Exploring the Genetic Potential of Hassawi Rice

Best agricultural practices for cassava production

Revolutionizing agriculture: gene stacking and genome editing for enhanced crop resilience

Supporting policies and innovations for integrated water management in the OIC member states

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CONTENT

Dear Esteemed Readers,

As we step into 2024, it brings me immense joy to introduce the 14th edition of the Food Security Hub of the Islamic Organization for Food Security (IOFS). This quarterly publication is dedicated to advancing knowledge and fostering discussions on critical issues within the geography of the Organization of Islamic Cooperation (OIC) concerning food security. It reflects our ongoing commitments to making a positive impact in the realm of food security and upraising living standards of the Muslim world.

Looking back on 2023, a pivotal moment was the 6th IOFS General Assembly hosted in Doha, Qatar in October, which provided a unique platform for Member States to gather and address vital issues, encouraging collaboration in our collective fight against food insecurity. Additionally, the 2nd IOFS High-Level Forum served as a significant milestone with sessions on Advancing AgriTechnology to Ensure Sustainable Food Security, Engaging Civil Society against Food Insecurity, International Islamic Food Processing Association (IFPA) – Enhancing OIC Food Markets and lastly, Synergizing Media within Food Systems.

In the spirit of reinforcing our commitment to knowledge sharing, this edition explores a diverse array of topics. We discussed the impact of climate change on three important strategic commodities (wheat, rice and cassava) and presented the best agricultural practices for these commodities, along with visionary insights through gene stacking and genome editing for improved crop resilience. Our contributors also address social considerations in gene editing and public acceptance, alongside elaborations into veterinary and sanitary assessments, ensuring the quality and safety of fish in reservoirs. This edition also explores the importance of establishing food banks in OIC Member States as a solution to combat food insecurity and reduce food waste. Furthermore, we advocate integrated efforts by putting forward supporting policies and innovations for water management in the OIC Member States.

I trust that the content presented in this edition will enlighten and inspire you to join us in further ensuring food security within the OIC. Your feedback is invaluable as we collectively strive to contribute to a more food-secure and sustainable future.

Best Regards,

Dr. Masoud Jarallah Al-Marri
Caretaker Director General
Islamic Organization for Food Security

EXPLORING THE GENETIC POTENTIAL OF HASSAWI RICE *(Oryza sativa L.)* THROUGH MODERN BIOTECH TOOLS FOR SUSTAINABLE FOOD SECURITY IN SAUDI ARABIA

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Introduction

Rice (*Oryza sativa* L.) is one of the most significant staple food crops for half of the world's human population and ranks second after wheat for consumption. It is an essential food commodity in the Arabian Gulf countries, including Saudi Arabia.

The historical Al-Ahsa oasis in Al-Sharqiyya region of Saudi Arabia hosts a rare reddish-brown rice local landrace called "Hassawi Rice". Hassawi rice is an old genetic landrace adapted to the climatic conditions in the Eastern Province of Saudi Arabia and has been widely adapted to the native environmental stresses such as drought and salinity. It is a long-grain Indica-type rice with a reddish-brown color (Figure 1). In the current scenario of significant challenges of food security and sustainability of food sources, the indigenous Hassawi rice merits starting the empirical investigations for genetic improvements in its agronomic, morphological and nutritional traits. Hassawi rice is a relatively rare type of rice. It is only grown in a small area of Saudi Arabia, with limited production (Figure 2). This makes Hassawi rice a relatively expensive type of rice. This highly nutritious rice is a delightful food source for the locals. Besides being an attractive source of income for local farmers, it has been described as a traditional heritage passed down to the locals through generations.

In Saudi Arabia, two cultivars of Hassawi rice have been developed, Hassawi-1 and Hassawi-2 (the hybrid cultivars). Despite its rich genetic background, this valuable Saudi genetic resource has been subjected to limited research. Our understanding of the genetic potential of Hassawi rice in terms of high salt and drought tolerance through high-throughput technologies is minimal. The organelle genome of chloroplast and mitochondria of Hassawi rice was sequenced in 2012. However, until now, the nuclear genome of Hassawi rice cultivars has yet to be sequenced. Modern –omics and next-generation technologies are highly needed to understand the developmental potential of Hassawi rice for genetic improvement in yield, biotic stresses and other related traits.

Figure 1. *Hassawi rice spikes and grains. (Photo credit: Mustafa I. Almaghasla)*

Figure 2. *Hassawi rice field in the Al-Ahsa Oasis, Saudi Arabia (Photo credit: Mustafa I. Almaghasla)*

Importance of Hassawi Rice

Despite its high price, Hassawi rice is a popular choice in Saudi Arabian farming. It is known for its delicious flavor and ability to make dishes more nutritious. If you are looking for a high-quality type of rice, Hassawi rice is a good option.

- Hassawi rice is known for its high nutritional value and ability to absorb flavors well. It is often used in traditional Saudi Arabian dishes such as kabsa and mandi. Hassawi rice is lower in carbohydrates and is a rich source of protein and fiber. It is also a good source of vitamins and minerals, including thiamin, riboflavin, niacin, folate, and magnesium.
- Due to its nutritional value, Hassawi rice consumption is also considered safer for women during pregnancy and post-pregnancy than white rice.
- Hassawi rice is a good absorber of flavors. This makes it a good choice for heavily seasoned dishes or cooked with a lot of sauce.
- Hassawi rice has a delicious, nutty flavor. It is a good choice for a variety of savory and sweet dishes.

Nutraceutical benefits of Hassawi rice

- Hassawi rice is a good source of fiber, which can help slow down sugar absorption into the bloodstream. This can help to prevent spikes and crashes in blood sugar levels.
- Hassawi rice is a good source of magnesium, which is vital for heart health. Magnesium helps to regulate blood pressure and heart rate. It also helps to protect the heart from damage.
- Hassawi rice is a good source of fiber, which can help keep the digestive system healthy. Fiber helps to add bulk to the stool and can help prevent constipation. It also helps to keep the intestines healthy by feeding the beneficial bacteria that live there.
- Hassawi rice is a good source of niacin, which is essential for skin health. Niacin helps to keep the skin looking healthy and radiant.
- Overall, Hassawi rice is a nutritious food that can be enjoyed as part of a healthy diet. It is a good source of carbohydrates, protein, fiber, vitamins, and minerals. Hassawi rice has been shown to offer several health benefits, including improved blood sugar control, heart health, digestion, energy levels, and skin health.

Challenges for Hassawi rice production in Saudi Arabia

The production of this elite landrace is highly threatened by its extinction due to declining freshwater resources in Saudi Arabia, elevated heat and increasing saline soils. Moreover, Hassawi rice cultivars are tall-statured plants; ultimately, plant lodging poses a significant problem for its open-field cultivation (Figure 3).

Figure 3. *Hassawi rice is a tall-statured plant and plant lodging is one of the significant challenges for its cultivation. (Photo credit: Mustafa I. Almaghasla).*

The Potential of High Throughput Technologies in Hassawi Rice Genetic Improvement

The global climate change scenario, shrinkage of freshwater reservoirs, increasing salinity, drought and heat collectively necessitate the development of tolerant rice cultivars for various stresses. Several different methods can be used to breed Hassawi rice. One standard procedure is to cross Hassawi rice plants with other varieties of rice that have desirable traits, such as high yield or resistance to pests and diseases. Another method is genetic engineering to introduce new traits into Hassawi rice plants.

Numerous biotic and abiotic stress-related genes have been empirically validated for stress tolerance in many cultivars of *indica* and *japonica* rice cultivars. However, introgressing these genes into Hassawi rice cultivars through conventional breeding can be very time consuming and labor intensive. Additionally, the introgressed alleles may carry certain genetic linkage groups and thus, potentially, the conventional breeding may introgress the non-desirable traits into the recipient Hassawi cultivars. The adaptation of Hassawi rice under abiotic and biotic stresses in Saudi Arabia can be better explored using high throughput fourth-generation sequencing and genome editing technologies. Many of these genes induce tolerance to multiple abiotic stresses and, therefore, can be used for the genetic improvement of the Hassawi rice landrace. These genes can be investigated for their role in tolerance against biotic and abiotic stresses in Hassawi rice using modern genome editing techniques such as Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR)-associated endonuclease Cas9 (CRISPR/Cas9). An effective regeneration system in Hassawi rice is already established, which is an essential prerequisite for implementing different biotechnological approaches for the future improvement of this critical Saudi landrace rice.

CRISPR/Cas9-based genome editing has established its supremacy for precisely editing crop plant genomes and has extensive applications encompassing insertion and/or deletion at a particular locus of a gene, site-directed mutagenesis, induction/expression/repression of gene(s), epigenome re-modeling and SNPs detection. Applying such new breeding toolsя (NBT) can be beneficial in breeding Hassawi rice cultivars tolerant against abiotic and biotic stresses. Applying such techniques can also assist the researchers to develop elite Hassawi rice cultivars without compromising the genetic linkage problem by precisely editing a specified gene at the desired locus. However, there are some concerns about the safety of genetically modified crops. These concerns include the possibility that genetically modified crops could cross-pollinate with non-genetically modified crops and the possibility that genetically modified crops could harm human health or the environment. Despite these concerns, genetic engineering is a promising technology that can potentially improve the quality and yield of Hassawi rice. More research is needed to address the safety concerns associated with genetic engineering, but if these concerns can be managed, genetic engineering could be a valuable tool for improving the world's food supply. However, the development of transgene-free or DNA-free genome editing methods makes this technique more pronounced to carry desired genetic improvement in crop plants for sustainable agriculture production.

What does the future hold?

In short, genetically engineered drought- and salt-tolerant plants could provide an avenue to reclamation farmlands lost to agriculture because of salinity and a lack of rainfall. The advancement in biotechnological tools, especially in genome editing, brings revolution among existing hands of scientists owing to its simplicity, precision and power as it offers new opportunities to develop improved crops with editing in undesirable traits.

Aligning with the Saudi Green Initiative program, the futuristic research focus should be the development of climate-resilient Hassawi rice lines that can encode tolerance against the major abiotic stresses in Saudi Arabia. As these abiotic stresses are yield-limiting factors in rice, genetically improved lines are strongly believed to show remarkable potential under changing climate in the present and future.

EN SUMMARY

Rice *(Oryza sativa L.)* is a staple food for three billion people across the globe and a major source of diet in the Middle-East, particularly in Saudi Arabia. However, emerging challenges of continuously growing world population, reduced arable lands and intensified threats due to climatic changes necessarily demand genetic improvements in rice to boost its yield potential under irrigated and non-irrigated arable lands. The availability of more advanced genetics and molecular biology tools enable scientists to utilize yield-enhancing functional genes to bring genetic improvements in rice crop against various biotic and abiotic stresses. New methods for the identification of yield-expressing genes and subsequently transfer them into the elite rice cultivars are helpful not only to increase rice production but also to incorporate resistance against biotic and abiotic stresses. In Saudi Arabia, Hassawi rice is an elite landrace of reddish-brown rice primarily grown in the Al-Sharqiyya region. Hassawi rice is rich in essential nutrients vital for daily human uptake and well known for its nutraceutical properties. The major limiting factors for rice cultivation in Saudi Arabia are water scarcity, high salinity, high temperature in the agro ecological areas and high cost of production for indigenous rice production. Considering the Saudi Green Initiative program, further genetic improvements in the local Hassawi rice landrace need empirical investigations to improve agronomical, morphological and nutritional traits. Genetically engineered biotic or abiotic stress-tolerant Hassawi rice can be beneficial in the reclamation of farmlands lost to agriculture in this region because of salinity and drought conditions. It will also pave the way toward sustainable rice cultivation, one of the primary objectives of the Saudi Green Initiative program in Saudi Arabia.

FR RÉSUMÉ

Le riz *(Oryza sativa L.)* est un aliment de base pour trois milliards de personnes dans le monde et une source majeure de nutrition au Moyen-Orient, en particulier en Arabie saoudite. Cependant, les défis émergents d'une population mondiale en constante augmentation, la diminution des terres arables et les menaces croissantes dues au changement climatique nécessitent inévitablement des améliorations génétiques du riz afin d'augmenter son rendement dans les cultures irriguées et pluviales. La disponibilité d'outils de génétique et de biologie moléculaire plus avancés permet aux scientifiques d'utiliser des gènes fonctionnels améliorant le rendement pour apporter des améliorations génétiques dans la culture du riz contre divers stress biotiques et abiotiques. Les nouvelles méthodes d'identification des gènes exprimant le rendement et leur transfert dans les variétés élites de riz sont utiles non seulement pour augmenter la production de riz, mais aussi pour améliorer la résistance aux stress biotiques et abiotiques. En Arabie saoudite, le riz Hassawi est une variété élite de riz brun rougeâtre cultivée principalement dans la région d'Ash-Sharqiyah. Le riz Hassawi est riche en nutriments essentiels pour l'absorption quotidienne par l'homme et est bien connu pour ses propriétés nutraceutiques. Les principaux facteurs limitant la culture du riz en Arabie saoudite sont la pénurie d'eau, la salinité élevée, les températures élevées dans les zones agro-écologiques et le coût de production élevé du riz local. Dans le cadre du programme Saudi Green Initiative, d'autres améliorations génétiques de la variété de riz local Hassawi nécessitent des études empiriques afin d'améliorer les caractéristiques agronomiques, morphologiques et nutritionnelles. Le riz génétiquement modifié Hassawi, tolérant au stress biotique ou abiotique, pourrait être utile pour récupérer les terres agricoles perdues dans cette région en raison de la salinité et de la sécheresse. Il ouvrira également la voie à une riziculture durable, qui est l'un des principaux objectifs du programme Saudi Green Initiative en Arabie saoudite.

AR ملخص

الأرز *(Oryza sativa L.)* هو غذاء أساسي لثلاثة مليارات شخص في جميع أنحاء العالم ومصدر رئيسي للنظام الغذائي في الشرق الأوسط، وخاصة في المملكة العربية السعودية. ومع ذلك، فإن التحديات الناشئة المتمثلة في التزايد المستمر لسكان العالم، وانخفاض الأراضي الصالحة للزراعة، والتهديدات المتزايدة بسبب التغيرات المناخية تتطلب بالضرورة تحسينات وراثية في الأرز لتعزيز إمكانات إنتاجه في الأراضي الصالحة للزراعة المروية وغير المروية. إن توفر أدوات علم الوراثة والبيولوجيا الجزيئية الأكثر تقدمًا يمكّن العلماء من استخدام الجينات الوظيفية المعززة للغلة لإدخال تحسينات وراثية في محصول الأرز ضد مختلف الضغوط الحيوية وغير الحيوية. إن الطرق الجديدة لتحديد الجينات المعبرة عن المحصول ونقلها بعد ذلك إلى أصناف الأرز النخبة مفيدة ليس فقط في زيادة إنتاج الأرز ولكن أيضًا لدمج المقاومة ضد الضغوط الحيوية وغير الحيوية. في المملكة العربية السعودية، يعتبر الأرز الحساوي من سلالات النخبة من الأرز البني المحمر الذي يزرع في المقام الأول في منطقة الشرقية. الأرز الحساوي غني بالعناصر الغذائية الأساسية الحيوية لامتصاص الإنسان اليومي ومعروف بخصائصه الغذائية. العوامل الرئيسية التي تحد من زراعة الأرز في المملكة العربية السعودية هي ندرة المياه، وارتفاع الملوحة، وارتفاع درجة الحرارة في المناطق الزراعية البيئية وارتفاع تكلفة إنتاج الأرز المحلي. وبالنظر إلى برنامج المبادرة الخضراء السعودية، فإن إجراء المزيد من التحسينات الوراثية في السلالة الأصلية للأرز الحساوي المحلي يحتاج إلى تحقيقات تجريبية لتحسين السمات الزراعية والمورفولوجية والغذائية. يمكن أن يكون أرز الحساوي المعدل وراثيًا والذي يتحمل الإجهاد الحيوي أو اللاأحيائي مفيدًا في استصلاح الأراضي الزراعية المفقودة بسبب الزراعة في هذه المنطقة بسبب ظروف الملوحة والجفاف. كما أنه سيمهد الطريق نحو زراعة الأرز المستدامة، وهو أحد الأهداف الرئيسية لبرنامج المبادرة السعودية الخضراء في المملكة العربية السعودية.

