

# STATEMENTS *on* GENE EDITING TECHNOLOGY



Endorsements by NASAC Member Academies



# TABLE OF CONTENTS

<b>PARTICIPATING ORGANIZATIONS</b> .....	5
<b>THE GENE EDITING TECHNOLOGY INITIATIVE WORKING GROUP MEMBERS</b> .....	6
<b>TARGET AUDIENCE: POLICYMAKERS</b>	
<b>SECURING POLITICAL GOODWILL FOR GENE EDITING TECHNOLOGY IN AFRICA</b> .....	7
1. Science Policy Interface .....	7
2. Gene Editing Technology as a National, Regional and Global Priority .....	8
3. Progressive Gene Editing Technology Policies in Africa .....	9
4. Gene Editing Technology in Pursuit of Economic and Food Security .....	9
5. Conclusion .....	10
<b>TARGET AUDIENCE: REGULATORS</b>	
<b>GENOME EDITING OF CROPS IN AFRICA: TO REGULATE OR NOT TO REGULATE?</b> .....	11
Recommendations .....	14
<b>TARGET AUDIENCE: RESEARCHERS</b>	
<b>ACCELERATING UTILIZATION OF GENE EDITING TECHNOLOGY FOR FOOD SECURITY IN AFRICA</b> .....	15
Introduction .....	15
Scientific Approach and Opportunities .....	15
Importance of Appropriate Regulation of Gene Editing Products .....	16
Recommendations .....	17
<b>TARGET AUDIENCE: THE PUBLIC</b>	
<b>DEMYSTIFYING COMMON MYTHS AND TRUTHS ABOUT GENE EDITING TECHNOLOGY</b> .....	18
Introduction .....	18
Recommendations .....	19
<b>ENDORSEMENTS BY NASAC MEMBERS</b> .....	21

# **STATEMENTS ON GENE EDITING TECHNOLOGY**

## **Endorsements by NASAC Member Academies**

© 2022 Network of African Science Academies (NASAC)

**ISBN** 978-9914-9636-2-5

Apart from any fair dealing for the purposes of research or private study, or criticism or review, no part of this publication may be reproduced, stored or transmitted in any form or by any means, without the prior permission in writing of the publisher, or in accordance with the terms of licenses issued by the appropriate reproduction rights organization.

Enquiries concerning reproduction outside the terms stated here should be sent to:  
[nasac@nasaonline.org](mailto:nasac@nasaonline.org).

### **NASAC secretariat**

Jackie Kado, *Executive Director*

### **Africa Harvest**

Florence Wambugu, *CEO*

### **Design and Layout**

Irene Ogendo, *DTP Consultant*

### **Printers**

Oriak Books Limited

# PARTICIPATING ORGANIZATIONS

**Network of African Science Academies (NASAC)** [[www.nasaonline.org](http://www.nasaonline.org)] is a consortium of 29 science academies in Africa. NASAC aspires to make the “voice of science” heard by policy and decision makers within Africa and worldwide. Among its activities, NASAC has organized major conferences and workshops on thematic issues like agricultural biotechnology, food security, sustainable agriculture and climate change adaptation just to name a few. NASAC has also increased the capability of its members to do programmatic work and developed joint statements and policymakers’ booklets. NASAC’s networking capacity has enabled it to serve as an effective resource for disseminating and communicating pertinent information as well as centralizing and coordinating efforts among different sectors in academia, policy and society. *For more information on NASAC, please visit [www.nasaonline.org](http://www.nasaonline.org) or contact the secretariat at [nasac@nasaonline.org](mailto:nasac@nasaonline.org).*

**Africa Harvest** [[www.africaharvest.org](http://www.africaharvest.org)] has extensive experience in communication and advocacy to support the acceptance of new agricultural technologies across Africa. A good example is a fifteen-year communication program implemented with country partners and supported by CropLife International in Burkina Faso, Ghana and Nigeria that was instrumental in bringing stakeholders working on biotech projects together and linking them with the private sector like the seed trade industry. *For more information on Africa Harvest, please visit [www.africaharvest.org](http://www.africaharvest.org) or contact the secretariat at [info@africaharvest.org](mailto:info@africaharvest.org).*

**InterAcademy Partnership (IAP)** [[www.interacademies.org](http://www.interacademies.org)] is a global network of the world’s science academies, launched in 1993. It is hosted by TWAS, the World Academy of sciences, in Trieste, Italy. IAP’s primary goal is to help member academies work together to advise citizens and public officials on the scientific aspects of critical global issues. Given that NASAC is the regional network for IAP in Africa, the financial support accorded to NASAC to communicate and disseminate projects’ outputs has remained invaluable. This support facilitated the discussion of Gene Editing Technology as a session of the 2022 Annual Meeting of African Science Academies and NASAC’s General Assembly. The IAP Secretariat is hosted by two of its member academies: In Trieste, Italy, by TWAS – The World Academy of Sciences; and in Washington, DC, USA, by the US National Academies of Sciences, Engineering, and Medicine. *For more information on InterAcademy Partnership, please visit [www.interacademypartnership.org](http://www.interacademypartnership.org) or contact the secretariat at [iap@twas.org](mailto:iap@twas.org); [secretariat@iappartnership.org](mailto:secretariat@iappartnership.org).*

