ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY REPORT FOR THE PROPOSED INTRODUCTION FOR CULTIVATION OF POTATO (*Solanum tuberosum* L.*)* WITH RESISTANCE TO LATE BLIGHT (*Phytophthora infestans*) DEVELOPED THROUGH MODERN BIOTECHNOLOGY

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DECLARATION

We the undersigned, proponents and the NEMA registered Lead Expert, hereby confirm that this study is conducted in compliance with Terms of Reference and the EMCA ESIA regulations for the ESIA Study for the proposed introduction of potato with resistance to Late Blight (*Phytophthora infestans*) developed through modern biotechnology for cultivation in selected counties in Kenya.

Proponent;

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LIST OF ACRONYMS

AATF	African Agricultural Technology Foundation
AIGAs	Alternative Income Generating Activities
ASALS	Arid and Semi-Arid Lands
BMU	Beach Management Units
CASO	County Agricultural Statistical Officer
CDA	Coastal Development Authority
CBOs	Community-Based Organizations
CDF	Constituency Development Fund
CDDCs	Community-Driven Development Committee
CDDO	Community-Driven Development Organizations
CIGs	Common Interest Group
CIP	International Potato Centre
CPSC	County Project Steering Committee
CPCU	County Project Coordinating Units
CMA	Co-Management Area
CoK	Constitution of Kenya
CSA	Climate Smart Agriculture
ESIA	Environmental Social Impact Assessment
ESMF	Environmental and Social Management Framework
ESMF/P	Environmental and Social Management Framework /Plan
ESMS	Environmental and Social Management System
ESS	Environmental and Social Standard
ESMMP	Environment and Social Mitigation and Monitoring Plan
EMCA	Environment Management and Coordination Act
ESMP	Environmental and Social Management Plan
FGD	Focus Group Discussions
FPIC	Free, Prior and Informed Consent
FAO	Food and Agriculture Organization of the United Nations
FBO	Faith Based Organization
FPO	Farmer Producer Organizations
GoK	Government of Kenya
GBPP	Global Biotechnology Potato Partnership
GBV	Gender Based Violence
GM	Grievance Mechanism
GBPP	Global Biotech Potato Partnership
GRC	Grievance Redress Committee
HH	Household
GIS	Geographical Information System

ICT	Information and Communication Technology
IP	Indigenous peoples
IVM	Integrated Vector Management
ILF	Inter-community Learning Forum
IPF	Investment Project Financing
ILO	International Labor Organization
IUU	Illegal, Unreported and Unregulated
KALRO	Kenya Agricultural Livestock Research Organization
KAPAP	Kenya Agricultural Productivity and Agribusiness Project
KCDP	Kenya Coastal Development Project
KEPHIS	Kenya Plant Health Inspectorate Services
KII	Key Informant Interviews
NBA	National Biosafety Authority
NEMA	National Environment Management Authority
NGO	Non-Governmental Organization
NPSC	National Project Steering Committee
NPT	National Performance Trials
NVT	National Variety Catalogue
MoA&LD	Ministry of Agriculture & Livestock Development
OHS	Occupational Health and Safety
PCR	Physical Cultural Resource
PCU	Project Coordination Unit
PDO	Project Development Objectives
PIM	Project Implementation Matrix
PIU	Project Implementation Units
RPF	Resettlement Policy Framework
SDG	Sustainable Development Goals
SEP	Stakeholder Engagement Plan
SESA	Strategic Environmental and Social Assessment
SIA	Social Impact Assessment
TIMP	Technology, Innovation, and Management Practice
ToR	Terms of Reference
UPOV	Union of Protection of new Potato Varieties
USAID	United States Agency for International Development
VMGs	Vulnerable and marginalized groups
WRA	Water Resources Authority

TABLE OF CONTENTS`

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

EXECUTIVE SUMMARY

Project Background

The potato value chain in Kenya employs over 3.5 million actors, contributing over Kshs 50 billion to the economy. However, potato production today is facing adverse effects from climate change resulting in reduced yield posing a huge threat to food security. For example, specialists on food security in Kenya contend that agricultural productivity, food systems, and food security are adversely affected by climate change and unpredictability. A number of climate-smart potato producers have been facing obstacles including pests and diseases as well as soil-borne diseases; as such, experts in agriculture and food sustainability have been pushing for the adoption of modern biotechnology as a means of overcoming the climate change related challenges.