BEST AGRICULTURAL PRACTICES FOR CASSAVA PRODUCTION

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Cassava (*Manihot esculenta Crantz*) is a root staple mainly grown in the tropical and subtropical regions of Africa, Asia, and Latin America. It is most cherished for its resilience and ability to thrive in poor soil conditions and drought-stricken areas with limited water resources. Cassava thus tops as an ideal crop for the resource poor smallholder farmers who rely on it as a staple food providing the much-needed carbohydrates for human survival. This is much valued and vital particularly in Africa where food insecurity prevails.

While cassava seems an easy crop to grow, the apparent big yield gap often observed between the research station and farmer's field situation clearly indicates that many farmers are still limited in the knowledge on best ways to grow cassava. Additionally, already known good management practices that would lead to very good yields of cassava seemed to be under deployed by many growers. This guide therefore provides best agronomic practices for farmers to adopt in order to cultivate cassava successfully to increase production and productivity.

Critical steps to follow for good cassava cultivation

Step 1: Site selection

A suitable site is crucial for proper cassava establishment, hence good yields. Select lands with deep sandy-loam or loamy soils. Loamy soil type is fertile and well drained as it has moderate water infiltration and retention abilities good for cassava growth. Avoid site with clayey soils because this soil type is heavy and impedes cassava root development and penetration during growth. Areas that are stony, shaded, and swampy should also be avoided as they are unsuitable for cassava cultivation. Newly cleared forested areas with many tree stumps is equally unsuitable as the decaying tree stumps may habour some soil pathogens that can cause rotting of cassava roots. Cassava should not follow other root and tuber crops such as yam, sweet potato or potatoes because they are equally heavy nutrient consumers and hence will have depleted a number of soil nutrients already in that garden. If cassava is to follow, due to land limitation, where non-leguminous crops have been grown for some time then apply fertilizer to improve the soil.

Step 2: Land preparation

Once a suitable location has been selected, the land must be prepared for planting. Preparation should be done at the end of a dry season to allow for planting at the beginning of the first rains. Begin by slashing or removing tall grasses and shrubs and where you have stubborn weeds like couch grass (*Cynodon dactylon*) or spear grass (*Hyparrhenia rufa*) apply herbicides before ploughing. Contact agricultural extension officer on suitable herbicide to use and how to apply it. Herbicides, and so do other agrochemicals, can be harmful so always wear protective clothes and gears such as overalls, gloves, head protection and gum boots when applying them. Land for planting cassava should be ploughed at least twice to loosen the soil for healthy root establishment. This may be done by hand with a hoe, ox-plough or with a tractor. The depth of ploughing by a tractor should be 15-30 cm to prevent nutrient-rich top soil from moving down beyond the reach of plant roots. For hilly areas, ridges may be made to prevent water and soil run-off. If the soil is poor incorporate organic matter such as compost to boost the soil structure and fertility. Inorganic fertilizer such as NPK may also be applied. Cassava requires high amounts of phosphorus for proper tuber formation, thus suitable combinations of NPK fertilizer should be applied to achieve the desirable root yields.

Step 3: Stem selection and preparation

The choice of a cassava variety to plant normally depends on the interest of the farmer and most times this is influenced by consumer preference, yield, resistance to pests and diseases and the maturity period of the cassava. A good cassava crop is obtained by planting cuttings from healthy plants free from diseases and pests. Common diseases spread through infected cuttings are cassava brown streak disease (CBSD), cassava mosaic disease (CMD), cassava bacterial blight (CBB) and, cassava frog skin disease (FSD) which is common in Southern America. These diseases can cause substantial root yield loss if not managed well. Cassava mealybug, cassava green mite and cassava scales are the common pests that can be spread through infested cuttings. Do not get cuttings from fields where the above mentioned diseases and pests are present. Stem for planting should be cut from plants that are 8-12 months old. Get cuttings from lower and middle part of matured stem for better germination. Use sharp cutlass to cut the stem into 20-25cm long pieces with 5-7 nodes and pack in gunny bags ready for planting immediately. Planting materials should always be obtained from cassava clean-seed producers where cassava variety purity and quality of planting materials are guaranteed. Planting material from a clean source will enhance crop productivity and also cut down any buildup of diseases and pests in the community.

Step 4: Planting

The best time to plant cassava is at the onset of the wet season whether the season has a mono-modal or bi-modal rainfall distribution. Do not plant when there is drought because it will affect cassava establishment leading to poor yield at crop maturity. Once cuttings are sourced, plant within 14 days because any further delay will lead to drying of cuttings especially when kept in open sun in the field. Such cuttings when planted will germinate poorly and the plants will have decreased survival. There are two commonly used methods of planting cassava: (i) horizontal planting, where each cutting is planted at depth of 5-10 cm in a hole of 20-30 cm length and covered thinly with soil. This method is suitable for heavy soils or when practicing zero or minimum tillage. It is also suitable for flat land; (ii) vertical or slanted planting, where two-third of the cutting is inserted below the ground with the "eyes" or buds facing up. This method is suitable for loose and friable soils and also hilly land. Plant spacing for both methods should be 1m x 1m giving a plant population of 10,000 plants per hectare. In land where termites may be a problem, it is advisable to first dip the cuttings in a systemic insecticide before planting to protect from termite damage. This will guarantee high germination percentage. High cassava plant density in the garden with good field management will produce high root yield.

Step 5: Replanting or Gap filling

Planted cuttings may fail to germinate due to damage by termites, rotting due to soil pathogens or too much rains and, drying due to drought. Once cassava is planted, walk through the garden at 4 weeks after planting and check to establish the level of plant germination. Sample a few holes where germination has failed to check whether it was due to termite damage or stem rotting. This will guide whether to treat the stems before replanting. If the moisture in the garden is still good, gaps fill immediately with good quality cuttings of the same variety planted earlier to restore the required plant population.

Step 6: Weeding

Weeds can cause considerable yield loss in cassava if not well controlled because they compete for sunshine, space, nutrient and water. While weeding frequency may depend on the severity of local weeds in the garden and rainfall, cassava should be weeded at least 4 times. Do the first weeding at 4 weeks after planting and then repeat the weeding at 8, 12, 18 and 24 weeks after planting. It is very important to keep cassava weed free in the first 12 weeks after planting because that is when root formation and bulking has commenced. If this is not done root development will be affected leading to very poor yield at crop maturity. Weeding is usually done using a hand hoe or mechanized for larger cassava farmers.

Some varieties of cassava that form canopy early are also effective in weed control.

Step 7: Harvesting

Depending on the use, cassava can be harvested between 8-12 month after planting for most of the varieties or up-to 18 months for late maturing varieties. Harvesting involves a process of digging out cassava roots from beneath mature plants. For piece meal harvesting carefully remove one or two well developed roots from a cassava plant and carefully cover the remaining roots with soil to continue growing. For whole harvesting first remove top canopy of the cassava plant at about 30cm above the ground and carefully pull the remaining stump to pull out all the roots from the soil at once. If the soil is hard use a hoe, shovel, pick or fork to remove the roots. Large scale farmers should use tractor drawn root digger or up-rooter to harvest the cassava. After harvesting roots can be utilized accordingly. If there is need to store them, roots should be cleaned off every soil and thereafter stored in a cool dry place for a few days. However, for longer storage, the roots can be buried in soil, sand or saw dust to maintain freshness and prevent drying out.

Acknowledgement

This guide was developed by the National Root Crops Research Team of the National Agricultural Research Organization (NARO)-Uganda and edited by Dr. Omongo Christopher Abu, the National Root Crops Research Program Leader.

EN SUMMARY

Cassava *(Manihot esculenta Crantz)* is a root staple mainly grown in the tropical and subtropical regions of Africa, Asia, and Latin America. It is most cherished for its resilience and ability to thrive in poor soil conditions and drought-stricken areas with limited water resources. Cassava thus tops as an ideal crop for the resource poor smallholder farmers who rely on it as a staple food providing the much-needed carbohydrates for human survival. This is much valued and vital particularly in Africa where food insecurity prevails. While cassava seems an easy crop to grow, the apparent big yield gap often observed between the research station and farmer's field situation clearly indicates that many farmers are still limited in the knowledge on best ways to grow cassava. Additionally, already known good management practices that would lead to very good yields of cassava seemed to be under deployed by many growers. This guide therefore provides best agronomic practices for farmers to adopt in order to cultivate cassava successfully to increase production and productivity.

FR RÉSUMÉ

Le manioc *(Manihot esculenta Crantz)* est un aliment de base des racines principalement cultivé dans les régions tropicales et subtropicales d'Afrique, d'Asie et d'Amérique latine. Il est particulièrement apprécié pour sa résilience et sa capacité à prospérer dans des sols pauvres et des zones touchées par la sécheresse avec des ressources en eau limitées. Le manioc est donc une culture idéale pour les petits exploitants pauvres en ressources qui en dépendent comme aliment de base fournissant les glucides indispensables à la survie humaine. Ceci est très apprécié et vital, en particulier en Afrique où l'insécurité alimentaire prévaut. Bien que le manioc semble être une culture facile à cultiver, le grand écart de rendement apparent souvent observé entre la station de recherche et la situation des champs des agriculteurs indique clairement que de nombreux agriculteurs ont encore des connaissances limitées sur les meilleures façons de cultiver le manioc. De plus, de bonnes pratiques de gestion déjà connues qui conduiraient à de très bons rendements de manioc semblaient être sous-déployées par de nombreux producteurs. Ce guide fournit donc les meilleures pratiques agronomiques à adopter par les agriculteurs afin de cultiver le manioc avec succès pour augmenter la production et la productivité.

AR ملخص

الكسافا *(Manihot esculenta Crantz)* هو نبات أساسي يزرع بشكل رئيسي في المناطق الاستوائية وشبه الاستوائية في أفريقيا وآسيا وأمريكا اللاتينية. إنها موضع تقدير كبير لمرونتها وقدرتها على الازدهار في ظروف التربة السيئة والمناطق المنكوبة بالجفاف ذات الموارد المائية المحدودة. وبالتالي فإن الكسافا تتصدر كمحصول مثالي للمزارعين أصحاب الحيازات الصغيرة الذين يفتقرون إلى الموارد والذين يعتمدون عليها كغذاء أساسي يوفر الكربوهيدرات التي تشتد الحاجة إليها لبقاء الإنسان. وهذا أمر ذو قيمة كبيرة وحيوية خاصة في أفريقيا حيث يسود انعدام الأمن الغذائي. في حين أن الكسافا يبدو محصولًا سهل النمو، إلا أن الفجوة الكبيرة الواضحة في الإنتاجية التي يتم ملاحظتها غالبًا بين محطة الأبحاث والوضع الميداني للمزارعين تشير بوضوح إلى أن العديد من المزارعين لا يزالون محدودين في المعرفة حول أفضل الطرق لزراعة الكسافا. بالإضافة إلى ذلك، يبدو أن ممارسات الإدارة الجيدة المعروفة بالفعل والتي من شأنها أن تؤدي إلى عوائد جيدة جدًا للكسافا لا يتم نشرها من قبل العديد من المزارعين. ولذلك يوفر هذا الدليل أفضل الممارسات الزراعية للمزارعين لاعتمادها من أجل زراعة الكسافا بنجاح لزيادة الإنتاج والإنتاجية.

REVOLUTIONIZING AGRICULTURE: GENE STACKING AND GENOME EDITING FOR ENHANCED CROP RESILIENCE

CRISPR/CAS9 MEDIATED GENETIC IMPROVEMENT OF CROPS

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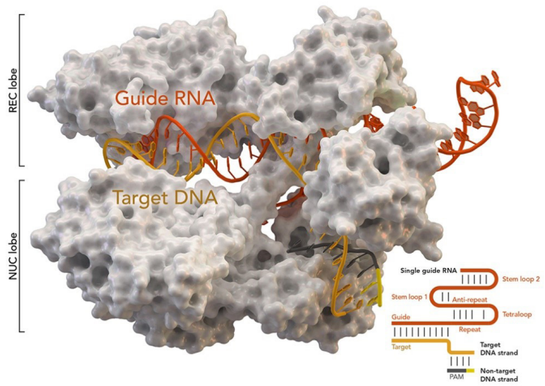


Ref: UC-Berkeley

Food security is a paramount concern in an era of rapid climate change and increasing global population. A growing demand for sustainable food production, emerging pests and diseases, and weather extremes; all require an evolution in agricultural practices. Scientists and researchers are investigating cutting-edge technologies like genome editing via CRISPR/Cas system and site specific gene stacking in their quest for resilient crops. These innovative technologies provide unprecedented opportunities to improve crop resilience, providing farmers the ability to overcome challenges and ensure future produce.

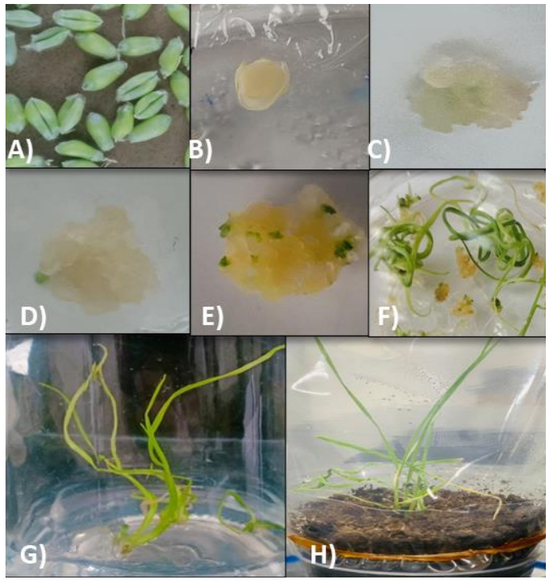
Genome editing unleashed: Genome editing technology, particularly CRISPR/Cas9 system has revolutionized agriculture by providing an effective and precise method of editing the crop genome. Genome editing technology enables researchers to target a very specific region of DNA with remarkable precision, in contrast to conventional breeding techniques that rely only on tedious cross-breeding. This breakthrough technique can accelerate the development of new crop varieties with improved resilience.

Gene stacking is the simultaneous integration of multiple genes to combine numerous desirable traits. With the use of this method, researchers can develop crop varieties that can successfully handle multiple problems in a single cultivar. Coupling genome editing with gene stacking technology enabled researchers to edit a very specific genomic site along with integration of multiple desirable genes to enhance resilience. Enhancing stress tolerance, combating pests and diseases, boosting nutritional value, and multiplying resilience are some of the outcomes of coupling gene stacking with the genome editing. As we navigate a changing climate and start struggling for sustainable food production, these innovative technologies will play a significant role in securing future food supply.

The demand for wheat varieties with resistant starch has increased globally in recent years. A form of starch that withstands digestion in the small intestine and passes through to the large intestine intact, where it functions as a prebiotic and offers a host with health advantages. Maintaining a healthy digestive system, keeping blood sugar at an optimized level, preventing obesity, improving nutrition absorption rate, and solving dietary restrictions; are a few factors driving the demand for wheat with resistant starch worldwide.

We have been working to manipulate SSIIa gene in wheat through genome editing for the purpose of modifying the structure and composition of wheat starch to enhance the resistant starch and amylose content. We are in the process of develop-

ing transgene free wheat by knocking down SSIIa gene involved in erucic acid biosynthetic pathway using CRISPR/Cas9 system, which will lead to developing the wheat lines with lower levels of amylose. Alongside we are knocking down GW5 gene as a negative regulator of grain weight in commercial wheat lines of Pakistan using CRISPR/Cas9 system.



Wheat transformation by CRISPR/Cas9 constructs using immature embryos as an explant at Wheat Biotechnology lab, NCGE, CAS-AFS, UAF, Pakistan.