**CropLife International** [[www.croplife.org](http://www.croplife.org)] is passionate about improving agriculture through engagement and partnerships and aim to become the voice and leading advocates for the plant science industry. CropLife International therefore champions the role of agricultural innovations in crop protection and plant biotechnology to support and advance sustainable agriculture. This is driven by the belief that plant science provides modern agricultural tools and technologies that help farmers look after the planet, feed a growing population and progress rural communities. In the Gene Editing Technology Initiative, CropLife provided financial support that enabled the constitution of the Working Group and facilitated their contribution, meetings, webinars and delivery of outputs. *For more information on CropLife International, please visit [www.croplifeinternational.org](http://www.croplifeinternational.org) or contact the secretariat at [croplife@croplife.org](mailto:croplife@croplife.org).*

# THE GENE EDITING TECHNOLOGY INITIATIVE WORKING GROUP MEMBERS

Formal name adopted by the Working Group:  
**AFRICAN ASSOCIATION OF GENE EDITING PROFESSIONALS FOR SUSTAINABLE AGRICULTURE**

Name	Gender	Country	Statement Lead
Mr. Samson Nankone	Male	Burkina Faso	
Dr. Irakoze Willy	Male	Burundi	
Dr. Samson Musonerimana	Male	Burundi	Policymakers
Prof. Nzawe Dowiya	Male	DR Congo	
Prof. Badr Abdelfattah	Male	Egypt	
Mr. Reuben Quainoo	Male	Ghana	
Dr. Abkallo Hussein	Male	Kenya	
Mr. Justus Obara	Male	Kenya	
Dr. Magomere Titus	Male	Kenya	The Public
Mrs Ndegwa Doris	Female	Kenya	Regulators
Dr. Olweny Calleb	Male	Kenya	Researchers
Prof. Runo Stephen	Male	Kenya	
Dr. Susan Moenga	Female	Kenya	
Dr. Taracha Catherine	Female	Kenya	
Dr. Animasaun David Adedayo	Male	Nigeria	
Dr. Rose Maxwell	Female	Nigeria	
Prof. Diouf Diaga	Male	Senegal	
Dr. Botes Marietjie	Female	South Africa	
Dr. Hennie Groenewald	Male	South Africa	
Dr. Njuguna Elizabeth	Female	South Africa	
Dr. Soni Sheetal	Female	South Africa	
Dr. Maeda Daniel	Male	Tanzania	
Mr. Salehe Masoud	Male	Tanzania	
Prof. Bouhamed Chaabouni Habiba	Female	Tunisia	
Mr. Reagan Mudziwapasi	Male	Zimbabwe	

# SECURING POLITICAL GOODWILL FOR GENE EDITING TECHNOLOGY IN AFRICA

Africa is the continent most vulnerable to climate change and is now experiencing serious shortages of food, and in some cases, desperate famine. Change is needed in our agricultural and pastoral practices to provide food security for the populations of our nations and to ensure that our farmers and pastoralists can continue to earn a livelihood. We need to reduce the displacement of peoples whose agricultural practices are failing, and to minimize conflict arising from forced migrations.

Given these drivers, in this statement we address gene editing for plants and animals in terms of agricultural and food production purposes. It is a route to increased crop yields and higher drought resistance.

The advent of gene editing has evoked both enthusiasm and controversy, creating regulatory and governance challenges worldwide. Special attention must be given to policies and governance, as well as contributions addressing regulatory aspects of gene editing for plants. The success of gene editing techniques cannot be guaranteed by science alone. Political influence and social acceptance significantly contribute to market performance of crops. The acceptance and application of gene editing technology requires a framework that is approved by legislation and policy of national government. The role of science in policy and decision-making is crucial. It is very important that policy dialogue is encouraged between policymaking government agencies and different actors to guide decision-making on gene editing technology, especially at national levels

## 1. Science-Policy Interface

Engaging policymakers illuminates the policy landscape and plays a vital role in supporting the application of gene editing technology. A number of frameworks can be used by policymakers to engage the public and secure their support for gene editing technology. Since the advent of recombinant DNA technology in 1973, novel tools for breeding by genetic engineering have received significant focus resulting in accelerated development of genetic engineering technology. The applications of these technologies are diversely used in medicine, pharmaceutical industries, agronomy, and food production. In spite of the remarkable potential for success of the gene editing technology, the production of genetically modified organisms (GMOs) raised several concerns, which limited the acceptance of GMOs by policymakers.

Gene editing involves making targeted changes to the existing genetic sequences in a plant or animal similar to (but more targeted than) those accomplished by cross-breeding. Unlike genetic engineering techniques, gene editing may not involve the



insertion of foreign genetic material from other species. Gene editing technology utilizes deliberate genetic modifications like plant breeding techniques of hybridization and mutations. However, gene editing is more predictable and time-efficient than previous less targeted methods. These features resulted in the lauding in 2015 of CRISPR CasX as the *'breakthrough of the year'* by the journal Science. The Nobel prize winners in 2020 Emmanuelle Charpentier and Jennifer Doudna were notably two gene editing pioneers in Europe and the US recognized for their work on the development of Crispr-Cas9 in particular - a method for Gene editing which provides the ability to search and edit specific genes with even greater specificity. With this factual information, gene editing technology can combat hunger by increasing crop production in Africa.

