WELCOME MESSAGE OF H.E. PROF. YERLAN A. BAIDAULET DIRECTOR GENERAL OF IOFS

OVERVIEW OF THE WHEAT GROWING IN OIC GEOGRAPHY AND IOFS INTERVENTIONS TO IMPROVE WHEAT PRODUCTIVITY

MOVING TOWARDS DIGITAL AGRICULTURE: IOFS E-CENTERS OF EXCELLENCE FOR STRATEGIC COMMODITIES

IOFS TO DISPATCH HUMANITARIAN CONVOY TO AFGHANISTAN

المنظمة الإسلامية للأمن الغذائي
Islamic Organization for Food Security
l'Organisation Islamique pour la Sécurité Alimentaire

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CONTENT

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Dear Readers,
assalamu'alaikum warahmatullahi wabarakatuh!

I am pleased to present to you the 11th edition of the IOFS Food Security Hub, which focuses on wheat development in member countries of the Organization of Islamic Cooperation (OIC).

In today's world, with the ongoing global crisis, wheat has been recognized as a vital and highly demanded food crop. In addition, as an OIC strategic commodity wheat contributes to the state of food security in the majority of OIC Member States.

In most of these countries, the future outlook for wheat production and consumption could be influenced by a number of factors. Firstly, population growth in many OIC Member States is expected to drive up demand for wheat in the coming years. In order to meet this growing demand, countries may need to invest more in their agricultural sectors, improve infrastructure and develop new technologies to increase productivity. Secondly, rising incomes and growing urbanization in many OIC countries are likely to increase demand for processed and packaged foods made using wheat as a key ingredient. The above-mentioned elements will further drive demand for wheat in these countries.

Despite these positive trends, there are several challenges that may impact the future outlook for wheat in the OIC geography. One major challenge is the threat of climate change, which could reduce yields and increase the risk of crop failures. Another challenge is the need for increased funding of research and development to introduce new technologies and advanced agriculture practices that can help farmers grow wheat more efficiently and sustainably. Hybrid wheat is among the top innovative technologies that are becoming popular globally.

Against this backdrop, the future outlook for wheat, globally and within OIC Member States, is likely to be shaped by a number of factors, including climate change, technological advancements and economic trends. While there are challenges to overcome, the continued growth of the demand for wheat and the need for sustainable food production present opportunities for investment and innovation in the agricultural sector. With the right policies and investments, OIC Member States should build resilient and sustainable agricultural systems that could help ensure food security and promote economic growth in the coming years.

IOFS is striving hard to explore and find the best practices globally and scale up its production in the OIC Member States to overcome food insecurity. In this issue of the Food Security Hub, you will be able to read and analyze that achieving the target of food security is scientifically possible. Hybrid wheat, packaged with precise and innovative agronomic practices and quality seed supply chain can revolutionize wheat production and help eradicate hunger and poverty.

Sincerely,

Prof. Yerlan A. Baidaulet

IOFS Director General

EN SUMMARY

The future outlook for wheat, globally and in OIC member countries, is likely to be shaped by a number of factors, including climate change, technological advancements, and economic trends. While there are challenges to overcome, the continued growth of demand for wheat and the need for sustainable food production present opportunities for investment and innovation in the agricultural sector. With the right policies and investments, OIC member countries can build resilient and sustainable agricultural systems that can help ensure food security and promote economic growth in the coming years.

FR RÉSUMÉ

Les perspectives d'avenir du blé, au niveau mondial et dans les pays membres de l'OCI, sont susceptibles d'être façonnées par un certain nombre de facteurs, notamment le changement climatique, les progrès technologiques et les tendances économiques. Certes, il y a des défis à relever, mais la croissance continue de la demande de blé et la nécessité d'une production alimentaire durable offrent des possibilités d'investissement et d'innovation dans le secteur agricole. En adoptant des politiques et des investissements appropriés, les pays membres de l'OCI peuvent mettre en place des systèmes agricoles résilients et durables qui peuvent contribuer à assurer la sécurité alimentaire et à promouvoir la croissance économique dans les années à venir.

AR ملخص

من المرجح أن تتأثر التوقعات المستقبلية للقمح، على الصعيد العالمي وعلى صعيد البلدان الأعضاء في منظمة التعاون الإسلامي، بمجموعة من العوامل، بما فيها تغيّر المناخ والتقدم التكنولوجي والاتجاهات الاقتصادية. وعلى الرغم من التحديات القائمة التي يتعين التغلب عليها، فإن النمو المستمر للطلب على القمح والحاجة إلى إنتاج غذائي مستدام يُتيحان فرصًا للاستثمار والابتكار في القطاع الزراعي. ويمكن للبلدان الأعضاء في منظمة التعاون الإسلامي، من خلال اعتمادها للسياسات والاستثمارات الملائمة، أن تبني أنظمة زراعية مرنة ومستدامة قادرة على المساهمة في ضمان الأمن الغذائي وتعزيز النمو الاقتصادي خلال السنوات القادمة.

ENSURING FOOD SECURITY IN A CHANGING CLIMATE: THE PROMISE OF CLIMATE RESILIENT WHEAT HYBRIDS

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Nourishing the population is the most sensitive and top priority for any country. Wheat is a staple food crop that is widely cultivated and consumed across the world, influencing the political economy of many countries. One-fourth of the global population lives on one-fifth of global land in OIC member countries. The majority of this population is wheat dependent for their staple food. OIC member countries produce more than 110 million tons of wheat from about 50 million ha (Figure 1). Nine out of 57 OIC member countries namely Pakistan, Türkiye, Kazakhstan, Iran, Egypt, Morocco, Uzbekistan, Iraq, and Afghanistan cultivate 88% of land and produce about 88% of wheat grains.

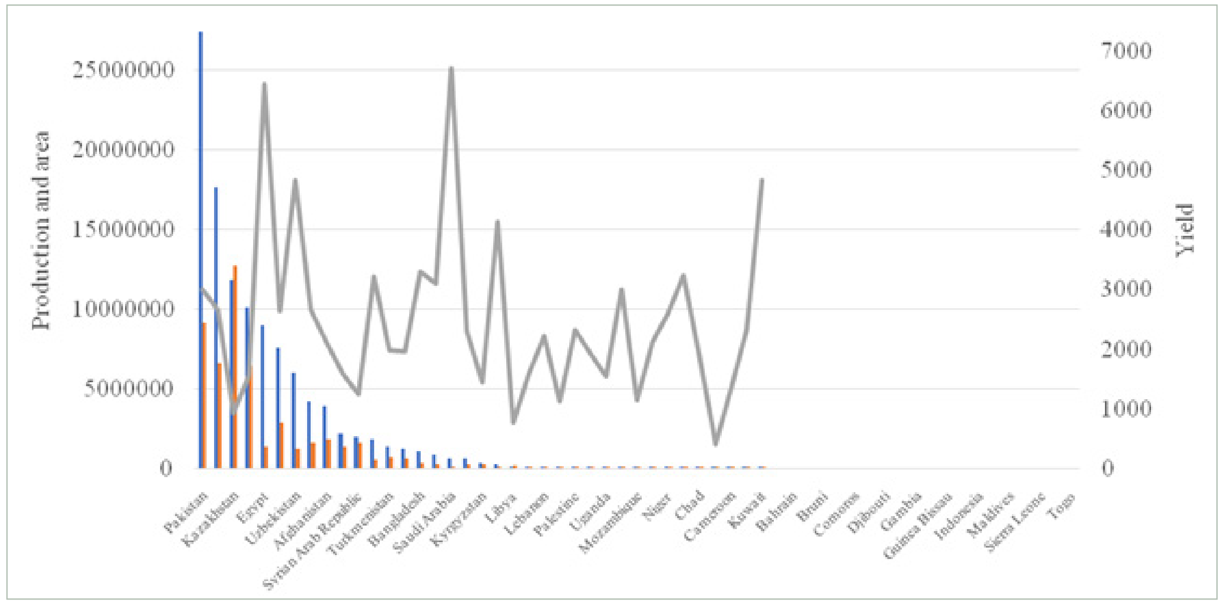
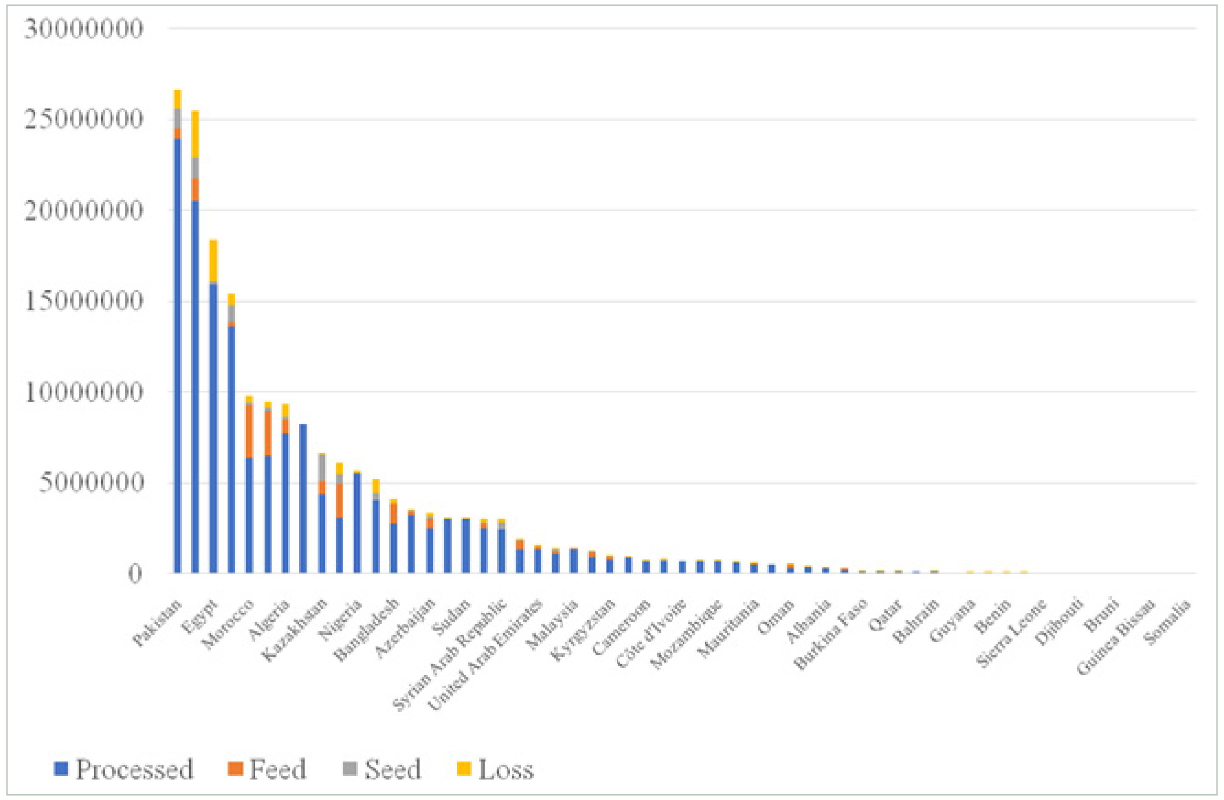


***Figure 1:** Area, production and yield of wheat in OIC member countries. Source FAOSTAT 2023, latest access on February 18, 2023.*

OIC countries have to net import upward of 80 million tons of wheat to meet their demand of about 190 million tons (Figure 2). This demand is expected to continue to grow in the coming years, driven by increasing demand from growing populations, urbanization, and rising incomes. Moreover, dietary habits are also changing and the demand for special-purpose kinds of wheat like pasta and biscuit wheat, biofortified wheat (high in Fe and Zn), low-gluten wheat, organic wheat, etc. is increasing. On the other hand, globally, the prices have doubled in the last two years due to climate change and the global political situation, which, ultimately, left a large population food insecure. The situation of food security in OIC member countries will become more alarming as the pace of growth in demand will increase.

A



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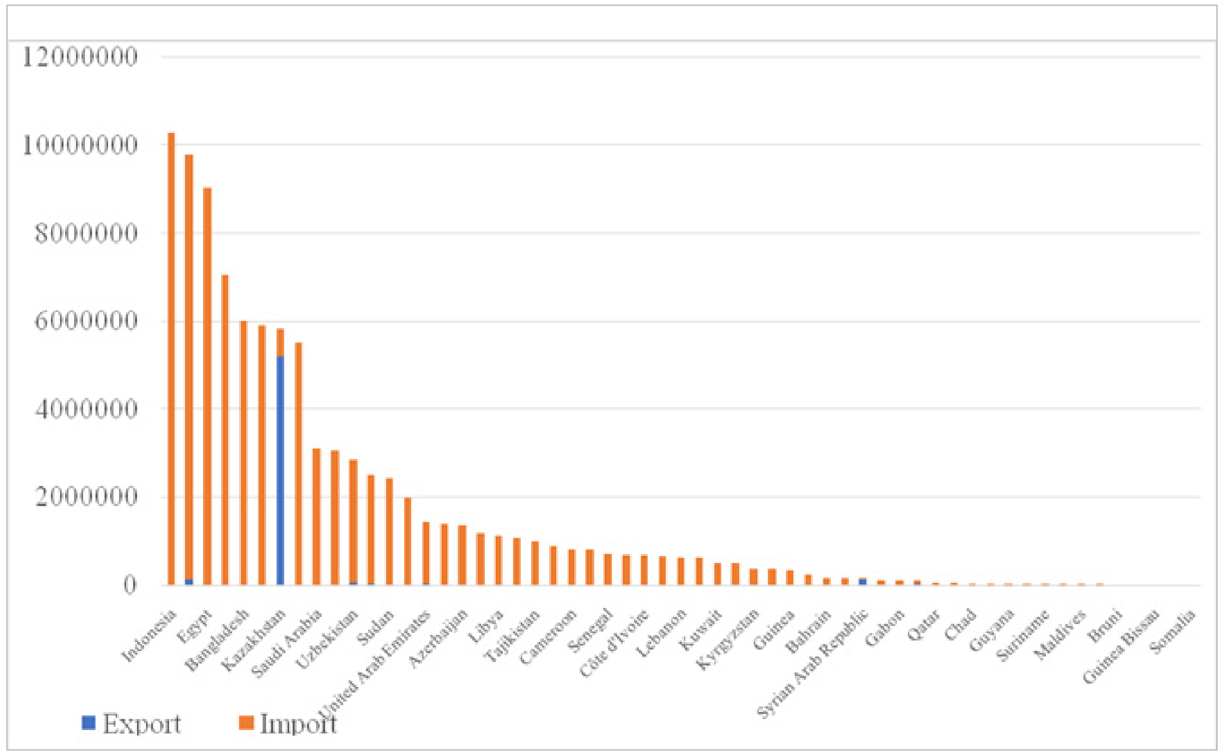


***Figure 2**: Wheat balance in OIC countries: (A) demand and (B) export/import pattern of wheat. Source FAOSTAT 2023 latest access on February 18, 2023.*

Globally, wheat-dependent populations, including OIC member countries, are facing multifaceted challenges to their food security. The biggest challenges and threats to food security in these populations include:

1. Climate change: One of the biggest challenges to agriculture is climate change, including greater frequency of abrupt changes in precipitation magnitude and distribution patterns, seasonal shift and shortening, temperature erratic changes and warming, and new pests/diseases. These changes are affecting wheat production via poor crop stand and tillering, high temperature during anthesis and grain formation stages, severe lodging and rust attack.

2. Rust: In recent years, rusts are emerging as a potential threat to the wheat economy throughout the world. Due to climate change, the environment is becoming very conducive for its sexual reproduction to evolve new pathotypes, which are virulent to most of the resistant gene(s) combinations. In the near future, potentially, it can invade rust-resistant wheat varieties on a large scale. It's necessary to understand locally emerging new pathotypes of rusts and combinations of resistance gene(s) in wheat for food security.

3. Grain yield stagnation: The trend of grain yield is almost stagnant in top-producing countries like Pakistan i.e. 2.5 t/ha to 2.9 t/ha. The yield of Egypt and Uzbekistan, which is higher than in Pakistan, is among the top nine wheat-producing OIC countries (Figure 1).

4. Seed quality: Repeated sowings of self-kept low-quality seed by farmers are a problem. Seed is not produced as a seed crop with proper roughing to maintain true-to-type plants. Proper seed quality standards are not followed during processing, packaging, storing, and logistics. Wheat system in OIC countries also has poor or lacks seed testing and traceability facilities.

5. Precision or SMART Technology: Technology applications are critical to making agriculture competitive, efficient, cost-effective, profitable and hence, sustainable. The Green Revolution could not have occurred with the adoption of high-yielding varieties (HYV) alone. That was a combination of HYVs, chemical fertilizers and mechanization. The quantitative gains from HYVs and chemical applications could be handled with machines only. Precision agriculture is an evolved version of technology applications where mechanization has combined the use of remote sensing, satellite imagery, digital cameras and sensors, IoTs, artificial intelligence, etc. for better machine operations and sustainable solutions, especially sowing machines for proper seed placement, and harvesting machines. These technologies are not being applied in most of the OIC countries.

6. Soil Health: Most of the OIC member countries located in deserts/sub-deserts have poor soil health, soil health replenishment and crop rotational plan.

7. Losses: The magnitude of wheat grain losses is above 11 million tons in OIC countries (Figure 2A). Investment and resources to establish proper infrastructure to overcome these losses are scanty.

8. Value addition and marketing: Poor product development and marketing infrastructure.

9. These populations are further facing challenges of high population growth rate, poverty, lack of diet diversification and malnutrition.

10. Policy: Poor policy interventions to invest in R&D to improve seed genetics and quality, soil health, agronomic practices, the infrastructure of roads, storage and marketing, as well as reduce population growth, poverty and malnutrition.

SOLUTION:

To mitigate these challenges, farmers will need to adopt new technologies and practices that can help them grow wheat more efficiently and sustainably. Leaving aside the market part, it is believed that the current wheat crisis would persist in the future if we failed to break the stagnation in wheat yield genetically and/or agronomically. Food security for OIC countries demands achieving the goal of producing 190 million tons of wheat within the next few years and doubling its productivity within 10 years. Achieving that target is scientifically possible. There are three strategic ways to ensure food security in OIC countries.

Innovative agronomic practices of precision agriculture: Scaling up of best practices of high-yielding countries like Egypt and the Kingdom of Saudi Arabia yielding more than 6,400 kg/ha to other top wheat-producing OIC countries like Pakistan, Türkiye, Kazakhstan, Iran, Egypt, Morocco, Uzbekistan, Iraq, and Afghanistan. Enhancing the average yield of 2,493 kg/ha of OIC countries to 4,000 kg/ha will ensure meeting wheat demand.

The world has moved ahead with better options for precision agriculture while we are struggling to achieve a desirable level of mechanization. Our lag in catching up with the technological revolution has made agriculture uncompetitive due to the high cost of production and lower yields. Farm Mechanization is grossly insufficient and obsoleted, it is time to increase horsepower and available digital applications. The use of freely available and continuously improving high-resolution satellite imagery and weather data can be used for decision support in agriculture. The use of deep learning, machine vision and artificial intelligence to assess the irrigation water needs of crops on an as-needed basis is a usable application to enhance productivity in water-scarce countries. Fertigation practices and biofertilizer applications are yet to evolve to an easy form by an ordinary farmer and are necessary to be adopted by farmers for better soil health management and reducing costs. Realizing the limitations of the small farmers, the service providers' option has to be made possible. That can only happen through a major investment strategy where public expenditure could incentivize private investment (credit) and entrepreneurship.

Intervention to ensure quality wheat seed supply chain: The stagnant wheat yields are significantly attributable to the lack of adaptation of new wheat varieties. While wheat breeding programs have delivered a steady flow of new varieties (HYVs), this has not reached the farmer fields effectively. The quality of the seed sown by the farmer is substandard. There is a consensus that seeds with 99% purity and vigor can contribute up to a 15% increase in yield gains. The national Seed Acts of some countries provide a legal framework for the supply of certified seed to the farmers but an informal seed system is also a fact to be brought in the main streamline of quality seed production.

Traditionally, a home-saved seed has dominated wheat plantings. The green revolution brought in HYVs for which the growers remained interested. There is an instinctive demand for HYVs. However, the farmer remains underserved or incapacitated to take advantage of the newly released wheat varieties. Legally, the seed supply chain begins with the approval of a breeder's variety within the scope of the Seed Act. The weaker links in the seed supply chain are to be blamed for the lack of delivery of high-quality seed of HYVs to the farmers. Or that is because of poor extension and outreach. Outreach interventions by the universities, researchers and extension workers at district and lower levels where the introduction of new seeds is known to be a major attraction. Currently over seven million tons of wheat seed are being used to cultivate 50 million ha (Figure 2A), which can be reduced to less than five million tons if substituted by quality seed. If delivered and planted, the certified seed can raise the average yield by 38% (The difference between the current average of 2.5 t/ha and demonstrated yields with the certified seed of 4.0 t/ha).

Operation of seed multiplication and supply chain system through a licensing scheme where each and every transaction is documented can improve the seed supply system in OIC countries. Proper research can be charged for a sustainable supply chain. Inspection by licensed seed inspectors and the use of ICT (image analysis, dataloggers and apps, etc) in the seed certification process are innovative interventions to keep the seed supply system transparent. Seed certification can be more robust and transparent if the involvement of accredited seed certifying agencies is initiated like Seed Services Australia is assisting the Australian Seeds Authority (ASA). Deployment of licensed/authorized seed inspectors in addition to official inspectors like in the UK and internal certification/quality management systems in the seed companies can also add value to the quality of seed supply. Wheat seed processing plants are also needed to be made easily accessible for supporting SMEs in seed grading and treatments. The availability of quality seed can only be a catalyst for the mechanization of seeding/drilling and the balanced use of fertilizer. It is known that the act of buying better seeds inspires the farmer for improving other agronomic practices.

Intervention of innovative genetic technologies: Historically, the Green Revolution occurred after the introduction of fertilizer-responsive dwarf varieties. The varietal replacement has been a continuous process (post-Green Revolution) due to the availability of better genetics (disease resistance and environmental adaptations). The wheat variety development process in most of the OIC countries is a product of a grand collaboration between the NARS (National Agriculture Research System) and CGIAR/CIMMYT (Consultative Group on International Agriculture Research/International Maize and Wheat Improvement Center). CIMMYT was established in 1968 by Nobel Laureate Dr. Norman E. Borlaug, the father of the Green Revolution.

Breaking the yield barrier and improving rust resistance are continuing struggles. The stagnation can be effectively overcome with the introduction of genetically improved varieties at the farm level, which is currently a far cry. The OIC countries' average is less than 2/3 of the progressive farmers and a quarter of the realizable potential. Adaptation to climate change and input response are other critical objectives of wheat genetic improvement. Equally important is the quality of the wheat grain in terms of iron and zinc contents along with the traditional baking quality requirements. The breeders in most of the top wheat-producing OIC countries are equipped with fast breeding tools of marker-assisted selection, gene editing, phenotyping and transgenic interventions. Hybrid wheat is a relatively new type of wheat that has been developed through the process of hybridization, which involves cross-pollinating two different varieties of wheat. In the 1990s, the development of **hybrid wheat** was thought to be one of the options to boost the potential yield, but due to high seed production costs, it remained in the experimental phase. Now it is also a possibility due to the availability of simple, cheap and fast technologies like Bla technology.

State of the Hybrid Wheat Technology Development

Blue aleurone (Bla) system – blue seed technology has been established in wheat and patented (WO2019043082 (A1)) in Horizon 2020 project. The partnership of this project includes KWS European seed company UK, The University of Sydney, GCI Sydney Australia and the Universities of Agriculture in Faisalabad and Multan, Pakistan. This system is very simple, cheap and fast to develop hybrids from desirable parents for yield and quality gains (Figure 3). Any wheat cultivar having tall stature and better anther extrusion can be used as a male parent. Male and female parents can be drilled side-by-side in strips to produce hybrids through wind pollination.

Figure 3: *Blue aleurone (Bla) system generating (a) sterile female spikes (b) white and blue seeds in a spike to produce sterile and fertile females (c) male and female parents drilled side-by-side in strips to produce hybrids through wind pollination and (d) hybrid wheat crop growing in the field.*

The promise of climate-resilient wheat hybrids

Hybrid wheat has been widely adopted in many countries and its cultivation is becoming increasingly popular in Europe, America, and China, as farmers seek to increase their yields and improve the quality of their crops. With its improved resistance to pests and diseases, hybrid wheat is poised to play a major role in the future of global wheat production. Wheat hybrids developed using Bla technology showed promise to break **yield stagnation (>20% yield gain)** and are climate-smart, **resource-use efficient** and richer in essential micronutrients than traditional varieties. Hybrids were more vigorous, one week early in maturity (Figure 4) and rust-resistant (Figure 5).