Genome edited starch resistant wheat will represent a promising avenue for addressing numerous nutritional and health related concerns, offering an impactful solution for individuals trying to seek an improvement in their well-being. Wheat lines yielding increased grain weight could possibly secure the food security concern to some extent. It is significant to continue research on genome editing, keeping in view about the regulatory concerns of this innovation to the benefit of the society.

Conclusion

A new era in crop transformation has begun with the fusion of genome editing and gene stacking technologies. We are unlocking the potential to improve crop resilience and fight harmful biotic and abiotic stresses by utilizing the capabilities of genome editing through CRISPR/Cas9 system and integrating multiple genes to tackle several problems in one go. The transgenic plants produced by this research will offer farmers all around the world, a hope of promising genetic resources. These transgenic plants will be backcrossed with the promising commercial varieties of Pakistan to introgress genetically modified system to commercial varieties.

EN SUMMARY

The genome editing via CRISPR/Cas system has revolutionized agricultural biotechnology and crop resilience, however, in low-to-middle-income countries its appraisal is moderately adopted. CRISPR is likely to have an impact on our society in several different ways over the coming years, whether it is in agriculture, human health, animal health or infectious diseases. We are currently working on a project entitled “Genome Editing of Biological Agents for Nutritional, Biochemical and Therapeutic Purposes” funded by the Ministry of Science and Technology, Pakistan. This project focuses on using CRISPR technology for improvement of prominent crops of Pakistan. We are aiming at improving crop health through mitigation of disease burden by using CRISPR/Cas system such as gene stacking for viral disease, gene knock outs for susceptible genes and CRISPR/Cas based targeting for developing crops resistant to biotic and abiotic stresses. We are developing a CRISPR/Cas based model system by producing base lines that can be used for multiple targets in less possible time without the need to create a CRISPR based line each time a transformation event is required. The current objectives in focus include starch resistant wheat, biofortified wheat, knockdown SSIIa gene involved in erucic acid biosynthesis pathway and developing a wheat line having low amylose content. Further we have developed In-silico target identification, gBlock synthesis, CRISPR based construct development and bioinformatics studies in screening and identification of targe genes. Results of newly developed CRISPR/Cas focused center and outcomes of project will be discussed in the conference for global collaboration and new advancements in this area of solution-based research.

FR RÉSUMÉ

L’édition du génome via le système CRISPR/Cas a révolutionné la biotechnologie agricole et la résilience des cultures, cependant, dans les pays à revenu faible à intermédiaire, son évaluation est modérément adoptée. Le CRISPR est susceptible d’avoir un impact sur notre société de différentes manières dans les années à venir, de ce soit dans le domaine de l’agriculture, de la santé humaine, de la santé animale ou des maladies infectieuses. Nous travaillons actuellement sur un projet intitulé “Genome Editing of Biological Agents for Food, Biochemical and Therapeutic Purposes”, financé par le Ministère de la science et de la technologie du Pakistan. Ce projet vise à utiliser la technologie CRISPR pour améliorer les cultures connues du Pakistan. Nous visons à améliorer la santé des cultures en réduisant la charge de morbidité grâce au système CRISPR/Cas, par exemple en regroupant les gènes pour lutter contre les maladies virales, en éliminant les gènes sensibles et en ciblant les gènes à l’aide de CRISPR/Cas pour développer des cultures résistantes aux stress biotiques et abiotiques. Nous développons un système modèle basé sur CRISPR/Cas, créant des lignes de base qui peuvent être utilisées pour des cibles multiples en moins de temps, sans avoir à créer une ligne basée sur CRISPR chaque fois qu’une transformation est nécessaire. Les cibles actuelles comprennent le blé résistant à l’amidon, le blé biofortifié, le knockdown du gène SSIIa impliqué dans la voie de biosynthèse de l’acide érucique et la création d’une lignée de blé à faible teneur en amylose. En outre, nous avons développé l’identification de cibles In-silico, la synthèse de gBlocks, la création de constructions basées sur CRISPR et des études bioinformatiques pour le criblage et l’identification de gènes cibles. Les résultats du nouveau centre axé sur CRISPR/Cas et les résultats du projet seront discutés lors d’une conférence pour une collaboration mondiale et de nouvelles avancées dans ce domaine de la recherche basée sur des solutions.

AR ملخص

لقد أحدث تحرير الجينوم عبر نظام كريسبر/كاس ثورة في التكنولوجيا الحيوية الزراعية وقدرة المحاصيل على التحمل، ومع ذلك، يتم اعتماد تقييمه بشكل معتدل في البلدان المنخفضة والمتوسطة الدخل. من المرجح أن يكون لتقنية كريسبر تأثير على مجتمعنا بعدة طرق مختلفة خلال السنوات القادمة، سواء كان ذلك في الزراعة أو صحة الإنسان أو صحة الحيوان أو الأمراض المعدية. نحن نعمل حاليًا على مشروع بعنوان "تحرير الجينوم للعوامل البيولوجية للأغراض الغذائية والكيميائية الحيوية والعلاجية" بتمويل من وزارة العلوم والتكنولوجيا في باكستان. يركز هذا المشروع على استخدام تقنية كريسبر لتحسين المحاصيل البارزة في باكستان. نحن نهدف إلى تحسين صحة المحاصيل من خلال تخفيف عبء المرض باستخدام نظام كريسبر/كاس مثل تكديس الجينات للأمراض الفيروسية، وإلغاء الجينات للجينات الحساسة والاستهداف القائم على كريسبر/كاس لتطوير محاصيل مقاومة للضغوط الحيوية وغير الحيوية. نحن نعمل على تطوير نظام نموذجي قائم على كريسبر/كاس من خلال إنتاج خطوط أساسية يمكن استخدامها لأهداف متعددة في وقت أقل ممكن دون الحاجة إلى إنشاء خط قائم على كريسبر في كل مرة يلزم فيها حدث تحويل. تشمل الأهداف الحالية التي يتم التركيز عليها القمح المقاوم للنشا، والقمح المدعم بيولوجيًا، وتحطيم جين SSIIa المشارك في مسار التخليق الحيوي لحمض الإيروسيك، وتطوير خط قمح يحتوي على محتوى منخفض من الأميلوز. علاوة على ذلك، قمنا بتطوير تحديد الهدف داخل السيليكو، وتوليف gBlock، وتطوير البناء القائم على كريسبر ودراسات المعلوماتية الحيوية في فحص وتحديد الجينات المستهدفة. ستتم مناقشة نتائج المركز الذي تم تطويره حديثًا والمركّز على كريسبر/كاس ونتائج المشروع في المؤتمر من أجل التعاون العالمي والتطورات الجديدة في هذا المجال من الأبحاث القائمة على الحلول.

SUPPORTING POLICIES AND INNOVATIONS FOR INTEGRATED WATER MANAGEMENT IN THE OIC MEMBER STATES

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Introduction

Given the escalating risks to ecosystem sustainability and the livelihoods of billions, the efficient management of water resources has become a critical concern, particularly for the member states of the Organization of Islamic Cooperation (OIC). These countries, which collectively accommodate over 25% of the global population, find themselves at a pivotal moment. They are currently grappling with an extensive array of water-related issues that have far-reaching implications not only for the environment but also for their social, economic, and political structures.

physical scarcity of water in arid regions and the complexities associated with ensuring equitable water distribution in regions where abundant resources are unevenly distributed. In addition to these factors, the water scarcity dilemma is further complicated by the consequences of climate change, which include increased frequency of droughts and flooding, altered precipitation cycles, and more extreme weather patterns.Figure 1 depicts the projected water consumption in OIC nations by 2040. While increase in demand varies by country. The water demand in most OIC countries will increase by 1.4 to 1.7 times or more by 2040, compared to their 2010 baseline. It is predicted that world average water demand would rise by 20 to 30% by 2050.

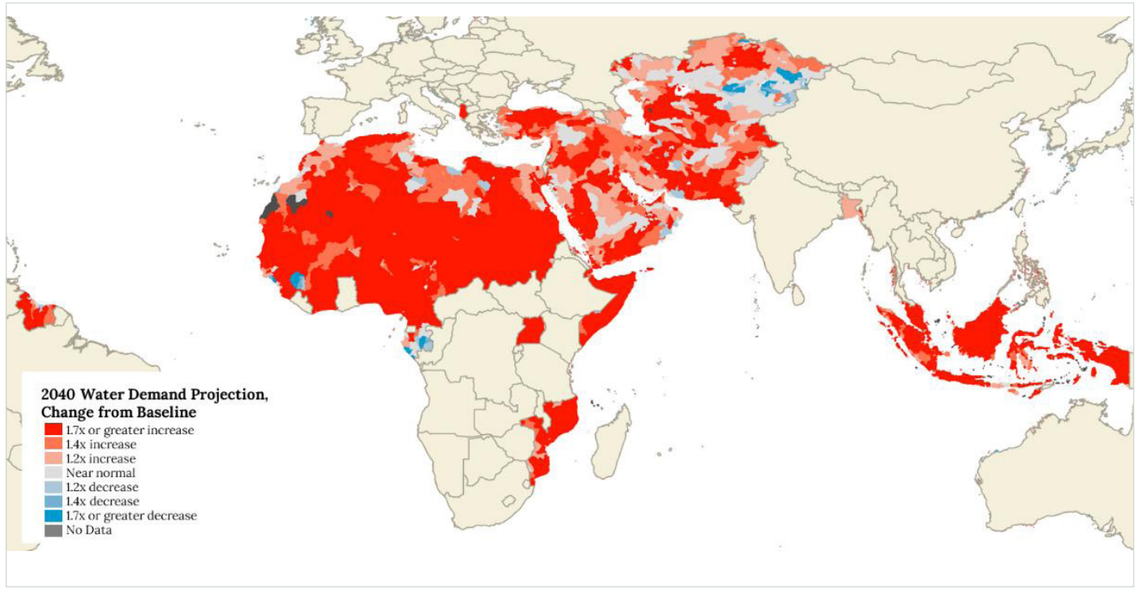

Figure 1. *Projected Change in Water Demand by 2040 (Source: OIC Water Report 2021)*

A considerable proportion of the population in several Member States of the OIC is situated in rural regions and is highly dependent on agriculture for sustenance; this reliance is fundamentally tied to the accessibility and environmentally responsible administration of water resources. The challenges encompass

Water demand in the OIC will continue to rise dramatically in the coming decades. This expansion would be mostly due to gains in the industrial and residential sectors. Nonetheless, agriculture would continue to account for the majority of total water demand, albeit to a smaller amount. Water competition among sectors poses significant issues, particularly in OIC nations where agriculture plays a significant economic role. As a result, the overall water development strategy should include

a sustainability approach that takes into account demand across all sectors, including the need for environmental sustainability.

Given the aforementioned challenges, it is not only essential but also critical to develop robust policy frameworks and innovative solutions for integrated water management. Subsequent portions examine the distinct obstacles pertaining to water resources in the Member States of the OIC. It emphasizes technological advancements designed to optimize water utilization, and deliberate policy frameworks that may bolster and magnify the effects of such innovations.

Challenges of Water Management in the OIC Member States

Despite vast cultural and geographical diversity, the OIC Member States share a number of common obstacles in the administration of water resources. A combination of natural, socioeconomic, and technological elements contribute to the complexity of water management in these regions.

Geographical Disparities and Water Stress.

Geographical diversity and the consequent disparities in water availability constitute a significant obstacle. For instance, nations situated in the Middle East and North Africa (MENA) region endure severe water scarcity and are distinguished by their arid climatic conditions. The water scarcity is not solely attributable to inadequate precipitation; an irregular distribution of water resources has also contributed to it. Water management strategies that are specific to each region are required due to these geographical disparities, which take into account the distinct hydrological and climatic conditions of that area (Smith, 2018).

Agricultural Water Use and Inefficiencies.

The agricultural sector, which is critical in the majority of OIC countries, consumes the most water. Significant water loss, nevertheless, results from the prevalence of antiquated and ineffective irrigation methods. For instance, flood irrigation in countries like Egypt and Pakistan, wastes a substantial amount of water (Ahmed & Aslam, 2020). Water scarcity exacerbated by such methods emphasizes the need for modern, and efficient irrigation techniques.

Impact of Climate Change.

IIt is anticipated that increasing temperatures and changing precipitation patterns will limit the availability of water, especially in regions that are already under water stress. Moreover, the escalating occurrence rate of severe meteorological phenomena, including flooding and droughts, exacerbates the burden on water resources and infrastructure (Khan & Hanjra, 2019).

Urbanization and Industrialization.

Industrial expansion and rapid urbanization present an additional set of obstacles. The growth of urban areas contributes to a heightened water demand, which encompasses not only domestic but also industrial requirements. This urbanization frequently results in excessive groundwater extraction, which degrades water quality and lowers the water table. In addition, it is worth noting that water contamination caused by industrial activities can exacerbate the scarcity of potable water for alternative applications (Jamil, 2021).

Policy and Governance Issues.

Additionally, policy and governance concerns impede effective water management. A number of OIC Member States have fragmented water governance structures that lack the necessary integration to sustainably manage water resources. The gap between policy development and execution is frequently exacerbated by insufficient data regarding water resources and consumption (Omar *et al.*, 2022).

Socio-Economic Constraints.

The influence of socioeconomic factors on water management challenges is substantial. In numerous OIC nations, inadequate investment in water infrastructure results in inefficiencies and financial losses. Furthermore, it is common for water resource management to fail to sufficiently address the concerns of all relevant parties, particularly marginalized communities, which results in unequal access to and utilization of water resources (Ali & Khan, 2020).

The water management challenges in the Member States of the OIC are diverse and necessitate a comprehensive strategy that considers factors such as geography, climate, technology, society, economy, and policy. It is critical to confront these challenges in order to guarantee sustainable water utilization and, consequently, agricultural security and economic stability in the area.

Policy Frameworks to Support Integrated Water Management in the OIC Member States

In order to ensure efficient management of water resources, comprehensive policy frameworks are indispensable for the OIC Member States. The design of these frameworks ought to be such that they facilitate technological advancements, promote sustainable methodologies, and guarantee fair allocation of water resources.

Investment in Research and Development

Investment in research and development (R&D) is of the utmost importance. Governments shall allocate funds for the development of new water management technologies and the enhancement of existing ones. This encompasses financial support for academic institutions and research institutions to investigate novel water conservation methods and technologies. The positive effects of government investment in water management research and development are underscored in a study by Rahman et al. (2021), which establishes a correlation between such investments and enhancements in water efficiency within the agricultural domain.

Regulatory Reforms for Water Conservation

Regulatory reforms are equally imperative. The enactment of legislation and regulatory frameworks that penalize water wastage and encourage conservation can generate substantial changes in practices and behaviors. For example, the implementation of pricing mechanisms and water rights can promote the prudent utilization of water resources. Al-Jayyousi (2020) examines the efficacy of regulatory reforms in arid regions to promote sustainable water use,

with a particular focus on the significance of pricing and allocation policies that are appropriate.

Public-Private Partnerships for Technology Development

Public-private partnerships (PPPs) are of paramount importance in the progression of water management solutions. The formation of these types of alliances may expedite the creation and deployment of state-of-the-art water management technologies. Furthermore, their assistance can extend successful pilot initiatives to a more extensive scale. In developing nations with limited resources, PPPs have been instrumental in introducing technological innovations to the market, as noted by Khan et al. (2022).

Community Engagement and Education

Local community participation in water management decisions is crucial to the effectiveness and longevity of water policies. Community engagement guarantees that water management initiatives are backed by the local populace and that policies are customised to the particular requirements of a given region. Moreover, public awareness and education campaigns can significantly influence a shift in public perceptions and behaviors concerning water usage. Ahmed and Aslam (2023) contend that education and community participation are essential for the successful implementation of water policies.