## **2. Gene Editing Technology as a National, Regional and Global Priority**

In the African Union (AU)-Agenda 2063, the fifth goal on *"Modern Agriculture for increased productivity and production"*, gene editing technology has a big role to play in achieving this goal. African countries have a good opportunity to take part in the new challenge of worldwide efforts to adapt gene editing as a legal, certified, and safe approach for food production. Several countries in the world, such as Argentina, Australia, Brazil, Canada, Chile, Japan, the USA as well as many more do not regulate gene editing varieties that have no foreign gene integration. African countries including; Kenya, Nigeria, Malawi and Ethiopia have developed and approved gene editing guidelines while Burkina Faso, Ghana and eSwatini are in the process of developing regulatory guidelines for the application of Gene editing technology.

Science-based regulatory guidelines will enhance the adoption of disease-resistant gene edited crop varieties, and therefore contribute to food security. It is important that policymakers in Africa engage in dialogue with scientists to pursue internationally recognized framework for facilitating gene editing technology for purposes of food security.

In this connection, the key recommendations for policymakers' dialogue with scientists include:

### **i. Build capacity for public discussion and debate**

Future initiatives should attempt to build capacity for public discussion about non-human Gene editing and its related applications. Research on public opinion suggests that public trust in science remains high.

### **ii. Connect public discussion to decision-making**

Identify opportunities for decision-making to include expertise that inform the public on development of new 'rapid methodologies' such as gene editing technology. These opportunities should focus on providing real-time information when the need arises.

### **iii. Hold and open policy moments**

Public discussion of non-human Gene editing will evolve around key moments, such as regulatory decisions or newly publicised products. It is in such moments that it is



especially important, but hard, to discuss and debate new technologies. An ambitious next step would be to develop new ways necessary to hold open discussion in real time.

#### **iv. Engage in science-policy dialogue**

Periodically hold discussions with all key actors in gene-editing technology involved. These actors may include and not be limited to politicians, academicians, researchers, regulators and the public.

### **3. Progressive Gene Editing Technology Policies in Africa**

To sustain life on earth, food production must provide an adequate supply of calories and nutrients to the whole world population. Food insecurity, that is the lack of access to an adequate food supply, threatens millions of people worldwide with malnutrition. Moreover, the problem is getting worse as the global human population is growing rapidly and is expected to reach 8.3 billion by 2030 as reported in the UN Population Facts of 2017. African policymakers must recognize the opportunities and challenges presented by gene editing technology so as to take timely decisions. The opportunities provided by gene editing technology and its applications can contribute to combating the challenge of food insecurity in Africa. Plant Gene editing can play a key role in developing crops that withstand extreme climates and or pest invasion. To commercially up-scale this technology and the accompanying rapid scientific progress, policy and governance problems will have to be solved on national and international levels.

### **4. Gene Editing Technology in Pursuit of Economic and Food Security**

#### **4.1 Gene Editing Technology for more food production**

Gene editing technology has been applied, using engineered endonuclease (GEEN) systems, to more than 50 different crop plants including main staple foods like rice, maize or wheat as well as economically less important crops like strawberry, peanut and cucumber. Several market-oriented traits have been produced with enhanced agronomic characteristics, improved food and feed quality, and increased tolerance to abiotic stresses, etc. More safe and efficient gene editing technologies are constantly evolving to enable breeders to introduce single point mutations or new DNA sequences at a specific location in the plant genome. For the first time, precise modulation of traits of interest with unprecedented control and efficiency is possible. Gene editing technology can improve crop traits in a targeted manner, such as improving abiotic and biotic stress resistance as well as yield and nutritional values.

#### **4.2 Regulatory status of gene editing of crops in African countries**

In Africa, gene editing technology can address a wide range of issues such as malnutrition, crop failure linked to climate change and hunger. Most African nations have not implemented specific independent regulations for gene-edited crops; rather, those that have issued guidance have clarified the pathway to exempt gene-edited crops

from existing GMO legislation, and, subsequently, their applicability under conventional seed laws. The process of adopting more flexible legislation for regulating gene-edited crops and animals is essential to allowing plant breeders the flexibility to start using this technology now.

South Africa, Sudan, Nigeria, Malawi, and Kenya have approved and/or have field trials for various GMO crops but most have not yet adopted specific regulations for gene editing. In 2016, South Africa's Department of Science and Technology completed an expert report on the regulatory implications of new breeding techniques (NBTs) but recently made determination that NBT will be regulated under the Biosafety Act. The revised 2019 Nigeria National Biosafety Management Amended Act (2019) was published to broaden the regulatory scope of the 2015 Act to include emerging aspects of modern biotechnology including gene editing and biosecurity with the view of preventing adverse effects to human health and the environment. Kenya's National Biosafety Authority (NBA) published national Guidelines in gene editing in 2020, while Malawi and Ethiopia developed and adopted guidelines in 2022.

## **5. Conclusion**

African policymakers should be informed on the opportunities and challenges that gene editing technology presents in order to take decisions at the right moment and in a timely manner. The opportunities serve to improve food security in Africa and a significant contribution from science is required. Based on Africa's increasing demographic needs, gene editing technology can guarantee sufficient food. The technology can help overcome challenges related to climate change and increased demand for food and pharmaceutical products. African Policymakers should take the lead in supporting commercialization of products of gene editing technology and provide a conducive environment for further research on this new and innovative technology for the welfare of the people of Africa.