The Project

The potato variety intended for introduction has been developed through modern biotechnology by introducing three Late Blight (LB) resistance genes derived from wild relatives of the potato (*RB, Rpi-blb2* genes from *Solanum bulbocastanum* and *Rpi-vnt1.1* gene from *S. venturii*) into the farmer and consumer preferred variety *Shangi*. Transgenic events of the so-called 3R-gene LBR potato varieties have been tested in the lab, greenhouse, and confined fields (CFTs) supervised by the National Biosafety Authority (NBA) in accordance with the Biosafety Act 2009.

Project Location

After Commissioning, the late blight resistant (LBR) variety will be grown in the Potato growing areas of Kenya including the Counties of Bomet, Bungoma, Elgeyo-Marakwet, Kiambu, Meru, Embu, Kirinyaga, Nakuru, Narok, Bomet, Nyandarua, Nyeri, Taita-Taveta, Tans- Nzoia, Uasin Gishu and West Pokot but may include agro-ecological zones within the altitudes between 1,500 and 2,800 m above sea level.

Environmental and Social Impact Assessment (ESIA) Methodology

The Environmental Experts teamconducted scoping as part of the preliminary assessment, which identified the likelihood of significant environmental and social impacts as a result of the proposed genetically improved potato. In order to further investigate the identified issues, the study team employed various data collection methods. This encompassed both primary and secondary data collection methods that were keenly evaluated and analyzed to assist in accurate reporting of this document. Primary methods employed included site visits, focus group discussions, key informants' interviews, use of global positioning system (GPS) coordinates, and photography. Secondary sources of data included desktop studies and mapping. The process also employed impact prediction and analysis, impact mitigation as well as public consultations with neighbouring potato farmers, County and government representatives in all regions. Finally, the outputs of these processes led to the development of this ESIA study report complying with the format prescribed in the Environmental Impact Assessment/Audit Regulations (2003) revised in 2015.

Policy, Legal and Regulatory Framework

Environmental issues are considered as an integral part of any development activity. The country's supreme law, the Constitution of Kenya, 2010 safeguards the environment by stipulating that every Kenyan has a right to a clean and healthy environment. Further, with reference to the schedule II of the Environmental Management and Coordination Act 1999 (Amended 2015), subject to conditions in the Environmental (Impact Assessment and Audit) Regulations, 2003 (Revised 2019). projects that require undertaking of an EIA are categorically listed. The proposed project is classified under high-risk impact project according to the Legal notice 31 and 32 of 2019. Overall, Kenya has over 77 statutes that relate to environmental concerns. Most of these statutes are sector specific, covering issues such as land uses, occupational health and safety, water quality, wildlife, public health; soil erosion; air quality, etc. Therefore, this report has highlighted all the legal, policy and regulatory frameworks as well as institutional arrangements relevant to the implementation of the proposed inclusion of GM potato with resistance to late blight. Some of the key legislations and regulations examined included

CoK, 2010, Biosafety Act, 2009, Water Act, 2016, Public Health Act (Cap 242), Agriculture Act (Cap 318), Food, Drugs and Chemical Substances Act (CAP 254), EMCA, 1999 (Amended 2015), Occupational Health and Safety Act of 2007, Sexual Offences Act No.3 of 2006, Seed and Plant Varieties Act (Cap 326), Biosafety (Environmental Release) Regulations, 2011, Environmental (Impact Assessment and Audit) Regulations of 2003, Water Quality Regulations of 2006 and Waste Management Regulations of 2006.