International Cooperation and Transboundary Water Management

Due to the transboundary characteristics of numerous water resources, the establishment of international collaboration is imperative. Member States of the OIC must participate in regional and international dialogues and agreements in order to efficiently govern shared water resources. This may encompass the exchange of data, the joint administration of river basins, and cooperative endeavors to tackle common water predicaments. Omar *et al.* (2024) highlights the significance of global collaboration in the administration of transboundary water resources, specifically in areas where river basins are shared.

In summary, for the OIC Member States to achieve effective water management, a comprehensive policy framework is required, which should include investments in research and development, regulatory reforms, public-private partnerships, community support, and international collaboration. These policies, in conjunction with technological advancements, have the potential to facilitate water resource management in the region that is sustainable, efficient, and fair.

Technological Innovations for Optimal Water Use in OIC Member States

Technology advancement is of the utmost importance when it comes to resolving the water management issues in the OIC Member States. The adoption of novel approaches has the potential to greatly improve the efficacy and sustainability of water usage.

Smart Irrigation Systems

An enormous advancement in water management is the creation of intelligent irrigation systems. By utilizing AI-driven algorithms and sensors, these systems optimize water use by customizing irrigation schedules and volumes according to the unique requirements of crops, utilizing real-time data. An investigation conducted by Hassan et al. (2022) illustrated the potential of intelligent irrigation systems to augment crop yields while mitigating water consumption by as much as 30%.

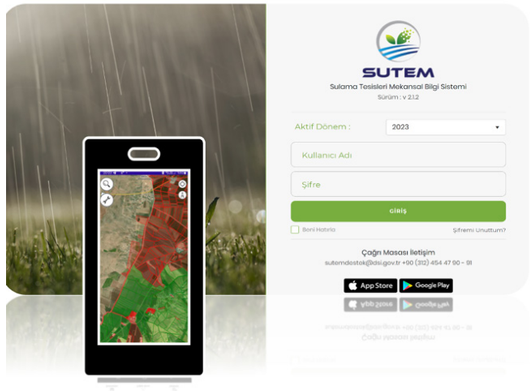

Figure 2. *A cutting-edge e-government service for comprehensive irrigation management. SUTEM (Türkiye) operates through web and mobile interfaces to optimize water distribution and usage. It skillfully combines GIS capabilities with real-time data for efficient tracking, planning, and execution of irrigation strategies, ensuring sustainable water management and enhanced agricultural productivity.*

Figure 3. *ELMAN Electronic Water Management System (Türkiye) featuring a sensor-based irrigation automation device embodies advanced digital twin technology for agricultural irrigation areas. Serving as an intuitive management interface, it enables remote control and leverages artificial intelligence for autonomous decision-making, optimizing irrigation with precision and efficiency.*

Water Recycling and Reuse Technologies

Water reuse and recycling constitute an additional area of innovation that holds significant importance. Sophisticated treatment technologies facilitate the secure reutilization of effluent for purposes related to agriculture and industry. In addition to conserving freshwater resources, this practice mitigates pollution. Al-Maktoumi *et al.* (2021) emphasize the efficacy of water recycling endeavors in a number of OIC nations, thereby highlighting their capacity to substantially enhance water provisions, particularly in arid areas.

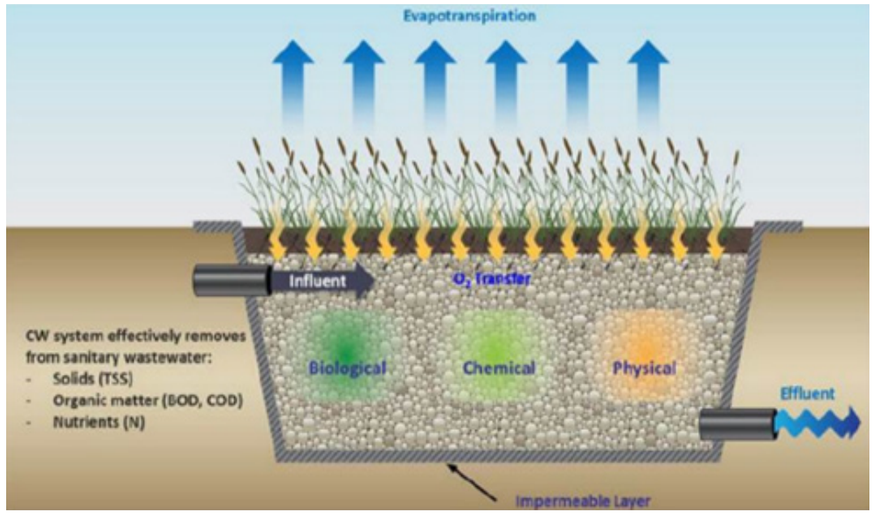

Figure 4*. Produced water from gas fields as an unconventional water resource for agri-food industry by Qatar Environment and Energy Research Institute.*

Desalination Technologies

Technologies for desalination are indispensable for nations with limited freshwater resources. Energy-efficient and economical desalination techniques, such as reverse osmosis, are gaining prominence in the industry. The technological advancements in desalination, with a specific focus on the Gulf Cooperation Council (GCC) countries that house some of the most sizable desalination facilities globally, are examined in a report by Farooq and Kumar (2023).

Rainwater Harvesting Techniques

Particularly in arid regions, rainwater harvesting is a straightforward and efficient method for capturing and storing precipitation. This can serve as an additional agricultural and domestic water source. Khan and Ahmad (2022) have conducted research that highlights the capacity of rainwater harvesting to augment water security in OIC countries grappling with water scarcity.

Figure 5. *The Islamic Network for Water Resources Development and Management (INWRDAM) Sama Sarhan WEFE Nexus project, Mafraq.*

Drought-Resistant Crop Varieties

The development of drought-resistant crop varieties that require less water and are suitable for arid and semi-arid regions is being facilitated by biotechnology and breeding. This methodology guarantees both water conservation and nutritional security. Malik and Singh (2021) suggest that genetically modified crops possessing enhanced drought tolerance have the potential to significantly contribute to sustainable agriculture in OIC countries.

Figure 6. *ICBA hosts open-day to showcase research on millets (March 2023) presenting breakthrough research on minor millets. These resilient crops, thriving in arid and saline conditions, are hailed for their stress resistance and nutrient richness, offering sustainable solutions in the face of climate change.*

Overall, the incorporation of these technological advancements into the water management strategies of OIC Member States has the potential to yield substantial enhancements in water utilization, sustainability, and efficiency. To successfully implement these technologies, however, capacity building, supportive policies, and adequate funding are required.

Figure 7. *Highlights from the Advanced Agri-Tech Sub-Forum, Doha, October, 2023. Showcasing groundbreaking advancements in agricultural irrigation systems, spatial management, and sustainable aquaponics to revolutionize water resource management in the agri-food industry.*

Conclusion

The obstacles encountered in the OIC Member States regarding water management are as varied as the regions in question. Nevertheless, these obstacles are united by the critical requirement for comprehensive resolutions that integrate technological advancements with resilient policy structures.

An assortment of technological developments, including drought-resistant crops and intelligent irrigation systems, offer a glimmer of optimism for sustainable water management. Should these advancements be efficiently utilized and executed, they possess the capacity to fundamentally transform water consumption in the agricultural and other industries, resulting in heightened efficacy, preservation, and ultimately, water security.

Nevertheless, technology in isolation is insufficient to resolve the water-related issues that the OIC Member States confront. It is impossible to overstate the significance of comprehensive, coherent, and forward-thinking policy frameworks. It is essential to implement policies that effectively promote sustainable water use practices, encourage investment in water-saving technologies, and facilitate public-private partnerships. International cooperation and local community participation are of equal importance, particularly with regard to the administration of transboundary water resources.

As a unifying vehicle, the Islamic Organization for Food Security (IOFS) is of critical importance in this scenario. The IOFS, in its capacity as an intermediary between OIC Member States, possesses a distinctive advantage in promoting the exchange of information, optimal methodologies, and technological progress among its member states.

Furthermore, by assuring that innovations in water management are not only developed but also effectively integrated into national and regional water management strategies, the IOFS can serve as a crucial link between policy and technology. Partnerships with research institutions, private sector stakeholders, and international organizations can facilitate the attainment of this objective. By strategically integrating policy and innovation, the IOFS can assist in guiding these countries towards a future in which universal access to water security is a tangible reality.

Recommendations:

Based on the observations and perspectives offered in this article, the following recommendations can be made to address the OIC region's water management challenges:

1. Enhance Investment in Water Management Research and Development: OIC Member States should prioritize and enhance investment for advanced water management research and development. Investing in the development of smart irrigation systems, effective water recycling methods, and drought-resistant crops is one example. Such investments will encourage innovation and deliver long-term solutions to water scarcity.

2. Implement and Enforce Regulatory Reforms: Member countries should enact and strictly enforce rules and regulations that encourage water conservation and sustainable use. Water rights, adequate price mechanisms to discourage wasteful usage, and regulations to promote equitable allocation of water resources are all part of this.

3. Encourage collaborations between government institutions and private sector enterprises to harness experience, technology, and money for water management projects. These collaborations can hasten the adoption of new water management technologies and make it easier to scale up successful programs.

4. Encourage community involvement and education: Involve local communities actively in water management choices and projects. Implement educational activities to create awareness about the need of conserving water and using it in a sustainable manner. Community involvement ensures that water management techniques are adapted to local needs, increasing the likelihood of success and sustainability.

5. Increase International Cooperation: Increase international cooperation, particularly in the management of transboundary water resources. This can involve collaborative initiatives, data exchange, and collaborative projects to successfully manage shared water resources. Cooperation is critical for addressing the OIC region's shared water management concerns.

6. Develop Comprehensive Water Management Policies: Member states shall develop and implement comprehensive water management policies that consider technical advances, regulatory frameworks, and socioeconomic factors. These policies should try to strike a balance between the need for water conservation and economic development and social equality.

7. Utilize the Islamic Organization for Food Security as a platform for member states to share best practices, information, and technologies: To enhance integrated water management across the OIC region, the IOFS may facilitate policy debates, capacity building, and the formation of strategic partnerships.

Figure 8. *A Snapshot from Cairo Water Week 2023, Cairo, October 2023. The IOFS and INWRDAM's joint side event, 'Supporting Policies and Innovations for Integrated Water Management in the OIC Member States', spotlighted innovative solutions to water scarcity challenges. Emphasizing AI-driven irrigation, remote sensing, and capacity building, the event set a course for sustainable agricultural water management and intersectoral collaboration across the OIC community.*

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EN SUMMARY

Given the escalating risks to ecosystem sustainability and the livelihoods of billions, the efficient management of water resources has become a critical concern, particularly for the member states of the Organization of Islamic Cooperation (OIC). These countries, which collectively accommodate over 25% of the global population, find themselves at a pivotal moment. They are currently grappling with an extensive array of water-related issues that have far-reaching implications not only for the environment but also for their social, economic, and political structures.

A considerable proportion of the population in several Member States of the OIC is situated in rural regions and is highly dependent on agriculture for sustenance; this reliance is fundamentally tied to the accessibility and environmentally responsible administration of water resources. The challenges encompass physical scarcity of water in arid regions and the complexities associated with ensuring equitable water distribution in regions where abundant resources are unevenly distributed. In addition to these factors, the water scarcity dilemma is further complicated by the consequences of climate change, which include increased frequency of droughts and flooding, altered precipitation cycles, and more extreme weather patterns.

FR RÉSUMÉ

Compte tenu des risques croissants pour la durabilité des écosystèmes et les moyens de subsistance de milliards de personnes, la gestion efficace des ressources en eau est devenue une préoccupation essentielle, en particulier pour les États membres de l'Organisation de la Coopération Islamique (OCI). Ces pays, qui accueillent collectivement plus de 25 % de la population mondiale, se trouvent à un moment charnière. Ils sont actuellement confrontés à un large éventail de problèmes liés à l'eau qui ont des implications considérables non seulement pour l'environnement, mais aussi pour leurs structures sociales, économiques et politiques.

Une proportion considérable de la population de plusieurs États membres de l'OCI est située dans des régions rurales et dépend fortement de l'agriculture pour sa subsistance ; cette dépendance est fondamentalement liée à l'accessibilité et à l'administration écologiquement responsable des ressources en eau. Les défis englobent la rareté physique de l'eau dans les régions arides et les complexités associées à la garantie d'une distribution équitable de l'eau dans les régions où les ressources abondantes sont réparties de manière inégale. En plus de ces facteurs, le dilemme de la rareté de l'eau est encore compliqué par les conséquences du changement climatique, qui comprennent une fréquence accrue des sécheresses et des inondations, une modification des cycles de précipitations et des conditions météorologiques plus extrêmes.

AR ملخص

ونظراً للمخاطر المتصاعدة التي تهدد استدامة النظام البيئي وسبل عيش المليارات من البشر، أصبحت الإدارة الفعالة للموارد المائية مصدر قلق بالغ، وخاصة بالنسبة للدول الأعضاء في منظمة التعاون الإسلامي. وتجد هذه البلدان، التي تستوعب مجتمعة أكثر من 25% من سكان العالم، نفسها في لحظة محورية. وهم يتصارعون حاليا مع مجموعة واسعة من القضايا المتعلقة بالمياه والتي تخلف آثارا بعيدة المدى ليس فقط على البيئة ولكن أيضا على الهياكل الاجتماعية والاقتصادية والسياسية.

تتواجد نسبة كبيرة من السكان في العديد من الدول الأعضاء في منظمة التعاون الإسلامي في المناطق الريفية وتعتمد بشكل كبير على الزراعة لكسب قوتها؛ ويرتبط هذا الاعتماد بشكل أساسي بإمكانية الوصول إلى الموارد المائية وإدارتها بطريقة مسؤولة بيئيًا. وتشمل التحديات ندرة المياه في المناطق القاحلة والتعقيدات المرتبطة بضمان التوزيع العادل للمياه في المناطق التي يتم فيها توزيع الموارد الوفيرة بشكل غير متساو. بالإضافة إلى هذه العوامل، تزداد معضلة ندرة المياه تعقيدا بسبب عواقب تغير المناخ، والتي تشمل زيادة تواتر حالات الجفاف والفيضانات، وتغير دورات هطول الأمطار، وأنماط الطقس الأكثر تطرفا.

PROMOTING FOOD BANK AS A WAY OF ENSURING FOOD SECURITY IN OIC MEMBER STATES

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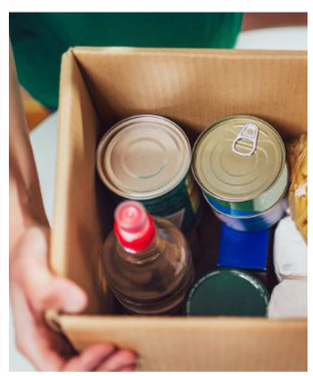

Introduction

Food insecurity, often defined as the lack of sustainable access to sufficient and nutritious food for a healthy and active life, remains an unrelenting global challenge. The United Nations Sustainable Development Goal 2 (SDG 2) emphasizes to "end hunger, achieve food security and improved nutrition, and promote sustainable agriculture." In the context of the OIC-MS, this challenge is further intensified by a multitude of factors, including global economic recessions, protracted conflicts, the intensifying effects of climate change, and most notably, the immediate repercussions of the COVID-19 pandemic. Food insecurity is not solely a consequence of food shortages but also a reflection of the gross mismanagement and wastage of food resources. Shockingly, in both developing and developed nations, a substantial portion of the food supply chain—up to 30%—goes to waste, directly contributing to the gravity of the issue.

The Role of Food Banks

The phenomenon of food wastage holds true for OIC-MS, where, on an average, roughly 30% or even more of the food supply is wasted. Furthermore, OIC developing countries grapple with substantial food wastage, often rooted in cultural, negligence or other contextual factors.

