic Development Bank (IsDB), with whom issues of mutual interests were discussed within the context of ensuring cooperation and coordination towards successfully implementing the IOFS 2031 Strategic Vision geared to addressing the challenges of food insecurity faced by some Member States.

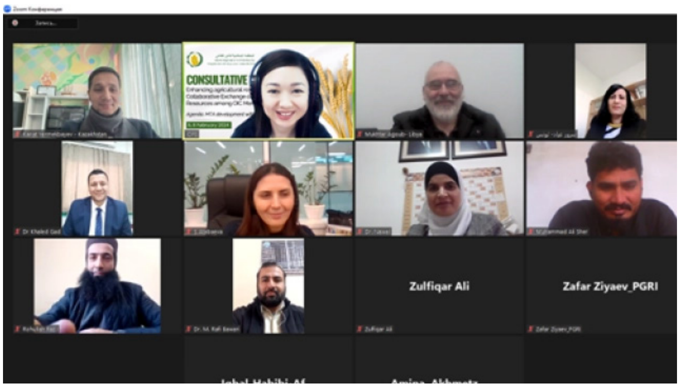
12th Executive Board Meeting of the IOFS Convenes in Astana

On 29-30 January 2024, the 12th Executive Board Meeting of the Islamic Organization for Food Security (IOFS) convened for its statutory meeting at the Organization›s headquarters to, inter alia, review the past activities and to chart the course for the Organization›s work in 2024. The meeting, chaired by H.E. Dr. Masoud Jarallah Al-Marri of the State of Qatar, is the first of its gathering to welcome H.E. Amb. Askar Mussinov in his capacity as the IOFS Director General. The attendees that showcased the collaborative spirit and commitment of the Executive Board, counted with the Honorary Chair, H.E. Eng. Al-Howaish of the Kingdom of Saudi Arabia, alongside distinguished members as H.E. Eng. Muhammad Musa Al-Amiri from the United Arab Emirates, H.E. Mr. Alibek Bakayev from the Republic of Kazakhstan (hosting country of the IOFS), H.E. Mr. Maina Hamadou from the Republic of Cameroon. Representatives from Republic of Tajikistan, Ms. Nigina Anvari and from the Islamic Republic of Pakistan, Captain Muhammad Asif, followed the proceedings remotely.

IOFS Director General and Libyan Ambassador Discuss Strategic Cooperation in Food Security and Agriculture Development

The Director-General of the Islamic Organization for Food Security (IOFS), H.E. Amb. Askar Mussinov, met with H.E. Alaadin Adbussalam Lehwaik, the Ambassador Extraordinary and Plenipotentiary of the State of Libya to the Republic of Kazakhstan, at the IOFS Headquarters on 01 February 2024. During the visit, H.E. Ambassador Lehwaik extended his congratulations to Amb. Mussinov on his appointment as the Director-General of the IOFS and conveyed his best wishes for the success of the Organization in implementing its' vital mission of addressing food security challenges in Member States. The meeting offered an opportunity to review the current state of bilateral relations between the IOFS and State of Libya.

Consultative Webinar on the Development of Material Transfer Agreement for the Wheat Germplasm Exchange within the OIC Geography



The Islamic Organization for Food Security (IOFS) hosted a Webinar on 06-08 February 2024, titled "Consultative Webinar on the Development of Material Transfer Agreement for the Wheat Germplasm Exchange within the OIC Geography." This pivotal event marks the first step towards the establishment of a nursery distribution system aimed at enhancing the productivity, resilience, and nutritional value of wheat across the OIC member states.The webinar convened 14 esteemed wheat breeders from diverse countries, including Kazakhstan, Tunisia, Jordan, Uzbekistan, Pakistan, Turkiye, Libya, Tajikistan, and Afghanistan. These experts shared invaluable insights into the phytosanitary practices and regulations of their respective countries.

IOFS and Niger Strengthen Collaboration to Enhance Food Security Initiatives

On 07 February 2024, a virtual bilateral meeting took place between H.E. Amb. Askar Mussinov, Director General of the Islamic Organization for Food Security (IOFS), and H.E. Colonel Mahaman ELHADJI OUSMANE, Minister of Agriculture and Livestock of the Republic of Niger. The meeting focused on fostering cooperation to address agricultural and food security challenges in Niger.Both parties reaffirmed their commitment to advancing food security agendas and identified key areas of cooperation. The Secretary General of Niger's Ministry of Agriculture and Livestock presented the Ministry's current plans and priorities, emphasizing crucial areas for agricultural development and food security. The IOFS expressed strong support for these initiatives and agreed to provide assistance and support.