Consultation and Public Participation

The consultation with the public in the potato growing counties laid emphasis on promoting stakeholder participation and consultation. Stakeholder involvement and consultation was undertaken at both individual and public levels. This study adopted a multi-stakeholder public participation approach which involved seeking the opinions of the relevant government authorities, project affected and interested persons in all potato growing counties. Some of the approaches applied to aid in data collection included administration of questionnaires, public participation meetings and key informant interviews for institutions and lead agencies. To reach as many stakeholders as possible, public fora (barazas) were held in 11 potato growing counties. Interviews and discussion were held with a total of 86 key informants representing various institutions and departments/ministries of both National Government and County Governments within and outside the potato growing counties. A national stakeholder validation workshop was held to further evaluate proposed issues and establish the mitigation measures,

All the respondents (100%) were in support of the implementation of the introduction of 3 R-gene LBR biotech Potato as recorded in the questionnaires.

Evaluation of Alternatives

In analysing alternatives, emphasis was laid on the project locations, cost and benefit criteria, environmental impacts, social acceptability, economics (including productivity of land-use), the notion or probability of GM seeds wiping out local species and farmers' dependability on the market to buy seeds each year as opposed to the traditional practices of using seeds from previous farming season.

Impact Identification and Management

The objective of undertaking this ESIA process was mainly to ensure that the proposed project is environmentally, economically and socially feasible; thus, reducing conflict between the project proponents and affected persons as well as interested persons throughout the project cycle. This ESIA report assessed both the social and environmental impacts of the proposed project. The study considered the provision to further assessment, under the auspices of the National Biosafety Authority (NBA), any potential biosafety risk, and further evaluation of the candidate variety under the Seeds and Plant Varieties Act. It is therefore concluded that regarding environmental and social impact, the potato has no significant environmental risk and is as safe as the conventional Potato *Shangi* variety which is cultivated widely.

Some of the pertinent potential negative impacts assessed regarding the proposed introduction of 3 R-gene LBR Biotech Potato include;

i. Market Saturation: Increased yields could flood the market, leading to the need for better market linkages.
ii. Cultural and Social Resistance: Negative perceptions, myths, and backward cultural norms may hinder acceptance of GM crops by farmers and consumers.
iii. Lack of Information: Insufficient dissemination of information might lead to misunderstanding and low adoption rates.
iv. Health and Environmental Concerns: Potential risks such as crossbreeding with other plants, development of resistant fungal strains, and health issues like allergies or immune system interference.
v. Impact on Indigenous Varieties: There is a risk of depletion or extinction of indigenous seeds and reduced use of other potato varieties.
vi. Seed Viability and Costs: The need to buy new seeds each season, as seeds may lose viability after harvest could increase costs for farmers.
vii. Economic impact on agro-dealers: Reduced use of pesticides might lead to loss of income for agro-dealers.

Positive impacts of the proposed introduction of 3 R-gene LBR Biotech Potato include: -

i. Creation of employment
ii. Reduced cost of production
iii. Improved Potato varieties
iv. Food security as a result of increased Potato production
v. Knowledge transfer to farmers during the trials.
vi. Selection of best performing varieties.
vii. Environmental safety due to reduced chemical sprays.

Social and environmental safeguards have been proposed to minimize the anticipated negative impacts and enhance the resultant positive impacts. These are presented in the Environmental and Social Management Plan (ESMP) in this report for implementation by responsible parties and stakeholders where applicable.

Conclusion and Recommendation

Overall, the study team concluded that the proposed project will not pose any significant environmental hazard or health and safety concerns. This leads to the conclusion that 3 R-gene LBR Biotech Potatoes are safe and thus not likely to cause an altered risk to the environment relative to conventional Potatoes. In general, the risk of adverse consequences from the environmental release of 3 R-gene LBR Biotech Potato is negligible. The identified risk mitigation measures if properly implemented according to the guidelines of this report and in compliance with all legal provisions highlighted, will ensure that the project will be environmentally, socially, and economically feasible.

Thus, it is our recommendation that NEMA issues a license for the 3R-gene LBR Biotech Potatoes to be allowed to proceed to carry out the Project, on the understanding that the proponent will adhere to the mitigation measures proposed herein and further implement the proposed ESMP. In addition, the proponent ought to perform continuous monitoring and evaluation of the various environmental and social parameters to ensure close adherence to the ESMP.