# GENE EDITING OF CROPS IN AFRICA: TO REGULATE OR NOT TO REGULATE?

Gene editing offers great potential in addressing specific concerns in food production, food security, nutrition, health interventions, environmental restoration and conservation. The definition of gene editing is widely accepted by scientists to mean, “*specific modification of the DNA of an organism to create mutations or introduce new alleles or new genes*”.<sup>1</sup> These modifications or mutations are made possible through a diverse range of modern and emerging biotechnology techniques gene editing applications such as CRISPR-Cas, TALENS, meganucleases, ZFN or ODM or the broader new breeding techniques that include cisgenesis and intragenesis. The technologies have been identified as a potential new option to augment existing interventions in pursuance of achieving the African Union Agenda 2063.

There are many global and regional discussions about the need to regulate gene edited agricultural products. The debate has been whether or not gene edited agricultural products can be considered as Genetically Modified Organisms (GMOs), which then determines whether these products are governed by a country’s national biosafety regulatory system or not. Determining whether an organism is a GMO often hinges on whether “foreign DNA” has been added. If an organism or product is considered not to be a “GMO”, then it should be determined whether such organisms or products should be regulated as conventionally bred.

Consideration was made of the existing regulatory frameworks in the 28 NASAC-member countries to ascertain the current status of Gene editing technology regulations in Africa. A majority of these countries, including Benin, Botswana, Burkina Faso, Cameroon, Ghana, Kenya, Egypt, Mauritius, Nigeria, Senegal, South Africa, Sudan, Zambia and Zimbabwe have existing laws, regulations and/or guidelines dealing with biosafety in general. Other countries like Madagascar, Burundi, Morocco, Mozambique, Togo, Tunisia, Rwanda, Algeria, Congo Brazzaville, Uganda and Ethiopia have a Draft National Biosafety Framework (Developed under the UNEP-GEF Biosafety Project) in terms of the Cartagena Protocol on Biosafety to the Convention on Biological Diversity (2002). Tanzania and Ivory Coast have no regulatory framework in these contexts at all.

Several African countries namely: Kenya, Nigeria, Malawi, and South Africa have established and published guidelines on their approach for regulating gene editing. Nigeria was the first country to publish the national biosafety guidelines for the regulation of gene editing. In March 2022, Kenya published their gene editing guidelines as an important step towards the development of a gene editing regulatory framework with eleven (11) approved gene edited ongoing researches. Both countries’ regulatory guidelines are based on the applied

<sup>1</sup> National Academies of Sciences, Engineering and Medicine Report 2016, P.385

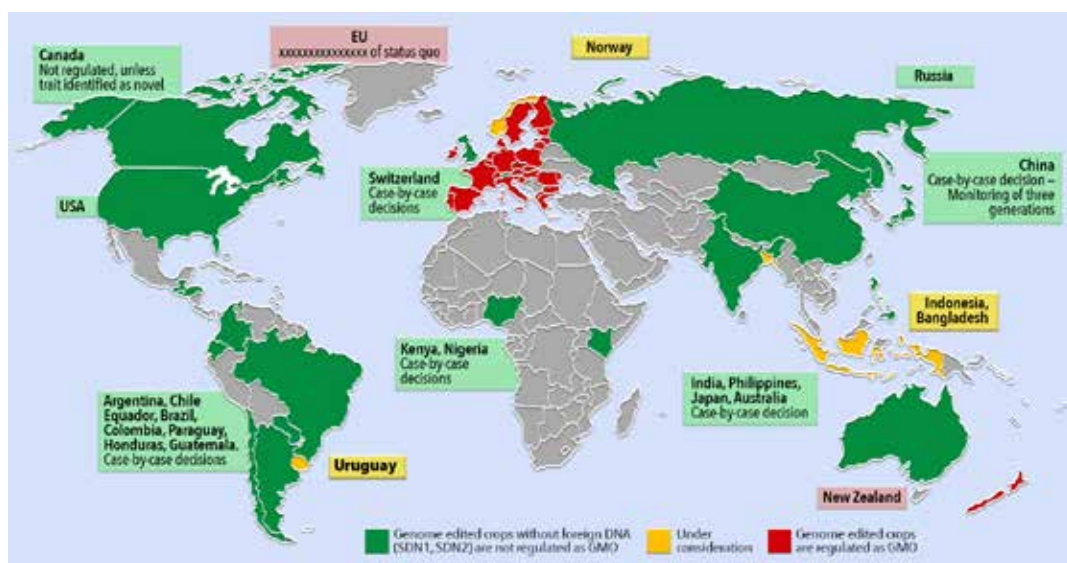


Figure sourced from 'Current state of genome editing legislation by Buchholzer and Frommer (June 2022).

gene techniques and products thereof will be subject to appropriate Biosafety regulations on a case-by-case basis. South Africa has a functional biosafety regulatory system and has approved numerous GMOs for planting and for food, feed, or processing, it currently takes gene edited products through the same biosafety regulatory systems applied to GMOs.