IOFS Director General Holds Meeting with Ambassador of Türkiye to Kazakhstan

On 08 February 2024, the Director General of the Islamic Organization for Food Security (IOFS), H.E. Ambassador Askar Mussinov, welcomed H.E. Mustafa Kapucu, the Ambassador of the Republic of Türkiye to the Republic of Kazakhstan, to the IOFS headquarters. The change of views between the two dignitaries marked a pivotal step in strengthening ties and exploring new collaborative opportunities.

IOFS Director General Receives Ambassador of Iraq to Kazakhstan

On 09 February 2024, His Excellency Ambassador Askar Mussinov, Director General of the Islamic Organization for Food Security (IOFS), welcomed His Excellency Dr. Jaber Al-Tamimi, the Chargé d'Affaires of the Republic of Iraq to the Republic of Kazakhstan, at the IOFS headquarters. This meeting provided an opportunity to exchange views and review the existing relationships between both parties.

IOFS Director General Holds Online Bilateral Meeting with Benin's Minister of Agriculture, Livestock, and Fisheries

On 09 February 2024, the Director General of the Islamic Organization for Food Security (IOFS), H.E. Askar Mussinov held an online bilateral meeting with H.E. Mr. Gaston Cossi DOSSOUHOUI, Minister of Agriculture, Livestock, and Fisheries of the Republic of Benin. The meeting aimed to discuss collaboration opportunities and priorities in agricultural development and food security between Benin and IOFS.

In Loving Memory of Ambassador Askar Mussinov

It is with profound sorrow and deepest respect that we, the staff of the Islamic Organization for Food Security (IOFS), commemorate the illustrious life of Ambassador Askar Mussinov, our esteemed former Director General, who departed from us at the age of 63, on 10 February 2024. Ambassador Mussinov's legacy is one of exemplary dedication and unyielding commitment to advancing global food security and fostering international diplomacy.

Ambassador Mussinov was a beacon of wisdom and leadership, a distinguished diplomat whose career was marked by a visionary zeal for international cooperation. Under his stewardship, the IOFS began to flourish increasingly. His prior high-level diplomatic roles showcased his profound understanding and adept handling of complex international relations, earning him accolades and respect across the global community.

As we reflect on his monumental contributions, we are reminded of his passion for humanitarian causes and his tireless work that has left an indelible impact on the world. The void left by his passing is deeply felt, yet his spirit and principles will continue to inspire and guide us in our mission.

We extend our heartfelt condolences to his family, friends, and all those touched by his remarkable life. Ambassador Mussinov's legacy will forever be a cornerstone of our commitment to nurturing a safer, more secure world.

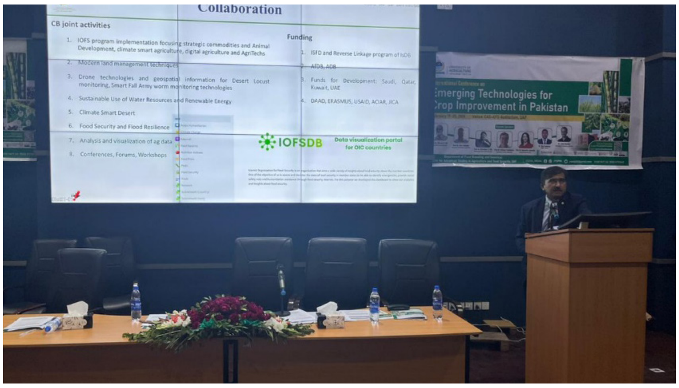
IOFS Headquarters Hosts Tribute to Ambassador Askar Mussinov

On 13 February 2024, the Islamic Organization for Food Security (IOFS) Secretariat solemnly hosted the signing of the Tribute and Memorial Book in honor of the late Ambassador Askar Mussinov, the esteemed Director General of IOFS. Ambassador Mussinov's passing on 10 February 2024, has deeply grieved the international diplomatic community. On this occasion, distinguished ambassadors gathered from 13-15 February at the IOFS headquarters to pay their respects and honor the memory of Ambassador Mussinov.

IOFS Co-Organizes Training on AI Application in Agriculture in Mauritania

From 13-15 February 2024, in Nouakchott, Mauritania, the Islamic Organization for Food Security (IOFS), in partnership with COMSTECH (Ministerial Standing Committee on Scientific and Technological Cooperation of the OIC), the Mauritanian Government represented by the Ministry of Higher Education, Science and Research, and the National Agency of Scientific Research and Innovation, along with other esteemed partners, conducted a significant three-day Training Workshop titled "The Application of Artificial Intelligence in Precision Agriculture for Food Security." Bringing together a diverse audience of over 70 government officials, researchers, academia, and representatives from the private sector and industry from 9 OIC Member States including Mauritania, Algeria, Egypt, Mali, Qatar, Türkiye, Pakistan, Niger and Uganda the event has been set to accelerate progress in farming methods using artificial intelligence.