1. INTRODUCTION

1.1 Background

Agriculture is one of the four core pillars that were targeted in the Bottom-Up Economic Transformation Agenda (BETA) by the Kenya Kwanza Government with an objective of economic turnaround and inclusive growth through a value chain approach which would bring down the cost of living, eradicate hunger, create jobs, expand the tax base, improving foreign exchange balances and inclusive growth. Potato (*Solanum tuberosum* L) is one of the main staple food crops in Kenya and second most consumed crop in the country after maize. The potato value chain employs over 3.5 million actors, contributing over KES 50 billion to the economy. In view of the above, the Government of Kenya included potato in the Big 4 Agenda under the pillars of food nutrition and security. The primary goal was to enhance large scale food production, drive smallholder productivity, and reduce the cost of food to improve accessibility to all (The National Potato Strategy 2021-2025). In summary, potatoes produced locally do not fully meet consumption demand therefore not fully utilized in other industrial areas. KALRO is looking forward to test a variety of potatoes for animal feed.

Growing of potatoes in Kenya and many parts of the world is faced with disease and pest challenges, including the most serious disease known as late blight (LB). Growers control the late blight through calendar sprays; they do not wait for the disease to set since it can lead to total crop failure. Scientists have tried to get natural resistance from existing potato and its relatives through traditional breeding techniques but little success has been released. However, through the use of modern biotechnology, resistance to LB disease has been successfully conferred to potato varieties.

Biotechnology is mostly utilized for crops such as canola, maize, soybean, and cotton varieties. In 2018, biotechnology was used in 48% of these four crops' worldwide. (Brookes & Barfoot, 2020). Even while GM technology is not as frequently applied to specialized crops, when applied properly, it offers a chance to alleviate the world food issue. The world food system is facing serious challenges from a fast-growing population, climate change, and agricultural pests including weeds and insects. The world food

system as it exists now cannot last. At the nexus of long-term viability physical well-being and nourishment lies the discipline of dietetics. Understanding the status of the global food system as well as the customs and technological advancements that impact it is therefore essential. While biotechnology provides various benefits, there have been concerns on potential ecological and societal consequences that require thoughtful consideration. As such, this study will focus on exploring environmental and social impacts of GM potatoes.

1.2 Biotechnology Developed Potato

1.2.1 Biotechnology Developed Potato with Resistance to Late Blight Commercialization Progress

The potato variety intended for introduction has been developed through modern biotechnology by introducing three LB resistance genes derived from wild relatives of the potato (*RB, Rpi-blb2* genes from *Solanum bulbocastanum* and *Rpi-vnt1.1* gene from *S. venturii*) into the farmer and consumer preferred variety Shangi. Transgenic events of the so-called 3R-gene LBR potato varieties have been tested in the lab, greenhouse, and confined fields (CFTs) supervised by the National Biosafety Authority (NBA) in accordance with the Biosafety Act 2009. Similar and replicate trials have also been carried out by the proponents in Uganda and Nigeria, and by other teams in Bangladesh, Belgium, Indonesia, Ireland, Sweden, The Netherlands, United Kingdom, and the United States of America.

In the USA, one LB resistant variety is currently cultivated and consumed while others are in the process of being released. In Kenya, phenotypic characterization, and agronomic performance in field conditions were tested in three locations over three (3) seasons in Muguga in Kiambu County, Njabini in Nyandarua County and Molo in Nakuru County with oversight of the National Biosafety Authority (NBA) and Kenya Plant Health Inspectorate Service (KEPHIS). Approvals were made for the confined field trials in which suitable varieties that will be availed to farmers were selected. The selected transgenic events are considered as essentially derived varieties since the variety they were derived from (*Shangi*) is already being cultivated by farmers using multiple

fungicide sprays for LB disease control. The Project will commence upon approval by the National Biosafety Authority (NBA) and the construction phase will entail evaluation of the candidate variety by KEPHIS. All other requisite approvals including import permission and those required by potato growing Counties and other laws implemented by other Government Agencies will be sought prior to and during cultivation and use. The proponents will comply with existing laws that pertain to use of modern biotechnology.