In response to this challenge, the food banking system has emerged as a proactive solution. It operates by rescuing surplus food that is on the brink of being discarded and redirecting it to individuals in need. This endeavor involves diverse stakeholders and social groups, including government entities, private sector organizations, civil society, and international organizations. Food banks acquire donated food from various sources, including farms, manufacturers, restaurants, hotels, distributors, retail establishments, and even consumers. Subsequently, they chan-

nel these rescued food resources to those facing food insecurity, particularly vulnerable segments of society. This critical distribution process is facilitated through the collaboration of civil society members, non-governmental organizations (NGOs), and community agencies, which may include entities such as school feeding programs, healthcare institutions, orphanages, nursing homes, and food pantries, among others, all working together under the umbrella of nonprofit programs committed to providing sustenance to those experiencing hunger.

In the Regional Training Workshop on Strategic Planning and Policy Development in Food Security held on 20-21 September in Cairo, Egypt, the Director of Food Security Lab of the Egyptian Food bank presented the Food Bank activities and stressed its importance for consideration of policymakers.

The COMCEC Study 2017

In 2017, the COMCEC embarked on an analytical journey that yielded invaluable insights into the role of food banks in OIC MC. Notably, the Egyptian Food Bank emerged as a beacon of success. Operating in partnership with the Egyptian Hotel Association, this initiative effectively curbed food waste originating from hotels and restaurants by redirecting unused yet safe and nutritious food to those in need. Since its inception in 2005, this program has consistently donated over 17 million meals each month, significantly alleviating hunger, and food waste.

Inspired by the remarkable success of the Egyptian Food Bank, the Arab Food Bank Regional Network (FBRN) was established in 2013 with the mission of replicating this model across the food service sector. The FBRN aspires to eradicate regional hunger through the establishment, enhancement, and support of food banks across the region. It has succeeded in uniting a diverse array of food banks from OIC Member States in a united and coordinated effort to combat food insecurity.

In the meeting of the IOFS Director General Prof. Yerlan Baidaulet with the Founder and CEO of FBRN, Dr. Moez El Shohdi, both sides agreed on joint collaboration to assist OIC MS on establishing food banking where such systems are not present.

Establishment of Food Banks in OIC Member States

Recognizing the success of food banks in OIC geography and the pressing need to address food insecurity and food waste, a project has been initiated to establish food banks in OIC MS lacking such systems. This project aligns with the UN SDG 2 and aims to reduce food waste while promoting sustainable agriculture.

To facilitate the realization of this ambitious endeavor, the Islamic Organization for Food Security (IOFS) is actively engaged in the identification process. It seeks to identify organizations, whether nonprofit, non-governmental, private, or government-based, that are well-suited to organize food banking systems in their respective countries.

These identified organizations will receive comprehensive capacity-building training in Cairo, Egypt, that is agreed to be held with the Food banking Regional Network and Egyptian Food Bank on 21-23 November 2023. This event will serve as a platform for showcasing the best practices adopted by the Food Banks of Egypt, Türkiye and UAE. Participants will not only gain an in-depth understanding of the establishment and operations of food banks but will also have the unique opportunity to develop a comprehensive business plan. Additionally, the event will focus on essential pillars to consider when establishing a food bank, including a field visit to several food bank facilities. This hands-on approach aims to empower identified organizations and private sector entities to effectively manage food banking systems in their respective countries.

Ways Forward for Project Implementation

High-Level Mauritanian delegation led by the Food Security Commissioner H.E. Fatimetou Khatry visited Egyptian Food Banking and met with the FBRN CEO Dr. Moez Al Shohdi and agreed to establish such system in Mauritania.

Several key strategies are crucial for the successful implementation of this project:

- **Collaboration:** Strong collaboration between OIC MS, FBRN, international organizations, and civil society is essential for knowledge sharing and the establishment of new food banks.
- **Capacity Building:** Investing in the development of human resources within the food banking sector is essential. Training programs, workshops, and knowledge-sharing initiatives should be organized to equip staff and volunteers with the necessary skills and expertise in food collection, storage, distribution, and outreach efforts.
- **Financial Support:** Securing robust financial support is essential to sustain the operations of the envisioned food banks. This can be achieved through a multifaceted approach, including mobilizing funds from national governments, international donors, and corporate social responsibility initiatives. Moreover, engaging the private sector and relevant stakeholders to integrate food banking into their corporate social responsibility endeavors will significantly contribute to the long-term sustainability of these initiatives.
- **Awareness Campaigns:** Developing comprehensive awareness campaigns and educational programs is imperative to raise public consciousness regarding the pressing issues of food waste, food insecurity, and the pivotal role of food banks in ameliorating these concerns. These campaigns may encompass diverse mediums, including media outreach, educational materials, and community-based initiatives designed to foster behavioral change. These efforts will motivate individuals, businesses, and organizations to actively participate in food donation and food waste reduction initiatives.
- **Community Engagement:** Engaging local communities is fundamental. Mobilizing volunteers and community groups to participate in food rescue, distribution, and awareness campaigns can foster a sense of ownership and collective responsibility in addressing food insecurity and waste.
- **Public-Private Partnerships:** Collaboration with the private sector should be encouraged. Private companies can provide financial support, donate surplus food, and engage in cross-sector partnerships that leverage their expertise and resources for the benefit of food banks.
- **Monitoring and Evaluation:** Instituting robust monitoring and evaluation systems is essential to track the impact and effectiveness of the food banking systems. Regular assessments will yield invaluable data on food security levels, reductions in food waste, and the number of beneficiaries reached. This empirical evidence will serve as a compass for continuous improvement and evidence-based decision-making.

Through these strategies, the project aims to establish a comprehensive food banking system in OIC MS, contributing to the achievement of food security, reduced food waste, and sustainable agriculture in the region.

Conclusion

Food banks have been proven to be effective tools in addressing food insecurity and reducing food waste in OIC Member States and beyond. The establishment of food banks in countries lacking such systems is a crucial step toward achieving food security and promoting sustainable agriculture. Collaboration, financial support, awareness campaigns, and monitoring and evaluation systems are key elements in ensuring the success of these initiatives. By working together, OIC Member States can make significant progress toward ending hunger and achieving food security as outlined in UN SDG 2.

EN SUMMARY

This article explores the importance of establishing food banks in Organization of Islamic Cooperation (OIC) Member States (MS) as a solution to combat food insecurity and reduce food waste. It discusses the background of food insecurity, emphasizing its global impact and aggravation due to world economic and political crises. The article highlights the role of food banks in addressing food waste, drawing insights from successful models like the Egyptian Food Bank. It discusses the significant findings from the Standing Committee for Economic and Commercial Cooperation (COMCEC) study in 2017, which emphasized the effectiveness of food banks in OIC Member States. The article also presents an overview of existing and upcoming food banks within OIC Member States and introduces a project aimed at establishing food banks in countries without such systems. Finally, it outlines key strategies for project implementation, emphasizing collaboration, financial support, awareness campaigns, and monitoring and evaluation systems to ensure the success of food banking initiatives.

FR RÉSUMÉ

Cet article explore l'importance de l'établissement de banques alimentaires dans les États membres de l'Organisation de la coopération islamique (OCI) en tant que solution pour lutter contre l'insécurité alimentaire et réduire le gaspillage alimentaire. Il examine le contexte de l'insécurité alimentaire, mettant l'accent sur son impact mondial et son aggravation en raison des crises économiques et politiques mondiales. L'article souligne le rôle des banques alimentaires dans la lutte contre le gaspillage alimentaire, en tirant des enseignements de modèles réussis tels que la Banque alimentaire égyptienne. Il discute des conclusions significatives de l'étude du Comité permanent de la coopération économique et commerciale (COMCEC) en 2017, qui ont souligné l'efficacité des banques alimentaires dans les États membres de l'OCI. L'article présente également un aperçu des banques alimentaires existantes et à venir au sein des États membres de l'OCI et présente un projet visant à établir des banques alimentaires dans les pays dépourvus de tels systèmes. Enfin, il expose les principales stratégies de mise en œuvre du projet, mettant l'accent sur la collaboration, le soutien financier, les campagnes de sensibilisation et les systèmes de suivi et d'évaluation pour assurer le succès des initiatives de banques alimentaires.

AR ملخص

يستكشف هذا المقال أهمية إنشاء بنوك الطعام في الدول الأعضاء في منظمة التعاون الإسلامي (OIC) كحل لمكافحة انعدام الأمن الغذائي والحد من هدر الطعام. ويناقش خلفية انعدام الأمن الغذائي، مع التركيز على تأثيره العالمي وتفاقمه بسبب الأزمات الاقتصادية والسياسية العالمية. يسلط المقال الضوء على دور بنوك الطعام في معالجة هدر الطعام، مستمدًا رؤى من نماذج ناجحة مثل بنك الطعام المصري. ويناقش النتائج الهامة التي توصلت إليها دراسة اللجنة الدائمة للتعاون الاقتصادي والتجاري (الكومسيك) في عام 2017، والتي أكدت على فعالية بنوك الطعام في الدول الأعضاء في منظمة التعاون الإسلامي. يقدم المقال أيضًا لمحة عامة عن بنوك الطعام الحالية والمستقبلية داخل الدول الأعضاء في منظمة التعاون الإسلامي ويقدم مشروعًا يهدف إلى إنشاء بنوك الطعام في البلدان التي ليس لديها مثل هذه الأنظمة. وأخيرًا، فهو يحدد الاستراتيجيات الرئيسية لتنفيذ المشروع، مع التركيز على التعاون والدعم المالي وحملات التوعية وأنظمة المراقبة والتقييم لضمان نجاح مبادرات بنوك الطعام.

SOCIAL ISSUES IN GENE EDITING AND PUBLIC ACCEPTANCE

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Genome editing is technology for manipulating genomic DNA sequences. Its applications include targeting mRNAs, viruses, chromatin structures, and other cellular processes. Genome editing uses sequence-specific nucleases, such as zinc-finger nucleases (ZFNs), transcription-activator-like effector nucleases (TALENs), or clustered regularly interspaced short palindromic repeat (CRISPR) associated protein endonucleases (CAS), such as cas9. CRISPR/cas9 mediated gene-knockout based on Non-Homologous End-Joining (NHEJ) has proven to be of high efficiency in animals and plants. This method has multiplier capabilities, this allows for modifying multiple sites & genes at one time – it is especially useful while studying redundant genes.

Genome editing begins with the introduction of a DNA double-stranded break at a pre-determined locus using a sequence-specific nuclease. Sequence targeting ZFNs and TALENs is mediated by protein-DNA interactions. CRISPR/cas recruits a guideRNA to direct an endonuclease to a target DNA sequence via base-pairing. Type II CRISPR/cas9 system from streptococcus pyogenes is currently the most widely used owing to its high efficiency and simplicity, with alternatives such as CRISPR/cpf1. By linking cas9 to other domains, CRISPR/cas system can also be used for epigenome editing or targeted transcriptional control and other types of genome engineering.

Ethical considerations in the purview of social acceptability of CRISPR/cas-mediated gene editing can be traced to the initial application of the techniques in human embryos in 2015. Jennifer Doudna, Emmanuelle Charpentier, and Fen Zhang co-authored a letter to Science recommending a 'prudent pathway' for genomic engineering and germline gene modification. It called for a self-imposed temporary moratorium on germline application of CRISPR/Cas9. This call was reminiscent of the self-imposed moratorium on recombinant DNA technologies in 1975 at the Asilomar conference. In April 2015, the NIH Director released a statement saying the NIH would not fund any research for using gene-editing technologies in human germline, terming it a line that 'should not be crossed'. This stance was echoed by the Broad Institute at MIT and the International Bioethics Committee of UNESCO, calling it a 'long-standing consensus'. However, there are those in the scientific community that do not confirm to said 'consensus'.

Lovell Badge, a British scientist disagreed with the moratorium, describing it as 'likely ineffective' as it should be used for in vitro human embryo research, especially those that would otherwise be discarded. The reasoning presented was that if there were successes, it would help understand the functions of genes in early human embryo development. British scientists at Oxford also supported CRISPR applications in embryo research. They categorized a moratorium as 'wrong' and that such research is a 'moral imperative'. The technology could be used to lower disease burden 'thereby intentionally benefitting billions of people'. 'To refrain from engaging in life-saving research is to be morally responsible for foreseeable, avoidable deaths'. British philosopher, John Harris stated that risks of CRISPR are overstated and overemphasized. He said safety issues should be used as a basis for conducting safe research, rather than banning it.

The Hixton Group, of which John Harris is a part of, supported applications in basic research, while putting clinical applications on hold. This approach is a utilitarian one; which argues that the criterion of 'right action' is the principle of utility, therefore an action is right if it maximizes utility. The same principle is what serves as the basis of the notion that a failure to invest and conducting such life-saving research is what equates to killing people. The precautionary position towards CRISPR is based on two elements: (i) the age-old fear of creating designer babies (ii) and the risk of unforeseen effects on future generations. The former is driven by the so-called 'slippery slope argument'; the latter is an instance of precautionary considerations driven by limits of knowledge and technical feasibility. According to the slippery slope argument, allowing practice X although not particularly ethically troubling in itself, would initiate a process of leading to unethical practices W, Y, Z. In this instance, X would be gene editing of human embryos in vitro, and W, Y, Z could be forms of germline modification. A slippery slope argument is widely criticized in the philosophical arena, it is widely used in debates on reproductive technologies and policy-making.

Beyond human embryo, CRISPR has other applications too. It can be used to decrease disease vectors. What are some common disease vectors we have? Endonucleases such as Cas9 cut the corresponding chromosomal locus lacking them. This in turn induces the cell to repair the break by copying the nuclease gene onto the damaged chromosome via homologous recombination. This mechanism is called 'gene-drive' and was developed in Drosophila melanogaster i.e fruit fly. Gene Drive is now being used to engineer Aedes aegypti, the carrier of dengue, zika and chikungunya. The engineering would be such that only male offspring would be produced, as the male does not 'bite'. When an organism carrying an engineering endonuclease gene-drive mates with a wild-type organism, the gene-drive is preferentially inherited by all the off-spring. This can enable to drive to spread until it is present in all members of the population. If the gene in question is propagated across multiple generations, the mosquitos would eventually go extinct (pending acquiring of resist-

ance). Drive-mediated genome alterations are not permanent on an evolutionary timescale and would not be effective in species that reproduce asexually.

Genetically engineered mosquitos of A. aegypti species have been developed by Oxitec and have been released in Piracicba district in Brazil. This resulted in an 82% reduction in larvae. These CRISPR engineered mosquitos were also released in the Cayman Islands. To control unpredictable consequences on the ecosystems, scientists have proposed a reverse engineering mechanism that can be built in species as an 'intrinsic safeguard'. Gene-drive is also being used to control invasive species, keeping in view the questionable safety and sustainability of herbicides and pesticides. While these are examples of 'well-meaning' applications, it is not implausible that the same technology can be used for exactly opposite applications. Hence, CRISPR presents us with a dual-use dilemma which demands that we take its ethical implications under consideration. The 'disruption of natural order' is a tale of classic bionconservatist worry. According to this, 'tampering' or 'meddling' with nature is intrinsically wrong, regardless of the concerns and outcomes. 'Nature' is assumed to hold an intrinsic moral value as the product of intelligent design. CRISPR is also being heralded as a possible solution to harvesting human organs from non-human hosts for organ transplants.

Perhaps, the most promising application of CRISPR lies in Agriculture. Transgenic crops present a similar opportunity, but the social acceptability of these crops is patchy and not universal. CRISPR allows for genetic engineering of crops without the introduction of any foreign genes. Sensu stricto they would no longer qualify as 'transgenic'. So much so, Europe, traditionally a bionconservatist region, has considered wider applications of CRISPR. Sweden has advocated for a split in the definition; bifurcating the definitions of transgenic crops and CRISPR-mediated genome editing. The basis of the argument being that mutagenesis, which is essentially the core of CRISPR mediated editing, is exempt from transgenic regulations. CRISPR is merely viewed as a targeted and accurate approach of mutagenesis. The introduction of such a powerful technique without significant legislative, legal, and policy cover would be irresponsible.