Figure 4: *Hybrids were more vigorous and at least one week early in maturity.*

Figure 5: *Rust resistant wheat hybrids produced by crossing rust sensitive male and female parents.*

Wheat hybrids are lodging resistant (Figure 6) and better in quality (especially those hybrids were high in Fe and Zn where male parent was high in Fe and Zn) compared to normal OPV wheat varieties.

Figure 6: *Hybrids showing lodging resistance compared to dotted/lodged plots of parents and OPVs.*

Ten hybrids selected from ~1700 made-in-Pakistan wheat hybrids after country-wide trialling show more than 20 % wheat yield gain over OPV cultivars/checks (Figure 7).

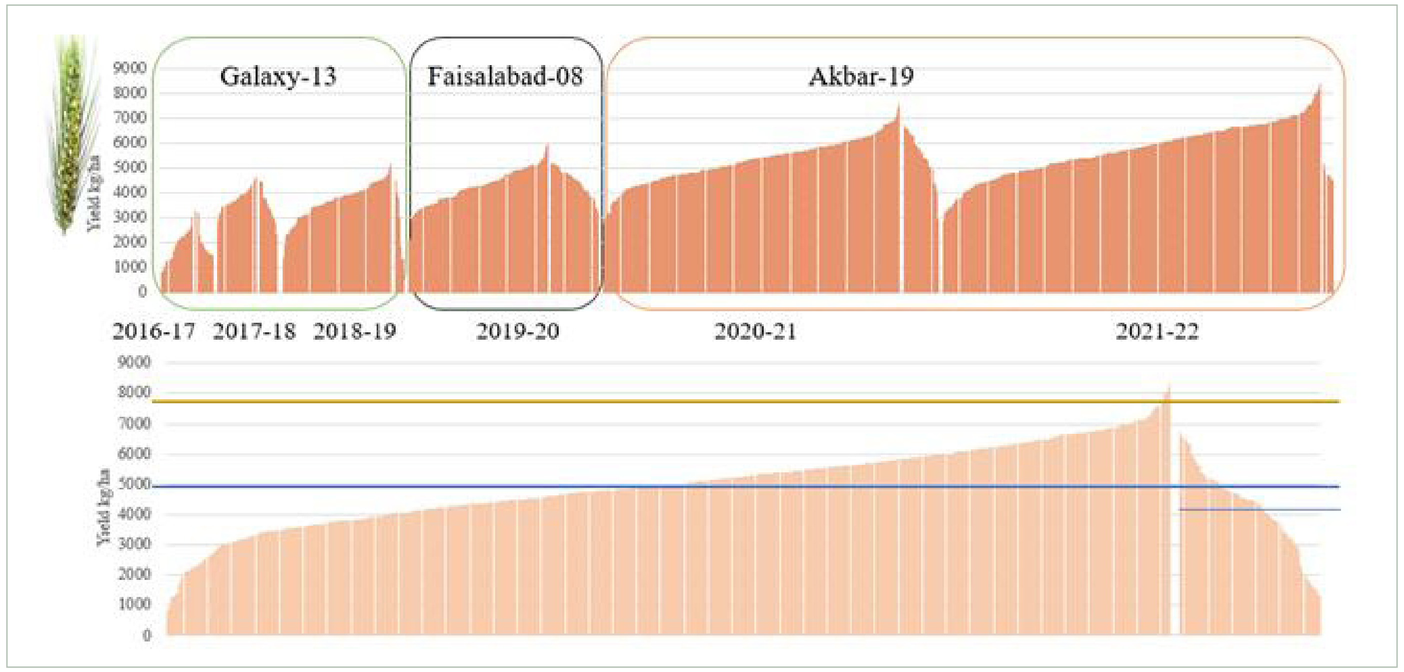


Figure 7: *Wheat hybrid yield performance (Hybrids on the left side vs OPVs on the left of each graph) developed and tested in multi-environment trials in rice-wheat, cotton-wheat and mix cropping systems in Pakistan since 2016. The lower part shows pooled data (ten hybrids depicted above 20% of OPV cultivars and shown above the golden horizontal line.*

In-hand-ready wheat hybrids for testing

Ten hybrids selected from ~1700 made-in-Pakistan wheat hybrids after country-wide trialing are ready for testing and scaling-up in OIC countries. Fifty new hybrids identified during 2021-22 showing a 20-50% yield increase over OPV best cultivar can be tested in different ecologies of OIC member countries (Figure 8). Hybrid wheat introduction at farmer's fields could further increase the yield by 10% due to seed quality or seed replacement. In net, more than 20 to 40% wheat yield gain is possible by replacing existing wheat OPVs (open-pollinated varieties, the current/stagnant technology) with hybrids.

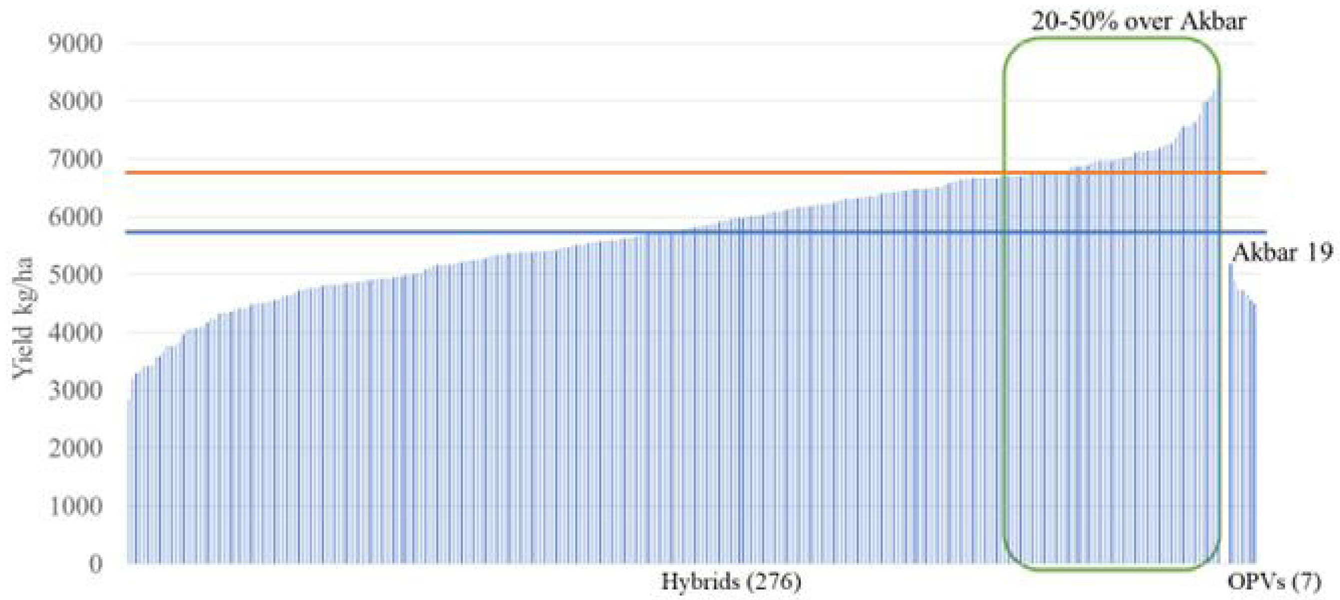


Figure 8: *Fifty new hybrids identified in a multilocational trial during 2021-22 showing a 20-50% yield increase over OPV best cultivar and shown above the golden horizontal line.*

Wheat hybrids assist in

1. Breaking wheat yield stagnation through introducing wheat hybrids in different agroecologies.
2. Addressing climate changes through quick trait mobilization related to resilience for temperature, water and disease upsets.
3. Addressing rust resistance through new combinations of rust resistance genes.
4. Addressing nutrition security with high Fe and Zn through wheat security.
5. Increasing wheat productivity and profitability through quality seed (seed replacement), reduced seed rate (efficient seed placement sowing machines) and reduced tillage and fertilizer costs.
6. Poverty alleviation for rural masses due to higher yields and by creating new jobs in the wheat hybrid seed industry and entrepreneurship.

The expected extent of the impact of hybrids

1. More than 20% gain in grain yield of hybrids with the same land, water and other resources. This will enhance farmers' profitability by at least 20% leading to the alleviation of poverty in rural areas and contributing to rural development.
2. High-yielding hybrids will enable farmers to spare at least 20% of land to cultivate other crops including oilseed, pulses and other neglected cereals for food diversification.
3. Upscaling of high Fe and Zn enriched hybrids for cultivation in wheat-dependent ecologies will help in reducing stunting and wasting in the regions.
4. Wheat hybrids are better to cope with climate changes, insect pests and diseases, etc., and thus will reduce the cost of production and help to improve the environment.
5. Wheat hybrid seed production, storage, logistics and distribution will occupy a major component in the seed industry and thus create new jobs.
6. New foundation seed business incubations, start-ups and entrepreneurship will emerge.
7. Contract farming for wheat hybrid seed production will be initiated.

EN SUMMARY

OIC member countries produce more than 110 million tons of wheat from about 50 million ha. Nine out of 57 OIC member countries produce 88% of wheat grains. Globally, wheat-dependent populations, including OIC member countries, are facing multifaceted challenges to their food security such as climate change, rust, grain yield stagnation, seed quality, precision or smart tech, soil health, losses, value addition and marketing, population growth and policies. Some of the solutions include innovative agronomic practices of precision agriculture, intervention to ensure quality wheat seed supply chain and intervention of innovative genetic technologies. Hybrid wheat is one of the feasible options to introduce these interventions.

FR RÉSUMÉ

Les pays membres de l'OCI produisent plus de 110 millions de tonnes de blé sur environ 50 millions d'hectares. Neuf (9) des 57 pays membres de l'OCI produisent 88% des grains de blé. À l'échelle mondiale, les populations tributaires du blé, y compris les pays membres de l'OCI, sont confrontées à des défis multiformes pour leur sécurité alimentaire, tels que le changement climatique, la rouille, la stagnation du rendement des grains, la qualité des semences, la technologie de précision ou intelligente, la santé des sols, les pertes, la valeur ajoutée et la commercialisation, la croissance démographique et les politiques. Parmi les solutions, citons les pratiques agronomiques innovantes de l'agriculture de précision, l'intervention pour garantir la qualité de la chaîne d'approvisionnement en semences de blé et l'intervention de technologies génétiques innovantes. Le blé hybride est l'une des options envisageables pour instaurer ces interventions.

AR ملخص

تُنتج الدول الأعضاء في منظمة التعاون الإسلامي أكثر من 110 مليون طن من القمح على مساحة تبلغ حوالي 50 مليون هكتار. تنتج تسعة من أصل 57 دولة عضو في منظمة التعاون الإسلامي 88 في المائة من حبوب القمح. وعلى الصعيد العالمي، يواجه السكان المعتمدون على القمح، بما في ذلك البلدان الأعضاء في منظمة التعاون الإسلامي، تحديات متعددة فيما يتعلق بأمنهم الغذائي مثل تغير المناخ والصدأ وركود غلة الحبوب وجودة البذور، والتكنولوجيا الدقيقة أو الذكية، وصحة التربة والخسائر، والقيمة المضافة والتسويق، والنمو السكاني والسياسات. وتشمل بعض الحلول الممارسات الزراعية المبتكرة للزراعة الدقيقة والتدخل لضمان جودة سلسلة توريد بذور القمح والتدخل في التكنولوجيات الجينية المبتكرة. ويعد القمح الهجين أحد الخيارات الممكنة لتنفيذ هذه التدخلات.

OVERVIEW OF THE WHEAT GROWING IN THE OIC GEOGRAPHY AND IOFS INTERVENTIONS TO IMPROVE WHEAT PRODUCTIVITY

MAKPAL BULATOVA
IOFS Programme Manager

INTRODUCTION

1. STATUS OF WHEAT PRODUCTION.

Agriculture has continued to play a crucial role in the social and economic development of OIC Member Countries by providing employment and livelihood for millions of people, particularly in rural areas. Agriculture linkages with food security, economic growth, employment, poverty eradication, the environment and natural resource management, nutrition, and health are reflected in most of the SDGs outlined by the United Nations, and wheat contributes to the achievement, in particular, to end poverty in all its forms everywhere (SDG 1); end hunger, achieve food security and improved nutrition, and promote sustainable agriculture (SDG 2).

Countries with high agricultural production have employment growth in other sectors. Countries with high agricultural productivity growth and well-developed agricultural infrastructure have higher per capita incomes, as producers in these countries innovate through technology and farm management practices to increase agricultural productivity and profitability.

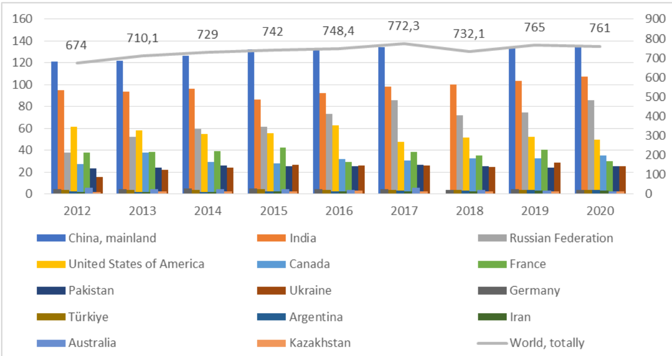
The development of the sustainable agriculture sector and food systems in OIC Member Countries is mired by a multitude of constraints concerning agricultural resources, infrastructure, policy, and international commodity markets. Development of strategic commodities that are considered to be of utmost importance to the economy of a nation and its stability, especially for the least developed countries (LDC) that are dependent on a single or at most two commodities as the main source of income generation and trade.

Wheat is a key food staple that provides around 20 percent of protein and calories consumed worldwide. Demand for wheat is projected to continue to grow over the coming decades, particularly in the developing world to feed an increasing population, and with wheat being a preferred food, continuing to account for a substantial share of human energy needs in 2050[1]. Wheat has been a staple ingredient for centuries, not only in developed countries but also in developing ones. Over 80% of the world's wheat is now used to make flour.

Despite its global importance, wheat production is concentrated in a few countries. Only seven countries account for 86% of global wheat exports, while only three accounts for nearly 68% of global wheat reserves, with some of the world's most vulnerable and impoverished countries relying on them for more than half of their wheat imports[2].

Ukraine and Russia are both significant players in the highly concentrated international wheat market. Many consider these two countries to be the breadbaskets of the world, accounting for just under 30% of global wheat exports. The majority of their wheat is exported to North Africa, and the Middle East. Russia and Ukraine also contributed 20% of total food commodities procured by the World Food Programme in 2020, playing a critical role in ensuring food security in developing countries around the world. The current conflict between the two countries has caused massive disruptions to the global wheat market[3].

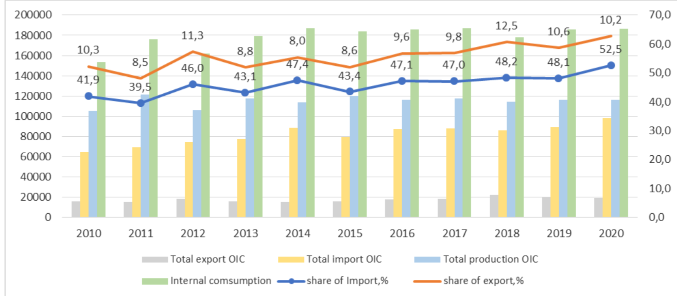
In 2020, the total global production of wheat was 761 million tonnes. China, India, and Russia are the three largest individual wheat producers in the world, accounting for about 41% of the world's total wheat production according to the UN FAO. The total production of wheat in 2020 of the OIC Member Countries is 116 million tonnes, which accounts for 15 % of the share in the world. In the same year, OIC countries were producing wheat with a total wheat harvested area of nearly 49 million hectares[4] (Figure 1).



Source: World wheat production from 2012-2020, FAO STAT (mln tonnes)
***Figure 1.** Wheat production of global top 14 countries for the period of 2012 – 2020.*

1 https://www.scirp.org/journal/paperinformation.aspx?paperid=78066
2 https://earth.org/wheat-shortage/
3 https://reliefweb.int/report/world/new-scenarios-global-food-security-based-russia-ukraine-conflict
4 https://www.fao.org/faostat/en/#data/FBS, accessed on 1/3/2023

In Figure 1, it is shown that World wheat production for the period of 2012 - 2020 increased steadily. 3 countries remain top by China, India, and Russia, followed by the United States of America, Canada, France, Pakistan, and Ukraine. World production within the 10 years raised by only 13%. Among the top 14 wheat-producing countries 4 OIC Member Countries such as Pakistan, Turkiye, Iran and Kazakhstan considered top wheat-producing countries within the OIC geography.

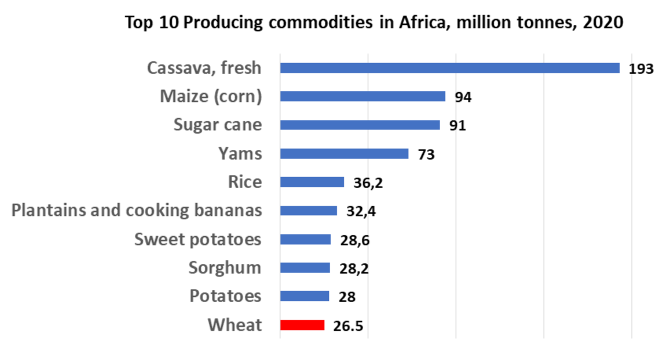


Source: FAO STAT, 2010-2019
***Figure 2.** Wheat grains balance sheet of OIC geography for the period 2010-2020.*

It is observed that in the correlation of the Total Production of Wheat in OIC from 2010-2020 the internal wheat consumption of the countries does not meet the expectations of the production and export potential. The total production in the OIC within the 10 years increased by 10.8 million tonnes. Total export in 2020 accounted for 19 million tonnes, while import and consumption of wheat were 98 million tonnes and 186 million tonnes, and the share of export of the countries within this period has not increased enough, which shows the vulnerability of the countries to strategic commodities self-sufficiency, relying on global imports to meet demand, and there is a dramatic need for improvement of local production[5].

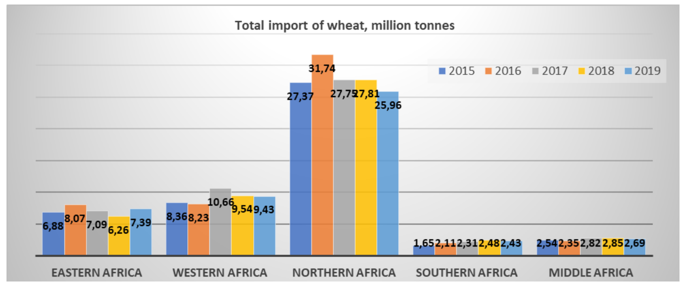
When we look at the situation by regions within the OIC geographical classification high population growth and rapidly changing lifestyles and diets are leading to a growing demand for wheat in all OIC countries. This rising demand for wheat is not just an OIC phenomenon; it is a global issue, implying that ensuring wheat availability will remain at the top of the regional agenda for the foreseeable future. Wheat is divided into several subcategories that can be grouped into two major types, both of which have a significant economic impact: hard wheat, which is processed into semolina and pasta and is mostly produced in hot and dry areas, and soft wheat, which is processed into flour for bread and other products and is produced in more temperate areas. Both types are adaptable to a wide range of climatic conditions.

1.1. AFRICA. SUB-SAHARAN AFRICA produces a variety of strategic commodities, the most important of which are cassava, maize, sugarcane, yams, and rice according to UN FAO, 2020, but wheat consumption has an increasing trend in Africa. According to the available data, the total production of wheat accounted for 26.5 million tonnes in 2020 (Figure 3), while the total import and consumption of wheat were 48 million tonnes and 75 million tonnes shows major consumption and import focus on wheat in Sub-Saharan Africa (SSA) (Figure 4 and Figure 5)[6].

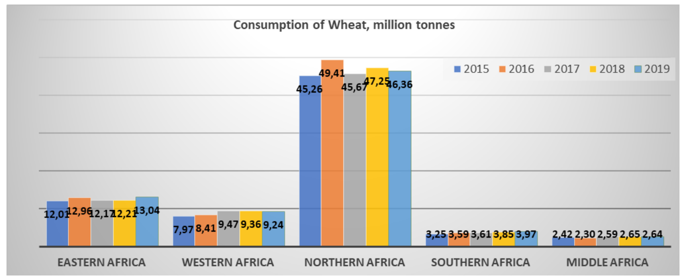


Source: FAO STAT (2020)
***Figure 3.**Top commodities produced in Africa.*

According to the Figure 3, wheat is the 10th commodity in production ranking in the African continent.



Source: FAO STAT (2015-2019)
***Figure 4.** Regional wheat import pattern in Africa.*



Source: FAO STAT (2015-2019)
***Figure 5.** Regional wheat consumption pattern in Africa.*

The consumption of wheat in Africa is taking popularity and becoming one of the preferable sources of food. Urbanization, rising incomes, food aid, globalization of cuisine, and fluctuations in the relative price of other staple crops such as corn are all factors driving Africa's increased appetite for wheat. Demand for wheat-based foods has reached all-time highs in many countries, both at home (as sales of items like pasta increases in grocery stores) and in restaurants (as international restaurant chains continue to do well in Africa). Wheat consumption is increasing in Eastern and Western Africa, but the current climate, soil, and/or irrigation infrastructure is not favorable to wheat production in these regions.

Traditional and modern cultivation systems are widely used in SSA. Farmers in the traditional wheat cultivation system are completely reliant on their traditional know-how, as well as the

5 https://www.fao.org/faostat/en/#data/FBS, accessed on 1/3/2023
6 https://www.fao.org/faostat/en/#data/FBS, accessed on 1/3/2023

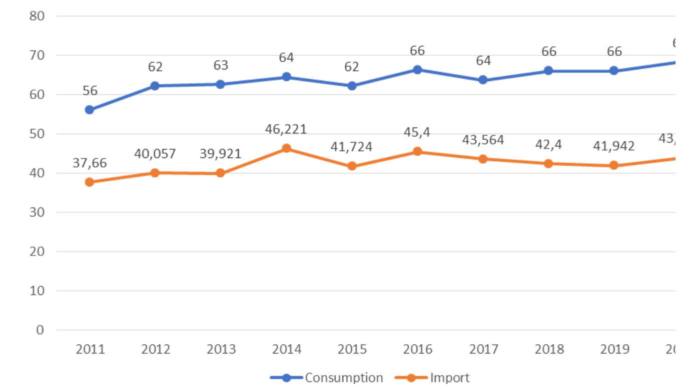
tools and resources at their disposal. The harvested grain is stored for local consumption, while the straw is used to feed livestock. Surplus items are sold in nearby stores. The productivity of such systems is typically low and is primarily dependent on soil fertility and rainfall availability.

In these countries, small-scale farmers continue to cultivate wheat using the traditional system. Different rotation systems, such as legume-wheat, potato-wheat, or oil crops-wheat, are used in rain-fed environments. Wheat-rice, wheat-legumes, or wheat-cotton rotation systems are practiced in irrigated environments by growing wheat in the winter season[7].

There is a significant opportunity in SSA to expand wheat production into non-traditional wheat areas by implementing improved crop management practices and enacting favorable policies to enable the availability and accessibility of inputs, extension services, transportation, and marketing infrastructures.

African countries must pursue policies and programs that will enable the continent to become a net food exporter, while also leveraging agricultural industrialization to add value to processed foods and export commodities. There is a need to support Africa to address the huge challenges posed by climate change to the agriculture sector and strengthen the food system's resilience.

1.2. ARAB REGION. Given the cultural importance of wheat, the Arab region is considered a significant importer of wheat due to its geographical setting. In 2020 with a total production of 24 million tonnes, 44 million tonnes were imported to meet consumption needs of 68 million tonnes according to FAO STAT (Figure 6). For instance, per capita consumption in the same year, Tunisia consumed wheat about 200 kg per annum, Algeria 176 kg, Morocco 173 kg, and Egypt 147 kg which are the most wheat-consuming countries in the region[8].



Source: FAO STAT (2011-2020)

Figure 6. Wheat consumption and import pattern in Arab region

Considering the increasing trend of wheat import in the region, in short and long-term consequences of the growing demand and population, particularly in vulnerable Arab countries, may necessitate costly emergency expensive wheat imports. As a result, wheat rationing and increased use of available storage may be unavoidable.