1.2.2 Commercialization

The Environment Management and Coordination Act EMCA 1999 (Amended, 2015), requires that plant varieties that are modified or transformed using modern biotechnology (GM technology) must undergo environmental and social impact assessment (ESIA) before introduction into the environment. In addition, the Legal Notice 150 of 19th August 2016 lists major developments in Biotechnology including the introduction and testing of Genetically Modified Organisms (GMOs) as high-risk projects that require full ESIA study.

Consequently, the requirement for a full ESIA study is mandatory. The proponents have carried out a full ESIA study for the proposed introduction of potato with resistance to Late Blight (*Phytophthora infestans*) developed through modern biotechnology for cultivation and have prepared this report in this regard.

Potato Late Bright (LB) is managed by growers through calendar fungicides sprays which are programmed to be applied before the disease sets. A study carried out by Scientists from Jomo Kenyatta University of Agriculture and Technology (JKUAT) in Kinangop, Nyandarua County, farmers reported that they sprayed from twice a month during the dry season up to thrice a week during the wet season with, alternating nine different fungicides. Some of the sprays used are copper-based fungicides which were due to be banned by 2002 due to their damage to the environment. However, due to lack of alternatives to synthetic fungicide or LB resistant varieties, their phasing-out has been delayed in the EU until better control solutions are available.

The introduction of LB resistant potatoes will lead to reduction of exposure to fungicides with positive impact on the fauna and flora in the environment. There are other indirect social and environmental benefits anticipated in reduced fungicide uses which include reduced fossil energy used in chemical synthesis, improved road infrastructures from factories to farmers with a reduced impact of agriculture on global warming and creation of value addition facilities such as cold storage rooms. It shall also be more economical to grow potatoes with reduced production costs, improve the farmers' health with reduced exposure to agro-chemicals among other benefits. In conclusion, the genetically engineered potatoes used in the present trial pose no risks to human health and the environment.

2. PROJECT DESCRIPTION

2.1 Proponent

Whereas the introduction of plant varieties is undertaken by the Cabinet Secretary in charge of Agriculture, this application is provided to NEMA, by the Kenya Agricultural and Livestock Research Organization (KALRO), African Agricultural Technologies Foundation (AATF) and the International Potato Centre (CIP), based in Nairobi Kenya, being the ESIA proponents.

2.2 Background

2.2.1 Project Initiation

The Project will be initiated through an application to the National Biosafety Authority – NBA, who are mandated by the Biosafety Act to approve the biosafety of the introduced genes and the proteins they confer. After the approval by the NBA, at least one variety, possibly two and later more, will be selected and presented to the Kenya Plant Health Inspectorate Service - KEPHIS, for testing as essentially derived varieties in suitable agro-ecologies in accordance with the Seeds and Plant Varieties Act to confirm their yield potential for different potato growing agro-ecological zones. After the determination of the suitability of the 3R variety by KEPHIS, the successful candidate 3R variety will be presented by KEPHIS to the National Variety Release Committee – NVRC convened by the Cabinet Secretary in charge of Agriculture, for consideration and listing in the Plant Variety Catalogue. When the varieties are listed, the Project will be commissioned for those willing to cultivate them to do so (in a similar manner that a complete building can be occupied by those willing to be tenants). It is expected that the potato will be grown in all potato growing zones alongside other varieties as is the case currently where many potato varieties are grown together. It is noted that varieties listed in the National Variety Catalogue are availed only to those willing to use them and there is no guarantee that a listed variety will ever be planted by growers.

2.2.2 Objectives

The project has two objectives;

i. Successful generation of suitable data to support Environmental and Social Impact Assessment and compliance under Environmental Management and Coordination Act (EMCA).

ii. Commission suitable varieties as will be listed in the National Variety Catalogue by the Cabinet Secretary in of charge Agriculture, to provide growers with alternative control for LB in potato.