Other African countries, including Burkina Faso, Ghana, Ethiopia, Sudan, Eswatini, and Zimbabwe with GMO governance frameworks, have also started considering developing genome-editing policies.

Eleven Gene editing Projects have been approved by the Kenya National Biosafety Authority (KNBA) at the Research Level and these include;

- The Africa Swine Fever Vaccines
- Goat Resistant to trypanosomes
- Surrogate Host Chicken
- Sorghum resistant to Striga
- Sorghum Resistant to anthracnose
- Yams high in vitamin A and resistant to diseases
- Nutritionally enhanced Cassava
- Banana for nano and caulimo viruses and aphid resistance
- Early flowering cassava
- Bananas resistant to fungal and bacterial diseases
- Potato resistant to potato virus Y.

In addition the KNBA has approved maize lines tolerant to Maize lethal necrosis diseases (MNLN) for open field evaluation and seeds multiplication. Burkina Faso on the other hand approved testing to gene edited rice resistant to Bacterial blight for contained testing.

From the aforementioned analysis, Africa is making progress in creating an enabling environment for the commercialization of gene-edited crop varieties. It is clear that

harmonization of these laws is urgent, so as to promote scientific knowledge transfer and cross border trade in gene-edited products. The acceptance of these products, will largely depend on public acceptance through trust via public engagement and education. Although many of these regulatory frameworks deal with biosafety, these laws, regulations and guidelines do not adequately distinguish between GMO's and gene edited organisms and products. The differentiation between these concepts in regulatory frameworks and its management needs better clarification and perhaps even separate regulation.

Africa Biennial Biosciences Communication Symposium's (ABBC, 2019) theme, *Getting it Right: Communicating about Gene editing*, provided a platform for interrogating best communication practices that facilitated informed dialogue and decision making on Gene editing in Africa. This forum highlighted several challenges that call for linkage between researchers and regulators in regulating technologies. These include, but are not limited to, the prospect of over-regulation should African policymakers decide to treat gene edited crops similar to GMOs. Limited infrastructure for novel scientific research poses a challenge to adopting improved technologies like gene editing on the continent. Researchers therefore must seek clear regulatory guidelines, with their inclusion and active involvement in the development of regulatory frameworks at national levels.

Many African countries that have made decisions on gene editing technology have clarified that products of the technology should be treated like products of conventional breeding; there is thus need for an ideal facilitative and supportive regulatory framework among African countries based on a two-tiered approach:

- National legislation aligned to the African Union AUDA NEPAD guidelines on gene editing technology enacted in respective African countries to create a science based enabling regulatory framework within the country. This national framework could consist of legislation, regulations or regulatory policies drafted and enacted in line with the relevant laws.
- Applicable International laws which would act as a guide or create common standards acceptable to all African countries. An international regulatory framework could be achieved through deliberation by representatives in national and regional institutions such as the African Union.

In order to advance a cohesive approach to gene editing in Africa, when countries are enacting national laws, regulatory frameworks created need to possess some common features as summarised briefly below:

1. **Regulator:** an overarching centralised authority should be created to oversee genome edited plants within the country. The regulator should possess powers to perform this role as created by the policy or law, and may perform functions such as issuing permits or licences on application for research, marketing and development of gene edited crops;
2. **Principles:** the policy or law within countries should describe the legal position of genome edited plants in the country and clarify the legal and policy provisions;
3. **Target:** a clear definition of what it means to be 'genome edited' and 'gene editing' must be contained in the policy or law. When the definition is clear, it is easy to identify which crops would fall within the ambit of the regulatory framework.

- 4. Compliance:** to encourage compliance with regulation, penalties for non-compliance with the law or policy may be contained. This would ensure that regulatory enforcement of all gene edited crops fall under the ambit of the regulatory framework.

## Recommendations

Increase capacity of decision-makers in African countries to develop an understanding of the science and regulatory issues. This should follow a “whole of government” approach, working with multiple agencies with a focus on the cultivation and food/feed policies which begin with those that have an appropriate legal or regulatory platform and strong political will. Significant education and training are necessary to ensure that all regulators are knowledgeable about gene editing and know the policies that are supported and implemented by multiple agencies.

Consider targeted harmonization efforts that could yield success at sub-regional levels (e.g., EAC, COMESA, SADC, ECOWAS) among the African countries, whilst recognizing the time and cost constraints associated with these efforts.

African Union, regional communities as well as African governments should award competitive grants to enable scientists to access and invest their time to research on these new technologies.

# ACCELERATING UTILIZATION OF GENE EDITING TECHNOLOGY FOR FOOD SECURITY IN AFRICA

This policy brief will demonstrate that the scientific community can conduct novel research with gene editing techniques to gather evidence and knowledge that addresses public and regulatory concerns. Developments of gene editing technology have shown great potential to be highly beneficial to the public in transforming agriculture and industrial biotechnology, so as to reduce Africa's burden of food and nutrition security.

## Introduction

Science-led agricultural growth has played a key role in Africa. While these gains are outstanding, Africa is still home to most of the world's undernourished, and faces enormous challenges like the emerging and re-emerging biotic and abiotic stresses due to agricultural intensification and climate change. To meet these challenges, the continent has no option but to use all the available and emerging tools and technologies to improve food production. *Gene Editing technology is a promising, relevant, safe and efficient technology for low-input high-output agriculture.* It is an important tool to improve agricultural crops for their nutritional value, nutrient and water use efficiency, productivity, and tolerance/resistance to biotic and abiotic stresses.