It is important to highlight the developments of wheat growing in drought and hot climates such as Egypt, Morocco, and Tunisia. A tremendous efforts and results in studies and practical implementation of wheat breeding of biotic and abiotic resistant varieties, as well as high yielding production strategies for farmers, and newly introduced irrigation system for water saving purpose have been evident.

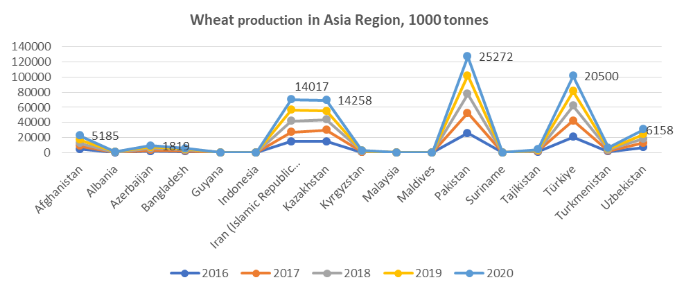
This region considers one of the most water-scarce regions in the world. Adequate water availability is essential for agricultural production and, thus, can have an important impact on crop growth and food security. This necessitates both vertical and horizontal agricultural expansion, which will increase productivity per hectare as well as the total area of cultivated lands. The region possesses the necessary technologies, skills, and land resources to carry out such an expansion9. The joint capacity-building efforts are to be designed to blend traditional knowledge, local institutions, and private-sector entrepreneurs with modern state-level considerations governing water use.

Considerable opportunities exist for increasing food self-sufficiency through the implementation of appropriate policies and improved agricultural technologies in the region, as well as the establishment of an integrated food value chain capable of ensuring food security based on the pillars of food availability, accessibility, stability, and utilization.

Integrated approaches to soil, crop, and water management in agriculture enable farmers to maximize productivity and resource efficiency while ensuring consistent and adequate harvests. This entails promoting sustainable and climate-smart farming techniques, selecting crop varieties that are less susceptible to salinity, drought, heat shocks and insect/pests, and improving agricultural water management and water-use efficiency.

1.3. ASIAN REGION. Wheat is one of the most important staple foods in the region, which specializes in agricultural production and has a large rural population. As it was mentioned earlier, among the top world wheat producers the countries such as Pakistan, Turkiye, Kazakhstan, and Iran are considered of the Asian Group of countries by OIC classification. These are the largest wheat producers and exporters that play a crucial role in assisting other OIC Member States to encourage the development of the wheat productivity.

The total production of wheat in this region is 91.3 million tonnes in 2020, which accounts for 78% of the share of the OIC production with a total consumption of 109 million tonnes (Figure 7). Although countries with high production levels, still have to import wheat to meet the national consumption requirement (Figure 8)[10].



Source: FAO STAT (2016-2020)

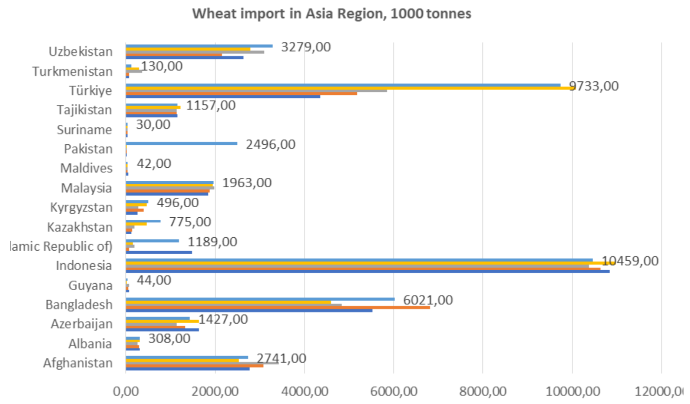
Figure 7. Wheat production in Asian OIC region

7 https://www.emerald.com/insight/content/doi/10.1108/IJCCSM-02-2018-0015/full/pdf?title=wheat-production-and-breeding-in-sub-saharan-africa-challenges-and-opportunities-in-the-face-of-climate-change

8 https://www.fao.org/faostat/en/#data/FBS, accessed on 1/3/2023

9 https://www.ifad.org/documents/38714170/39974421/Fighting+water+scarcity+in+the+Arab+countries_eng.pdf/cdfbf41a-4945-42a5-87dd-ef01c0732869

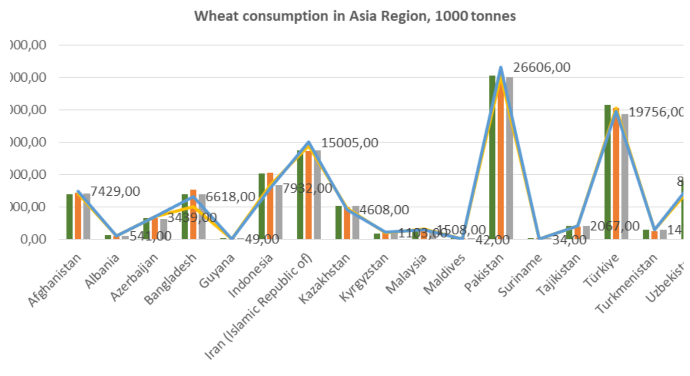
10 https://www.fao.org/faostat/en/#data/FBS, accessed on 1/3/2023



Source: FAO STAT (2016-2020)

Figure 8. Wheat import pattern in Asian OIC region.

Indonesia in the Asian region is the largest wheat-importing country amounting to 10.4 million tonnes in 2020 (271.9 million people). In the same year Turkiye as top wheat-producing country in the OIC geography imported 9.8 million tonnes of wheat due to high-level of population and consumption followed by Bangladesh importing 6 million tonnes, Pakistan 2.5 million tonnes, Malaysia 2 million tonnes, and Iran 1.1 million tonnes of wheat[11].



Source: FAO STAT (2016-2020)

Figure 9. Wheat consumption pattern in Asian OIC region.

According to the FAO STAT in 2020, three countries, Pakistan, Turkey, and Iran, consumed the most wheat (61.3 million tonnes) out of the total consumption of the OIC countries (107 million tonnes) (Figure 9).

Moreover, the stated wheat-producing countries are undertaking enormous work on enhancing the wheat quality and productivity driven by practicing modern techniques and innovations in wheat research, new approaches to managing pests and diseases, and improving abiotic stress tolerance and nutrient use efficiency. In some Asian countries, wheat is not a significant crop due to their climate conditions, availability of farmland, as well as established food culture, although the consumer preferences in the changing trend.

Asia, which includes many developing economies, has enormous potential to increase wheat productivity; the challenge is figuring out how to do so in a sustainable manner when resources are scarce. Considering the increasing demand for wheat and wheat-based products, the best way forward is for national research-extension-policy-institutions to work together under a unified framework. To deliver the impact, Asian wheat-growing countries must frame the research agenda and set priorities for resource allocation to reinforce interventions and innovations that result in overall wheat improvement.

2. MAIN CONSTRAINTS AND CHALLENGES.

Globally, among the most serious constraints to achieving sustainable agriculture and food security in the face of population growth are shortages of arable land, degradation of land resources, loss of agricultural land due to urbanization, water shortages and pollution, irrigation problems, disappearing genetic diversity, the emergence of new virulent diseases and pests that attack crops, and climate change. The OIC Member States face a wide range of above-stated challenges in the production of wheat, in addition to poor mechanization and high production cost, inadequate or weak policy environment, and low funding of the national agricultural research and extension institutions, among others.

Some of the important factors for wheat production are highlighted as follow:

2.1. Various wheat cultivation environments.

Based on the sources of water availability, the global wheat production depends on the irrigated and rain-fed environments of the countries.

In the developing world, the temperate irrigated environment is the most important agro-ecological zone for wheat production. This environment encompasses vast swaths of Pakistan, Bangladesh, Afghanistan, Iran, Turkey, Iraq, Saudi Arabia, and Egypt[12]. Irrigated cultivation accounts for more than half of the world's wheat production area.

The majority of wheat grown in the developed world is rain-fed. It includes high rainfall areas in the developing world. Temperate, low-rainfall production areas include North Africa, West Asia, and parts of Pakistan and Afghanistan[13].

Climate change is influencing wheat production impact of both abiotic (heat, drought, cold, salinity, and waterlogging) and biotic stresses (diseases and insect pests). With the current climate change consequences, new pests and diseases are expected to emerge, as evidenced by the recent epidemics of stripe/yellow rust across Central & West Asia and North Africa, and the Ug99 stem rust epidemic in East African countries[14].

2.2. Farming system: Crop management practices.

Crop rotation is one of the principal pillars on which conservation agriculture (CA) relies. The most OIC countries are practicing rotation system with rice, cotton, potato, maize, and legumes. It is evident that it is to enhance the productivity and sustainability of wheat-based farming systems. In addition, crop rotation is one of the oldest and most fundamental agronomical practices, and is thought to have a great impact on increasing crop yield. Rotations primarily help in weed control, improve soil fertility, and increase wheat grain yield when compared to mono-cropping.

11 https://www.fao.org/faostat/en/#data/FBS, accessed on 1/3/2023

12 https://www.researchgate.net/publication/313553933_Approaches_and_strategies_for_sustainable_wheat_production

13 https://www.researchgate.net/publication/313553933_Approaches_and_strategies_for_sustainable_wheat_production

14 https://www.researchgate.net/publication/313553933_Approaches_and_strategies_for_sustainable_wheat_production

OIC countries mostly practice of traditional system, rather than improved cultivation system that relies on the development, accessibility and utilization of innovation, such as modern agricultural inputs, tools, knowledge, resources, technology, management, investment, markets and supportive government policies.

2.3. Climate Smart Agriculture

Climate-smart agriculture (CSA) has been identified as an important tool for overcoming the challenges posed by climate change to agricultural systems and better-incorporating agriculture into international climate dialogue. It enables farmers, key institutions and service providers to farmers build the capacity to adapt and effectively respond to long-term climate change as well as manage the risks that come about as a result of increased climate variability. Agro-ecological approaches, sustainable natural resource management, and ecosystem management are examples of integrated options for climate change adaptation.

2.4. Limited availability and high price of inputs.

Wheat productivity is dominated by subsistence farmers, and input use remains very low, owing to the limited availability, accessibility, and affordability of inputs such as fertilizers, improved seeds, irrigation water, pesticides, and farm machinery. The cost of fertilizer rises over time, particularly when energy prices are high like cost of natural gas used to produce ammonia and the cost of transportation. Lack of access to credit, roads, and transportation also limits farmers' access to fertilizers, seeds, and agrochemicals at the right time.

2.5. Capacity-building of farmers – extension services

Farmers' education appears to be critical to improving social, economic, and environmental sustainability. The necessary measures for increasing wheat yield and improving sustainability include to enhance farmers capacities through extension services for the use of certified seeds of suitable wheat varieties and appropriate crop management practices including weed control while taking biodiversity into account.

2.6. Genetic diversity distribution.

One of the critical issues in the international agenda is plant genetic diversity which provides opportunities to improve plant characteristics. Its evaluation is required to tackle the mitigation of environmental threats and the efficient usage of genetic resources in breeding programs. Developing new varieties of wheat is key to growing wheat within the abiotic and biotic stresses, as well as identifying the high yielding.

There are about 117285 of wheat accessions organized from the OIC member countries, which is critical for making it possible for the countries to exchange germplasm to broaden genetic diversity and tackle the climate change impact issue[15].

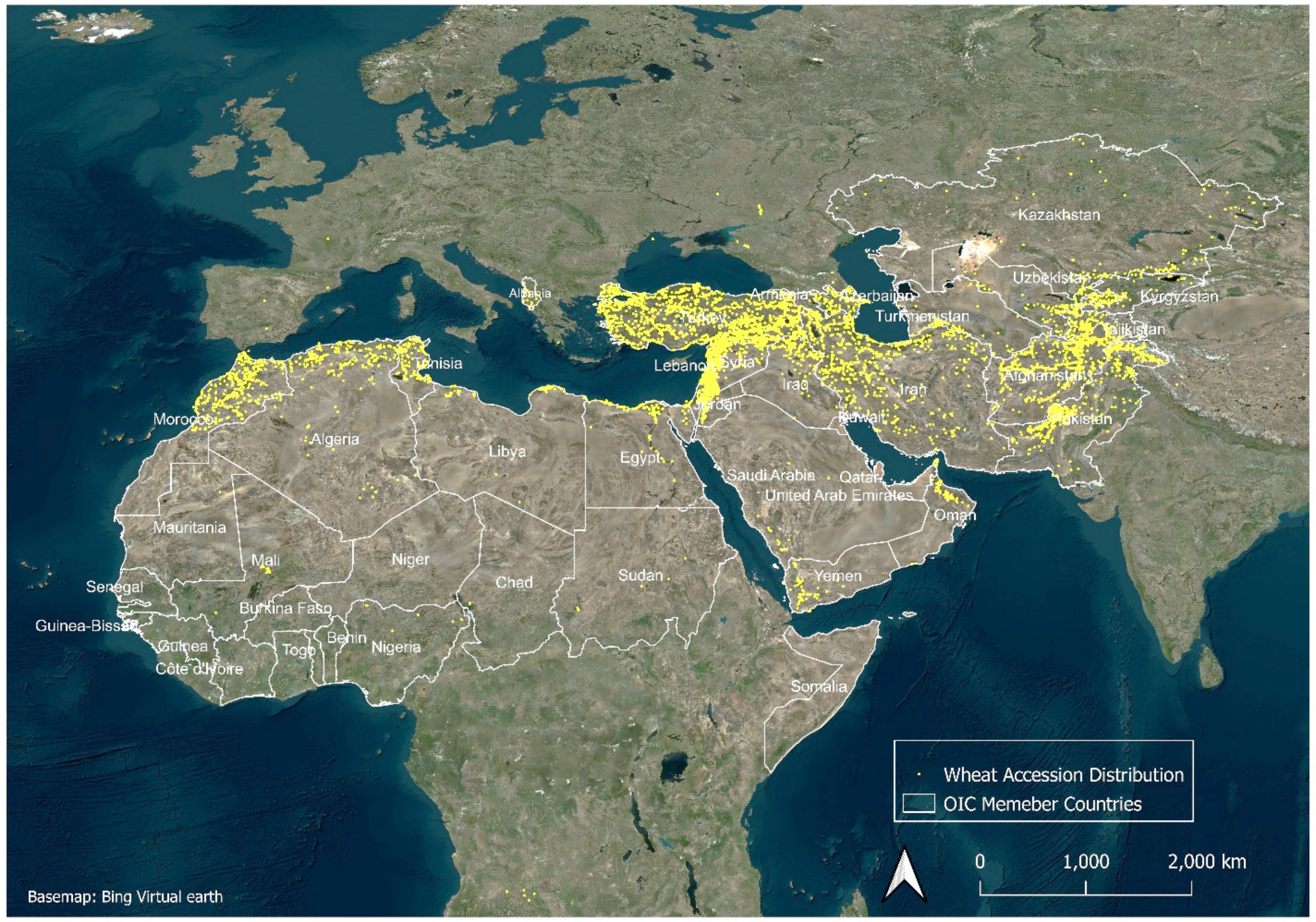


Figure 10: Mapping of the wheat accessions within the OIC geography, (Genesys, 2023)

15 https://www.genesys-pgr.org/a/v2jLpgZYkJ8

3. IOFS UNDERTAKING ACTIONS

In this regard, the Islamic Organization for Food Security (IOFS) in accordance with Resolution N° 1/46-E adopted at the 46th Council of Foreign Ministers of Organization of Islamic Cooperation (OIC) held in Abu Dhabi on 1-2 March 2019, as well as the given mandate by the Council of Foreign Ministers, has developed the respective Plan of Action for Development of each commodity as of Wheat, Rice, Cassava, and Palm Oil in the OIC region. The IOFS has further worked on the development of the Programme on Strategic Commodities, within which special attention to wheat development in the OIC Member States is paid, as wheat production plays a crucial role in sustainable food security.

The Strategic Commodities Programme is to enhance crops production through the improvement of human and institutional capacity of the involved countries and to facilitate the scientific collaboration between stakeholders by providing the Platform for interaction. In this regard, the IOFS currently working on the E-Platform for the Strategic Commodities that will be launched in 2023 for the scientists, breeders, farmers, and other interested parties for access and exchange of the relevant information, expert guidance, coordination, and opportunities for the joint projects with IOFS and its partners.

3.1. IOFS Strategic Programmes.

3.1.1. "Africa Food Security Initiative".

In addition, it is critical to note that the IOFS attaches paramount importance to the African continent, where nearly half of its member countries are located. IOFS believes in the continent's ability to feed its people and even feed the world by transforming its agricultural systems. The Institution's commitment to Africa is exhibited by its decision to initiate the "Africa Food Security Initiative" in 2023, where various programs and activities are dedicated to this mission. Within this Programme, the Secretariat goes for Regional Initiatives such as the planned Regional Project for North Africa piloting for Mauritanian Wheat System Development in collaboration with leading wheat breeders and scientists from North Africa and in partnership with International Organizations.

A Regional Project is planned for the medium-term focusing on the capacity-building of the scientists and farmers in wheat farming practices, improving the extension services, and best practices of the irrigation system suitable for Mauritania. As the initial step of the project, the First Task Force Meeting and Inception Workshop along with the Field Visits will take place in Nouakchott, Mauritania from 15-17 March 2023 to discuss the details of the project, identify the concrete tasks, and further implementation and progress of the initiative.

Cross-country visits by scientists and extension agents will have resulted in valuable new knowledge about the application of agronomic techniques, improved varieties, and dissemination strategies, and enhance interactions and information-sharing among scientists from different countries.

3.1.2. Afghanistan Food Security Program (AFSP).

Another prioritized Programme of the IOFS is the Afghanistan Food Security Program (AFSP) which is targeted to implement a mid-long-term response in the format of projects (Project No. 3) to Afghanistan's agricultural development, particularly wheat production. As the initial part the IOFS in last November 2022 conducted three days Expert Meeting in partnership with the Ministerial Standing Committee on Scientific and Technological Cooperation of the OIC (COMSTECH) and Pakistan Agricultural Research Council in Islamabad, Pakistan gathering the wheat breeders and scientists from the OIC member countries to discuss the wheat improvement efforts to tackle the climate change impact, in which the special session was dedicated to wheat production issues of Afghanistan. As a result of the deliberations, experts identified the main concerns and recommended necessary actions, such as:

- ✓ problems with the certified seeds and their availability.
- ✓ farmers' participatory or community-based seed production system;
- ✓ need for capacity-building of plant breeders on DUS and provision of support for early-generation seed production;
- ✓ strengthening of seed storage facilities and seed testing laboratories,
- ✓ strengthening local wheat breeding system; and
- ✓ strengthening the extension department.

It is planned to form a Working Group of OIC wheat experts to work on the aforementioned wheat development projects in the near future.

Additionally, IOFS gives special consideration to Project No. 3 and has already started working with its partners to support small farmers and farming communities with equipment that is compatible with the technical requirements of agricultural land and the nature of the agricultural output.

4. RECOMMENDATIONS

Meeting the demand is very challenging and complicated. To address the issues of improvement of wheat production, global development, agricultural research, and extension communities must first better understand the drivers of past wheat production trends as well as future challenges. It is required to build on this perspective to develop effective strategies that leverage the most recent technologies, farming practices, and enabling policies, as well as engage in global knowledge sharing in new networks and research for development partnerships on an ongoing basis.

The partnership brings together funders and research groups and aims to deliver one of the wheat initiative's key aims, to increase wheat yield and develop new wheat varieties adapted to different geographical regions.

There are large cross-country productivity differences in agriculture due to farmland misallocation, insufficient fertilizer and water use, and labor intensiveness of agriculture in poor countries[16]. As a result, governments must encourage the private sector to participate in the agricultural development process.

In addition, agricultural universities and research institutes' roles should be expanded. Furthermore, agricultural research should be prioritized, and the government should fund fundamental and applied research, particularly R&D processes. Training and knowledge-sharing opportunities equip farmers, researchers, and extension officers with the expertise they need to enhance productivity of wheat-based agricultural systems.

Moreover, economic and political factors influencing agricultural development in countries should be considered. Coordination is especially important when implementing regional projects and taking collective action on existing issues.

Working harder together to mitigate risk and reduce uncertainty is a reasonable goal of the Partnership of the OIC countries in this period of political, economic, and social transitions. Greater cooperation in the field of food security, particularly in the supply of wheat, appears obvious.

16 https://www.aeaweb.org/articles?id=10.1257/aer.104.5.165

EN SUMMARY

Wheat is a key food staple that provides around 20 percent of protein and calories consumed worldwide. Demand for wheat is projected to continue to grow over the coming decades, particularly in the developing world to feed an increasing population, and with wheat being a preferred food, continuing to account for a substantial share of human energy needs in 2050. When we look at the situation by regions within the OIC geographical classification high population growth and rapidly changing lifestyles and diets are leading to a growing demand for wheat in all OIC countries. This rising demand for wheat is not just an OIC phenomenon; it is a global issue, implying that ensuring wheat availability will remain at the top of the regional agenda for the foreseeable future.

FR RÉSUMÉ

Le blé constitue un aliment de base essentiel qui fournit environ 20 % des protéines et des calories consommées dans le monde. Selon les prévisions, la demande de blé devrait continuer à augmenter au cours des prochaines décennies, notamment dans les pays en développement pour nourrir une population croissante. Le blé étant un aliment de prédilection, il continuera à représenter une part importante des besoins énergétiques de l'humanité en 2050. Lorsqu'on examine la situation par région au sein de la classification géographique de l'OCI, la forte croissance démographique et l'évolution rapide des modes de vie et des régimes alimentaires se traduisent par une demande croissante de blé dans tous les pays de l'OCI. Cette demande croissante de blé ne concerne pas seulement les pays de l'OCI ; c'est un problème mondial, ce qui signifie qu'assurer la disponibilité du blé restera en tête des priorités régionales dans un avenir prévisible.

AR ملخص

القمح هو غذاء رئيسي يوفر حوالي 20 في المائة من البروتين والسعرات الحرارية المستهلكة في جميع أنحاء العالم. ومن المتوقع أن يواصل الطلب على القمح في النمو خلال العقود المقبلة، لا سيما في العالم النامي لإطعام عدد متزايد من السكان. ونظرًا لأن القمح هو غذاء مُفضل، فلا يزال يُمثل حصة كبيرة من احتياجات الطاقة البشرية بحلول عام 2050. عندما ننظر في الوضع الراهن للمناطق التي تندرج ضمن التصنيف الجغرافي لمنظمة التعاون الإسلامي، فإننا نجد أن النمو السكاني المرتفع والتغيّر السريع في أنماط الحياة والوجبات الغذائية يؤديان إلى زيادة الطلب على القمح في جميع دول منظمة التعاون الإسلامي. ولا تقتصر ظاهرة الطلب المتزايد على القمح على بلدان منظمة التعاون الإسلامي، بل هي قضية عالمية. وهو ما يعني أن ضمان توافر القمح سيظل على رأس جدول الأعمال الإقليمي خلال الأمد المنظور.

WHEAT PRODUCTION IN AFGHANISTAN (CURRENT STATUS AND CHALLENGES, 2022)

IQBAL HABIBI

Senior Agriculture Specialist and Deputy Minister of Irrigation and Natural Resources, Ministry of Agriculture, Irrigation and Livestock

Wheat is a major crop and staple food in Afghanistan, which accounts for 60% of calorie intake, and plays a vital role in maintaining food security in the country. Wheat is the basic food and a major component of the Afghan diet. Per capita, wheat consumption comprises 162 kg per year, which is the highest rate in the world. During the 1960 and 1970s, domestic production of wheat in Afghanistan was able to meet its country's demand, producing surplus production in some years. However, in the decades of conflict, which destroyed agricultural infrastructure and disrupted population growth, Afghanistan became dependent on large-scale commercial imports of wheat and wheat flour. Low productivity per unit area and poor quality of the crop became another critical challenge that Afghanistan faces.

Wheat is one of the basic grains, which accounted for 85% of the total annual production of Afghanistan's cereals in 2010-2020. However, the production quantity and land cultivation of wheat varied from year to year. In 2022, a total of 1.9 million hectares of wheat was cultivated, which consisted of 1.3 million hectares of irrigated and 0.6 million hectares of rain-fed land. The yield resulting from the irrigated land under wheat cultivation was reported to be 18% smaller in 2022 when compared to the previous year due to the drought that the country is experiencing. The total wheat production in the country is reported to be 3.8 million tons, out of which 3.31 million tons were produced from the irrigated land (11% reduction in comparison with the last year) and 0.487 million tons from rain-fed areas[1].