2.2.3 Duration of the Project

The Project will take three steps including: initiation through an application to the NBA (190 days – Approx. 7 months), determination of performance of candidate 3R variety by KEPHIS (for essentially-derived variety: One (1) growing season – Approximately six (6) months) and listing of the candidate(s) in the National Variety Catalogue by the Cabinet Secretary in charge of Agriculture (Approximately 6 months) upon which the 3R variety will be Commissioned. This is expected to therefore take approximately twenty months.

2.2.4 Project Counties

The proposed project is located in the territory of the Republic of Kenya. After Commissioning, the 3 R-gene LBR biotech potatoes will be grown in the main potato growing Counties of Bomet, Bungoma, Elgeyo-Marakwet, Kiambu, Meru, Embu, Kirinyaga, Nakuru, Narok, Nyandarua, Nyeri, Taita-Taveta, Tans- Nzoia, Uasin Gishu and West Pokot but may include agro-ecological zones within the altitudes between 1,500 and 2,800 m above sea level.

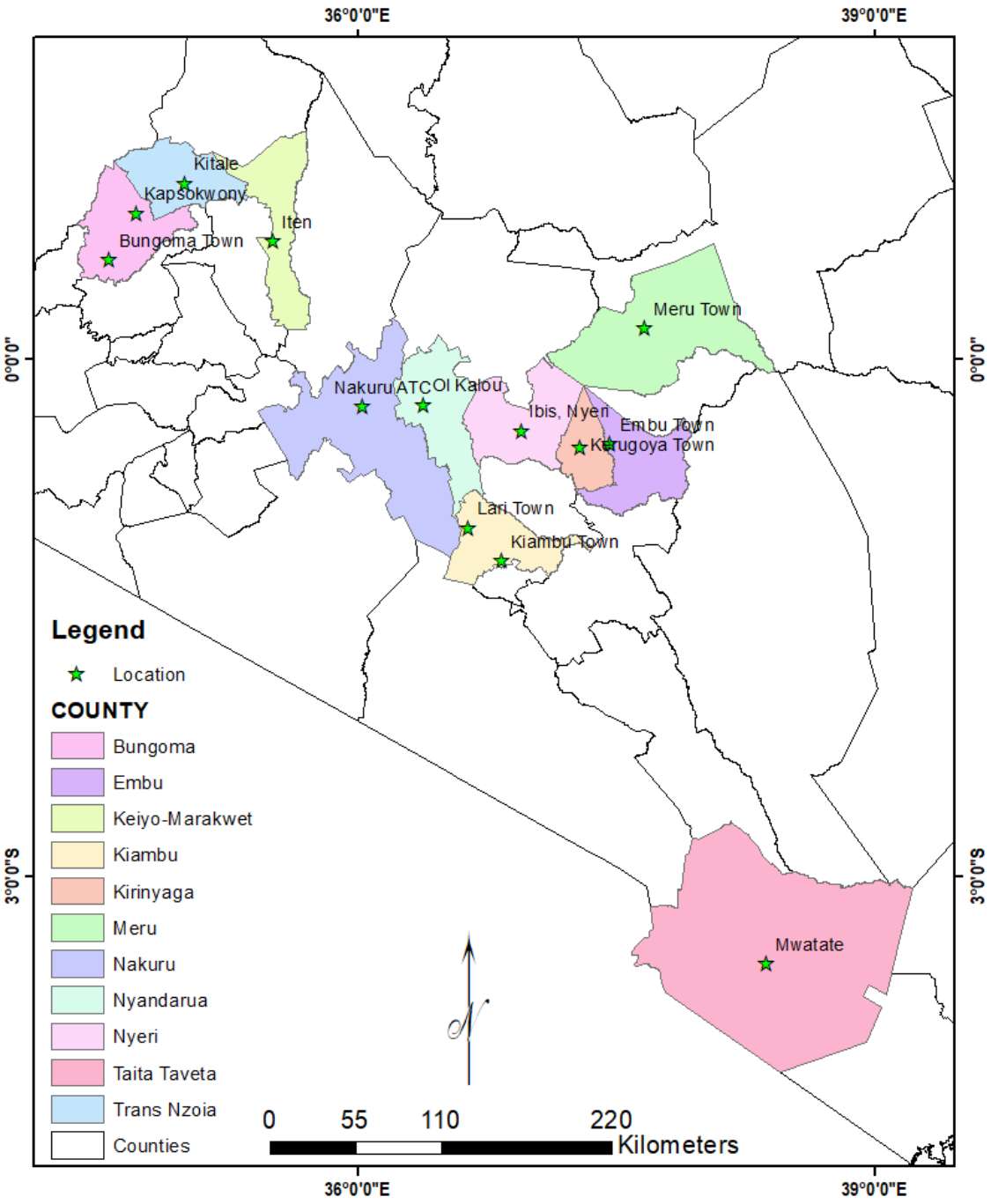

Figure 2-1: Potato Growing Counties in Kenya and stakeholders' meetings location

2.2.5 Project Budget

The initiation application fees payable to the NBA, including advertising in the media and conducting risk assessment is Kshs. 2,000,000. The cost of field evaluation payable to KEPHIS for one season for one variety is Kshs. 175,000 while listing in the National Variety Catalogue (NVT) is not borne by the proponent. The estimated cost of the project is therefore Kshs. 2,175,000 including foreseeable incidental costs.

2.2.6 Project Teams

The project engaged the services of NEMA accredited experts from the KARI Land Resources and Analytical Services to generate an ESIA Study Report in accordance with the NEMA regulations. A technical team of the project proponent, collaborators and the ESIA team of experts will be working with the NEMA, KEPHIS and NBA to meet regulatory compliance objectives and sustainability of the project.

2.3 Project Activities

2.3.1 Project Initiation

i. Submission of ESIA report and ESIA License by NEMA

ii. Development of Application and submission by the proponent for Approval by NBA,

2.3.2 Project Construction

This will not be a construction in the sense of an infrastructure project but will involve field evaluation/confirmation of candidate varieties. Activities will include:

i. The Proponent will provide NEMA ESIA and NBA Approval to KEPHIS