## SCIENTIFIC APPROACH AND OPPORTUNITIES

### What do we mean by 'gene editing'?

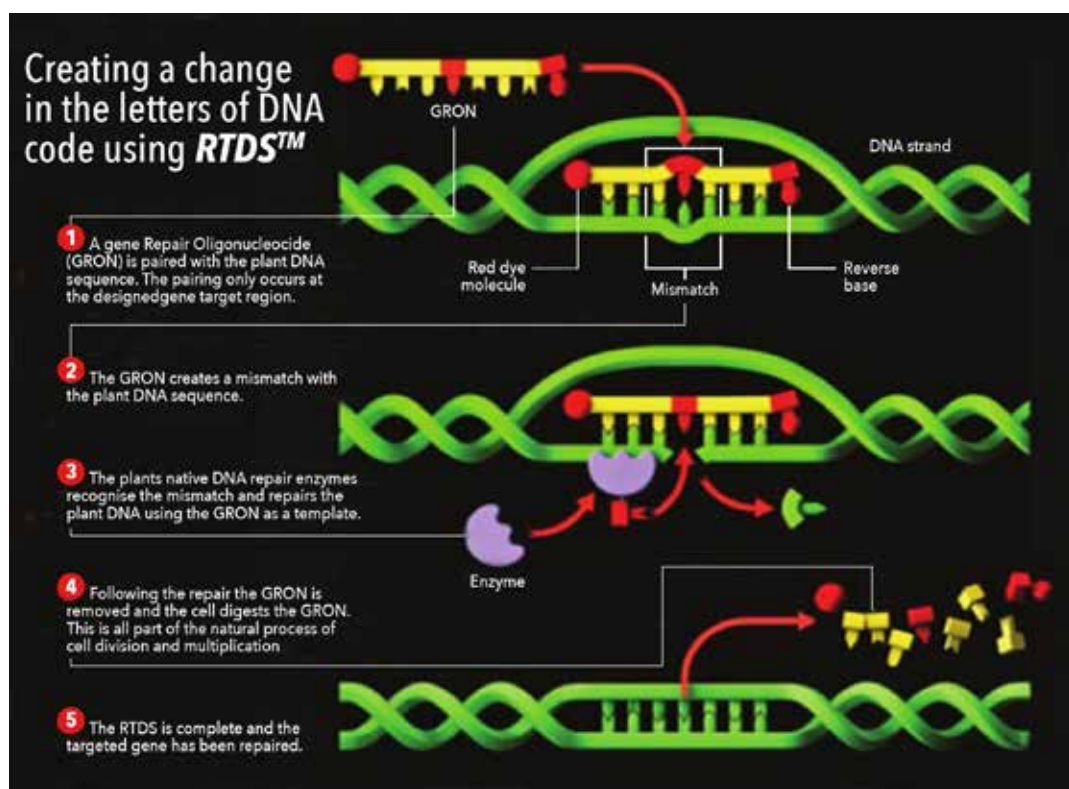
Gene editing is the targeted alteration of a DNA sequences in a living cell. It can utilize targeted double strand DNA breaks and naturally existing cellular repair mechanisms to induce targeted changes. The way they are repaired can affect the function and new DNA sequences can be delivered when the DNA is cut and act as templates for generating an altered or unaltered sequence. More information can be retrieved from the following link: <https://medlineplus.gov/genetics/understanding/genomicresearch/genomeediting/>.

As of 2015 four families of engineered nucleases were used: meganucleases, zinc finger nucleases (ZFNs), transcription activator-like effector-based nucleases (TALEN), and the Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR/Cas9) system. Among the gene editing technologies, CRISPR-based methods are particularly promising owing to their relative efficiency, low cost and ease of use, as well as the prospect of making edits at multiple sites in the genome in a single procedure. The possibility of gene edited crops posing human health and environmental risks are marginal given the often identical outcomes to conventional plant breeding. Discussions concerning the risks are driven



more by socio-political factors than scientific principles. The specificity in the CRISPR/Cas9 system provides solid genotype-phenotype correlations, and thus enable faithful interpretation of genome-editing data.

In addition to the preceding four enzymes applications, gene editing could also be achieved by Oligonucleotide Directed- Mutagenesis (ODM). Introduction of short to medium sized DNA sequences complementary to the target sequence except for one or few bases results in mutations; a phenomenon called Oligonucleotide Directed-Mutagenesis. ODM results in genetic changes that are equivalent to those obtained through conventional breeding and in most jurisdictions product obtained through gene editing using ODM are not regulated under the GMO acts.



Source- <https://news.agropages.com/News/NewsDetail---16544.htm>

### What opportunities can Gene Editing present in agriculture and Industry?

Areas of research and possible applications of gene editing technology include:

- Agricultural biotechnology, crops and livestock (e.g., increasing yield, introducing resistance to disease and pests, tolerance to different environmental stresses)
- Industrial biotechnology (e.g. developing 'third generation' biofuels)

### Importance of Appropriate Regulation of Gene Editing Products

The enactment and application of regulations is part of policymaking, where the aim is to establish frameworks for safe and adequate development of the innovation system.