The total demand in the country in 2022 was estimated to be 6.40 million tons, which included 5.60 million tons of food, 0.285 million tons of seeds, and 0.570 million tons of post-harvest losses. Considering the total production and demand, the deficit comprises approximately 2.60 million tons of wheat (Figure 1). In 2022, the average yield of wheat amounted to 2.58 tons and 0.84 tons per hectare from irrigated and rain-fed land, respectively.

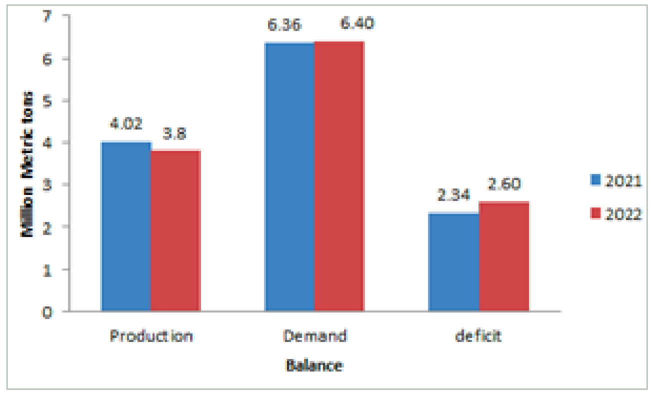


Figure 1: *Wheat balance in 2022*

Wheat production in Afghanistan remains extremely sensitive to variations in precipitation, and the aggregate annual production of wheat in any given year depends on the performance of the rain-fed crop. Wheat is cultivated in all parts of Afghanistan with the majority of it being grown in 16 provinces. Considering the data over the past 10 years, on average, 58% of wheat cultivation takes place on irrigated land, while the remaining 42% takes place on rain-fed land.

The ***key challenges*** to the wheat sector in Afghanistan are as follows:

Pest and disease: Diseases and pests, manifesting both normally and aggressively, cause huge losses in wheat production. The most important types of disease and pests are rust, smut, locust and sunn pest. The spread of diseases and pests can usually cause crop losses between 30-40% and, if not timely controlled, can cause up to 100% of crop losses.

Low Productivity: Limited availability of improved wheat varieties, inadequate quality seed production both by the public and private sectors and poor distribution are the main factors that lead to low productivity per unit area**.**

Farmers having less access to quality inputs: The majority of farmers do not have direct access to quality seeds, and it has made the wheat production sector unstable.

1 Wheat production report 2022, MAIL

Drought: In the past years, drought has reduced wheat yield significantly, leaving farmers in a difficult situation. The drought seems to continue, which can impact production in the next year and lead to further food insecurity in the country.

Agricultural machinery: Few farmers have access to agricultural machinery during the cultivation, harvesting and processing of wheat, which causes product waste before and after harvesting.

Research: The lack of a wheat research and improvement department, the limited number of employees, the low capacity of staff, and the lack of equipped laboratories are among the critical limitations. So, the re-establishment of the genetic resource facilities and capacity building, including professional human resources should be continuously supported.

Quarantine centers: The lack of equipped quarantine centers in the ports has caused a large number of agricultural chemicals and low-quality inputs to be imported into the country, which resulted in the waste of farmers' capital and reduced production of agricultural commodities, including wheat. It even leads to the depletion of water and the diminishing of soil quality.

Irrigation system: The lack of sufficient facilities and resources of introducing new irrigation technology to prevent water waste in the field, the traditional irrigation system and the lack of knowledge of farmers about the effective use of water have caused low water efficiency resulting in low yield of wheat.

Extension: Organizational limitations, low capacity of extension workers, and lack of administrative, technical, and transportation facilities for the relevant workers are among the major challenges that prevent proper communication between extension workers and the agricultural community.

EN SUMMARY

Wheat is one of the staple foods in Afghanistan, the production of which has suffered over the decades of conflicts the country experienced. Wheat production is decreasing every year, generating over two million tons of deficit. It remains extremely sensitive to variations in precipitation, and the aggregate annual production of wheat in any given year depends on the performance of the rain-fed crop. The Afghani agricultural sector faces an array of challenges, among which is the lack of proper facilities, quality seed, appropriate machines, policies and trained personnel.

FR RÉSUMÉ

La production de blé, qui est l'une des denrées alimentaires de base en Afghanistan, a pâti des conflits que le pays a connus pendant des décennies. Chaque année, la production de blé diminue, engendrant ainsi un déficit de plus de deux millions de tonnes. Il demeure extrêmement sensible aux variations des précipitations, et la production annuelle globale de blé d'une année donnée dépend des performances de la culture pluviale. Le secteur agricole de l'Afghanistan fait face à de nombreux défis, parmi lesquels le manque d'installations adéquates, de semences de qualité, de machines appropriées, de politiques et de personnel qualifié.

AR ملخص

يعتبر القمح أحد المواد الغذائية الأساسية في أفغانستان التي عانى إنتاجها على مدى عقود من النزاعات التي شهدتها البلاد. ويتسبب تناقص إنتاج القمح كل عام في عجز يفوق المليوني طن. ولا يزال القمح شديد الحساسية لتغيرات هطول الأمطار ويعتمد إجمالي الإنتاج السنوي للقمح في أي سنة معينة على أداء المحاصيل البعلية. ويواجه القطاع الزراعي الأفغاني مجموعة من التحديات، من بينها الافتقار إلى المرافق المناسبة والبذور الجيدة والآلات والسياسات المناسبة والموظفين المدربين.

WHEAT PRODUCTION IN TURKIYE

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Turkiye is one of the biggest wheat producers in the world, generating nearly 20 million tons of wheat each year. However, it still imports a big quantity of wheat from other countries. This is mainly because the country's wheat production is not enough to cover the population's demand and the production of the export goods, since Turkiye is the leading flour and the second biggest pasta exporter in the world. The export goods such as wheat flour, pasta, bulgur, and semolina are produced mainly from imported wheat.

Wheat is produced on nearly seven million hectares of land in Turkiye, making it the leading crop in terms of area of cultivation. However, the average wheat yield in Turkiye is about 2.7 tons, a number lower than the world's average. There are many reasons for this. One important factor is low precipitation, as a big part of Turkiye's wheat production is done in rain-fed areas. Drought is the major yield-limiting factor in rain-fed wheat-producing areas. With global climate change, drought instances are expected to get more frequent and severe, which will cause even more yield losses for the area. Developing new wheat varieties that are tolerant to abiotic stresses such as drought and heat is essential.

One other important aspect to consider for increasing the yield potential is the adaptation of new and superior varieties by the farmers. Plant breeding programs in Turkiye are working tirelessly to develop varieties that are high-yielding, tolerant to abiotic and biotic stresses, with higher grain quality characteristics and higher adaptability to different environments. These breeding programs are utilizing all the tools and technologies such as marker-assisted selection, double-haploid technique and speed breeding to achieve their goals in a short time with high efficiency. However, the adoption of new varieties, proper agricultural practices and certified clean seeds by the farmers is limited. Extension activities aimed at the farmers and producers are key to the adaptation of these new varieties and technologies.

EN **SUMMARY**

Turkiye is one of the biggest wheat producers in the world, producing nearly 20 million tons of wheat each year. However, it still imports a big quantity of wheat from other countries. Drought is the major yield-limiting factor in rain-fed wheat-producing areas. Adoption of new and superior varieties of wheat by the farmers needs to be considered for increasing the yield potential.

FR **RÉSUMÉ**

La Turquie est l'un des plus grands producteurs de blé au monde, avec une production de près de 20 millions de tonnes de blé par an. Cependant, il importe toujours une grande quantité de blé d'autres pays. La sécheresse est un facteur majeur de limitation du rendement dans les zones de production de blé pluvial. Afin d'augmenter le potentiel de rendement, il convient d'envisager l'adoption de nouvelles variétés de blé supérieures par les agriculteurs.

AR **ملخص**

تعد تركيا واحدة من أكبر منتجي القمح في العالم، حيث تنتج ما يقرب من 20 مليون طن من القمح كل عام. ومع ذلك، فلا تزال تستورد كمية كبيرة من القمح من بلدان أخرى. ويعد الجفاف العامل الرئيسي الذي يحد من الغلة في مناطق إنتاج القمح البعلية. وبالتالي، فإنه يجب على المزارعين أن ينظروا في اعتماد أصناف جديدة ومتفوقة من القمح من أجل زيادة إمكانات الغلة.

CURRENT WHEAT STATUS IN TUNISIA IN THE CONTEXT OF CLIMATE CHANGE

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Importance of wheat in Tunisia

Tunisia is a small and densely populated (11 million inhabitants) Mediterranean country (164.000 km2) which is located on the northern tip of Africa. Cereals constitute a major part of the Tunisian diet, providing 52% of calories and 53% of proteins. Cereal acres make up one third (33%) of the usable agricultural land (UAA). As the most staple cultivated in the country, durum wheat accounts for 47% of the cereal cropping area, followed by barley (44%) and bread wheat (8%). The appreciation of this species has a long history and was associated with several traditional foods, such as pasta and couscous, in addition to several other semolina products, such as frike, bourghul, and unleavened breads. For these raisons, durum wheat is regarded as a strategic crop at the national level and has been always favored for cultivation over bread wheat. Nonetheless, due to a more constrained global production for the specific requirements of durum wheat, this species is less abundant and has consistently been more expensive than bread wheat on the world market.

During the last seven years, an average of 16 million quintals (Mq) of grain was produced annually between 2015 and 2022. Most of this production (13.03 Mq) came from durum wheat with a total area of roughly 542 Mha (OC, 2023), but with significant inter-annual variations due to rainfall fluctuation (table 1, DGPA 2023). Wheat yields are inconsistent on an interannual basis, with national averages never exceeding 20 and 21 q ha−1 for durum and bread wheat, respectively (DGPA, 2023). Such values are well below the yield potential estimated nationally at an average of 50 q ha−1 (ONAGRI, 2018). These average yields result in a total production which is insufficient to cover the local population needs. A population that is known as the world's largest wheat consumer (12 qx in 2022). Consequently, the country depends largely on wheat imports, thus exposing itself to structural food insecurity.

Table 1: Acreage (x1000 ha), production (x1000 qx) and percentage of imported wheat in Tunisia between 2015-2022

	Crops	2015	2016	2017	2018	2019	2020	2021	2022
Acerage (1000 ha)	Durum wheat	540	515	580	535	564	543	545	515
	Bread wheat	111	95	95	85	80	63	65	64
Production (x1000 qx)	Durum wheat	7 576	8 119	9 509	9 624	12 676	9 585	10 747	11 350
	Bread wheat	1 548	1 146	1 534	1 130	1 879	841	1 178	1 168
Importation (%)	Durum wheat	56	58	49	49	34	51	54	55
	Bread wheat	93	96	94	96	94	98	96	97

Main constraints of wheat production

The low durum wheat production level and productivity in Tunisia is primarily linked to its strong dependence on growing climatic conditions. In fact, durum wheat is commonly grown in diverse agro-ecological zones, mainly in arid and semi-arid regions under rainfed conditions (more than 80%), where the precipitation is irregular across years and locations, and with low inputs. In addition, the small size of cereal farms (80% of them do not exceed 20 hectares) contributed to the limited production. Several regions already showed wide yield gaps due to the use of inadequate technological packages with relation to crop genetics and management strategies, technological innovation such as, certified seeds (use of less than 20%, Photo 1), fertilizers, new cultivar, and better farming practices under monoculture system. The monoculture not only leads to soil degradation, but also reduces the harvested yield compared to the potential yield (average national yield/potential yield <1), which results in lower profitability. In addition, farmer's revenue is negatively affected when one a single input, such as seeds, fertilizer, pesticides, etc. is unavailable at the appropriate time. Increased costs for inputs, energy, and labor will has also reduced the profitability of crops.

***Photo 1:** Durum wheat certified seeds*

Furthermore, in recent years, durum wheat production is threatened by climate change and the extreme weather events in Tunisia recognized as a climate change hotspot region. Climate change has a direct impact that varies between cultivars, years, soil conditions, and agronomic management. The effect of weather and climate on the different components of crop production can vary and often occur at the same time. The increase in temperature in response to climate change raises the risk of heat stress and water demand during flowering time and boosts earlier and faster crop growth, thereby reducing yield. On the other hand, higher temperature can reduce the risk of severe/late frost damage and thus leads to higher yield and biomass accumulation.

Such agronomic management in combination with climatic changes has negatively affected durum wheat performance over time, with significant instability of yields and quality traits. Furthermore, these practices led to a great pressure for several years of diseases mainly for septoria leaf blotch which is the most productivity threatening biotic constraint in the major durum wheat production areas.

To boost the durum wheat productivity, especially in rainfed environments, great efforts were made under the national breeding program, led by the National Institute of Agricultural Research of Tunisia (INRAT), resulting in the creation and the registration of several durum wheat cultivars in the national catalogue since 1980 (e.g., 'Karim', 'Razzek', 'Om Rabiaa', 'Khiar', and 'Nasr', Maali). In recent years, continuous breeding efforts by the national program have led to the release of higher yielding, better disease resistance and more drought tolerant durum wheat cultivars ('Salim', 'INRAT 100', and 'Dhahbi') (Photo 2). These varieties have positively impacted the yield at the farmer and national levels. Indeed, the resistance to septoria was improved overtime through selection, genetic improvement in collaboration with International Centers (CIMMYT and ICARDA). Other diseases, such as rusts and tan spot (photo 3), have also emerged as serious concerns for durum wheat cultivation as result of climate change. These diseases are characterized by changing dynamics and the emergence each year of new virulent races with greater adaptability. Thus, the breeding program is challenged to improve durum wheat production by reducing environmental and climatic impacts as well as by managing these diseases in the future.

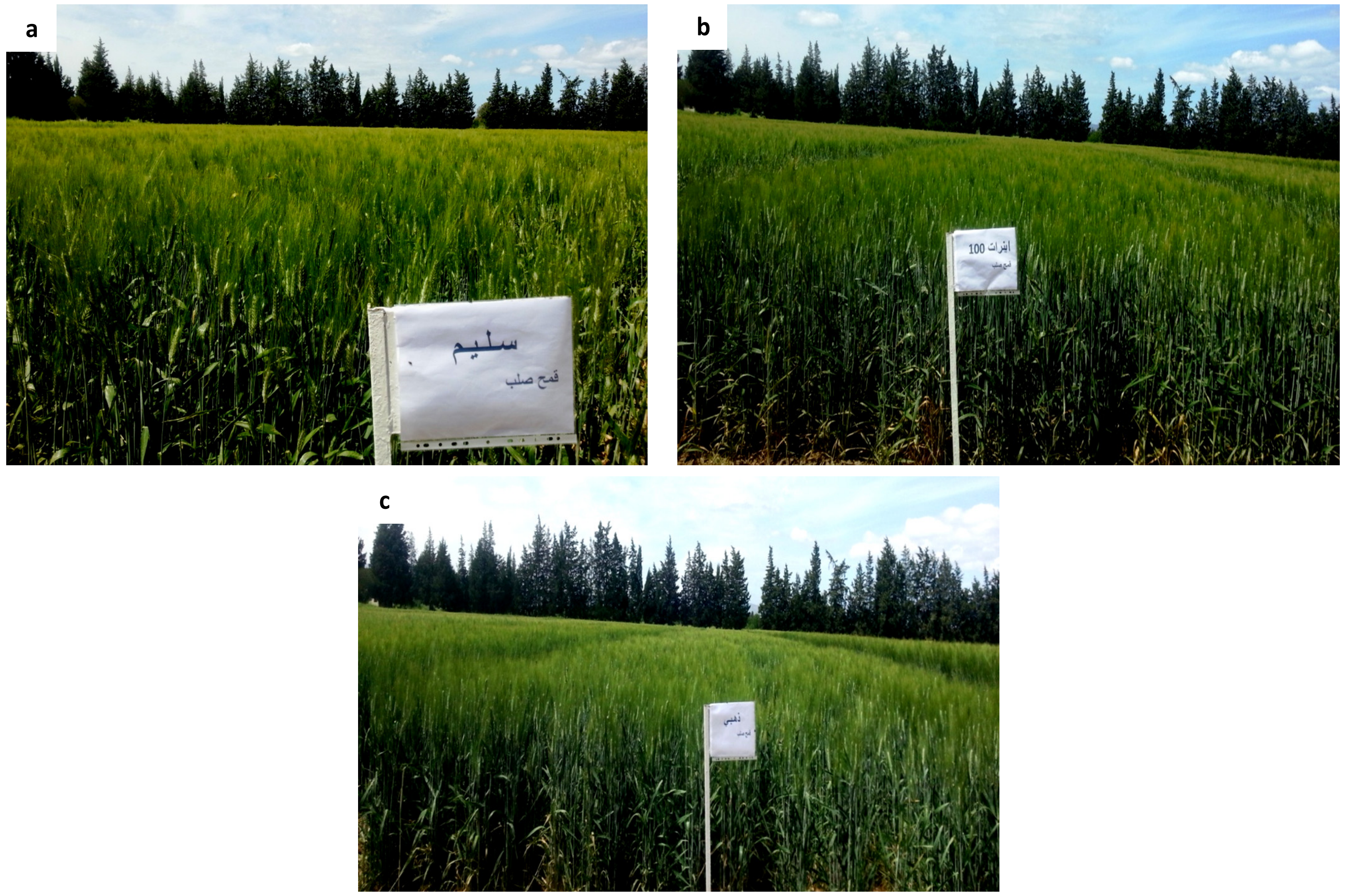

***Photo 2:** New durum wheat varieties released by national program (a) Salim, (b) INRAT 100 and (c) Dhahbi*

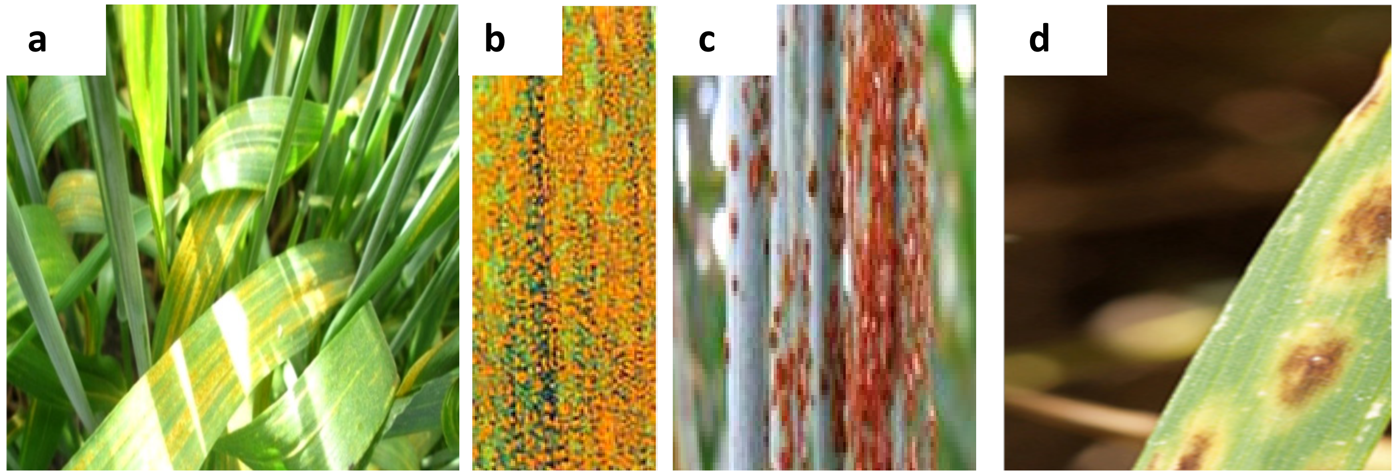

Photo 3: Main diseases emerged in durum wheat fields: Yellow (a), leaf (b), stem (b) rusts and tan spot (d)

Additional factors that contributed to low wheat production included the efficacy of the extension programs, the lack of strong producer organizations, post-harvest losses and constraints related to wheat collection and storage facilities. Great efforts were made by technical services of the Ministry of Agriculture, Water Resources and Fisheries during the first decades after independence in relation to the adoption of high-yielding varieties, new management approaches and agricultural inputs. Such efforts enabled cereal production to increase from 7 to 12 million quintals in twenty years (1964-1984) with an annual growth average of 2.7% (FAO, 1987). However, since the 2000s, there has been some stagnation or even a regression in yields, which can be explained by limiting factors at the farm level, as well as, by constraints linked to the extension and support system.

Up until 1990, the Cereals Office (CO) was the only national actor involved in the activities of collecting, transporting, storing, and marketing cereals. Since then, these activities were gradually transferred to private operators and mutual companies (former cooperatives), SMSA on behalf of the Cereal Office. These operators receive various subsidies (transport, storage, etc.) depending on handled quantities. The price of wheat delivered for farmers depends on a basic price set by the State, to which bonuses or discounts, are added based on the delivered product's quality (impurities, abnormal grains, etc.).

The calculation of wheat price is made according to a scale fixed by the Decree No. 621 of June 13, 2012. To organize the collection operation and to encourage farmers to deliver their crop quickly to the collection centers, an exceptional bonification is offered to farmers who deliver their produced wheat from June 1 to August of each year. Indeed, the quantities of cereals collected yearly have always been well below the expected harvest estimates. On average, only half the harvest is collected by centers. Over the last 7 years, there has been a great inter-annual variability of collected quantities (table 2, DGPA 2023). The average is around 3.460 million quintals: 6.408 and 511.449 million quintals for durum wheat and bread wheat, respectively. In the case of a good year, such as the 2019 cropping season, the wheat quantity (9.264 million quintals) delivered to the collection centers exceed their maximum storage capacity. In addition, post-harvest loss caused by climatic conditions, infrastructure and storage methods is a major problem for cereal safety. There are numerous ways to prevent damage before cereal storage, including timely crop harvesting, on-farm crop drying, cautious site and the selection of appropriate storage facilities, as well as the appropriate fumigation of empty storage facilities. During storage, proper aeration of grains, regular inspection of grain stock, cleaning and fumigation of stored grains are need to ensure safe storage.

Table 2: Wheat quantities collected (x1000 qx) by Cereal office in Tunisia between 2015-2022

	Years							
Crops	2015	2016	2017	2018	2019	2020	2021	2022
Durum wheat	4921	5279	5980	6242	8531	6023	7537	6758
Bread wheat	776	479	676	483	733	259	341	345
Total	5697	5758	6656	6725	9264	6282	7878	7103

Current challenges and prospects

The above discussed constraints of wheat crop represent a serious risk to national food security as it may have consequence on the social and economic stability of the country. Given the great demand for cereal and climatic change threat, stabilizing and increasing production will be a real challenge for Tunisia, calling for improvements in technical and economic efficiencies. Accordingly, adaptation strategies that are resilient to such changes across different climates regions should be implemented immediately, and the local authorities must take decisive action to ensure sustainable cereal crop production. To cope with climate change, farmers will need to diversify their farming systems to improve ecosystem resilience, reduce risk, and simultaneously generate new income opportunities. System diversification includes diversification of crop rotations, for instance by promoting the integration of legume crops in cereal systems which contributes to maintaining soil fertility and providing balanced humans and animal nutrition. Other measures, such as crop genetic and management strategies, certified seeds tillage practices, innovative fertilizers, new cultivar adoption and better farming practices constitute potential options to a sustainable increase of production by the small farmers. Promoting the adoption of high-yielding cultivars with the appropriate recommended practices in a sustainable manner helps to improve the livelihoods of rural farmers. Successful on-farm demonstrations, as an essential part of the extension system, has gained the confidence of farmers and have led to the adoption of new developed technologies and new practices by the farmers. Enhanced collection and the storage conditions of wheat will with no doubt have a positive effect on the cereal sector.

EN SUMMARY

Tunisia is a small and densely populated (11 million inhabitants) Mediterranean country (164.000 km2) which is located on the northern tip of Africa. Cereals constitute a major part of the Tunisian diet, providing 52% of calories and 53% of proteins. Cereal acres make up one third (33%) of the usable agricultural land (UAA). As the most staple cultivated in the country, durum wheat accounts for 47% of the cereal cropping area, followed by barley (44%) and bread wheat (8%). The appreciation of this species has a long history and was associated with several traditional foods, such as pasta and couscous, in addition to several other semolina products, such as frike, bourghul, and unleavened breads. For these reasons, durum wheat is regarded as a strategic crop at the national level and has been always favored for cultivation over bread wheat.