Islamic Organization for Food Security Embarks on Official Visit to Pakistan

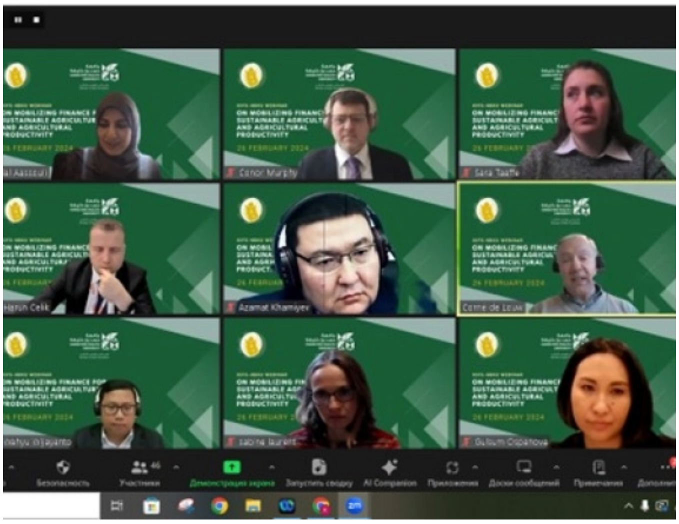


The Islamic Organization for Food Security (IOFS) delegation visited Pakistan from 19-20 February 2024, marking a significant step in fostering agricultural innovation and collaboration. In partnership with the University of Agriculture Faisalabad (UAF), the Australian Centre for International Agricultural Research (ACIAR), and the International maize and Wheat Improvement Center (CIMMYT), the IOFS organized the International Conference on Emerging Technologies for Crop Improvement. This gathering served as a platform for leading experts to convene and discuss strategies to enhance crop productivity, fortify nutrition, and promote sustainability through methodologies like biofortification, sustainable intensification, and the adoption of technologies such as genetically modified (GM) and hybrid crops.

Hand on Training on Wheat breeding technologies in Pakistan

The Islamic Organization for Food Security (IOFS) with esteemed partners including University of Agriculture Faisalabad (UAF), MNS University of Agriculture Multan, and the University of Sydney through the Australian Centre for International Agricultural Research (ACIAR), has embarked on an intensive Hands-on Training program for wheat breeding practices and technologies across the Organization of Islamic Cooperation (OIC) Member States, held from 19-23 February 2024, in Pakistan. This unique training initiative spans the cities of Faisalabad and Multan, showcasing cutting-edge wheat breeding trials, including hybrid breeding techniques.Participants hailing from Tunisia, Libya, Egypt, Iraq, Kazakhstan, Tajikistan, and Uzbekistan engaged in comprehensive theoretical sessions led by eminent figures such as Prof. Dr. Zulfiqar Ali from IOFS and Prof Dr. Richard Trethowan and Dr Rebecca from University of Sydney.

IOFS-HBKU Webinar on Financing Sustainable Agriculture Marks Success in Advancing Global Food Security Goals



The Islamic Organization for Food Security (IOFS) and Hamad Bin Khalifa University conducted a collaborative webinar titled "Mobilizing Finance for Sustainable Agriculture and Agriculture Productivity." Hosted on 26 February 2024, the virtual event brought together an esteemed panel of experts and stakeholders to delve into critical strategies for financing sustainable agriculture in alignment with the Sustainable Development Goals (SDGs).

IOFS Mobilizes Youth Towards Sustainable Management of Water Resources during Arab Water Summit

From 04th to 07th March 2024 in Rabat, Morocco, the Islamic Organization for Food Security (IOFS), marked a significant stride in mobilizing young minds from across the Arab world, including Morocco, Egypt, Lebanon, Palestine, Kuwait, Syria, the United Arab Emirates, and Libya, towards the sustainable management of water resources, during the Arab Water Summit.

A Deep Dive Discussion into the Arab Water Commitment to Water Management

On 05 March 2024, in a concerted effort towards sustainable water management in the Arab region, the Islamic Organization for Food Security (IOFS) conducted a series of dynamic workshops to address the complexities of water challenges. These workshops featured interactive sessions aimed at harnessing the innovative potential of youth in water management, fostering collaboration among participants from various Arab nations.