Regulations have a direct impact on technology diffusion because they affect the generation of gene editing technology, as well as decisions on their uptake, adoption and efficient commercialization of local gene editing products by potential users. Since particular products developed using gene editing technology are equivalent to conventionally bred product, the regulatory processes applied upon them should be the same as those of conventionally bred products such as the current conventional seed laws. The European Court of Justice recently ruled that the use of CRISPR on crops or in the drug development process need not be regulated as strictly as genetically modified organisms (GMOs), which is a potentially inhibitory decision in adoption of the technology and the timely realization of its benefits.

## Recommendations

The science and application of gene editing technology transcends national boundaries. Issues that need to be addressed should be similar to those applied to products of conventional plant breeding and include the health and well-being of individuals, respecting individual rights, careful attention to constantly emerging and evolving information on the process, guarding against unwanted societal effects, and equitable distribution of information, risks and benefits.

To realize the benefits of gene editing technology, African Countries should consider the following recommendations:

- Place the responsibility of enforcing different policies, coordinating regulatory standards and procedures to a specific regulatory authority working closely with researchers.
- Facilitation of inter-country collaboration and data-sharing opportunities on gene editing technology between the scientific community and the regulatory authorities.
- Regard all gene-editing projects as research to be conducted under supervision.
- Adoption of various legislation by researchers to incorporate social and economic guidance on gene-editing and gene drive research.
- Strengthen capacity for research ethics to support disciplines that underpin gene editing technologies. The gene editing projects should only proceed if conducted under strict research conditions, with a priori submission to an in-country research ethics committee.
- Inform policymakers and possibly the public on the gene editing technology developments and opportunities for improving agricultural productivity and the health of people
- Make effort in relation to communicators, to use adequate wordings and if possible local language to demystify gene editing technology, especially among the general public.

# DEMYSTIFYING COMMON MYTHS AND TRUTHS ABOUT GENE EDITING TECHNOLOGY

## Introduction

Population increase, high demand for food worldwide, the effect of climate change and global warming are postulated to increase poverty and food shortage. So many technologies have emerged such as site specific nucleases (SSNs), transcriptional activators-like effector nucleases (TALENs), Zinc Finger nucleases (ZFNs), mega-nucleases, CRISPR/Cas9 technology as well as Oligonucleotide Directed- Mutagenesis (ODM) that can improve crop yield, disease resistance, drought tolerance and nutritional traits. The application of this new technology is increasing rapidly by developing non-transgenic gene edited plants that can tolerate adverse impacts that may occur due to climate change. Gene editing is a breeding technique that allows plant breeders to introduce new traits simultaneously to improve crop yields.

Novel scientific innovations that enhance the quality of life of many people tend to be masked by speculations about their scientific merits or demerits or risks. This influences the rejection or acceptance of the innovation, leading to linear categorization of adoption of the same from early adopters to the laggards. Speculation for or against the innovation are the result of poor communication and information sharing on the proven benefits and scientifically derived possible risks.

In light of this, gene editing technology could easily become a victim of gross bashing, unnecessary barriers and stumbling blocks, similar to Genetically Modified Organisms (GMOs). This may ultimately diminish the acceptance of gene editing technology and reduce its contribution to the development of the crop and food production industry.

**Misleading information on the process and products of gene editing technology is on the rise.** Misleading information may diminish gene editing technology research or application and thereby reduce the potential good of current Gene editing technology in developing nations.

Some of the ongoing misleading information about Gene editing Technology include the following:

- Next-generation plant breeding tools are just “GMO 2.0” and pose a threat to human health and the environment.
- Poses some “unanticipated threat” without being clear on the particular threats and leaving readers to guess.

- The National Organic Coalition (NOC) terms GE products are “next generation GMOs”.
- The Sierra Club, an environmental group terms CRISPR as “a weapon of mass destruction”.
- Unnatural and potentially harmful to the environment and human health.
- UK’s Soil Association: “Gene-editing technologies give rise to similar uncertainties and risks as GM always... the very definition of genetic engineering, and gene-editing risks introducing similar uncertainties and unintended consequences as genetic modification of DNA”.
- International Federation of Organic Agriculture Movements: “The rapid development and dissemination of new genetic engineering techniques in recent years brings a level of interference in the genetic make-up of the planet’s biodiversity, with consequences that remain poorly understood let alone evaluated, which society has never seen before ...it is not possible to know the full impact of any given genetic engineering process; most of these techniques may trigger numerous off target effects at different steps of their production process and risk is inherent”.

## Recommendations

### Evidence-based dialogue to increase public awareness

There is a need for evidence-based dialogue to increase public awareness of gene editing technology and its applications. Gene editing technology should be distinguished from genetically modified organisms (GMOs) and compared to the conventional breeding method. In addition, it is vital to clarify the risk management issues of gene editing technology.

**There is distinction between the products of gene editing technology and those of transgenic technology.** The lack of foreign DNA, RNA and proteins including DNA sequences necessary for the stable expression and selection of alien biomolecules in crops can appeal to the end users.

**Gene editing products have potential for superior traits** and greater potential for cultivation and storage under a variety of biotic and abiotic stresses. These products also show promise to maintain high yield and better nutritional value compared to other crop breeding techniques. This can lead to stakeholders’ acceptance of gene editing technology products compared to conventional plant breeding products.