In recent years, durum wheat production is threatened by climate change and the extreme weather events in Tunisia recognized as a climate change hotspot region. Climate change has a direct impact that varies between cultivars, years, soil conditions, and agronomic management.

To boost the durum wheat productivity, especially in rainfed environments, great efforts were made under the national breeding program resulting in the creation and the registration of several durum wheat cultivars in the national catalogue since 1980. Great efforts were made by technical services of the Ministry of Agriculture, Water Resources and Fisheries during the first decades after independence in relation to the adoption of high-yielding varieties, new management approaches and agricultural inputs.

In addition, adaptation strategies that are resilient to such changes across different climates regions should be implemented immediately, and the local authorities must take decisive action to ensure sustainable cereal crop production. To cope with climate change, farmers will need to diversify their farming systems to improve ecosystem resilience, reduce risk, and simultaneously generate new income opportunities.

FR RÉSUMÉ

La Tunisie est un pays Méditerranéen (164 000 km2) densément peuplé (11 millions d'habitants), situé à l'extrémité nord de l'Afrique. Les céréales constituent la majorité du régime alimentaire Tunisien, fournissant 52% des calories et 53% des protéines. Les zones céréalières représentent un tiers (33 %) de la superficie agricole utilisée (SAU). Le blé dur, qui est l'aliment de base le plus cultivé dans le pays, représente 47% de la superficie céréalière, suivi de l'orge (44%) et du blé tendre (8%). L'appréciation de cette espèce a une longue histoire et a été associée à plusieurs aliments traditionnels, tels que les pâtes et le couscous, en plus de certains autres produits à base de semoule comme le freekeh, les bourgouls et les pains azymes. Pour ces raisons, le blé dur est considéré comme une culture stratégique au niveau national et sa culture a toujours été préférée à celle du blé tendre. Ces dernières années, la production de blé dur a été menacée par le changement climatique et les événements météorologiques extrêmes en Tunisie, reconnue comme une région sensible au changement climatique. Le changement climatique a un impact direct qui varie selon la variété, l'année, les conditions du sol et la gestion agronomique. Afin d'améliorer la productivité du blé dur, notamment en milieu pluvial, de grands efforts ont été déployés dans le cadre du programme national de sélection, ce qui a abouti à la création et à un enregistrement de plusieurs variétés de blé dur dans le catalogue national depuis 1980. Les services techniques du Ministère de l'Agriculture, des Ressources Hydrauliques et de la Pêche ont déployé de gros efforts au cours des premières décennies suivant l'indépendance en vue de l'adoption de variétés à haut rendement, de nouvelles méthodes de gestion et d'intrants agricoles. En outre, des stratégies d'adaptation qui résistent à ces changements dans les différentes régions climatiques devraient être mises en œuvre immédiatement, et les autorités locales doivent prendre des mesures décisives pour assurer une production céréalière durable. Pour faire face au changement climatique, les agriculteurs doivent diversifier leurs systèmes agricoles afin d'accroître la résilience des écosystèmes, de réduire les risques tout en créant de nouvelles opportunités de revenus.

AR ملخص

تُعتبر تونس بلدًا متوسطيًا صغيرًا ومكتظًا بالسكان (11 مليون نسمة) (164.000 كم2) يقع على الطرف الشمالي من إفريقيا. وتُشكل الحبوب جزءًا رئيسيًا من النظام الغذائي التونسي، حيث توفر 52 في المائة من السعرات الحرارية و 53 في المائة من البروتينات. وتُمثل أفدنة الحبوب ثلث (33٪) الأراضي الزراعية الصالحة للاستخدام (UAA). وباعتباره أكثر المواد الغذائية الأساسية المزروعة في البلاد، يمثل القمح الصلب 47 في المائة من مساحة زراعة الحبوب، يليه الشعير (44 في المائة) وقمح الخبز (8 في المائة). ويحضا هذا النوع من الحبوب بتاريخ طويل من التقدير ويرتبط بالعديد من الأطعمة التقليدية، مثل المعكرونة والكسكسي، بالإضافة إلى العديد من منتجات السميد الأخرى، مثل الفريك والبرغل والخبز الخالي من الخميرة. ولهذا، يُعتبر القمح الصلب محصولاً استراتيجيًا على المستوى الوطني ودائمًا ما تُفضل زراعته على على قمح الخبز.

أصبح إنتاج القمح الصلب في السنوات الأخيرة مهددًا بسبب تغيّر المناخ والظواهر الجوية المتطرفة في تونس التي يُعترف بها كمنطقة ساخنة لتغيّر المناخ. ويؤثر تغيّر المناخ تأثيرًا مباشرًا يختلف حسب اختلاف الأصناف والسنوات وظروف التربة والإدارة الزراعية.

ومن أجل تعزيز إنتاجية القمح الصلب وخاصة في البيئات البعلية، فلقد تم بذل جهود كبيرة في إطار البرنامج الوطني لتربية الماشية مما أدى إلى إحداث وتسجيل العديد من أصناف القمح الصلب في السجل الوطني منذ سنة 1980. ولقد بذلت الخدمات الفنية التابعة لوزارة الزراعة والموارد المائية الصيد البحري خلال العقود الأولى بعد الاستقلال فيما يتعلق باعتماد أصناف عالية الغلة ومقاربات إدارة ومدخلات زراعية جديدة.

علاوة على ذلك، يجب تنفيذ استراتيجيات التكيّف التي تكتسي القدرة على الصمود في وجه هذه التغيرات في مختلف المناطق المناخية بشكل فوري. كما يجب على السلطات المحلية اتخاذ إجراءات حاسمة لضمان الإنتاج المستدام لمحاصيل الحبوب. وللتعامل مع تغير المناخ، فسيتعين على المزارعين تنويع نظمهم الزراعية من أجل تحسين قدرة النظم الإيكولوجية على الصمود، والحد من المخاطر، وتوليد فرص دخل جديدة في نفس الوقت.

STATUS AND PROSPECTS OF WHEAT PRODUCTION IN KAZAKHSTAN

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Kazakhstan plays an important role in ensuring food security as it has large land reserves - almost 263 million hectares. Of these, more than 40% is agricultural land. One-fifth of agricultural land is occupied by crop areas. In 2022, Kazakhstan sowed 22.9 million hectares, this year it plans to sow 23.1 million hectares. Kazakhstan is a major wheat-producing country, and its grain is considered a national brand. Currently, the country is one of the top six global exporters of wheat and one of the largest exporters of flour. In 2022, it exported more than 13.2 million tons of grain and flour in grain equivalent, including 10 million tons of grain. The top 10 importers of Kazakh grain include Uzbekistan, Tajikistan, Iran, Afghanistan, China, Russia, Turkmenistan, Italy, Azerbaijan and Turkiye.

Thanks to the soil and climatic conditions of Kazakhstan, wheat grains are obtained with high protein content and strong gluten, which can compete with grains of this crop produced in the US, Canada and Australia. Kazakh durum wheat varieties produce high-quality grains, which in turn become a raw material for obtaining high-quality bakery and confectionery products, the best varieties of pasta and cereals, and is in great demand. In Kazakhstan, spring wheat is sown annually on an area of 13-15 million hectares, and the gross grain harvest averages to 9.36-13.23 million tons. However, the average yield of spring wheat in the state is not high - 1.29 t/ha and varies greatly by region from 0.71 t/ha in Western Kazakhstan to 19.5 c/ha in the South. The area of winter wheat is about 600,000 hectares with an average yield of 1.99 t/ha. A further increase in the volume of wheat harvests can become a strong base for stabilizing the country's economy. One of the main factors in solving this problem is the creation of high-yielding, high-quality products, as well as varieties of this crop that are resistant to adverse environmental conditions.

In Kazakhstan, selection and genetic studies are carried out on winter and spring forms of soft and durum wheat. As a result of many years of purposeful breeding and genetic work using modern methods of biotechnology, Kazakh scientists have bred several varieties of spring and winter wheat for various zones of their cultivation. When creating new varieties, the goal was, along with productivity, resistance to biotic and abiotic factors. The created varieties have adaptive features to specific environmental conditions and are characterized by high drought resistance as well as resistance to lodging and pre-harvest germination of grain in the spike. Currently, much attention is paid to the breeding of varieties of optional wheat, which is used both in autumn and spring sowing. The created varieties have low sensitivity to low temperatures, salt resistance, as well as resistance to lodging and shedding of grain during overmaturity, and meet the requirements for strong and valuable wheat. These varieties have good resistance to yellow and brown rust, some varieties are resistant to smut fungi. They also by different lengths of the growing season, are more adapted to adverse environmental conditions and have stable grain quality. Significant areas of spring wheat are occupied by foreign varieties, mainly of Russian selection. For winter wheat, more than 85% of the total sown area is occupied by local varieties. Varieties of winter wheat of the irrigated agroecotype have a potential yield ranging from 5.4 to 7 t/ha with high-quality grain and flour (gluten up to 35%, flour strength up to 400 joules.). In varieties of the dry steppe agroecotype of winter wheat, the yield varied from 1.8 to 2.3 t/ha with quality indicators of grain and flour for strong and especially valuable wheat (gluten up to 41%, flour strength up to 425 joules.). They are distinguished by frost and winter hardiness, heat and drought resistance. Some varieties are carriers of resistance genes to the recently widespread disease of winter wheat - yellow rust. They are also used in Kyrgyzstan and Tajikistan. Winter durum wheat varieties have an average yield of 58 cwt/ha, are winter hardy and resistant to diseases and pests, with a glassiness of 90%, raw gluten content of 30.8% and an overall pasta quality score of 4.4.

The breeding process is continuous and, taking into account the current realities of providing the market with sufficient and high-quality food, all new competitive wheat varieties with improved quantitative and qualitative parameters are required. To do this, it is necessary to conduct constant, purposeful work to create new productive and high-quality products, as well as varieties of wheat adaptive to adverse environmental conditions and introduce them into the production system. In this, great importance is attached to the use of plant genetic resources. In Kazakhstan, the seed material of the gene pool of wheat and local species, relatives of the natural flora of Kazakhstan, were collected, combined, systematized, reproduced and stored (≥ 18,000 samples). Wild and wild relatives of wheat are represented in the flora of Kazakhstan by two main genera: Triticum L. (6 species) and Aegilops L. (5 species). As a result of expeditions made to the Northern Tien Shan, Trans-Ili and Dzungarian Alatau, Southern Altai, Western Tarbagatai, Northern Balkhash, South-Eastern, Southern and Northern Kazakhstan in 2003-2015, a gene pool of wild species - relatives of wheat (726 samples) under the threat of genetic erosion were collected.

EN SUMMARY

Kazakhstan has large land reserves, almost 263 million hectares, of which more than 40% is agricultural land. Kazakhstan is a major wheat-producing country, and its grain is considered a national brand. Currently, the country is one of the top six global exporters of wheat and one of the largest exporters of flour. However, the average yield of spring and winter wheat varies greatly depending on the region. One of the main factors in solving this problem is the creation of high-yielding, high-quality products, as well as varieties of this crop that are resistant to adverse environmental conditions.

FR RÉSUMÉ

Le Kazakhstan dispose de grandes réserves de terres, près de 263 millions d'hectares, dont plus de 40 % sont des terres agricoles. Le Kazakhstan est un important pays producteur de blé et son grain est considéré comme une marque nationale. Le pays figure actuellement parmi les six premiers exportateurs mondiaux de blé et l'un des principaux exportateurs de farine. Cependant, le rendement moyen du blé de printemps et d'hiver varie considérablement selon les régions. La création de produits à haut rendement et de haute qualité, ainsi que de variétés de cette culture résistantes aux conditions environnementales défavorables, constitue l'un des principaux facteurs permettant de résoudre ce problème.

AR ملخص

تمتلك كازاخستان احتياطيات كبيرة من الأراضي تبلغ حوالي ٣٦٢ مليون هكتار وتعتبر أكثر من ٠٤ منها أراضي زراعية. كما تُعد كازاخستان من الدول الرئيسية المنتجة للقمح وتُعتبر حبوبها علامة تجارية وطنية. وتندرج الدولة حاليًا في كل من قائمة أكبر ستة مصدرين عالميين للقمح وقائمة أكبر مصدري الدقيق. ومع ذلك، يختلف متوسط محصول القمح الربيعي والشتوي اختلافًا كبيرًا حسب المنطقة. وتتمثل أحد العوامل الرئيسية المساهمة في حل هذه المشكلة في إنشاء منتجات عالية الإنتاجية وعالية الجودة، بالإضافة إلى إنشاء أنواع مختلفة من هذا المحصول التي تكون مقاومة الظروف البيئية الضارة.

CURRENT AND FUTURE OUTLOOK OF WHEAT YELLOW RUST AND STEM RUST RESISTANCE IN THE BACKDROP OF CLIMATE CHANGE

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Introduction

Wheat *(Triticum aestivum and Triticum durum)* is the most cultivated plant, along with corn and rice among the cereals. Due to its high adaptability to diverse environmental conditions, wheat has spread worldwide. Wheat has rich nutritional elements, and it provides the essential ingredients for human nutrition, especially in rural areas. Wheat provides roughly 20% of the total calories provided by plant-based foods of the world population and contributes significantly to the nutrition and food security of the world's population[1].

Abiotic and biotic stress factors have serious adverse effects on wheat yields. Food safety and supply might be endangered because of global climate changes. Therefore, the protection of wheat from diseases and pests has become a more significant issue. It is estimated that approximately 25-30% of the yield losses occur annually due to wheat diseases and pests[2]. Wheat rust diseases are among the most threatening biotic factors on wheat yield.

The global temperature increase is widely accepted, with rates of change rising towards the poles and an associated increase in the frequency of extreme temperature events. The emergence and distribution of crop pathogens and pests significantly influence food security. Human transportation operations may affect the dispersal of pathogens. However, climate change phenomena (wind, rain, temperature, and humidity) are an increasing concern that allows pathogens to move and survive in different environmental areas. The changes in environmental conditions will lead to the selection of living organisms whose long-term survival will depend on their ability to migrate, tolerate, or adapt to adverse climatic situations.

In host-pathogen interactions, the temperature has a key role in epidemic progress in the short period, as well as the speed and result of antagonistic co-evolution over a long time. Temperature can strongly have an impact on vital phases of the pathogen life cycle[3]. Numerous pathogens have a broad geographical deployment and experience excessive fluctuations of warmth across their habitats. Pathogens can grow and reproduce across a wide range of temperatures and may tolerate wide temperature fluctuations in distinct environments[4].

It is vital for long-distance migrating fungal pathogens such as Puccinia spp. that can move to other distant areas and crops. Investigations of large-scale population structure of pathogens will allow the designation of migration routes, various reservoir sources or longevity of populations, the understanding of recent evolutionary rotations, and the expectation of coming ones.

1 Rahmatov, M., Otambekova, M., Muminjanov, H. et al. Characterization of stem, stripe and leaf rust resistance in Tajik bread wheat accessions. Euphytica 215, 55 (2019). https://doi.org/10.1007/s10681-019-2377-6
2 Bockus, W.W., Bowden, R.L., Hunger, R.M., Morrill, W.L., Murray, T.D., Smiley R.W. Compendium of wheat diseases and pests. 3rd ed. APS Press. Minnesota. (2010) 171 p.
3 Kniskern, J.M., Rausher, M.D.. Natural selection on a polymorphic disease-resistance locus in Ipomoea purpurea. Evolution 61 (2007) 377–387.
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Wheat Rust Diseases

The wheat rust pathogens are heteroecious fungal species belonging to the Basidiomycota group. Wheat rust pathogens stripe (yellow) rust caused by *Puccinia striiformis* f. sp. *tritici*. (Pst), stem (black) rust caused by *Puccinia graminis* f. sp. *tritici* (Pgt) and leaf (brown) rust caused by *Puccinia triticina* are some of the most common foliar diseases of bread wheat, durum wheat[5] and triticale[6]. However, in this article, stripe rust and stem rust will be considered. Figure 1 demonstrates the typical symptoms caused by these two rust diseases in wheat.

Figure 1: *Symptoms of rust diseases A) Stripe/yellow rust caused by* ***Puccinia striiformis*** *f. sp.* ***tritici*** *and B) Stem/black rust caused by* ***Puccinia graminis*** *f. sp.* ***tritici***

Wheat rusts have been shown to cause considerable losses in wheat yields in different regions, years, and environments. Nevertheless, wheat stripe rust has been reported as a significant problem with repeated cases of worldwide invasions[7]. This may be due to a combination of long-distance movement capacity, high rates of mutation from avirulence to virulence, adaptation to different climatic conditions[8], the existence of recombinant and highly variable populations, and the possible creation of new variants through a sexual cycle[9].

Stripe rust is a significant foliar disease of common wheat, pasta wheat, and triticale in temperate regions with cool and wet summers and mild winters[10]. The development of resistant wheat varieties remains the most economical and environmentally friendly strategy to manage yellow rust.[11] The severity of the yellow rust pathogen is related to the ability of the pathogen's mutation and fast generation turnover rates, the development of races, and the capability to extend over distances of hundreds of kilometres. Severe wheat yellow rust epidemics have occurred in major wheat-producing areas causing significant yield losses in recent years[12]. The divergence of races associated with epidemic sites at different continents will be helpful to facilitate the breeding of resistant or less susceptible crop varieties and the development of appropriate disease control methods[13].

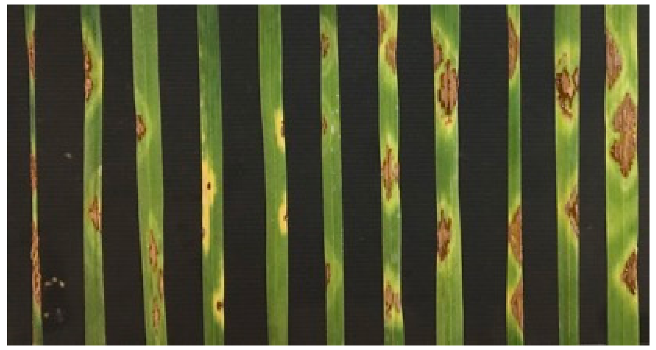

Figure 2: *Variation of TKTTF stem rust race on seedling stage of wheat plants.*

Stem rust of wheat is caused by the fungal plant pathogen *Puccinia graminis* f. sp. *tritici*. The pathogen moves by airborne urediniospores from one field to another field and over long distances. Urediniospores are responsible for multiple infections. In addition to wheat, *Puccinia graminis* f. sp. *tritici*, infects *Berberis*, *Mahonia*, and *Mahoberberis* species. *Berberis* plant is also the alternate host of the yellow rust pathogen (*Puccinia striiformis* f. sp. *tritici*). The life cycle of the pathogen consists of five different stages. Sexual recombination on *Berberis* species causes rust pathogens to develop new races and these may be responsible for new epidemics. Planting systems and climatic conditions play a significant role in the occurrence of major epidemics[14]. Weather conditions also are essential for the transmission of the pathogen to *Berberis* species and encourage the formation of infection, pathogen survival, growth, and sexual recombination. Additionally, environmental conditions help the pathogen to complete the life cycle and especially the survival of the teliospores, their germination, and the infection of *Berberis* leaves by basidiospores15.

The occurrence of infection under natural conditions relies on several factors. Teliospores should germinate when the susceptible *Berberis* leaves are green and encounter basid-

5 Dracatos, Peter M et al. "Complementary resistance genes in wheat selection 'Avocet R' confer resistance to stripe rust." TAG. Theoretical and applied genetics. Theoretische und angewandte Genetik vol. 129,1 (2016): 65-76. doi:10.1007/s00122-015-2609-7
6 Dean, Ralph et al. "The Top 10 fungal pathogens in molecular plant pathology." Molecular plant pathology vol. 13,4 (2012): 414-30. doi:10.1111/j.1364-3703.2011.00783.x
7 Hovmøller, M. S., Walter, S., Bayles, R., Hubbard, A., Flath, K., Sommerfeldt, N. Replacement of the European wheat yellow rust population by new races from the centre of diversity in the near-Himalayan region. Plant Pathol. 65, (2016) 402–411.
8 Milus, Eugene A et al. "Evidence for increased aggressiveness in a recent widespread strain of Puccinia striiformis f. sp. tritici causing stripe rust of wheat." Phytopathology vol. 99,1 (2009): 89-94. doi:10.1094/PHYTO-99-1-0089
9 Rodriguez-Algaba, Julian et al. "Sexual structures and recombination of the wheat rust fungus Puccinia striiformis on Berberis vulgaris." Fungal genetics and biology : FG & B vol. 70 (2014): 77-85. doi:10.1016/j.fgb.2014.07.005
10 Ali, Sajid et al. "Origin, migration routes and worldwide population genetic structure of the wheat yellow rust pathogen Puccinia striiformis f.sp. tritici." PLoS pathogens vol. 10,1 (2014): e1003903. doi:10.1371/journal.ppat.1003903
11 Sørensen, Chris K et al. "New Races of Puccinia striiformis Found in Europe Reveal Race Specificity of Long-Term Effective Adult Plant Resistance in Wheat." Phytopathology vol. 104,10 (2014): 1042-51. doi:10.1094/PHYTO-12-13-0337-R
12 Hu, Xiaoping et al. "Predicting Overwintering of Wheat Stripe Rust in Central and Northwestern China." Plant disease vol. 104,1 (2020): 44-51. doi:10.1094/PDIS-06-19-1148-RE
13 Hawkesford, M.J, Jose-Luis Araus, Robert Park, Daniel Calderini, Daniel Miralles, Tianmin Shen, Jianping Zhang, Martin A. J. Parry Food and Energy Security 2013; 2(1): 34–48
14 Sinha P, Chen X. Potential Infection Risks of the Wheat Stripe Rust and Stem Rust Pathogens on Barberry in Asia and Southeastern Europe. Plants. 2021; 10(5):957. https://doi.org/10.3390/plants10050957
15 Chen, X.M. Stripe rust epidemiology. In Stripe Rust; Chen, X.M., Kang, Z.S., Eds.; Springer: Dordrecht, The Netherlands, (2017) pp. 283–352.

iospores that germinate under suitable conditions. After the spermagonia formation on the leaves, aecia are developed under the leaves and aeciospores infect susceptible wheat plants, and dispersion of the pathogen occurs while the pathogen is in aecial form. There must be a favorable climate when the aeciospores infect susceptible wheat plants. The *Berberis* species has been known as a factor in the occurrence of major epidemics for a long time. The Asian and Southern European countries are known as the regions where *Berberis* species are seen in abundance[16]. It is known that the risk levels of pathogens are between high and very high due to the high presence of *Berberis* species in Azerbaijan, Russia, Türkiye, and Georgia.

The Function of Climate Between Host and Pathogen

Global climate change has an impact on the life cycle of crop pathogens, and it may modify the host resistance and host-pathogen interactions. The selection criteria for disease resistance to plant pathogens are being altered by climate change. Stress tolerance and photoperiod behavior are among the genetic basis of traits with a critical function under environmental change. This is beginning to be understood for model organisms, providing a starting issue for candidate gene approaches in targeted non-model species[17].

Genetic diversity is an inherent feature of pathogens that make persistent genetical adaptations to allow them to overcome the thermal fluctuations that can be different essentially in distinct areas. Considerable pathogens indicate genetically determined geographical differentiation in traits that are under thermal preference[18]. The underlying genetic divergence for temperature sensitiveness in the affected populations and the potential influence of global warming on species will rely on its thermal response.

The function of the environment in pathogen adaptation is mostly uncertain. Considerable studies have expressed climatic effects on disease development and transmission but frequently utilize a few host or pathogen genotypes[19]. Consequently, there is less knowledge about the potency of host-pathogen interactions and their adaptive significance. These can explain why environmental variables are occasionally considered when examining resistance durability.

The Effects of Global Warming on Aggressiveness of Yellow Rust and Stem Rust Pathogens and their Geographic Distribution

Global warming, climate changes, and alternate pathogen hosts affect the rate of spread of rust diseases and the distribution of disease races.[20] Yellow rust pathogen *Puccinia striiformis* f. sp. *tritici* provides an example of this phenomenon of thermal adaptation, and it was expected not to endure extreme summer conditions. Nonetheless, since 1979 there have been several reports of yellow rust in drought seasons, with significant yield losses seen under epidemic conditions.

Most yellow rust studies rely on molecular diversity and virulence phenotyping, which allows a good preference for the broad characteristics of a global population. Experiments assessing the latent period and production of spores have determined that strains PstS1 and PstS2 from East Africa[21] are more aggressive than the US Pst isolates at 18°C[22]. PstS2 was a dominant strain in the Lebanese and Syrian populations in 2010–2011[23]. Severe yellow rust epidemics emerged in the mid-west region of North America in 2000 by PstS1[24]. Almost the same lineage caused major epidemics recorded in Western Australia in 2002 and Eastern Australia in 2003[25]. Thus, the thermal adaptation and remarkable rise in aggressiveness in populations of pathogenic fungi can be driven by genetic differentiation.