ii. The Proponent will provide adequate seeds to KEPHIS in the months and quantities provided in the Seeds and Plant Varieties Act (National Performance Trial) regulations.

iii. KEPHIS will evaluate the 3R-gene LBR variety in suitable agro-ecological zones representative of the potato growing areas for one growing season since they are already being grown in the conventional form by farmers essentially derived variety as per the KEPHIS Guideline, requiring one growing season.

iv. KEPHIS through the National Performance Trial Committee (NPTC) will determine whether the candidate variety is successful and make recommendation for the listing in the National Variety Release Catalogue.

2.3.3 Commissioning of the Project (Varieties)

KEPHIS will present the 3R-gene LBR biotech Potato variety recommended by NPTC to the National Variety Release Committee – NVRC hosted by the State Department of Agriculture. The Cabinet Secretary in charge of Agriculture will Commission the new 3 R-gene LBR biotech potato variety by causing them to be listed in National Variety Catalogue, through a notice in the Kenya gazette.

NB: Not all listed (Commissioned) varieties get to be grown.

2.3.4 Decommissioning of the Project

The products introduced through this Project, i.e. the 3 R-gene LBR biotech potato variety will be decommissioned if more than 50% of the crop loses resistance to late blight. The duration of this possibility is not known but will be informed by KEPHIS seed post control monitoring and proponents' monitoring teams but not earlier than the period provided in the Biosafety Act, usually after ten years of introduction when new information should be provided for renewal of the biosafety approval. There will be an appointed steward team whose responsibility is on monitoring and progress reporting. There is a product recall mechanism in place by the developer presented by the regulators in case of product fail, they do not have to wait for 10 years to elapse. Exclusive and non-exclusive rights will be controlled/ owned by KALRO.

2.4 Project Compliance Requirements

The Commissioning of new crop varieties in Kenya must comply with the Seeds and Plant Varieties Act Cap 326 and also the Union for the Protection of New Plant Varieties Treaty – UPOV for which Kenya is a signatory. Varieties that are modified using modern biotechnology must also undergo risk assessment within the scope of the Biosafety Act.