Existing methods of crop breeding/editing include hybrid breeding, cross-fertilization of existing cultivars, wide crosses between related species, in vitro fertilization, physical mutagenesis, and chemical mutagenesis, among many others. These methods are inefficient, laborious, and non-specific. Sensibly, the products of sexual crosses, mutagenesis, and tissue culture-based plant breeding are free of government regulation, other than registration of varieties. Conventional breeding is limited by the ability to introduce novel traits not present in the domesticated or wild germplasm. This restriction was overcome by Genetic Modification techniques using transgenes, introduced by several methods.

Transgenic technology improved the efficiency of crop breeding, but debates of bio-safety & public acceptance have hindered widespread application and adoption. Genetically modified organisms (GMOs) are generated by transgenic approaches i.e. integrating target foreign genes into host genes. In genome edited crops (GECs), the genetic changes are based on small insertions and deletions of nucleotides in endogenous target genes, mimicking naturally occurring ones. These changes are similar to physical or chemical mutagenesis, albeit with targeting efficiency. Furthermore, the components delivered to enable plant genome editing (i.e. expression cassettes for cas9, gRNAs, and anti-body selection markers) can be completely removed. Alternatively, they may never even be incorporated into the genome when transient expression strategies or ribonucleoprotein complexes are used. Thus, the genetic properties of GMOs and GECs are distinctively different from one another. Rather, the genetic variations in GECs are substantially equivalent to natural or mutagenesis derived crop varieties.

The first genome sequence in 2000 of Arabidopsis Thaliana, two years later genome sequence of Oryza sativa ssp Indica and Japanica rice. First crop with short-read genome assembly was cucumber, many more crops have since followed. Crops that remain to be sequenced are those with large genomes such as onion (16.4GB haploid genome size), crops with complex genome types such as polypoid genomes (i.e. potato, sweet potato, sugarcane). Newer long-read technologies are enabling assemblies of these complex and large genomes too.

The decreasing cost of next-generation sequencing is also fueling population scale sequencing which enables the discovery of agronomically variants. Coupled with rapid advances in high-throughput phenotyping, genome sequencing is greatly expanding the potential to (i) identify genes and alleles that control agronomic traits interacting (ii) understand the interacting mechanisms that weave the genes into functional networks. This serves as the foundation of precise genome editing for crop improvement.

Scientists have been quick to adopt genome editing as a tool for crop improvement. For instance, phytate, an antinutritional compound that limits mineral absorption by farm animals and increases environmental pollution can be eliminated using directed mutations. One of the most impressive examples comes from hexaploid bread wheat, where the simultaneous editing of three homologous alleles of Mildew Resistance Locus genes created a novel cultivar that is resistant to powdery mildew.

Given this, genome editing is considered to be a promising technique for addressing our future needs. It has better efficiency, precision, and above all is as safe as any naturally occurring mutation. Its application in rice, wheat, sorghum, maize, tomato, potato, and soybean have resulted in higher yielding varieties, stronger disease resistance, and better quality crops. CRISPR/cas9 has been used in rice to confer herbicide resistance through gene replacement; and disease resistance through base-editing, albeit with relatively low efficiency.

Genome editing offers a unique opportunity to improve and increase the success of crop breeding. Humans have been manipulating genomes for more than 10,000 years, albeit in a random and non-targeted manner. Conventional crop breeding changes genome by direct selection of observable traits conditioned by natural variants or induced mutations or by using molecular markers linked to advantageous genes and alleles. Genetic crosses introduce myriad of nucleotide variants, often creating undesirable effects as a result of genotype x genotype interactions. Conventional methods were complemented by genetic modification using transgenes. Although the insertion of transgenes into the host genome is random, the breeder knows exactly which sequences are introduced, and the effects are therefore much more predictable.

The failure of GM crops in garnering significant social acceptability may be attributed to three reasons: (i) the shortfall between the 'revolutionary promises' of GM crops and the reality of the first generation of developments; (ii) the restricted scope of public & stakeholder involvement in the regulation of GM crops. This fed misinformation, as individuals who may have been oblivious to the technology otherwise, fell prey to misinformation campaigns, altogether misconstruing public opinion; (iii) the vastly differing regulations presented widely opposing views to clash on philosophical grounds, was misconstrued as a 'for and against' debate.

Regulatory frameworks of GMOs can be classified into two categories (i) process-based regulation (ii) product-based regulation. Process-based regulations impose strict oversight of the entire production procedure. This largely ensures biosafety, but is tedious, complex, costly, and time-consuming. This is untenable with GECs – GECs cannot be monitored in the same way as GMOs for the modifications are more often than not indistinguishable from natural mutagenesis-derived mutations. By contrast, product-based regulations assess final products and the potential risks due to those products, regardless of how they are generated. Product-based regulations bypass the uncertainties in process monitoring and provide more scope for the use of genome editing in crop breeding.

The commercial application of GECs will depend on the regulatory frameworks of individual countries. Several countries have established policies for managing GECs. Argentina and Brazil have issued 'New Breeding Techniques' regulations which are gene-editing centric. These product-based regulations stipulate that GECs not containing transgenes would not be classified as GMOs during commercial applications. Japan and the US have adopted registration and recording systems that allow transgene-free GECs to be commercially cultivated and sold free from regulation.

The different genetic properties of GECs and GMOs warrant the need for a bifurcation in the management policies of the two. It is also not practical to execute the regulations for GMOs on GECs, as their genetic nature is indistinguishable from natural and mutagenesis-based changes. Since there are no ethical concerns in plants, they should also be different for humans.

EN SUMMARY

Genome editing is technology for manipulating genomic DNA sequences. Its applications include targeting mRNAs, viruses, chromatin structures, and other cellular processes. Genome editing uses sequence-specific nucleases, such as zinc-finger nucleases (ZFNs), transcription-activator-like effector nucleases (TALENs), or clustered regularly interspaced short palindromic repeat (CRISPR) associated protein endonucleases (CAS), such as cas9. CRISPR/cas9 mediated gene-knockout based on Non-Homologous End-Joining (NHEJ) has proven to be of high efficiency in animals and plants. This method has multiplier capabilities, this allows for modifying multiple sites & genes at one time – it is especially useful while studying redundant genes.

FR RÉSUMÉ

L'édition du génome est une technologie permettant de manipuler des séquences d'ADN génomique. Ses applications comprennent le ciblage des ARNm, des virus, des structures chromatiniennes et d'autres processus cellulaires. L'édition du génome utilise des nucléases spécifiques à une séquence, telles que les nucléase à doigt de zinc (ZFN), les nucléases effectrices de type activateur de transcription (TALEN), ou les endonucléases protéiques associées à des répétitions palindromiques courtes et régulièrement espacées (CRISPR), telles que la cas9. L'élimination de gènes par CRISPR/cas9, basée sur la jonction d'extrémités non homologues (JENH), s'est avérée très efficace chez les animaux et les plantes. Cette méthode a des capacités multiplicatrices, ce qui permet de modifier plusieurs sites et gènes en même temps - elle est particulièrement utile pour l'étude des gènes redondants.

AR ملخص

تحرير الجينوم هو تقنية لمعالجة تسلسل الحمض النووي الجينومي. وتشمل تطبيقاته استهداف mRNAs والفيروسات وهياكل الكروماتين والعمليات الخلوية الأخرى. يستخدم تحرير الجينوم إنزيمات نووية خاصة بتسلسل معين، مثل نوكليازات إصبع الزينغ (ZFNs)، أو نوكليازات مؤثرات تشبه منشط النسخ (TALENs)، أو نوكليازات بروتينية داخلية متكررة متناوبة قصيرة متباعدة بانتظام (CRISPR)، مثل cas9. لقد أثبت نظام كريسبر/كاس9 أن عملية التخلص من الجينات بوساطة تعتمد على الانضمام النهائي غير المتماثل (NHEJ) ذات كفاءة عالية في الحيوانات والنباتات. تتمتع هذه الطريقة بقدرات مضاعفة، مما يسمح بتعديل مواقع وجينات متعددة في وقت واحد - وهو مفيد بشكل خاص أثناء دراسة الجينات الزائدة عن الحاجة.

VETERINARY AND SANITARY ASSESSMENT OF THE QUALITY AND SAFETY OF FISH IN WKR RESERVOIRS

Mr. ASKHAT ZHUMABAYEV,
Doctoral student of Veterinary Sciences Zhangir khan
West Kazakhstan Agrarian Technical University

Introduction

The intensive development of the fishing industry in the West Kazakhstan region creates a risk of the spread of a number of parasitic fish diseases that are dangerous to humans.

This is facilitated by its geographical location in the coastal region of the Caspian Sea and a dense network of freshwater rivers and lakes. There are 6 large rivers (Ural, Chagan, Derkul, Kushum, Bolshoy and Maly Uzen) and up to 200 small rivers. In addition, there are more than 60 freshwater and up to 100 salt lakes in the region.

By area, the most significant are Shalkar, Fish Sakryl and the system of Kamysh-Samara lakes. Therefore, pathogens characteristic of both river and marine ecosystems are detected in this region. Among the invasive fish diseases that are registered in this region and are dangerous to humans or other farm animals and birds, from an epidemic point of view, opisthorchiasis (Opisthorchis felineus), anisakidosis (Anisakis simplex), ligulosis (Ligula imestinalis), postodiplostomiasis (Posthodiplosto-muni cuticola) and aphanomycosis of crayfish (Aphanomyces astaci Schikora).

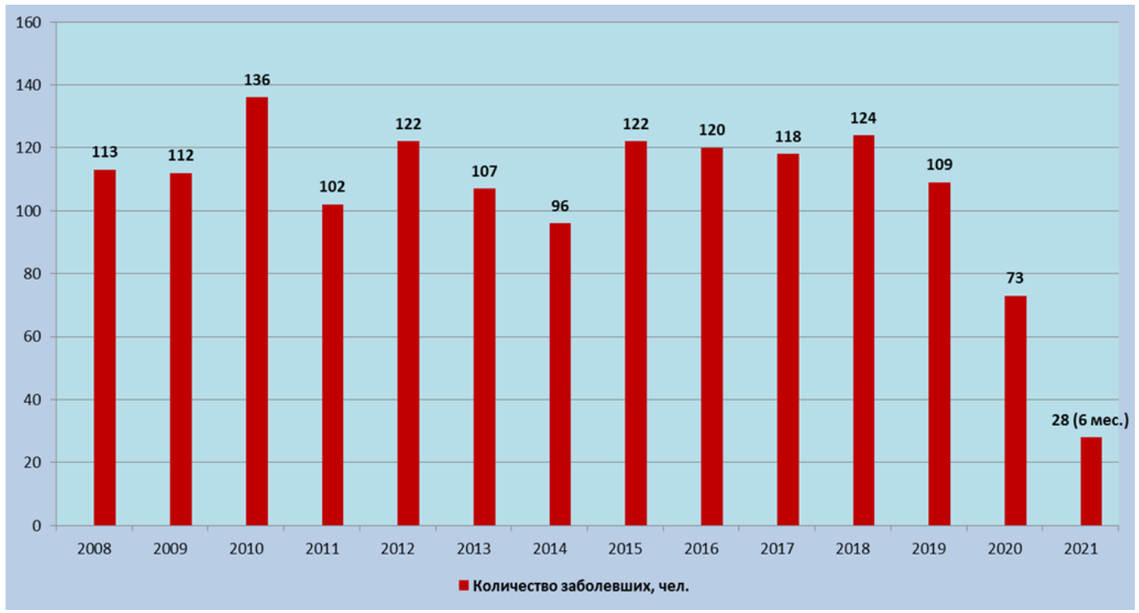


Figure 1. *Statistical data on the diagnosis of invasive fish diseases among the population of the region for 2008-2021.*

The purpose of our work is from 2021-2023, the veterinary and sanitary assessment of the environmental safety of fish living in reservoirs and fish hatcheries of the West Kazakhstan Region, as well as fish products from retail outlets in Uralsk for contamination with antibiotics, heavy metal compounds, radionuclides and infection with fish parasites.

MATERIALS AND METHODS

Representatives of 13 species of fish in the amount of 1364 specimens were subjected to parasitological studies: crucian carp - 394, perch -162, roach-26, bream-41, ide-58, rudd-146, gustera-7, podust-2, pike-86, tench-49, carp-166, pike perch-85) caught of the 15 reservoirs of the West Kazakhstan region (Derkul, Chizha-1, Shyngyrlau, Embulatovka, Shiderta, Berezovka, Solyanka, Barbastau, Chagan, Bagyrlay, Aschysai, Kaldygaity, Aydin Island, Livkino LLP fish nursery, Muratsai reservoirs), as well as (carp – 9, crucian carp – 27, asp – 8, pike perch – 7) and 120 pcs. fish products (dried bream – 30, dried chehon-30, smoked bream – 30, dried roach- 30) from the outlets of the city of Uralsk (markets, Ayazhan, Mirlan). Ichthyological and parasitological studies were performed according to generally accepted methods. Species diagnosis of parasites was carried out in accordance with the methodology described in the definition of parasites of freshwater fish. 1364 copies were examined by the method of complete parasitological analysis . fish to identify possible complex invasion of ichthyofauna, namely anisakidosis, ligulosis, postdiplostomiasis and opisthorchiasis.

To identify possible infection of fish with postdiplostomiasis, an external examination of the caught fish for the presence of pigment spots was performed and a partial autopsy was performed by dissecting muscle tissues using parallel incisions to identify metacercariae. The work was carried out in the period from 2021-2023 on the basis of the laboratory of veterinary sanitary Examination of the Higher School of Veterinary Medicine and Biological Safety, the Testing Center of the Zhangir Khan State Veterinary Laboratory, as well as in the Republican Veterinary Laboratory and in the reservoirs of the West Kazakhstan Region.

Residual amounts of antibiotics and heavy metal salts, radionuclides and parasitoses were determined (total number of 1364 fish).

Determination of heavy metals by atomic adsorption spectrometry on the Solaar 6M spectrometer.

For the determination of radionuclides, an ORTEC gamma spectrometer (USA) was used with a GEM 40 coaxal detector based on high frequency germanium (HPGe) with SpectraLine software.

The residual amount of antibiotics was determined by the method of solid-phase competitive ELISA performed in tablets (9018 Costar USA) using AKI-C-01 photometer (Russia).

Parasitological and microscopic studies of sick fish were carried out according to:

- GOST R 54378-2011 “Fish, non-fish objects and products from them methods for determining the viability of helminth larvae”.

- ST RK 2779-2015 “Food products. Methods of sanitary and parasitological examination of fish, shellfish, crustaceans, amphibians, reptiles and products of their processing”.

The obtained research results were subjected to statistical processing using the Excel analysis package included in the Microsoft Office software package.

RESEARCH RESULTS

Determination of the main parasitoses of fish in the reservoirs of the West Kazakhstan region .The selection of reservoirs was carried out in such a way that the surveys covered 4 districts of the region (Akzhayksky, Terektinsky, Taskalinsky, Bayterek), which, according to sources and the Department of Sanitary and Epidemiological Control in the West Kazakhstan Region, are considered unfavorable for opisthorchiasis.