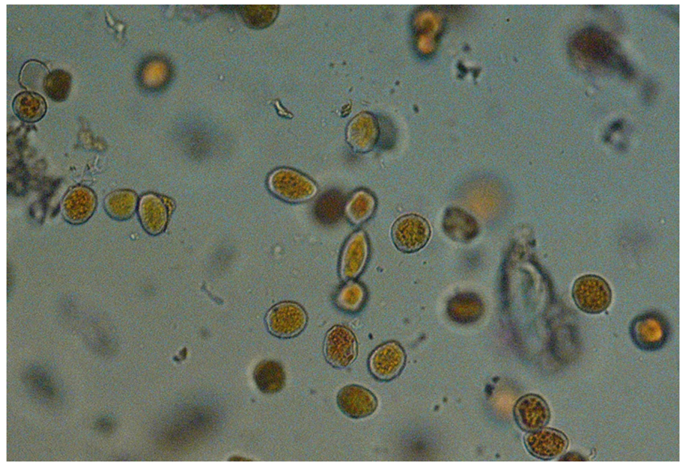

Figure 3: *Microscopic view of yellow rust urediospores.*

Nevertheless, occasional studies explained the impact of host-environment aspects on disease components at the population level and only included one or a few isolates. The Warrior race emerged in 2011 in North-western Europe and this race was seen both in cold and warm regions.[26] It is another exotic race attacking new areas and rapidly replacing the European Pst population. In France, proof of local adaptation to Pst temperature conditions has been obtained. Southern strains (PstS3) exceeded northern strains (PstS0) at high temperatures, and northern strains outperformed southern ones at low temperatures under controlled testing requirements[27].

16 Sinha P, Chen X. Potential Infection Risks of the Wheat Stripe Rust and Stem Rust Pathogens on Barberry in Asia and Southeastern Europe. Plants. 2021; 10(5):957. https://doi.org/10.3390/plants10050957
17 Reusch, Thorsten B H, and Troy E Wood. "Molecular ecology of global change." Molecular ecology vol. 16,19 (2007): 3973-92. doi:10.1111/j.1365-294X.2007.03454.x
18 Karl, I., Janowitz, S.A., Fischer, K. Altitudinal life-history variation and thermal adaptation in the copper butterfly Lycaena tityrus. Oikos, 117, (2008) 778–788.
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20 Elad, Y. Pertot, I.. Climate change impacts on plant pathogens and plant diseases, J. Crop Impr. 28:1, (2014) 99-139.
21 Walter, Stephanie et al. "Molecular markers for tracking the origin and worldwide distribution of invasive strains of Puccinia striiformis." Ecology and evolution vol. 6,9 2790-804. 20 Mar. 2016, doi:10.1002/ece3.2069
22 Milus, Eugene A et al. "Evidence for increased aggressiveness in a recent widespread strain of Puccinia striiformis f. sp. tritici causing stripe rust of wheat." Phytopathology vol. 99,1 (2009): 89-94. doi:10.1094/PHYTO-99-1-0089
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24 Chen, Xianming et al. "Wheat Stripe Rust Epidemics and Races of Puccinia striiformis f. sp. tritici in the United States in 2000." Plant disease vol. 86,1 (2002): 39-46. doi:10.1094/PDIS.2002.86.1.39
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Indeed, in the example cited above, southern French PstS3 strains exceeded northern PstS0 strains under all field conditions (including northern conditions) if susceptible hosts were provided. The isolates emerging in a specific province are defined not only by their capability to thrive under regional environmental conditions but also by the resistance structure of the available hosts. Infection emergence is, therefore, conditioned by regional host availability and the environmental aptitude of the pathogen. The Fertile Crescent is the origin of wheat and wheat wild relatives.

Undoubtedly, many uncharacterized resistance phenotypes in landraces are grown throughout Western Asia. Many of these landraces show segregation for resistance, displaying their variability and heterozygosity for these novel resistance genotypes. The survival ability of these landraces under different climate conditions might influence their biology and disease resistance status. In the wheat-growing regions of North America, north-western Europe, and Australia, single homogeneous genotypes are grown over vast areas. The appearance of high temperature-tolerant P. *striiformis* races has increased the disease in new geographic areas. Last two decades, unique, more aggressive P. *striiformis* races adapted to warmer temperatures and demonstrated extended virulence profiles had caused widespread epidemics[28]. As a case in issue, two highly aggressive P. *striiformis* races (PstS1 and PstS2) were present in epidemic areas across five continents in 2009, reflecting the quickest and vast distance of any significant plant pathogen to date[29]. This epidemic will likely continue as these strains develop in their new geographical area[30].

Stem rust disease has caused severe economic damage by creating epidemics from time to time around the world. When weather conditions are favorable for the development of the disease, stem rust causes epidemics and significant yield losses on susceptible wheat cultivars that do not contain resistance genes. Climate change has had a significant impact on the pathogen associated with stem rust of wheat.

One of the ways that climate change has affected stem rust is by altering the distribution and activity of the pathogen. As temperatures have risen, the pathogen has been able to expand its range and become more active in areas that were previously too cold for it to thrive. This has led to increased incidence and severity of stem rust in some regions. In addition, changes in precipitation patterns associated with climate change have also impacted the development of stem rust. The fungus requires moisture to infect and spread, and changes in rainfall patterns can affect its ability to do so. For example, prolonged periods of drought can make plants more susceptible to infection, while heavy rainfall can promote the spread of the disease.

Finally, changes in temperature and humidity can also affect the genetic makeup of the pathogen itself. Some studies have shown that warmer temperatures can increase the genetic diversity of the pathogen, which can in turn make it more virulent and difficult to control. In addition, changes in temperature and humidity can also impact the evolution of the pathogen, leading to the emergence of new strains that may be more aggressive and difficult to manage.

Future Perspectives

Long-distance migrating fungal pathogens such as Puccinia *striiformis* f. sp. *tritici* and *Puccinia graminis* f. sp. *tritici* can affect large areas and destroy susceptible crops. Global climate change will shift the lifecycle stages and their expansion rates for pests, pathogens, and associated antagonistic organisms. Expecting the future occurrence of crop diseases needs dependable environmental change scenarios and a definition of the pathogen response to climate changes[31]. Such responses may contain spore immigration, phenotypic plasticity, and genetic adaption to climate and climate change-driven changes in ecosystem attributes. Recent pathogen population shifts have been well documented[32]. Effects of climate change on pathogen biodiversity are frequently regarded as a forcing variable that drives demographic response through species dispersal, extension range, attacks, and genetic evolution of different rust races.

Furthermore, expecting the effect of climate on coming epidemics needs a better understanding of pathogen adaption to altering environment.[33] One strategy for studying the plant-pathogen response to temperature is to model pathogen race adaptation rates in response to changing temperatures. The response of plant-pathogen interactions to temperature is essentially nonlinear[34] and may be used to conclude environmental modification effects on pathogen aggressiveness. However, practical verification of this model type is unavailable, given that monitoring pathogen physiological or genetic adaption needs wide laboratory measures of fitness traits across various environmental requirements.

The designation of the present temperature response of well-characterized races, formerly adapted to high temperatures, is another strategy. If the current thermal adaptations benefit the races in a warmer climate, the temperature response arcs

26 Hovmøller, M. S., Walter, S., Bayles, R., Hubbard, A., Flath, K., Sommerfeldt, N. Replacement of the European wheat yellow rust population by new races from the centre of diversity in the near-Himalayan region. Plant Pathol. 65, (2016) 402–411.
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33 Garrett, K.A., Forbes, G.A., Savary, S., Skelsey, P., Sparks, A.H., Valdivia, C., van Bruggen, A.H.C., Willocquet, L., Djurle, A., Duveiller, E., Eckersten, H., Pande, S., Vera Cruz, C. and Yuen, J. Complexity in climate-change impacts: an analytical framework for effects disease mediated by plant. Plant Pathology, 60: (2011) 15-30. https://doi.org/10.1111/j.1365-3059.2010.02409.x
34 Bernard, Frédéric et al. "The development of a foliar fungal pathogen does react to leaf temperature!." The New phytologist vol. 198,1 (2013): 232-240. doi:10.1111/nph.12134

can be used under the environment models. This method would help to define whether current invasive races created under warmer temperatures have a particular benefit at the end of the century. A disease model relying on temperature for each race and to simulate infection efficiency for each isolate in moderate and Mediterranean countries for the near future (2021–2050) and far future (2071–2100) environment scenarios is needed.

Conclusion

Wheat yellow (stripe) rust has formerly shown preferential expansion in cold locations but was recently capable of invading warmer regions. Indeed, new aggressive races of Pst (PstS1 and PstS2) tolerant to high temperatures have recently been distributed worldwide. Therefore, stripe rust was identified as a good candidate disease to address the question of environmental modification. Stem rust extended all over the wheat-growing areas around the World and caused serious rust epidemics in different periods. Therefore, still it is one of the most feared diseases in wheat-growing areas. The rust populations must be strictly monitored for two significant reasons. New races may move from a wheat-growing area to another area including long-distance, either through wind-assisted or human activities. This makes global, regional, and national quarantines impossible. Rust pathogens have an excessive ability to change and develop new races through mutation and sexual recombination. For this reason, the effect of changing races on commercial varieties, genetic stocks, and advanced lines should be determined, and new sources of resistance against new and dominant races should be revealed[35].

35 Akci, N., Karakaya, A. Determination of the seedling reactions of some Turkish bread and durum wheat cultivars to stem rust races TTTTF, RTTTC and RTTTF. Tarım Bilimleri Dergisi 27 (3), (2021) 321 – 326.

EN SUMMARY

Yellow rust and stem rust are among the most common foliar diseases of bread wheat (*Triticum aestivum*), durum wheat (*Triticum durum*) and triticale (x *Triticosecale*). Climate change has a significant impact on the life cycle of crop pathogens that might affect the host resistance and host-pathogen interactions. Global warming, climate change, and alternate hosts of the pathogen affect the rate of spread of rust pathogens and the distribution of races. The rust populations have to be strictly monitored for two significant reasons; new races may move from a wheat-growing area to another area either through wind-assisted or through human activities. The long-distance transport of rust pathogens and their spores is possible, and this makes global, regional, and national quarantines impossible. Rust pathogens also have an excessive ability to change and develop new races through sexual recombination and mutation.

FR RÉSUMÉ

La rouille jaune et la rouille des tiges sont parmi les maladies foliaires les plus courantes du blé panifiable (*Triticum aestivum*), du blé dur (*Triticum durum*) et du triticale (x *Triticosecale*). Le changement climatique exerce un impact significatif sur le cycle de vie des agents pathogènes des cultures, ce qui pourrait affecter la résistance de l'hôte et les interactions hôte-pathogène. Le réchauffement climatique, le changement climatique et les hôtes alternatifs de l'agent pathogène affectent le taux de propagation des agents pathogènes de la rouille et la distribution des races. Les populations de rouille doivent faire l'objet d'une surveillance stricte pour deux raisons importantes : de nouvelles races peuvent se déplacer d'une zone de culture du blé vers une autre zone, que ce soit sous l'effet du vent ou des activités humaines. Le transport sur de longues distances des agents pathogènes de la rouille et de leurs spores est possible, ce qui rend impossible les quarantaines mondiales, régionales et nationales. Les agents pathogènes de la rouille ont également une capacité excessive à changer et à développer de nouvelles races par recombinaison sexuelle et mutation.

AR ملخص

يعد الصدأ الأصفر وصدأ الساق من أكثر الأمراض الورقية شيوعًا لقمح الخبز (*Triticum aestivum*) والقمح القاسي (*Triticum durum*) والتريتكال (x *Triticosecale*). ويؤثر تغيّر المناخ بشكل كبير على دورة حياة مسببات أمراض المحاصيل التي من شأنها أن تؤثر على مقاومة المضيف والتفاعلات بين المضيف والممرض. كما يؤثر الاحتباس الحراري وتغيّر المناخ والمضيفات البديلة لمسببات الأمراض على معدل انتشار مسببات الصدأ وتوزيع الأجناس. ولذلك، يجب رصد تجمعات الصدأ بدقة لسببين مهمين، أحدهما إمكانية انتقال الأجناس الجديدة من منطقة زراعة القمح إلى منطقة أخرى إما من خلال مساعدة الرياح أو من خلال الأنشطة البشرية. يعتبر تنقل مسببات الصدأ وجراثيمها لمسافات طويلة أمر ممكن، وهو ما من يجعل من عزلها على المستوى العالمي والإقليمي والوطني أمرًا مستحيلاً. كما تتمتع مسببات الصدأ أيضًا بقدرة مفرطة على تغيير وتطوير أجناس جديدة من خلال إعادة التركيب الجنسي والطفرة.

NOVEL WATER SMART WHEAT FOR A CHANGING CLIMATE AND FOOD SECURITY



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Wheat, heat, and drought

The wide adaptability of wheat across different agro-environmental conditions has made it critical for the global food supply. However, wheat productivity faces multiple challenges, driven primarily by climate change and input use efficiency constraints. Over the years, extensive research and breeding efforts have improved wheat production efficiency, but ideotype-focused research is needed to pace up with global changes.

Within climate change dimensions, water scarcity (drought stress) and higher mean and peak temperatures (heat stress) are factors affecting wheat yield the most. Increasing climate variability is intensifying the problem and could adversely affect wheat yield, especially in areas where optimum growth conditions already prevail and where the frequency and patterns of rainfall and temperature are altered. Studies indicate an increase in irrigation requirements reaching up to 74% in worst scenarios for the wheat crop due to increased evapotranspiration owing to the rise in temperature; each 1 °C temperature rise reduces wheat yield by 6%. In contrast, freshwater resources for irrigation purposes are largely depleting. Thus, the water availability for wheat cropping is predicted to decrease as the frequency and intensity of drought increase in many regions globally. This in turn creates big challenges for scientists and farmers: i) Often, farmers are reluctant to invest in more inputs necessary for water-deficient yield potential, and ii) scientists working on crop production and improvement face challenges in handling large sets of genotypes, seasonal variability, interaction, and low heritability. While management practices cannot be optimized due to the change in the amount and pattern of rainfall, scientists need to find alternative, cost-effective, and environmentally safe options to overcome these challenges.

Airborne moisture as an irrigation water source

There are many areas in the world where surface or groundwater is nearly inaccessible, or its availability is highly unpredictable. Plants have developed features that help capture and utilize air-borne moisture, particularly many dessert plants. Fog is considered an important moisture source for species in coastal deserts like the Namib (Namibia), the Mojave and Colorado (California, U.S.A), the Atacama (Chile), the Baja (Mexico), and the Wahabi Sands (Oman). Crops such as wheat, originally from dry temperate regions, are now also cultivated in regions where fog is the only prevailing source of precipitation in some months and can be therefore tested and adapted to use atmospheric moisture for irrigation purposes. Their canopy can be architected in such a way that it enhances not only the moisture interception ability but also the photosynthetic capacity and ultimately yield.

Leaf surface adaptations for air moisture capturing

Moisture is absorbed directly by the leaf and stem and channeled to the stem base to supply the soil around their rhizosphere. An extensive literature study led us to pull out a few leaf surfaces and architectural traits that are expressed by some wheat genotypes (as well as other cereals such as rice and barley) and function as air moisture traps. Wheat has very diverse leaf surface structures from dense to no hairs, droopy to erect stature, inward to outward, leaf rolling to longitudinal grooves, which can act as gradient channels for the water flow. These traits have been studied to understand the mechanism of fog water utilization in plants and to design artificial moisture harvesters. Five major leaf traits, termed novel leaf traits were found to be efficient in engineering air-moisture harvesting.

Leaf traits dynamics in wheat genotypes

Leaf prickle hairs and longitudinal grooves help in air-moisture interception

Mostly, the abaxial leaf surfaces of wheat genotypes are glabrous due to the absence of hairs, including glandular hairs. Epidermal trichomes are also scarce in wheat leaves. However, if present, large trichomes alongside leaf margins are dominantly present on leaf tips and gradually decrease towards the base, while small trichomes are located paracellularly on the adaxial leaf surface (Figure 1a). The leaf groove was categorized as deep, medium, and light based on the indentation of the midrib (Figure 1b).

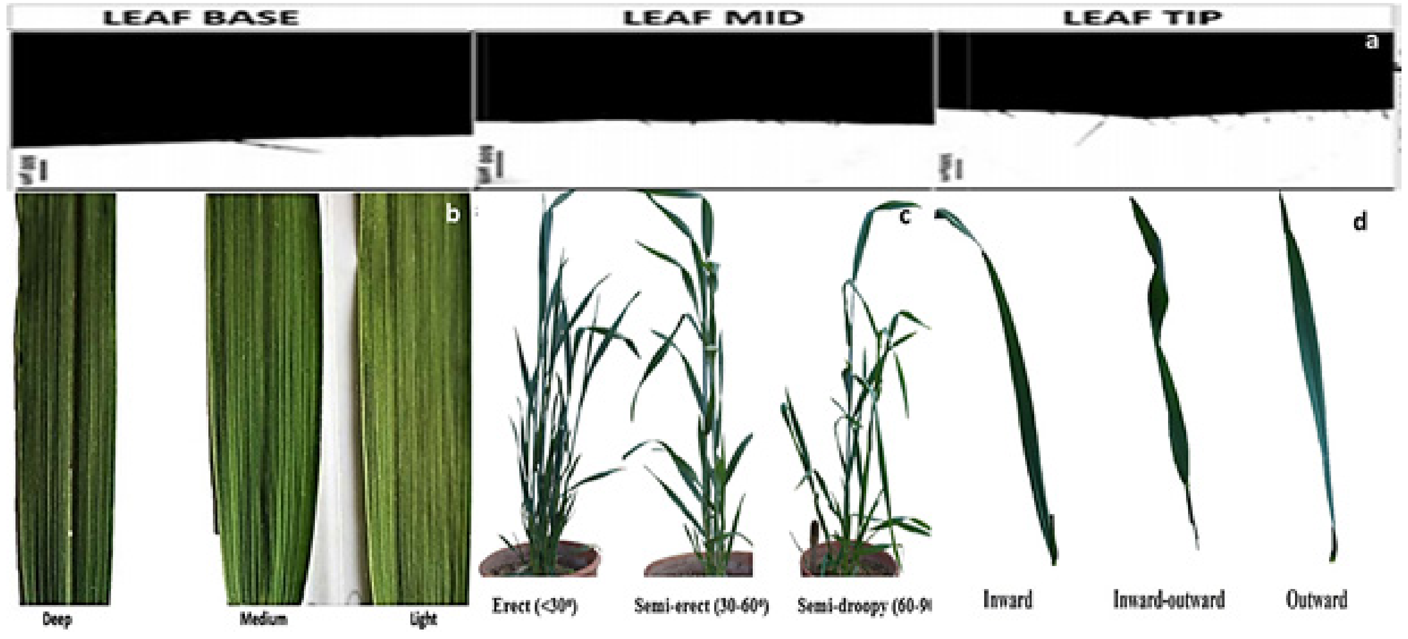

Figure 1: *Dynamics of leaf prickle hairs, longitudinal groove, leaf angle, and leaf rolling in wheat genotypes. a. Presence and density of leaf prickle hairs on different leaf portions on the adaxial leaf surface. b. Groove types on the adaxial leaf surface. c. Leaf-stem angle. d. Leaf rolling behaviors.*

Leaf angle, leaf rolling and leaf wettability help in water channeling

The wheat genotypes can be categorized as erect (<30°), semi-erect (30-60°), semi-droopy (60-90°), and droopy (>90°) based on the leaf-to-stem angle and overall stem angle (Figure 2a). In spring wheat, droopy leaf angle is scarcely observed. Although wheat genotypes are predominantly semi-erect type, erect genotypes can also be found. Under normal field conditions, wheat leaves show slightly inward leaf rolling. However, this trait is totally dependent on soil and air moisture conditions, time of the day and growth stage and may change periodically. For example, in response to drought stress conditions and during mid-day, the leaves tend to be more twisted with inward-outward leaf rolling. The abaxial and adaxial surfaces of the leaves show different wettable properties on either side and vary dynamically among genotypes depending upon the surface roughness developed by prickle hairs, cuticular wax and arrangement of leaf cells. These leaf surface properties give rise to different leaf rolling positions and aid droplet movement on the leaf surface. The hydrophobic surfaces generally form spherical drops, while hydrophilic surfaces have the ability to get more surface area of the leaf in contact with the water droplets. Wheat leaf was found to vary from super hydrophobic (leaf contact angle > 120°) to hydrophilic (leaf contact angle less than 60°). This gave rise to diversity in drop rolling efficiency as well represented by very high-to-low contact angle hysteresis (>30° to <10°), which ultimately affected the plant's ability to channel water droplets.

Ideal mechanism of air moisture interception

The prickle hairs on the wheat leaf surface act like a mesh by entangling moisture droplets (Figure 2a), while the larger trichomes on the margins help the droplet retention and prevent water losses from shattering and dripping off from sagging leaves. The small trichomes help in the collision of water droplets to grow bigger in size (Figure 2b). Subsequent coalescence at localized regions is enhanced by gradient grooves. These droplets trickle down along the stem, reaching the ground (Figure 2c). The leaf wettability supports the droplet movement towards localized positions and frees up space for the next cycle of moisture interception. The erect stature of the plant is helpful for the stem flow of collected water. The leaf rolling strengthens this whole phenomenon by preventing the loss of water through shattering. During fog in natural field conditions, wheat plants were observed to intercept a significant quantity of fog water, which dripped to the ground resulting in soil dampness (Figure 2d). Although, variations exist among genotypes for the stem flow capacity depending upon the leaf architecture. Generally, we found wider variation in the ability to capture air moisture corresponding to 0-7 ml in the root zone. But air moisture harvested through stem flow was remarkably higher (2.5-3.5 ml) for the genotypes with erect to semi-erect leaf angles and spiral leaf rolling, medium to deep groove and wettable leaf surface

with high drop rolling efficiency. Thus, a wheat plant with 5-7 tillers on average can capture 14 mm water per day, while its daily requirement is 2.6 mm per day, assuming 400 mm throughout the crop season. Although this amount can certainly be not accounted for by 100%, wheat can capture substantial amounts of air moisture to amend its irrigation needs.

Figure 2: Mechanism of air moisture utilization as an irrigation water source by the wheat plant under natural field conditions. *a. Fine drops on the abaxial and adaxial leaf surfaces. b. Droplets coalition into larger water drops. c. Gravitational movement of water drops towards the root zone. d. Soil damping due to moisture retention.*

Conclusions

Concludingly, the association among the leaf traits, leaf surface wettability, and soil moisture content favors that genotypes with higher wettability of abaxial surface and lower wettability for adaxial surface were efficient in droplet channeling towards the ground if they had erected leaf-stem angle, inward leaf rolling, deeper leaf groove, long marginal hairs, and denser surface hairs.

EN SUMMARY

Wheat productivity faces multiple challenges especially climate change and input use efficiency. Water scarcity and temperature stress are the factors affecting wheat yield the most. Heat and drought stress are becoming more prevalent. Depleting water resources have become a serious concern, especially for agriculture. Water availability for wheat cropping is predicted to decrease as the frequency and intensity of drought increase in many regions globally. However, air moisture can become an efficient water source for crop plants as evidently utilized by many desert plants. Crops like wheat, which are grown in the prevalent foggy months, can be designed and modified to utilize air moisture for irrigation purposes.

FR RÉSUMÉ

La productivité du blé est confrontée à de multiples défis, notamment le changement climatique et l'efficacité de l'utilisation des intrants. Le manque d'eau et le stress thermique sont les facteurs qui affectent le plus le rendement du blé. Le stress dû à la chaleur et à la sécheresse est de plus en plus répandu. L'épuisement des ressources en eau est devenu une préoccupation majeure, notamment pour l'agriculture. La disponibilité de l'eau pour la culture du blé devrait diminuer en raison de l'augmentation de la fréquence et de l'intensité des sécheresses dans de nombreuses régions du monde. Toutefois, l'humidité de l'air peut constituer une source d'eau efficace pour les plantes cultivées, comme l'utilisent manifestement de nombreuses plantes du désert. Les cultures comme le blé, qui sont cultivées pendant les mois de brouillard prédominants, peuvent être conçues et modifiées pour utiliser l'humidité de l'air à des fins d'irrigation.