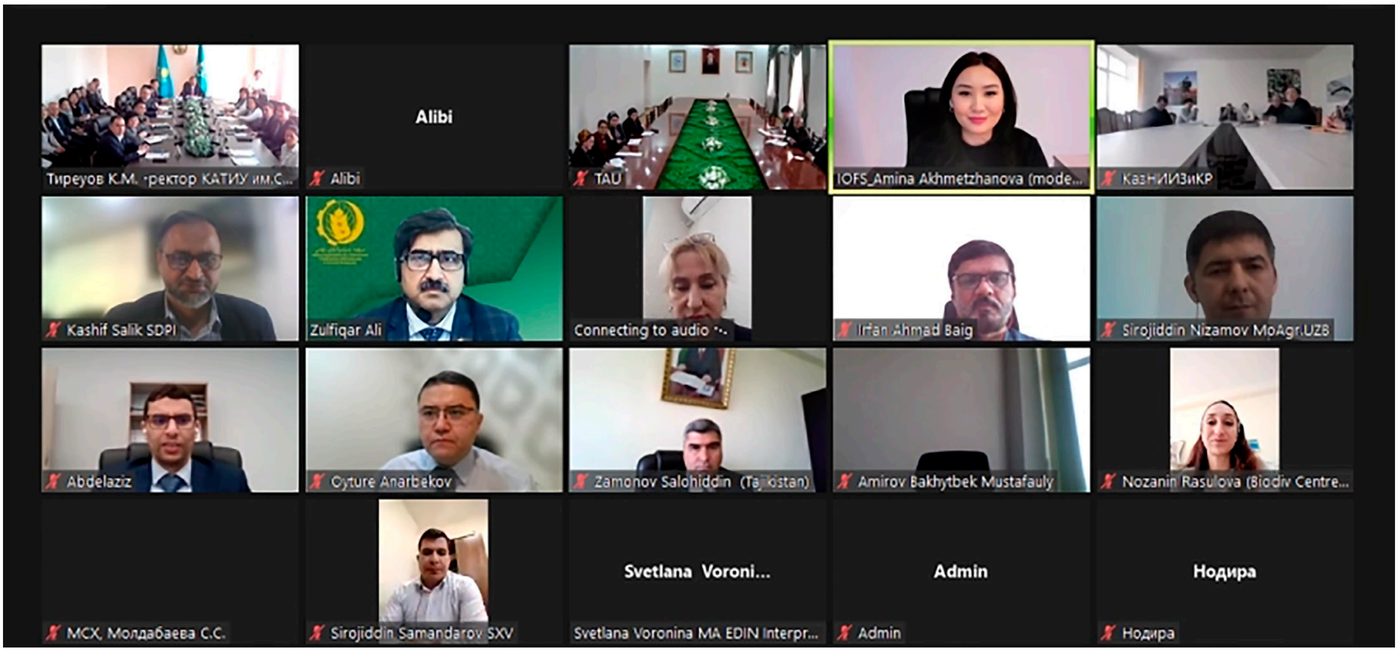
UK Embassy Delegation Explores Livestock Sector Development with IOFS

On 14 March 2024, a delegation from the United Kingdom Embassy in Kazakhstan, comprising of Dr. Rob Grinnall, Veterinary Consultant at UK Export Certification Limited, Meruyert Kairbekova, Agriculture Sector Lead at the Department for Business and Trade, Kazakhstan, and Paul Greenhalgh, Deputy Head of Mission at the British Embassy Dushanbe, visited the Islamic Organization for Food Security (IOFS) on the sidelines of the Agritek Farmtek Astana 2024 Fair. The purpose of the visit was to engage in discussions with IOFS on various issues related to livestock and genetics.

Islamic Organization for Food Security and Central Asia Climate Foundation Forge Partnership to Combat Climate Change in Central Asia

The Islamic Organization for Food Security and the Central Asia Climate Foundation held an online meeting on 2nd April 2024 to forge a strategic partnership aimed at addressing climate change challenges in Central Asia. This collaboration highlights their shared dedication to crafting sustainable solutions for climate adaptation and mitigation in the region.

Islamic Organization for Food Security Initiates a Project to Enhance Climate Resilience in Central Asia



The Islamic Organization for Food Security (IOFS) announced the commencement of a significant initiative titled "Integrating Climate-Smart Agriculture into Food Security Policy Frameworks in Central Asia". This initiative is designed to fortify the agricultural sectors of Kazakhstan, the Kyrgyz Republic, Tajikistan, Turkmenistan, and Uzbekistan against the adverse effects of climate change, thereby ensuring sustainable food security in the region.The launch was officiated through an inaugural webinar conducted on the 4th of April, 2024, which witnessed the participation of an extensive consortium of stakeholders. This assembly included national policymakers, esteemed agricultural experts, representatives of science and academia, as well as international organizations. The primary goal of the webinar was to establish a collaborative foundation for the promotion and adoption of Climate-Smart Agriculture (CSA) practices across the nations of Central Asia.

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