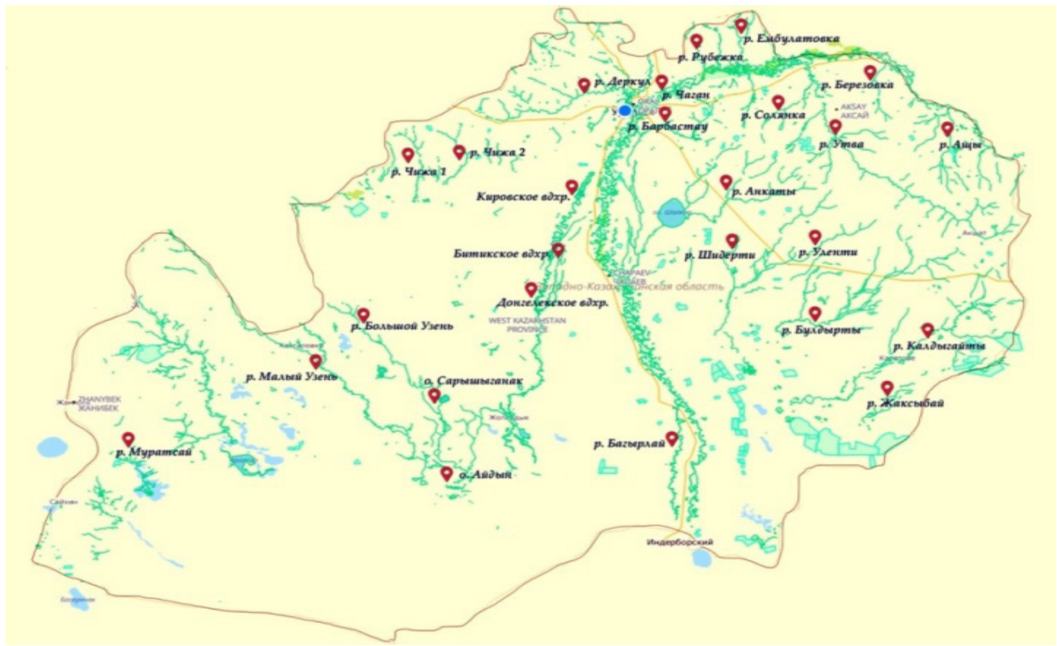


Figure 2. *Places on the topographic map of fish catch from reservoirs of the West Kazakhstan Region*

Anisakis simplex anisakidosis was diagnosed in 21.9% (18 specimens out of 1364 units) of the studied fish (Extensityinvasion 17.9%, intensity of invasion - 17 specimens).In 6 fish (1.6%) diphyllobothriasis Diphyllobothrium latum was found (Extensity of invasion -1.6% and intensity of invasion -3 specimens).Anisakid larvae were found in 3 asps from the outlets of the city (Extensity of invasion 0.8% and II-51 specimens), and eustrongylidosis larvae were found in 7 river perches (Extensity of invasion % 1.9%, intensity of invasion - 7 specimens).Out of 39 fish from reservoirs, larvae of Opisthorchis felineus were found in 7 specimens (Extensity of invasion - 17.9%, AI - 5 specimens), and dead larvae of O. felineus were found in one fish (crucian carp) from the outlet of the city (Extensity of invasion - 14.3%, intensity of invasion - 5 specimens). The residual amount of lead, cadmium, arsenic, mercury, cesium 137 and strontium 90 in the samples of the studied fish and fish products from reservoirs and outlets of the West Kazakhstan region is present and does not exceed the permissible norm.

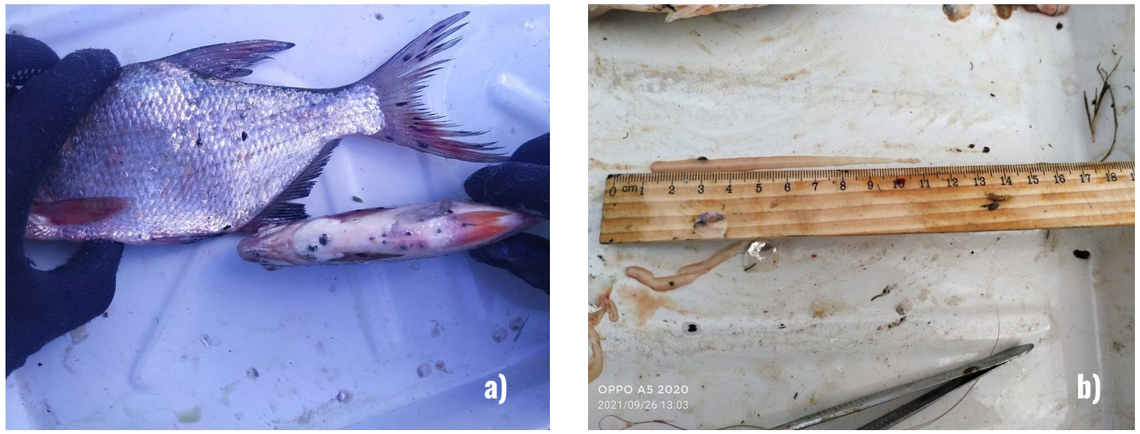


Figure 3. *Results of parasitological studies:a) Posthodiplostomum cuticula в) Ligula intestinalis; c) Anisakis simplex; d) E.excisus e) Opisthorchis felineus*

Summing up the data obtained, it is possible to state the infection of fish living in the reservoirs of the West Kazakhstan region with such parasitic diseases as anisakidosis, opisthorchiasis, postdiplostomiasis, ligulosis and eustrongilidosis. In this regard, in order to prevent the spread and occurrence of new fish parasitoses, it is necessary to carry out a set of measures on a regular basis, including mandatory quarantine of newly imported individuals, protective and restrictive measures during transportation and placement of fish in fish nurseries, as well as optimization of zoohygenic conditions by periodically flying ponds and veterinary and sanitary control over the health of fish.

The implementation of these measures will provide the population of the West Kazakhstan region with high-quality and safe fish products. Fish from the reservoirs of the West Kazakhstan Region is conditionally suitable for food due to the defeat of anisakidosis, postdiplostomosis, diphylloborizom, eustrongilidosis and opisthorchiasis after secondary treatment. It is necessary to conduct field research to monitor the biosafety of fish in the reservoirs of the West Kazakhstan Region annually and notify the population and publications in the media at the places of detection in the invasion.

EN SUMMARY

Control of the quality and safety of food products by the relevant authorities is not carried out in full, limited only by organoleptic studies and physical and chemical safety indicators. These indicators do not indicate the complete biosafety of food products in the regions of the Republic of Kazakhstan.

To fully guarantee the biosafety of food products, it is necessary to carry out organoleptic, physicochemical, parasitological studies of water bodies in our country. Also, together with parasitological studies, we investigated fish products for the content of heavy metal salts and antibiotics. In WKR, the risk of the spread of parasitic fish diseases that are dangerous to human health remains. At the same time, the regional features of the environmental hazard, as well as the epizootic process in parasitic diseases of fish, are not well understood, which significantly reduces the effectiveness of the safety of using fish and fish products in solving the country's food problem. The significance of the problem on a national and international scale; opisthorchiasis, anisakiasis of fish causes significant harm to the health of the population and carnivores. The economic damage is made up of the culling of infected fish and the diagnosis and treatment of these diseases in humans. To achieve sustainable growth rates of aquaculture in the Republic of Kazakhstan, it is necessary to ensure the veterinary well-being of the ichthyofauna. Infectious and parasitic diseases reduce the safety of fish during their cultivation and do not allow to obtain maximum productivity indicators. In addition, parasitic diseases contribute to a decrease in the quality of fish products. Sick fish lags behind in growth, through the development of clinical signs of helminthic lesions, it loses its presentation and it is not recommended to use it for food for people and animals without special neutralization. The use of fish products increases the risk of infecting people with dangerous invasive diseases, the pathogens of which use fish as an intermediate host Thus, a number of researchers point to the focus of opisthorchiasis in Northern and Western Kazakhstan with an annual incidence of people up to 1-150 cases.The impact of the obtained results on the development of science and technology and the expected social and economic effect, during the implementation of the program, monitoring of the epizootic situation on the main dangerous zooanthroponoses of fish in various environmental objects and the implementation of preventive measures will be carried out. There is also information from the sanitary and epidemiological station on cases of human and animal diseases with invasive diseases that were transmitted through fish and other representatives of the ichthyofauna in the reservoirs of the region.

FR RÉSUMÉ

Le contrôle de la qualité et de la sécurité des produits alimentaires par les autorités compétentes n'est pas entièrement effectué, limité uniquement par des études organoleptiques et des indicateurs de sécurité physique et chimique. Ces indicateurs n'indiquent pas la biosécurité complète des produits alimentaires dans les régions de la République du Kazakhstan.

Pour garantir pleinement la biosécurité des produits alimentaires, il est nécessaire de réaliser des études organoleptiques, physico-chimiques, parasitologiques des masses d'eau de notre pays. De plus, parallèlement à des études parasitologiques, nous avons étudié les produits de la pêche pour la teneur en sels de métaux lourds et en antibiotiques. Dans Kazakhstan-Occidental, le risque de propagation de maladies parasitaires des poissons dangereuses pour la santé humaine demeure. Dans le même temps, les caractéristiques régionales du danger environnemental, ainsi que le processus épizootique des maladies parasitaires des poissons, ne sont pas bien compris, ce qui réduit considérablement l'efficacité de la sécurité de l'utilisation du poisson et des produits de la pêche pour résoudre le problème alimentaire du pays. L'importance du problème à l'échelle nationale et internationale; l'opisthorchiase, l'anisakiase des poissons cause des dommages importants à la santé de la population et des carnivores. Les dommages économiques sont constitués de l'abattage des poissons infectés et du diagnostic et du traitement de ces maladies chez l'homme. Pour atteindre des taux de croissance durables de l'aquaculture en République du Kazakhstan, il est nécessaire d'assurer le bien-être vétérinaire de l'ichtyofaune.

AR ملخص

لا تتم مراقبة جودة وسلامة المنتجات الغذائية من قبل السلطات المختصة بشكل كامل، وتقتصر فقط على الدراسات الحسية ومؤشرات السلامة الفيزيائية والكيميائية. ولا تشير هذه المؤشرات إلى السلامة الحيوية الكاملة للمنتجات الغذائية في مناطق جمهورية كازاخستان.

لضمان السلامة الحيوية للمنتجات الغذائية بشكل كامل، من الضروري إجراء دراسات حسية وفيزيائية وكيميائية وطفيلية على المسطحات المائية في بلدنا. أيضًا، جنبًا إلى جنب مع الدراسات الطفيلية، قمنا بدراسة منتجات الأسماك لمعرفة محتوى أملاح المعادن الثقيلة والمضادات الحيوية. في WKR، لا يزال هناك خطر انتشار أمراض الأسماك الطفيلية التي تشكل خطرا على صحة الإنسان. في الوقت نفسه، فإن السمات الإقليمية للخطر البيئي، وكذلك العملية الوبائية في الأمراض الطفيلية التي تصيب الأسماك، ليست مفهومة جيدًا، مما يقلل بشكل كبير من فعالية سلامة استخدام الأسماك والمنتجات السمكية في حل مشكلة الغذاء في البلاد. . أهمية المشكلة على المستوى الوطني والدولي؛ داء opisthorchiasis، داء المتشاخسات في الأسماك يسبب ضررًا كبيرًا لصحة السكان والحيوانات آكلة اللحوم. ويتكون الضرر الاقتصادي من إعدام الأسماك المصابة وتشخيص وعلاج هذه الأمراض لدى البشر. لتحقيق معدلات نمو مستدامة لتربية الأحياء المائية في جمهورية كازاخستان، من الضروري ضمان السلامة البيطرية للأكثيوفونا.

IOFS NEWS OVER OCTOBER-NOVEMBER-DECEMBER

IOFS Launches High Level Forum in Collaboration with the Ministry of Municipality of the State of Qatar

On 01 October 2023, the Islamic Organization for Food Security (IOFS) marked the grand opening of the 2nd High-Level Forum with a ceremony attended by prominent dignitaries and esteemed experts from around the world in Doha, Qatar. The ceremony gathered over 150 participants from North America, Africa, Europe, the Middle East, and Asia. This landmark event, held in Doha, Qatar, has brought together a diverse array of stakeholders to deliberate on the critical issues surrounding food security and sustainable agriculture.

IOFS Strengthens International Partnerships with D-8 and DIHAD at 2nd High-Level Forum

The Islamic Organization for Food Security (IOFS) is pleased to announce the signing of Memoranda of Understanding (MoUs) with two prominent international organizations, the D-8 Organization for Economic Cooperation and the DIHAD Conference and Exhibition - Dubai International Humanitarian Aid & Development (DIHAD), on the sidelines of the 2nd IOFS High-Level Forum in Doha, Qatar.

IOFS Media Panel Underscores the Crucial Role of Media in Food Security and Sustainable Agriculture

The Islamic Organization for Food Security, in partnership with the Ministry of Municipality of the State of Qatar hosted the first groundbreaking IOFS Media Panel, under the theme "Synergizing Media within Food Systems, illuminated the critical role of media in advancing global food security and sustainable agriculture practices. The event, which took place during the 2nd High-Level Forum of the Islamic Organization for Food Security, featured a diverse panel of experts who collectively stressed the need for collaboration with media to raise awareness and promote responsible journalism within the context of food systems.

IOFS High Level Forum Amplifies Civil Society's Role in Addressing Food Insecurity

The inaugural sub-forum, "Engaging Civil Society against Food Insecurity," organized by the Islamic Organization for Food Security (IOFS) in partnership with the Ministry of Municipality of the State of Qatar, successfully concluded on 01 October 2023. Themed "Empowering Civil Initiatives for Cultivating Change: CSOs and IOFS for Food Security" and guided by the motto "From Fields to Futures: Empowering Communities for Food Security," this event marked a significant stride in addressing global food security challenges in OIC Member States.

IOFS High-Level Forum Focuses on Advanced Agri-Tech Development for OIC Member States

On 02 October 2023 the Islamic Organization for Food Security (IOFS) with support of the Ministry of Municipality of the State of Qatar has successfully concluded its groundbreaking Advanced Agri-Tech Sub-Forum in Doha. The event brought together a diverse group of global experts, innovators, policymakers, and stakeholders to explore and advance the application of cutting-edge agricultural technologies for sustainable food systems in the Organization of Islamic Cooperation (OIC) geography.

Qatar IFPA Forum Marks a Milestone in Food Security Development within the OIC Geography

The Doha Sheraton Hotel played host to a momentous event on the 3rd of October 2023, that brought together stakeholders from across the globe to address and advance Food Security Development within the Organization of Islamic Cooperation (OIC) geography. The Islamic Organization for Food Security (IOFS) and its subsidiary, the International Islamic Food Processing Association (IFPA), orchestrated this gathering, drawing in distinguished participants, prominent speakers, international and OIC organizations, as well as the business community. With over 20 speakers representing a diverse range of stakeholders in the agro and food industry, the panel sessions followed a dynamic format comprising presentations, speeches, and interactive Q&A discussions.

6th IOFS General Assembly Convenes in Doha: A Milestone Event for Global Food Security

On 03 October 2023 the 6th General Assembly of the Islamic Organization for Food Security (IOFS) marked a significant moment in the global quest for food security and agricultural development. This event, held in Doha, Qatar, brought together high-level officials and delegates from more than 40 Member States, reaffirming the organization's commitment to addressing critical issues in the realm of food security. To note, four new Member States were welcomed, with the Hashemite Kingdom of Jordan, the Republic of Yemen, the Republic of Gabon, and the Republic of Iraq that signed the Statute of the Islamic Organization for Food Security during the 9th OIC Ministerial Conference on Food Security and Agricultural Development on 02 October 2023.

The General Assembly adopted 12 Resolutions, which stand as a testament to to the organization's shared commitment to progress and dedication to make an impact on the global stage in the pursuit of food security. In accordance with the adopted resolutions, Ambassador Askar Mussinov was elected as the incoming Director General of the IOFS, with his term set to commence on January 1, 2024. The General Assembly also declared a grant of $2 million from Qatar to IOFS as a contribution to strengthening the programs of the Organization.

IOFS Addresses Global Food Security at International Soil Fertility Seminar in Turkistan

On 05-06 October 2023, Mr.Abdelaziz HAJJAJI, the IOFS Program Manager participated at the prestigious international seminar on Soil Fertility organized by the Agriculture Scientific Academy of the Republic of Kazakhstan, held in Turkistan. The seminar, a gathering of leading experts and professionals in the field, was dedicated to exploring innovative solutions to address the critical issue of Soil Fertility and its impact on global food security.