AR ملخص

تواجه إنتاجية القمح تحديات متعددة، أبرزها تغيّر المناخ وكفاءة استخدام المدخلات. وتعتبر ندرة المياه والضغط الحراري من العوامل التي تؤثر على محصول القمح أكثر من غيرها، حيث أصبحت ضغوط الحرارة والجفاف أكثر انتشارًا. وأصبح استنزاف موارد المياه مصدر قلق كبير، خاصة بالنسبة للزراعة. ومن المتوقع أن ينخفض توافر المياه لزراعة القمح مع زيادة وتيرة وشدة الجفاف في العديد من المناطق على مستوى العالم. ومع ذلك، فمن الممكن أن تصبح رطوبة الهواء مصدرًا فعالًا للمياه لنباتات المحاصيل كما هو واضح بين العديد من النباتات الصحراوية. ويمكن تصميم المحاصيل مثل القمح، التي تزرع في الأشهر الضبابية السائدة، وتعديلها لاستخدام رطوبة الهواء لأغراض الري.

MOVING TOWARD DIGITAL AGRICULTURE: IOFS E-CENTERS OF EXCELLENCE FOR STRATEGIC COMMODITIES

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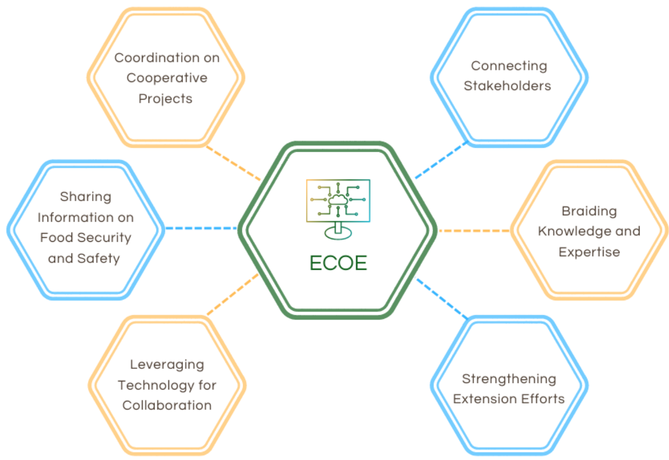
Advisor to the Programs & Projects Department

One of the major mainstays of intra-OIC cooperation in the relevant socio-economic domains is the mainstreaming of the role of the Centers of Excellence in building technical and industrial capacities of the member states' institutions to attain desired developmental objectives. The IOFS established Regional Centers of Excellence (RCOE) for the primary strategic commodities of Wheat, Rice, Cassava, and Palm Oil. The RCOE extended to serve Olive Oil and Date Palm. The establishment of these centers came with a view that pooling resources in the technological and scientific sectors would promote efficiency and cost-effectiveness, thereby providing quick wins toward rewarding multilateral cooperation among member states. The IOFS, during the last three years, succeeded in coordinating with Member States to establish RCOE for wheat, rice, and cassava and started cooperation on olive oil.

In 2020, the agriculture and food security sector received a massive shock from the Covid-19 pandemic. Suddenly, the food value chain was interrupted or blocked, and the borders were closed. The number of people facing acute food insecurity worldwide doubled in 2020, reaching 265 million, which is an increase from 135 million in 2019[1]. The prices of food were volatile and soared[2] and 25 million jobs in the agricultural sector were lost worldwide[3].

Post Covid-19, the world gained enough experience to rely on the importance of using all available technological and innovative tools, especially those related to Information Technology (IT) and, recently, Artificial Intelligent (AI), to overcome any other agricultural crises in the future. The call for the need to transform the agriculture sector and use smart agriculture was made, especially with the growth of other severe challenges, such as climate change, limited water resources, and high-yielding crops with more nutritional values. Within this context, the IOFS decided to add value to its related activities, particularly the programs on developing strategic commodities, by introducing a crucial digital platform called Electronic Centers of Excellence (ECOE). The establishment of the IOFS E-Platform for Development of Strategic Commodities will be initiated to enable OIC Member States' access to the progress already made, facilitate bringing various elements of the development of strategic commodities into the platform for discussion and find ways to mitigate the challenges through the partnership across all players in the agricultural sector in the OIC region.

ECOE CONNECTIVITY



The ECOE will play an essential role in connecting scientists, researchers, and farmers from the OIC geography to share knowledge and access up-to-date information on breeding techniques and best farming practices, exchange seeds germplasms, and genetic resources of plants and animals, among several others. The ECOE will facilitate coordinating on initiating cooperative projects among Member States. Additionally, the platform will be instrumental in sharing information on food security and safety and disseminating information on food loss, waste, and other related issues. By leveraging the power of technology, the ECOE will enable collaboration and cooperation among stakeholders, leading to sustainable agricultural growth and development in the region. These steps will further enhance to braid knowledge and expertise of the scientific and farming communities in the OIC region, which will ultimately contribute to the development of sustainable agricultural practices. The ECOE is expected to pay significant attention to strengthening the extension efforts and information to be handled by the farmers.

Moreover, the ECOE will be designed to cater to the unique needs and requirements of each Member State, ensuring that the platform is accessible and relevant to all stakeholders. The platform will also provide access to training programs and resources to equip users with the necessary skills and knowledge to maximize the benefits of the ECOE. The IOFS will ensure that the ECOE will use recent IT technologies such as Artificial Intelligent (AI).

The Organization, through ECOE, will coordinate and facilitate solving various strategic product development and production issues in the OIC region. The IOFS aims to gather the research institutes, individual scientists, and researchers from the OIC region in one cooperation platform, considering and finding ways to solve the existing issues and challenges of the Member States through coordination and identification of partners.

The Member States play a crucial role in contributing to the IOFS ECOE. The concept mechanism for ECOE is to accumulate the data shared by the users. That means the E-Platform value will be augmented by the number of users and the frequency of sharing their data and research findings. By other means, ECOE will need the support of all agricultural stakeholders in OIC Member States through a collaborative and supportive environment that fosters growth and innovation by sharing information, conducting research, and facilitating various activities. ECOE will contribute positively to optimizing agriculture resources, especially those related to water and best irrigation systems, crop yielding, and better pest control strategy. This sort of coherent cooperation between Member States will facilitate technology transfer, strengthen south-south cooperation, and work towards achieving food security.

1 UN World Food Programme (2020, April 21) Covid-19 will double number of people facing food crises unless swift action is taken. Available at: https://www.wfp.org/news/covid-19-will-double-number-people-facing-food-crises-unless-swift-action-taken#:~:text=ROME%20%E2%80%93%20The%20COVID%2D19%20pandemic,food%20crises%20around%20the%20world

2 FAO Food Price Index | World Food Situation (2023, February 03) Food and Agriculture Organization of the United Nations. Available at: https://www.fao.org/worldfoodsituation/foodpricesindex/en/

3 ILO Monitor: COVID-19 and the world of work. Seventh edition. Updated estimates and analysis (2021, January 25) International Labor Organization. Available at: https://www.ilo.org/wcmsp5/groups/public/@dgreports/@dcomm/documents/briefingnote/wcms_767028.pdf

EN SUMMARY

The Centers of Excellence play a major role in building the technical and industrial capacities of the member states' institutions to attain desired developmental objectives. The IOFS will establish Regional Centers of Excellence (RCOE) for the primary strategic commodities of Wheat, Rice, Cassava, and Palm Oil. The establishment of these centers came with the view that pooling resources in the technological and scientific sectors would promote efficiency and cost-effectiveness. IOFS decided to add value to its related activities by introducing a crucial digital platform called Electronic Centers of Excellence (ECOE). By leveraging the power of technology, the ECOE will enable collaboration and cooperation among stakeholders, leading to sustainable agricultural growth and development in the region.

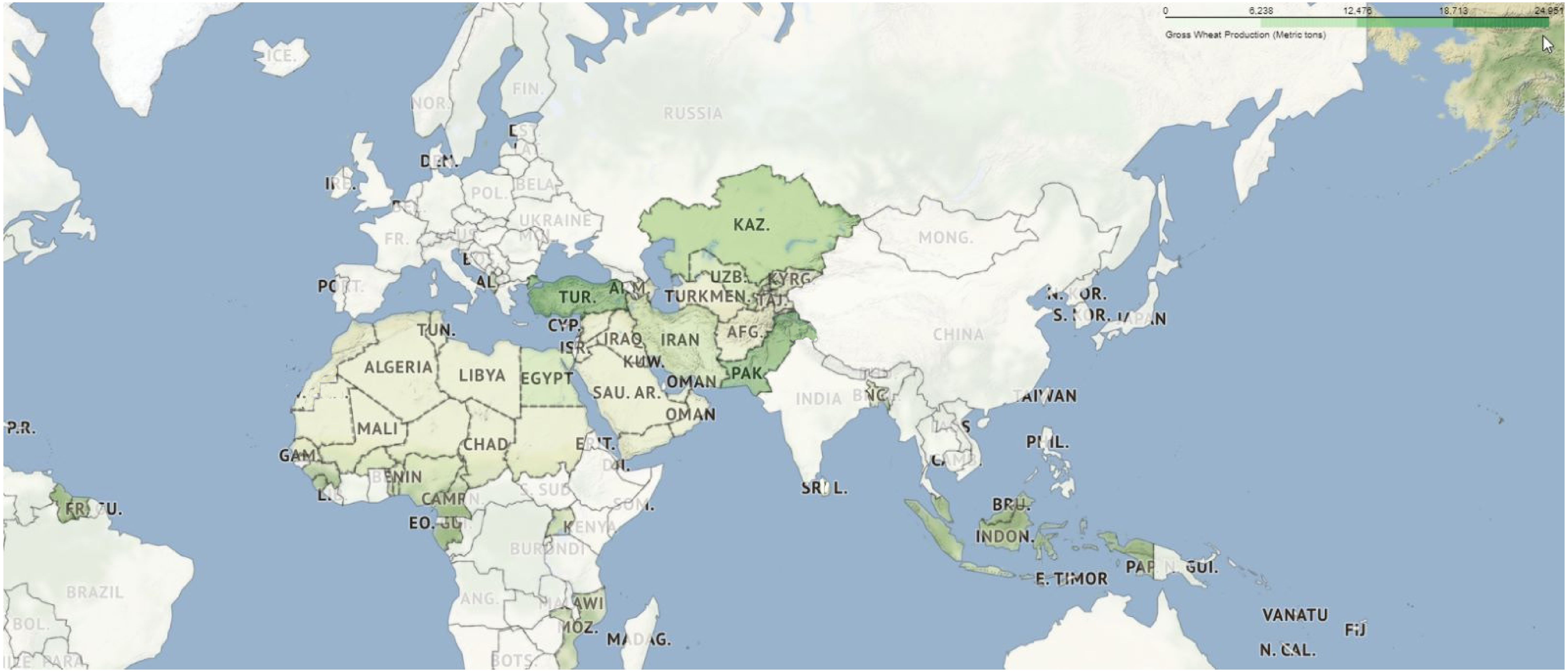
FR RÉSUMÉ

Les centres d'excellence contribuent grandement à renforcer les capacités techniques et industrielles des institutions des États membres afin d'atteindre les objectifs de développement souhaités. L'IOFS établira des centres régionaux d'excellence (RCOE) pour les principaux produits stratégiques que sont le blé, le riz, le manioc et l'huile de palme. La création de ces centres s'explique par l'idée que la mise en commun des ressources dans les secteurs technologique et scientifique favoriserait l'efficacité et la rentabilité. L'IOFS a décidé d'ajouter de la valeur à ses activités connexes en introduisant une plateforme numérique cruciale appelée "Electronic Centers of Excellence" (ECOE). En exploitant la puissance de la technologie, l'ECOE permettra la collaboration et la coopération entre les parties prenantes, ce qui conduira à une croissance et un développement agricoles durables dans la région.

AR ملخص

تضطلع مراكز التميّز بدور رئيسي في بناء القدرات الفنية والصناعية لمؤسسات الدول الأعضاء من أجل تحقيق الأهداف التنموية المرجوة. وفي هذا الصدد، المنظمة الإسلامية للأمن الغذائي ستقوم بإنشاء مراكز التميّز الإقليمية (RCOE) للسلع الاستراتيجية الأولية للقمح والأرز والكسافا وزيت النخيل. ويستند إنشاء هذه المراكز إلى فكرة أن تجميع الموارد في القطاعين التكنولوجي والعلمي من شأنه أن يعزز الكفاءة والفعالية من حيث التكلفة. ولقد قررت المنظمة الإسلامية للأمن الغذائي إضافة قيمة إلى أنشطتها ذات الصلة من خلال تقديم منصة رقمية مهمة تسمى مراكز التميز الإلكترونية (ECOE). وبفضل الاستفادة من قوة التكنولوجيا، فستتيح مراكز التميّز الإلكترونية فرص التعاون والتآزر بين أصحاب المصلحة، مما يُسهم في النمو الزراعي المستدام والتنمية في المنطقة.

WHEAT IN OIC GEOGRAPHY



IOFS AFRICAN COMMITMENT THROUGH THE AFRICA FOOD SECURITY INITIATIVE (AFSI)

ABDULA MANAFI MUTUALO
Advisor at the Coordination & Cooperation Department

The beautiful city of Nouakchott, capital of the Islamic Republic of Mauritania, on 16-17 March 2023, receives high-level officials from the Member States of the Organization of Islamic Cooperation (OIC) to participate at the *49th Session of the Council of Foreign Ministers (CFM).*

As usual, the Islamic Organization for Food Security (IOFS) is represented by its Director General, His Excellency Prof. Yerlan Baidaulet, who is to follow up on the proceedings of the meeting that needs to consider and adopt the Resolution on providing new mandates to the Organization. In this particular case, OIC Member States are to request the IOFS to implement an Africa Food Security Initiative (AFSI), as a means of addressing the pressing challenges the continent faces in relation to food security and agricultural development.

Such a move is to be the consolidation of the "IOFS African commitment" that witnessed its kickoff with the celebration of 2022 as "IOFS Year of Africa", which was marked with the convening of diverse activities in different OIC Member States, including Niger, Nigeria, Tunisia, and Türkiye.

It is important to note that the urge to embrace the "African commitment" emerges from the understanding, as the United Nations (UN) stated[1], that the continent has been particularly affected and vulnerable against the backdrop of the once-in-a-century pandemic (COVID-19), which was followed by the crisis in Ukraine, resulting in strong inflationary pressures around the world linked, ominously, to a surge in global food and energy prices. In such a bleak situation, about 21% of people in Africa suffered from hunger in 2020, which is a total of 282 million people. Between 2019 and 2020, in the aftermath of the pandemic, 46 million people reported experiencing hunger in Africa. No other region in the world presents a higher share of its population suffering from food insecurity.

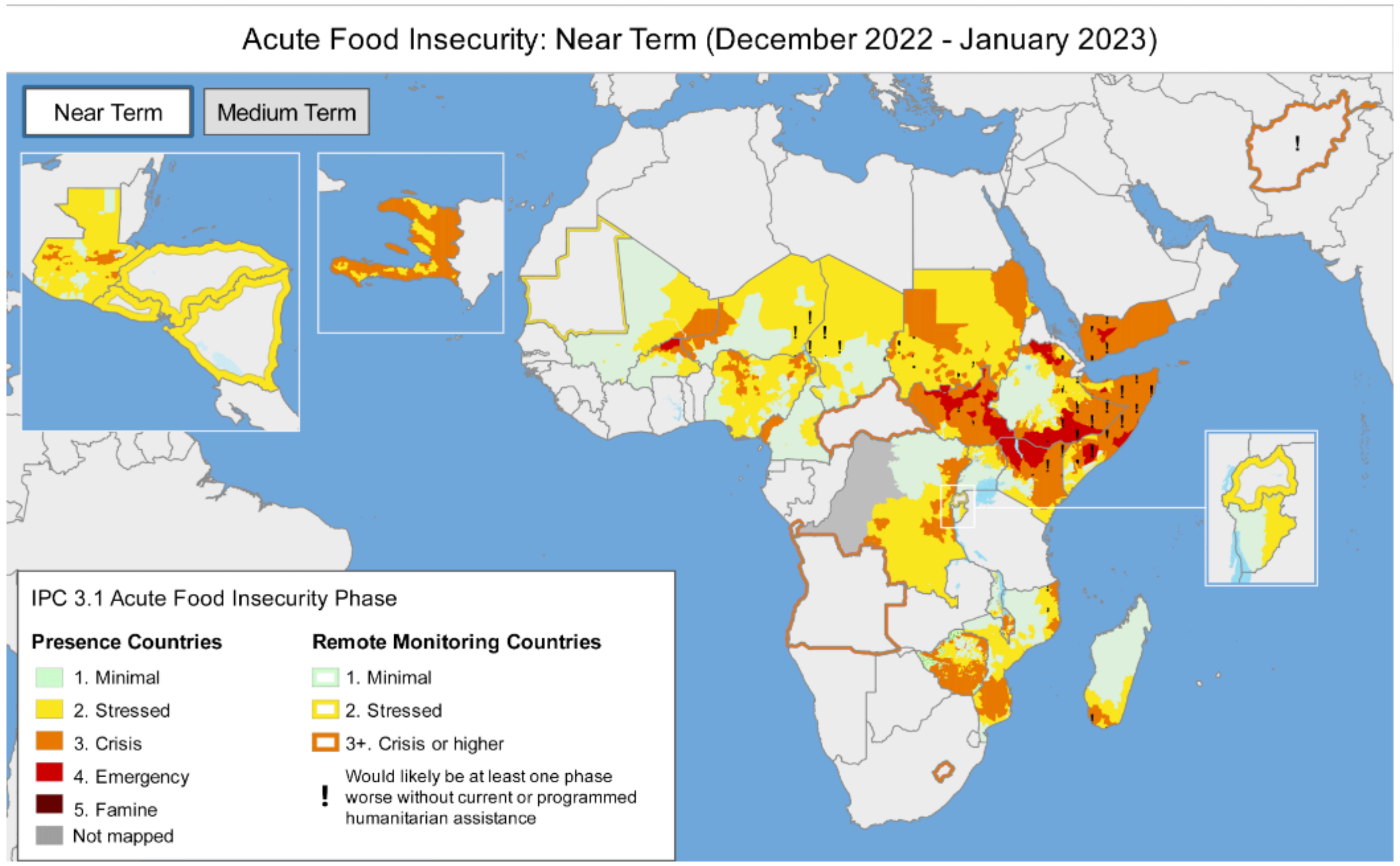
In fact, the hunger situation in Africa is not new. In reality, different reports issued by relevant UN Agencies, including the Food and Agriculture Organization (FAO) and the World Food Program (WFP), particularly the *Hunger Hotspots Report 2021*, conveyed the drastic situation of food insecurity in 11 OIC Member States, namely Afghanistan, Burkina Faso, Mali, Niger, Nigeria, Sierra Leone, Somalia, Sudan, Mozambique, Lebanon and Yemen, bringing the total amount of affected people to the scary number of around 66 million.

As the majority of the aforementioned countries are African, the continent was given particular attention by the IOFS, especially within the understanding of FAO *Africa Regional Overview of Food Security and Nutrition 2020*[2] published on 30 June 2021, which stated that Africa was not on track to meeting the Sustainable Development Goal (SDG) targets to end hunger and ensure access by all people to safe, nutritious and sufficient food all year round and to end all forms of malnutrition. The number of hungry people on the continent has risen by 47.9 million since 2014 and now stands at 250.3 million, or nearly one-fifth of the population.

2017, 2018 and 2019 editions of the same report explained that such **gradual deterioration of food security was due to conflict, weather extremes, and economic slowdowns and downturns, often overlapping**. A continued worsening of food security was expected also in 2020 as a result of the COVID-19 pandemic. The report also showed that 2020 food consumption patterns imposed high health and environmental costs, which were not reflected in food prices. The findings presented in this report highlighted **the importance of prioritizing the transformation of food systems to ensure access to affordable and healthy diets for all, produced in a sustainable manner**. On the other hand, rapidly rising demand for food, fueled by population and income growth, provides major opportunities for agri-food systems to accelerate employment creation, boost continental trade, strengthen resilience, and transform African economies. Africa's food market is projected to increase from US$313 billion in 2010 to US$1 trillion in 2030[3].

Unfortunately, the bleak scenario is not improving. The map below indicates that Africa continues to be the biggest hunger hotspot in 2023[4]:

1 Africa Renewal, available here: https://www.un.org/africarenewal/magazine/may-2022/growing-hunger-high-food-prices-africa-dont-have-become-worse-tragedy#:~:text=Africa%20has%20been%20particularly%20vulnerable,people%20became%20hungry%20in%20Africa, accessed on 04.08.2022
2 Cf. https://reliefweb.int/report/world/africa-regional-overview-food-security-and-nutrition-2020, accessed on 10.11.2021
3 In accordance with Alliance for a Green Revolution in Africa (Agra)'s findings here: https://agra.org/our-strategy/, accessed on 08.11.2021
4 Available here: https://fews.net/, accessed on 16.02.2023



IOFS Efforts

In this context, the AFSI is to be implemented through different programs to ensure that food systems in Sub-Saharan Africa would receive proper attention so that people across the region could have access to food.

The proposed programs for 2023 are as follows:

Month	No	Project Name	Potential Partners
MARCH	1.	International Training Workshop on "Addressing the Challenges of Food Security in the Sahel Countries"	COMSTECH, ICESCO, CILSS
	2.	Improvement of Wheat System in Mauritania through expert meetings, field visits and workshops	Mauritanian Ministry of Agriculture, ACSAD, AOAD, BADEA, CILSS, ICARDA
APRIL	3.	Land Development for Regional Cassava Value Chain Development Project: Raising Cassava Production and Productivity (Phase I)	IsDB, COMSATS, ICBA (TBC), ICCIA (TBC), COMSTECH, RUFORUM, AGRA
MAY	4.	Drone technologies and geospatial information for the Desert Locust monitoring and control in the Sahel and West Africa	ICCCT, CILSS, AOAD, COMSTECH
	5.	African Agri-Business Forum	Ministry of Agriculture of Sudan, ICDT, WAIPA, BADEA, AAAID
	6.	Land Development for Regional Cassava Value Chain Development Project: Raising Cassava Production and Productivity (Phase II)	IsDB,COMSATS, ICBA (TBC), ICCIA (TBC), COMSTECH, RUFORUM, AGRA
JUNE	7.	Capacity building of representatives of national research institutions on gene bank management and operations, breeding strategies, conservation and sustainable use of animal genetic resources	National Animal Genetic Resources Centre & Data Bank of Uganda, West Africa Livestock Innovation Center in Gambia, Azerbaijan Scientific Research Institute of Animal Husbandry, IsDB, TIKA, RUFORUM, ILRI
JULY	8.	Organizing a Training Session on Policymaking to Promote Adoption of Water-Saving Technologies and Transfer to Water-Efficient Crops	Ministry of Agriculture of Niger (beneficiary), CEDARE, INWRDAM, KAZNARU
SEPTEMBER	9.	Assistance to Member States in Establishing Food Banking Systems	AOAD, IsDB, TIKA, Egypt and UAE Food Banks
	10.	Training on Capacity Building in Developing/Improving Livestock Extension Services	ECO RCCFS, COMCEC, ILRI, ECOWAS, PICA
	11.	Workshop on Biodiversity, Ecosystem, and Salinity in the Sahel	COMSTECH
OCTOBER	12.	Presentation and discussion of the Project on Integrated Water Plan for the Sahel Region to 2030 at the Cairo Water Week	Ministry of Agriculture of Niger (beneficiary), CEDARE, INWRDAM, Gharysh Sapary

Month	No	Project Name	Potential Partners
NOVEMBER	13.	"Development of the Africa Rice Brand" through workshops, conferences and launching e-platforms	IsDB
	14.	Presentation and discussion of the Project on Integrated Water Plan for the Sahel Region to 2030 at the COP28	BADEA, AOAD, ICCCT, CILSS, KAZNARU, Aerospace Satellite
DECEMBER	15.	Caravan of trainings on agriculture. IOFS contribution with putting the topic of Food security governance and policies	RUFORUM
	16.	IOFS side-event within 19th Annual General Meeting of RUFORUM on Food Security Education	RUFORUM, IsDB, Universities of OIC MCs, ICYF
	17.	Support of Meat Export from African and the Central Asian OIC Member States to the Middle East	WOAH, PICA, ILRI, ECOWAS, GCC Council
	18.	Land Development for Regional Cassava Value Chain Development Project: Raising Cassava Production and Productivity (Phase III)	IsDB, COMSATS, ICBA (TBC), ICCIA (TBC), COMSTECH, RUFORUM, AGRA

The Way Forward

It is widely known that agriculture is the single greatest opportunity to deliver inclusive economic growth, jobs, and health to the African continent. No region in the world has built a modern economy without first strengthening its agricultural sector and addressing the food insecurity of its people.