The potential benefits of gene editing technology for deployment in crops and food include:

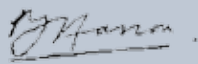




- Desirable traits such as improved nutritional value, better disease resistance and shorter growing cycles leading to increased yields.
- Lower production cost, which promotes sustainable farming.
- Expanded traditional plant breeding tools that introduce new plant traits more quickly and precisely, potentially saving many years of bringing new varieties to farmers.
- Eradicates various plant diseases and therefore eliminates a large percentage of the crop losses that farmers suffer every year

**Information systems for science-based facts on gene editing technology** is useful to the general public for providing a suitable societal basis for biosafety and regulatory institutions. An enlightened public is better placed to engage on issues pertaining to the judicious access, risk assessment, acceptance, use and proliferation of the products of the gene editing technology. Such public engagement should cut across all cadres of stakeholders from policymakers, researchers, media, regulators, commercial players, growers and farmers. Communication should also be structured to target the stakeholder groups based on their capacities and competence.

**Local avenues available for increased public awareness on gene editing technology should** address structural, policy, cultural, historical, social, scientific and economic factors in Africa. Use of social media to share the technology and its applications, must include policies that have been developed in African countries.

# ENDORSEMENTS BY NASAC MEMBERS

Country	Science Academy	Signature
ALGERIA	Académie Algérienne des Sciences et Technologies (AAST)	
BENIN	Académie Nationale des Sciences, Arts et Lettres du Benin (ANSALB)	
BOTSWANA	Botswana Academy of Sciences (BAS)	
BURUNDI	Burundi Academy of Sciences and Technology (BAST)	
CAMEROON	Cameroon Academy of Sciences (CAS)	
CONGO	Académie Congolaise des Sciences (ACCOS)	
CÔTE D'IVOIRE	L'Academie des Sciences, des Arts, des Cultures d'Africa et des Diasporas Africaine (ASCAD)	
EGYPT	Academy of Scientific Research and Technology (ASRT)	
ETHIOPIA	Ethiopian Academy of Science (EAS)	
KENYA	Kenya National Academy of Sciences (KNAS)	
MAURITIUS	Mauritius Academy of Science and Technology (MAST)	
MOZAMBIQUE	Academy of Sciences of Mozambique (ASM)	
NIGERIA	The Nigerian Academy of Science (NAS)	
RWANDA	Rwanda Academy of Sciences (RAS)	
SENEGAL	Academie des Sciences et Techniques du Senegal (ANSTS)	
SOUTH AFRICA	Academy of Science of South Africa (ASSAf)	

Country	Science Academy	Signature
SUDAN	Sudanese National Academy of Science (SNAS)	
TUNISIA	Tunisian Academy of Sciences, Arts and Letters	
UGANDA	Uganda National Academy of Science (UNAS)	
ZAMBIA	Zambia Academy of Sciences (ZaAS)	
ZIMBABWE	Zimbabwe Academy of Sciences (ZAS)	

At the time of publishing these statements, endorsement was still being sought from the following academies:

- Académie Nationale des Sciences, des Arts, et des Lettres du Burkina Faso (ANSAL-BF)
- Académie Nationale des Sciences et Technologie du Congo (ANSTC)
- Académie Nationale des Sciences, Arts et Lettres du Togo (ANSALT).
- African Academy of Sciences (AAS)
- Ghana Academy of Arts and Sciences (GAAS)
- Hassan II Academy of Science and Technology in Morocco
- Madagascar's National Academy of Arts, Letters and Sciences
- Tanzania Academy of Sciences (TAAS).





# Gene Editing Technology Initiative

## Background

Gene editing enables plant breeders to make precise changes to the plant's genetic material, with the aim of improving productivity and sustainability. It mirrors changes that occur in nature or traditional breeding; with the new plant displaying desired characteristics such as drought tolerance, disease resistance, improved yields and nutritional value, and even limited allergens. The editing tool acts within the plant cell's DNA and no foreign DNA is added, just like in traditional breeding methods (<https://www.worldseed.org/resources/faqs/#plant-breeding-innovation>). Crops developed through these inexpensive novel plant breeding technologies do not contain foreign genes and are as safe as conventionally bred crops. Both developed and developing countries are successfully transforming agricultural production into sustainable systems that require less agrochemical inputs through novel plant breeding systems. However, adoption of gene editing in Africa is still limited due to lack of awareness on the technology and misinformation of linking it with genetic modification.

## Goal

The main goal of this initiative was to expand and empower the working group to promote the adoption of gene editing technology in Africa that will contribute to food security. The working group would then serve as Champions, who would help to influence policymakers to create a supportive regulatory environment for the development and commercialization of gene editing technology products. The initiative also sought to provide a platform for dialogue among relevant stakeholders, who would build public support and acceptance for the utilization of gene editing technology to improve food security in Africa.



The NASAC Secretariat  
Miotoni lane, Off Miotoni Road  
Karen, Nairobi, Kenya  
Tel: +254 712 914285  
Email: [nasac@nasaonline.org](mailto:nasac@nasaonline.org)  
website: [www.nasaonline.org](http://www.nasaonline.org)

Supported by:



ISBN 978-9914-9636-2-5



9 789914 963625