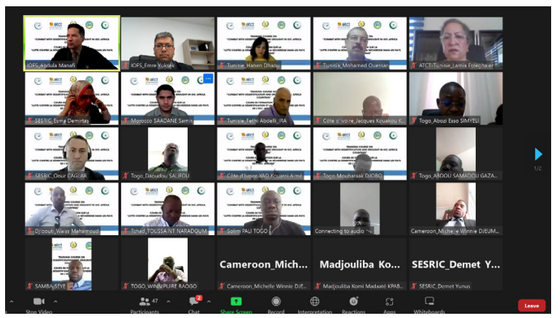
IOFS Holds Consultations in Ankara

Upon instructions of His Excellency Dr. Masoud Al-Marri, the Caretaker Director General of the Islamic Organization of Food Security (IOFS), an IOFS delegation (Mr. Abdula Manafi Mutualo, Advisor at the Coordination & Cooperation Department, and Mr. Emre Yuksek, Humanitarian Affairs Manager) headed to Ankara, Republic of Türkiye to attend the 21st Meeting of the COMCEC Agriculture Working Group held on 12-13 October 2023. Before the start of the COMCEC event, the IOFS delegation, on 11 October 2023, visited the headquarters of relevant partners, including the Ministry of Agriculture and Forestry of the Republic of Türkiye, the Turkish Cooperation and Coordination Agency (TIKA) and the Statistical, Economic and Social Research and Training Centre for Islamic Countries (SESRIC).

IOFS Participates in the 21st Meeting of COMCEC Agriculture Working Group in Ankara

The Islamic Organization for Food Security (IOFS) delegation attended the 21st Meeting of the Agriculture Working Group, hosted by The Standing Committee for Economic and Commercial Cooperation (COMCEC) on 12-13 October 2023, in Ankara, Turkey.

SESRIC Training Course in partnership with IOFS on "Combating Desertification and Drought" Paves the Way for a Sustainable Future in OIC-Africa Countries



In a concerted effort to combat the pressing challenges of desertification and drought in OIC-Africa countries, the Statistical, Economic and Social Research and Training Centre for Islamic Countires (SESRIC) partnered with the Islamic Organization for Food Security (IOFS) to organize an online training course on 16 October 2023, as per the Joint Action Plan of IOFS and SESRIC. The course aimed to equip participants with essential knowledge and skills to tackle issues that are affecting many developing nations within the Islamic world.

IOFS Celebrates World Food Day

On 16 October in celebration of World Food Day 2023, the Islamic Organization for Food Security (IOFS) joined the Food and Agriculture Organization and reaffirmed its commitment to combating hunger, malnutrition, and food insecurity within the Organization of Islamic Cooperation (OIC) and beyond.

IOFS Participates in World Investment Forum 2023: Harnessing Technology and Innovation for Agrifood System Resilience and Climate Change Mitigation

On 17 October 2023, the Islamic Organization for Food Security (IOFS) participated in the panel discussion, titled "Technology and Innovation to Increase Resilience and Support Climate Change Adaptation and Mitigation," which delved into a range of critical topics during the World Investment Forum 2023 in Abhu Dhabi, UAE.

Professor Dr.Zulfiqar Ali, Director of Programs and Projects of the Islamic Organization for Food Security, shared that the Organization is actively promoting agritech development to enhance agrifood system resilience and food security in its mem-

ber countries. Under programs like Bio & Agritech development, IOFS focuses on plant architecture innovations and genetic solutions. These advancements, such as plants with traits for self-irrigation, more efficient photosynthesis, and increased water-use efficiency, contribute to the resilience of agrifood systems.

High-Level Delegation from Kuwait Visits IOFS Headquarters in Astana

On 27 October 2023, the Islamic Organization for Food Security (IOFS) was honored to host a distinguished high-level delegation from Kuwait at its headquarters in Astana, Kazakhstan. The delegation, led by His Excellency Dr. Omar Alkanderi, the Ambassador of Kuwait to Kazakhstan, and Mr. Bassam Alghanem, Chairman of the Arab Turkish Commercial Organization, engaged in fruitful discussions regarding the strategic endeavors and vision of the IOFS.

Coordination Talks held with Iraqi Red Crescent Society

On 31 October 31 2023, In representation of His Excellency Dr. Masoud Al-Marri, the Caretaker Director General of the Islamic Organization of Food Security (IOFS), an IOFS delegation held consultations with His Excellency Dr. Yaseen Ahmed Abbas, President of the Iraq Red Crescent Society, to explore ways and means for establishing bilateral cooperation.The meeting served also to welcome the Republic of Iraq as a full-fledged IOFS Member State after it adhered to the Organization's Statute on the sidelines of the 9th Ministerial Conference on Food Security & Agricultural Development, held on 01-02 October 2023 in Doha, State of Qatar.

IOFS and INWRDAM Jointly Host a Cairo Water Week Side Event on Integrated Water Management Policies and Innovations in OIC Member States

On 31 October 2023 in Cairo, Egypt, the Islamic Organization for Food Security (IOFS) and Inter-Islamic Network on Water Resources Development and Management (INWRDAM) jointly hosted a side event during Cairo Water Week, titled "Supporting Policies and Innovations for Integrated Water Management in the OIC Member States". The roundtable aimed to address the most pressing water management challenges faced by the OIC Member States and discuss viable solutions through policy, technological innovations, and sustainable initiatives.The moderators of the round table were represented by Dr. Ismail Abdelhamid, Advisor of Programs and Projects Department (IOFS) and Mr. Timothy T. Hanlon, Programs Director (INWRDAM).

IOFS Participates in RUFORUM Conference in Cameroon

The IOFS delegation, led by Mr. Sofian Meddeb , Advisor of the Cabinet of the Director General of the IOFS, and accompanied by Dr. Mohamed Elkaramany, Dr. Muhammad Asif Kamran, and Mr. Bakytzhan Arystanbek, attended the 19th Annual General Meeting of RUFORUM Network in Yaounde, Cameroon from October 30 to November 2, 2023.

IOFS Conducts Side-Event Within RUFORUM AGM in Cameroon

On 01 November 2023 within the 19th RUFORUM Annual General Meeting the IOFS conducted the side-event titled "Building Food Systems Governance and Policy Analysis Capacity in Africa" aimed to present best practices in food policy education to principals of RUFORUM member universities, with a specific focus on food security policy and governance. This objective is to increase universities's capacity to empower a new generation of professionals capable of analysing and managing interdisciplinary food security and agriculture subjects. Representatives of academia, government agencies, international organizations, graduates of universities attended the side-event.

Collaboration Meeting Summary between NUST and IOFS for Advancing Sustainable Food Security

The National University of Sciences and Technology (NUST) and the Islamic Organization for Food Security (IOFS) held a high-profile online meeting with key representatives to discuss potential collaboration. The discussion aimed to reinforce sustainable food security for the member states of the Organization of Islamic Cooperation (OIC).The meeting was attended by Prof. Dr. Zulfiqar Ali, Director of Programs and Projects Department at IOFS, Prof. Dr. Rizwan Riaz, Pro-Rector of Research, Innovation, and Commercialization at NUST, and several esteemed heads and directors from NUST's School of Electrical Engineering and Computer Science (SEECS).

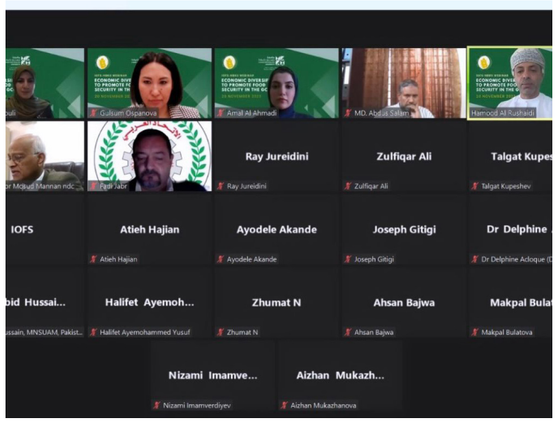
Islamic Organization for Food Security Participates in Qatar Sustainability Week 2023

On 09 November 2023, the Islamic Organization for Food Security , represented by Professor Dr. Zulfiqar Ali, Director of Programs and Projects, participated, in the 8th edition of Qatar Sustainability Week 2023. Professor Dr. Ali Zulfiqar, a recognized expert in the field, contributed to the International Training Program on Food Security by presenting IOFS's food security insights and outlining potential projects tailored for member states and the private sector.

IOFS Plays Key Role in CICA Business Forum, Unveils Strategies for Food Security

Astana, 13 November 2023 - The Islamic Organization for Food Security (IOFS) took center stage at the Sixth Plenary Session of the CICA Business Council and the Eighth CICA Business Forum, held on November 13, 2023, in Astana. The event, focused on cooperation prospects among CICA Member States in Food Security, Renewable Energy, and Green Finance. Professor Dr. Zulfiqar Ali, Director of Programs and Projects of IOFS shared analytics on the current state of food security in the Organization of Islamic Cooperation (OIC) region and elaborated on IOFS's strategy to address food insecurity. The presentation included specific plans for transforming Kazakhstan into a world food hub.

IOFS-HBKU Webinar Explores Economic Diversification for Enhanced Food Security in the GCC



On 20 November 2023 , the Islamic Organization for Food Security, and its subsidiary, the International Islamic Food Processing Association, in collaboration with Hamad Bin Khalifa University's (HBKU) hosted a webinar on "Economic Diversification to Promote Food Security in the GCC".

IOFS Advocates Coordinated Efforts for Sustainable Agriculture and Food Security in Pakistan

On 21 November 2023 in Faisalabad, Pakistan, Dr. Masoud Jarallah Al-Marri, Chairman of the Executive Board and Caretaker Director General of the Islamic Organization for Food Security (IOFS), highlighted the pressing issues of food security and sustainable agriculture during his visit to the University of Agriculture Faisalabad (UAF). Dr Al-Marri, accompanied by Director of Programs and Projects of the IOFS, Prof. Dr. Zulfiqar Ali, engaged with the leadership of the UAF, including Vice Chancellor Prof. Dr. Iqrar Ahmad Khan, deans, and directors, emphasizing the need for coordinated efforts in the face of climate change and a growing global population.

IOFS Welcomes High Level Delegation from Pakistan at Headquarters

On 21 November 2023, the headquarters of the Islamic Organization for Food Security (IOFS) welcomed a delegation of senior government officials from Pakistan as part of their visit to Astana during the 119th National Management Course (NMC) Foreign Study Tour.

The Islamic Organization for Food Security Elevates Commitment to Sustainable Food Security in Nigeria

On 27 November 2023, the Islamic Organization for Food Security (IOFS) marked a significant milestone as Prof. Dr. Zulfiqar Ali, the Director of Programs and Projects, embarked on a pivotal two-day working visit to the Republic of Nigeria. The highlight of this visit was a high-level meeting with HE Honourable Aliyu Sabi Abdullahi, the esteemed Minister of Agriculture and Food Security of the Republic of Nigeria. The primary agenda of this strategic encounter was to reinforce IOFS's unwavering commitment to supporting the Nigerian government in achieving sustainable food security and economic prosperity.

IOFS Empowers Cassava Innovation in Nigeria through Second Strategic Event

The Islamic Organization for Food Security (IOFS) marked a pivotal moment in its commitment to advancing strategic commodities for Member States of the Organization of Islamic Cooperation (OIC) with its second event in Nigeria. Prof. Zulfiqar Ali, Director at the Programs and Projects Department, led the organization's delegation for the Regional Workshop Training on "Cassava Next Generation Breeding," held on 28-29 November 2023 in Abuja, Republic of Nigeria.

International Conference on Wheat and Rice Value Chain Development and Food Losses and Wastes Strategies in CWANA Region

The International Conference on Wheat and Rice Value Chain Development, a landmark event in the CWANA region, was held in Ankara, Turkey from November 29 to December 1, 2023 organized by the Islamic Organization for Food Security (IOFS) jointly with the Arab Organization for Agricultural Development (AOAD) and in cooperation with the Ministry of Agriculture and Forestry of the Republic of Türkiye and the Arab Organization for Agricultural Development. The Conference aimed to address critical aspects of the rice and wheat value chains, as well as reviewing the Food Waste and Losses Strategies in Member States. Distinguished experts from various countries from CWANA Region such as Afghanistan, Bangladesh, Egypt, Kazakhstan, Mauritania, Morocco, Pakistan, Qatar, Tunisia, Türkiye who have presented insights and shared their experiences. Key topics included the development patterns and bottlenecks in the value chains, innovative technologies for crop improvement, and strategies for reducing food waste and losses.

IOFS participates in Decadal Workshop on Enhancing Food Security in Arab Countries Project

In Tunis, Republic of Tunisia, on 01 December 2023, the delegation of the Islamic Organization for Food Security (IOFS), led by the Director of Programs and Projects Prof. Dr. Zulfiqar Ali , participated at the Decadal workshop on Enhancing Food Security in Arab Countries Project organized by the ICARDA; International Center for Agricultural Research in the Dry Areas in Tunis, Republic of Tunisia.The two day (30 November – 01 December 2023) workshop aimed to review major achievements in each country; outcomes of the capacity development, adoption and impact assessment, food losses and return on investment. Strategic partners gathered from Algeria, Egypt, Iraq, Jordan, Morocco, Palestine, Sudan, Syria, Tunisia, Yemen.

IOFS Reports on its Activities to Senior Official Meeting Preparatory to the 39th COMCEC Ministerial Session in Türkiye

On 02 December 2023, upon instructions of His Excellency Dr. Dr. Masoud Almarri, the Caretaker Director General of the Islamic Organization of Food Security (IOFS), Mr. Abdula Manafi Mutualo, Advisor at the Coordination & Cooperation Department, is representing the Organization at the Senior Official Meeting Preparatory to the 39th Ministerial Session of the Standing Committee for Economic and Commercial Cooperation of the Organization of Islamic Cooperation (COMCEC), being held in Istanbul, Republic of Türkiye.

Transformative Regional Cassava Initiative Elevates Food Security, Climate Resilience, and Agro-Industrial Development

In Abidjan, Côte D'Ivoire, on 14 December 2023, the Islamic Organization for Food Security (IOFS), in collaboration with the Islamic Development Bank (IsDB) and the United Nations Development Programme (UNDP) successfully launched the Cassava Capacity Building Program, a pivotal step towards reshaping cassava production and processing for sustainable impact.

Food Banking in Focus of IOFS Organized Training in Cairo

On December 17, 2023, a three-day capacity-building training titled "Food Banking Regional Network Model: Establishment, Operations, Pillars to Focus" convened in Cairo, Egypt. The organization of the event was financially co-supported by the Islamic Development Bank (IsDB) and closely coordinated with the Food Banking Regional Network. The activity brought together over 60 participants representing government agencies, food banks, civil society, multinational companies, private sector from 20 Organization of Islamic Cooperation (OIC) Member States. The event aimed at showcasing the experience of Food Banks of certain OIC Member States in implementing food banking activities. The training familiarized participants with the best practices of the establishment and operations of food banks, and allowed them to build business plans, elaborating on pillars to consider in setting a food bank, field visits to the Egyptian Food Bank facilities, as well as assistance was provided in identifying non-profit organizations or private sector entities to run food banking system in home countries.International Conference on Food Security in the Arab World During and After Crises Launched in Tunis

The Islamic Organization for Food Security (IOFS) and the Arab Organization for Education, Culture, and Science (ALECSO) launched the International Conference on Food Security in the Arab World during and after Crises, which convened on December 20-21, 2023, at the ALECSO Headquarters in Tunis.

IOFS Facilitates In-Depth Discussions at Kazakhstan-Pakistan Round Table on Trade and Economic Cooperation

On 21 December 2023, the Islamic Organization for Food Security (IOFS) and its subsidiary, the International Islamic Food Processing Association (IFPA) , played a pivotal role in the Kazakhstan-Pakistan round table on trade and economic cooperation in Astana, Kazakhstan. This significant event, orchestrated by the Chamber of International Commerce Kazakhstan, the Embassy of Kazakhstan in Pakistan, and the Pakistan Ministry of Commerce, served as a dynamic platform for fostering a profound dialogue between the two nations.

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