The IOFS is therefore working to expand its geographic presence in the OIC Member States, referencing CFM Resolutions and those of the OIC Ministerial Conference on Food Security and Agricultural Development, which call on countries to join the IOFS and assist in the implementation of its different mandates. In this context, the IOFS Director General has been organizing bilateral discussions with relevant policymakers and decision-making officials of the OIC Member States to establish and materialize cooperation to achieve the shared objective of ensuring food security in the OIC geography.

The IOFS currently has 37 members, and every year, seeing the efforts and contribution of the Organization for the development of agriculture and food security, more and more countries that have not yet signed the IOFS Statute confidently express their intention to do so. In Africa, the IOFS is yet to be joined by Algeria, Gabon and Togo, and it is expected that soon these countries would become full-fledged IOFS Member States, as they have been benefiting from different capacity-building programs that the Organization has implemented within the framework of celebrating 2022 as the IOFS Year of Africa and will continue in the framework of AFSI.

It is well known that "…hunger is the world's greatest solvable problem. **Africa has tremendous potential to be a part of the solution.** This requires progress on reforms that could rapidly and sustainably boost food production, including wheat, rice, and other cereal crops. These reforms would significantly help African economies become more **resilient to shocks, more peaceful, and more prosperous…**"[5], goals that the IOFS shares with the remaining international community when it comes to developing the agriculture sector in Africa while addressing the growing threat of food insecurity of its people. The time to act is now and all should say "present" for Africa to strive and reach the potential that is well recognized by the world at large.

Finally, the IOFS joins the international community's understanding at the recently held Africa Food Security Summit (25-27 January 2023, Dakar-Senegal) that it is critical that African governments and development partners clearly outline the need to address the continent's food systems challenges with commitments to invest in research and strengthen local research mechanisms and entities for home-grown innovations that support food systems and increase uptake at the grassroots level.

5 Remarks by IMF Managing Director Kristalina Georgieva at the Emergency Meeting of African Ministers of Finance and Ministers of Agriculture on the Looming Food Security Crisis in Africa, on 19 May 2022. Seen here: https://www.imf.org/en/News/Articles/2022/05/19/sp051922-emergency-meeting-on-the-looming-food-security-crisis-in-africa, accessed on 04.08.2022

EN SUMMARY

The situation with food security and hunger in Africa has been becoming dire for years. Millions of people on the continent suffer from malnutrition and lack of access to food. The IOFS joins multiple pledges to help the people of Africa build a sustainable food system. As part of that pledge, the Organization held the Year of Africa in 2022. Seeing the success of the action, the IOFS will continue its work in Africa within the OIC global mandate "Africa Food Security Initiative".

FR RÉSUMÉ

La situation de la sécurité alimentaire et de la faim en Afrique devient catastrophique depuis des années. Des millions de personnes sur le continent souffrent de malnutrition et n'ont pas accès à la nourriture. L'IOFS s'associe à de multiples engagements pour aider les populations africaines à construire un système alimentaire durable. Dans le cadre de cet engagement, l'Organisation a célébré l'Année de l'Afrique en 2022. Au vu du succès de l'action, l'IOFS poursuivra son travail en Afrique dans le cadre du mandat global de l'OCI «Initiative pour la sécurité alimentaire en Afrique».

AR ملخص

لقد أصبح وضع الأمن الغذائي والجوع في أفريقيا مزريًا منذ سنوات. أذ يعاني ملايين الأشخاص في القارة من سوء التغذية وعدم الحصول على الغذاء. وفي هذا الصدد، تنضم المنظمة الإسلامية للأمن الغذائي إلى تعهدات متعددة لمساعدة شعوب إفريقيا على بناء نظام غذائي مستدام. وفي إطار هذه التعهدات، فقد خصصت المنظمة عام 2022 كعام لأفريقيا. وبالنظر إلى نجاح هذا الإجراء، فستواصل المنظمة الإسلامية للأمن الغذائي عملها في أفريقيا في إطار التفويض العالمي لمنظمة التعاون الإسلامي «مبادرة الأمن الغذائي لأفريقيا».

IOFS TO DISPATCH HUMANITARIAN CONVOY TO AFGHANISTAN

AZAMAT KHAMIYEV
Program Manager at the Programs & Projects Department

According to the estimates of international analysts, the degree of global food security has been declining since 2018. This is the result of international conflicts and unforeseen challenges like the pandemic having a combined negative impact, which has been reflected in disruptions to food production and distribution, as well as an increase in the cost of providing food to individuals and families. Additionally, according to the UN World Food Programme (WFP), frequent and severe climatic shocks resulted in 345 million people across 82 countries having their lives and means of subsistence threatened by food insecurity.

Among the ones at risk of serious famine are the Member States of the Organization of Islamic Cooperation (OIC). For instance, as per the *Hunger Hotspot Report 2021*, jointly prepared by the United Nation's Food and Agriculture Organization (FAO) and WFP, 11 OIC Member States are identified as hunger hotspots that require urgent and scaled-up assistance to address food insecurity.

Afghanistan is one of the countries that are in a dire state. According to the UN specialized organizations, two-thirds of Afghanistan's population will need humanitarian assistance in 2023. It is estimated that a record 28.3 million people will need humanitarian and protection assistance in 2023, up from 24.4 million in 2022 and 18.4 million at the beginning of 2021. The main drivers of the increase are the continuing drought-like conditions and economic decline lasting for three years now. This has been brought about by decades of conflict-driven vulnerability, all the while people have been unable to recover from the impact of the recent earthquake, floods and COVID-19 pandemic. Overall, 32 of Afghanistan's 34 provinces experience severe levels of need. It is worth noting that along with food insecurity and malnutrition, 30 out of 34 Afghan provinces have extremely poor indicators of water quality.

As a specialized institution of the OIC, the Islamic Organization for Food Security (IOFS) is actively and directly involved in the struggle for food security in the OIC geography. Paragraphs 18 and 19 of the Resolution adopted at the 17th Extraordinary Meeting of the Council of Foreign Ministers of the OIC Member States on the "Humanitarian Situation in Afghanistan" (Pakistan, 19 December 2021) along with other measures, bestowed upon IOFS the mandate to launch an Afghanistan Food Security Program (AFSP).

It should be noted that IOFS activities are not limited to providing humanitarian aid. The scope of the organization's work covers all aspects of food security, including knowledge development, exchange and transfer of various sustainable agriculture technologies and practices, assistance with the creation and implementation of food security policies, monitoring the state of food security in each country, mobilization and management of financial and agricultural resources, and more.

The 16 current IOFS projects under five strategic pillars are focused on developing the intra-OIC food supply chain, enhancing mutual investment, building capacity through training and consultation, developing agro-science, and improving the accessibility of financial resources to farmers. All these efforts contribute to strengthening the key components of food security and have an effect on availability, access to food, utilization, and stability.

However, as mentioned above, the Afghanistan Food Security Program (AFSP) was developed by the IOFS following the decisions made by the OIC. AFSP incorporates medium- and long-term responses in addition to immediate ones, such as humanitarian convoys. AFSP has been developed on the principle that food aid is just one of many tools that ensure food security. The goal of food aid should be to reduce people's reliance on it. The idea behind the program is to not only provide humanitarian aid but to assist those in need and enable them to produce the necessary quantity of food.

Immediate measures under AFSP consist of the following activities:

✓ Supply of humanitarian aid (convoys) in the form of wheat flour.

✓ Provision of equipment (oasis boxes) for water purification and filtration to settlements with the greatest shortage of clean drinking water.

✓ IOFS-ICIC partnership for emergency food support in Afghanistan (providing with early response food packages).

To achieve the medium- and long-term goals of the AFSP, the IOFS will concentrate on:

✓ Creating a model project based on a farm employing small-scale mechanization and contemporary technology, which will serve as a demonstration site for farmer training as well as for its future scaling up.

✓ Conducting training seminars and workshops, as well as exchanging scientific discoveries in grain and wheat production.

✓ Offering scholarships to Afghan students so they can attend agricultural universities in Kazakhstan and other OIC members.

The first IOFS Humanitarian Food Convoy to Afghanistan was officially announced to the Member States during the online Conference on AFSP Implementation held in November 2022. The funds, graciously provided by the Republic of Kazakhstan (100K USD) and the Republic of Tajikistan (10K USD), allow the formation of a humanitarian aid consisting only of about 350 tons of wheat flour.

Turkmenistan has graciously agreed to provide free passage for the humanitarian cargo of 350 tons through its territory. Despite the modest volume of the first batch, IOFS' main goal in this action is to raise awareness of the program and attract more donors. The convoy will dispatch from the north of Kazakhstan in mid-March with the intention to reach Afghanistan by the first week of the holy month of Ramadan.

To ensure transparency of the procurement procedures of humanitarian goods, the supplier for the IOFS Humanitarian Food Convoy to Afghanistan was chosen through a competitive selection process, managed by a competition committee made up of representatives of the donor countries/organizations that provided funding, as well as the IOFS Secretariat.

As the hadith of Allah's Messenger Muhammad said: "He who alleviates the suffering of a brother out of the sufferings of the world, Allah would alleviate his suffering from the sufferings of the Day of Resurrection".

The IOFS, for its part, will continue its tireless work to promote this noble cause and hopes that the First Humanitarian Convoy will serve as a successful launch for raising awareness of the IOFS initiatives and drawing the attention of more donors and philanthropists from the Islamic world to the issues of our brother Afghan people.

Recipients of 6 Oasis Boxes that IOFS obtained and sent to Afghanistan in April 2022.

EN SUMMARY

In keeping with IOFS's work to alleviate hunger in OIC member states, it has launched the Afghanistan Food Security Program, which aims to help the increasingly suffering Afghan population. The comprehensive approach of the Program incorporates short-, medium- and long-term actions. As one of the short-term actions, the goal of which is also to raise awareness of the program, the IOFS is preparing to dispatch a humanitarian convoy consisting of 350 tons of flour to Afghanistan.

FR RÉSUMÉ

Dans le cadre de son travail visant à soulager la faim dans les États membres de l'OCI, l'IOFS a lancé le programme de sécurité alimentaire en Afghanistan, qui vise à aider la population afghane qui souffre de plus en plus. L'approche globale du programme intègre des actions à court, moyen et long terme. Parmi les actions à court terme, dont l'objectif est également de faire connaître le programme, l'IOFS se prépare à envoyer un convoi humanitaire composé de 350 tonnes de farine en Afghanistan.

AR ملخص

تم إطلاق برنامج الأمن الغذائي الأفغاني تماشيًا مع عمل المنظمة الإسلامية للأمن الغذائي للتخفيف من الجوع في الدول الأعضاء في منظمة التعاون الإسلامي. ويهدف هذا البرنامج إلى مساعدة السكان الأفغان الذين يعانون بشكل متزايد. ويتضمن النهج الشامل للبرنامج إجراءات قصيرة ومتوسطة وطويلة الأجل. وكواحدة من الإجراءات قصيرة المدى، والتي تهدف أيضًا إلى زيادة الوعي بالبرنامج، فإن المنظمة الإسلامية للأمن الغذائي تستعد لإرسال قافلة إنسانية تتكون من 350 طنًا من الدقيق إلى أفغانستان.

IOFS NEWS OVER JANUARY-FEBRUARY-MARCH (till 06.03.2023)

NEW APPOINTMENT

The IOFS welcomed a new member of its team, Dr. Ali Zulfiqar, who has become the new Director of the Programs and Projects Department. Dr. Zulfiqar is a Pakistani national, who before IOFS worked as a professor of Plant Breeding and Genetics at the University of Agriculture Faisalabad.

His academic excellence was recognized by the President of Pakistan, who conferred upon him the national-level HEC-Best University Teacher Award 2020. His research excellence was well recognized by the Pakistan Academy of Sciences awarding him Gold Medal in Biotechnology in 2017. He has been a winner of the research productivity award in 2012 and 2013. As a Pioneer Professor of Plant Breeding and Genetics at MNS University of Agriculture in Multan, he managed to bring the university's ranking to first place in Pakistan and 154th in the UI GreenMetric World University Rankings 2021.

Dr. Zulfiqar published 90 papers having an Impact Factor above 260, five books, 17 book chapters and over 2080 citations with h-index 26 (Google Scholar), as well as four international and two national patents.

Prof. Zulfiqar's tremendous efforts in adopting a whole of chain approach for teaching excellence, students' learning experience and student outcomes to building a knowledge-based economy through selfless serving are highly commendable. As the world's leading agriculture scientist, teacher and leader, he is indeed an asset to the IOFS team.

IOFS helped Kazakhstan deliver 50 tons of humanitarian assistance to Syria

With the support of the IOFS, Kazakhstan delivered 50 tons of humanitarian aid to earthquake-shaken Syria. The Central Asian country sent canned food, warm clothes, winter tents, beds and bedding from the state reserve. The humanitarian aid was delivered to the city of Aleppo in four flights by the National Guard of Kazakhstan.

The IOFS Director General, Yerlan Baidaulet, on the instruction of Kazakh President Kassym-Jomart Tokayev, personally flew to Syria to oversee the cargo delivery.

Deputy Governor of Aleppo Abdel Qader Dawaalibi, Director of Aleppo Airport Mohammed Al-Masri, representatives of the Syrian Red Crescent Samir Shubuki, Ahmad Samoun, Anas Samaa, as well as the Ambassador of Kazakhstan to Lebanon Rasul Zhumaly took part in the ceremony of transferring appropriate assistance to the Syrian side at the Aleppo airport.

Speaking on behalf of the hosting side, the Deputy Governor of Aleppo, Abdel Kader Dawaalibi, expressed his deep gratitude to the people of Kazakhstan. According to him, the Kazakh nation, who shared the burden and extended a helping hand in difficult times, will never be forgotten.

IOFS participates in Riyadh International Humanitarian Forum and International Hybrid Wheat Conference

The IOFS delegation headed by the Director General, H.E. Prof. Yerlan Baidaulet flew to Riyadh, Kingdom of Saudi Arabia, to participate in the 3rd Riyadh International Humanitarian Forum (RIHF), organized by the King Salman Humanitarian Aid and Relief Centre ("KSrelief") on Feb. 20-21. The conference started with a session on the Evolving Humanitarian landscape for 2023 and beyond.

Humanitarian leaders from international governmental and non-governmental organizations, as well as leading UN organizations, donors, practitioners, researchers, and others gathered from around the world at the 3rd RIHF to promote dialogue on legislative, informational, and logistical mechanisms for delivering humanitarian aid. The Director General of IOFS took advantage of the opportunity and held several bilateral meetings on the sidelines of the event.

The International Hybrid Wheat Conference 2023, convened by the University of Agriculture Faisalabad, Pakistan launched on Feb. 23. The international platform gathered experts on the topic of wheat from different parts of the world, with the aim of finding innovative ways to overcome food insecurity and eradicating hunger and poverty.

The main topics of the first day of the Conference included scientific talks on "Breaking the yield barrier through hybrid wheat" and "Pushing the boundaries of high-temperature tolerance in wheat." This was followed by country case studies on Ethiopia, Bangladesh and Pakistan, and a panel discussion on hybrid wheat.

The IOFS was represented by Professor Ali Zulfiqar. The Professor presented a speech on behalf of the Director General of IOFS, H.E. Prof. Yerlan Baidaulet and himself, on the topic of Hybrid Wheat for Food Security.

The signings

IOFS signed a memorandum of cooperation and an action plan with Kazakh Agro-Technical University (KATU) on Jan. 18, focusing on food security education and talent development. The Organization also signed a memorandum of understanding with Transleadia Ltd on Feb. 24.

Its subsidiary, the International IFPA signed seven corporate membership agreements with the Jordanian Palestinian Agricultural Products Marketing Company, Amar Food Corporation Ltd., Cesan Walnut Production Marketing Export – Import Limited Company, ALATEGAHAT Company LTD, Transleadia Ltd, Atyab International Services, and AB'S Trading Co.; and four honorary membership agreements with the Palestinian Food and Agriculture Industries Union, Africa Food Basket Federation, Casablanca Chamber of Commerce, Industry, and Service (CCIS-CS), and National Federation of Agribusiness (FENAGRI).

As of 06 March, 2023, IFPA has 47 members - 27 Honorary and 20 Corporate from 15 countries, as well as 70 applications in progress from 22 countries. IFPA is now connected to 28 countries.

IOFS delegation holds negotiations in Kyrgyz Republic

In the Kyrgyz Republic on February 25, a delegation from IOFS, including Amb. Murat Tashibayev, Advisor at the Administrative department, Mr. Adbelaziz Hajaji, Program Manager, and Mr. Sofian Ben Mouaddeb, Advisor of the Cabinet of the IOFS, paid a visit to Bishkek, and had fruitful discussions with senior officials from the Ministry of Foreign Affairs and Ministry of Agriculture.

The IOFS delegation gave a succinct outline of the organization's main missions, as well as its flagship initiatives and endeavors throughout the OIC region.

The opportunity presented by this bilateral encounter was also a good one to encourage the esteemed Kyrgyz Republic to join the IOFS, as called for by a number of CFM and MCFSAD resolutions urging OIC nations that have not yet joined the IOFS statute to do so at their earliest convenience.

The Kyrgyz side congratulated IOFS for its accomplishments and promised to inform the secretariat of their decision after carefully considering the proposal.

The IOFS begins Activization of the Humanitarian Convoy to Afghanistan

The IOFS signed an agreement with the Afghan Red Crescent Society (ARCS) in the context of preparations for sending the IOFS Humanitarian Convoy to Afghanistan by the first week of Ramadan.

This comes in light as the first pilot batch project of Supplying Wheat Flour to Afghanistan is underway. To note, as Afghanistan's food crisis has reached unprecedented levels as nearly 22.8 million people (or 55% of the population) are highly food insecure due to prolonged drought, conflict and economic collapse, the IOFS continues to provide an opportunity for OIC member states to improve the current situation for the people of Afghanistan through the IOFS Afghanistan Food Security Program (AFSP).

Against this backdrop, the IOFS and ARCS have signed an agreement to further enhance the principles of mutually beneficial cooperation, understanding and trust, in order to support the Afghan people. ARCS has agreed to assist the IOFS in distributing humanitarian aid on the ground in Afghanistan to the most vulnerable layers of the population.

For reference, the Afghan Red Crescent Society is an organization that was established in 1934 with the aim of alleviating human suffering and providing support to the victims of man-made and natural disasters all over Afghanistan.

Libyan Ambassador to Kazakhstan expresses willingness to cooperate with IOFS

On February 28, 2023, H.E. Pr. Yerlan A. Baidaulet, Director-General of IOFS, welcomed Mr. Alaadin Adbussalam Lehwaik, Ambassador of the State of Libya to the Republic of Kazakhstan, to the IOFS Headquarters.

The two officials discussed the present status of the bilateral relationship between IOFS and Libya, H.E. Ambassador highlighting, in particular, IOFS's continued efforts to address issues with food security and poverty alleviation in the OIC geography. H.E. Prof. Baidaulet, DG of IOFS, received an official invitation from H.E. the Ambassador of the State of Libya to visit Tripoli in the first half of 2023 during this meeting.

H.E. DG of the IOFS thanked his guest for the invitation on behalf of the organization and stressed that this forthcoming visit will be a good opportunity to advance the bilateral collaboration between Libya and the IOFS in various areas.

Prior to the conclusion of this fruitful meeting, H. E. the Libyan Ambassador expressed the State of Libya's willingness to actively cooperate with IOFS to consolidate food security and agricultural development, as well as he emphasized the hosting country's role in the Organization's continued development within the OIC region.

Food Security to be Included in Newly Stablished Social Peace Building Center of the Islamic Committee of the International Crescent (ICIC)

Upon instructions of His Excellency Mr. Yerlan A. Baidaulet, the Director General of the Islamic Organization of Food Security (IOFS), Ambassador Daulet Yemberdiyev, Director of the Country Operation Department is leading the Organization's delegation to attend the 36th Session of the Islamic Committee of the International Crescent (ICIC) and the 1st Promotional Forum of Social Peace Building Center (SPBC), which opened on 28 February and will continue until 02nd March 2023 in Baghdad, Republic of Iraq.

The Opening Ceremony was addressed by His Excellency Ambassador Ali Buhedma, ICIC President, and other dignitaries representing the Ministry of Foreign Affairs of the Republic of Iraq, the Iraq Red Crescent Society, the General Secretariat of the Organization of Islamic Cooperation (OIC), and the Permanent Representative of the Kingdom of Saudi Arabia to OIC, His Excellency Ambassador Saleh Hamad Alsuhabani Saudi.

The IOFS delegation's intervention at the meeting aimed at raising awareness about the Organization, while showing the interrelation between conflicts, insecurity and food insecurity, and, in this context, proposing that matters related to food security be added in the relevant initiatives geared towards peacebuilding and peacekeeping to be implemented by the newly established SPBC in the OIC Member States. Within such proposal that was widely welcomed, the Delegation also showed readiness of the IOFS to partner with the SPBC in that regard.

On the sidelines of the meeting, the Delegation had consultations with different participating delegates, particularly Ambassador Abbas Kadhem Obaid, Head of the International Organizations and Conferences Department at the Iraqi Ministry of Foreign Affairs, with whom discussions were conducted on ways and means to strengthen bilateral cooperation, especially the standing invitation for the Republic of Iraq to kindly consider joining the IOFS as a full fledge Member State.

It should be mentioned here that different brochures highlighting the IOFS Strategic Framework and 2031 Vision, as well as the Afghanistan Food Security Program (AFSP), African Food Security Initiative (AFSI), etc, were made available for the participants to make them aware of the important work being implemented by the IOFS.

EN SUMMARY

- IOFS welcomed the new Director of the Programs and Projects Department, Dr. Ali Zulfiqar.
- IOFS helped Kazakhstan deliver 50 tons of humanitarian assistance to Syria.
- IOFS participates in Riyadh International Humanitarian Forum and International Hybrid Wheat Conference in Pakistan.
- International IFPA signed seven corporate membership agreements and four honorary membership agreements.
- IOFS delegation holds negotiations in Kyrgyz Republic
- The IOFS begins Activization of the Humanitarian Convoy to Afghanistan
- Libyan Ambassador to Kazakhstan expresses willingness to cooperate with IOFS
- Food Security to be Included in Newly Stablished Social Peace Building Center of the Islamic Committee of the International Crescent (ICIC)

FR RÉSUMÉ

- L'IOFS a accueilli le nouveau directeur du département des programmes et projets, le Dr Ali Zulfiqar.
- L'IOFS a aidé le Kazakhstan à livrer 50 tonnes d'aide humanitaire à la Syrie.
- L'IOFS participe au Forum humanitaire international de Riyad et à la Conférence internationale sur le blé hybride au Pakistan.
- L'IFPA a conclu sept accords d'adhésion d'entreprise et quatre accords d'adhésion honoraire.
- La délégation de l'IOFS tient des négociations à la République Kirghize
- L'IOFS commence l'activation du Convoi humanitaire vers l'Afghanistan
- L'Ambassadeur de Libye au Kazakhstan exprime sa volonté de coopérer avec l'IOFS
- La sécurité alimentaire sera incluse dans le nouveau Centre de consolidation de la paix sociale du Comité islamique du Croissant international (ICIC)

AR ملخص

- رحبت المنظمة الإسلامية للأمن الغذائي بالمدير الجديد لإدارة البرامج والمشاريع، الدكتور علي ذو الفقار.
- ساعدت المنظمة الإسلامية للأمن الغذائي كازاخستان في تقديم 50 طنًا من المساعدات الإنسانية إلى سوريا.
- تشارك المنظمة الإسلامية للأمن الغذائي في منتدى الرياض الإنساني الدولي والمؤتمر الدولي للقمح الهجين في باكستان.
- وقعت الرابطة الإسلامية الدولية لتجهيز الأغذية (IFPA) سبع اتفاقيات عضوية للشركات وأربع اتفاقيات عضوية فخرية.
- يجري وفد المنظمة الإسلامية للأمن الغذائي مفاوضات في جمهورية قيرغيزستان
- المنظمة تبدأ تفعيل القافلة الإنسانية إلى أفغانستان
- السفير الليبي لدى كازاخستان يعرب عن استعداده للتعاون مع المنظمة
- إدراج الأمن الغذائي في مركز بناء السلام الاجتماعي المنشأ حديثا التابع للجنة الإسلامية للهلال الدولي

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