2.5 Scope of ESIA Study

2.5.1 Purpose

The project is proposed to commence in 2024 and therefore, there is need to carry out an Environmental and Social Impact Study to identify gaps in Environmental and social management measures and therefore propose appropriate mitigation measures to ensure sustainability.

2.5.2 ESIA Study Specific Objectives

The ESIA Experts are expected to prepare and submit a Study Report consistent with the relevant clause(s) of the environmental law and/ or regulations guided by the following;

i. Prepare a detailed description of the proposed introduction of transgenic potato with resistance to potato late blight, in consultation with Global Biotech Potato Partnership - GBPP Project team in Kenya.

ii. Prepare a detailed description of the proposed agro-ecologies for introduction of the late blight resistant potato variety in liaison with KEPHIS.

iii. Identify potential environmental impacts likely to arise during or following introduction for cultivation and use, of the late blight resistant potato variety in Kenya.

iv. Propose mitigation measures to potential environmental and social impacts that could be associated with the introduction of late blight resistant potato variety in Kenya.

v. Develop environmental and social management and monitoring Plan for the proposed introduction of the late blight resistant potato variety in Kenya.

vi. Review relevant laws and regulations including; recommendations for project implementation.

vii. Submit a detailed ESIA Study Report to NEMA for review and approval.

viii. Undertake environmental audit within the time to be stipulated in the ESIA License.

2.5.3 Output of this ESIA Study

i. Detailed methodology, approaches, data collection tools, public participation methodology and processes.

ii. A comprehensive baseline report.

iii. The data collection tools used, raw data and analyzed data in soft copy including; tables as collected and captured in electronic format using an agreed upon database management software.

iv. Stakeholders' engagement workshop to review the draft ESIA Study report.

v. Submission of final ESIA study report in prescribed format for submission to NEMA.

2.6 Advantages of The Late Blight Resistant Potato Developed Through Modern Biotechnology

The late blight resistant potato will be grown alongside other existing varieties and will therefore not replace any preferred variety. It will only give farmers an additional option in their production tools to enhance food security. Since farmers spray potatoes routinely and also lose their harvest when they do not spray, there are obvious benefits from this new variety.

i. Improved crop quality.

The damage by late blight disease affects the quality of the tubers including rotting from infection sites. This will be eliminated so that farmers can have healthier tubers and plants.

ii. Time saving on labour

Time spent by farmers in spraying will be used for other ventures and will likely lead to better farm productivity.

iii. Improved health and safety for farmers and farm workers

Pesticide usage will be reduced by adopting the late blight resistant potato. This will translate to less chemical exposure and therefore better health and savings by farmers by spending less money in buying pesticides.

iv. Reduced negative environmental impact

Pesticides affect flora and fauna in the environment. Therefore, by reducing their usage, biodiversity and ecological integrity will be sustained; hence more beneficial organisms and healthier environment will be realized.

v. Income to farmers

The money saved from reduced pesticide sprays, the enhanced yields due to disease protection and the additional time available to farmers would lead to additional income to farmers. The potato value chain will become more vibrant since more LB resistant potato could be available where more farmers would improve their livelihoods.

vi. Increased yields

This would enable Kenya to attain improved food security by protecting crops against late blight diseases.

vii. Reduced use of chemical pesticides/insecticides.

Farmers are already growing Bt cotton which has reduced sprays for cotton boll-worms. Potatoes with resistance to late blight will lead to reduced spraying with fungicides because the crops produce their own fungicidal protection.

viii. Knowledge transfer to farmers.

KALRO intends to indulge the potato farmers in the regions selected for the study. Their engagement will contribute to knowledge transfer from the experts who will be foreseeing the study process elaborating the performance of the existing potato varieties vis a vis the improved ones.

2.7 Environmental and Social Impacts of Genetically Modified late blight resistant potato

The potato in this project has been modified using modern biotechnology to address the challenge of late blight disease. The disease, if not controlled can lead to 100% crop failure. Due to the newness of Modern Biotechnology that produced genetically modified crops, social impacts or perceptions of the same require to be outlined. These social and environmental concerns are discussed below: -

Positive Environment impacts;

i). Reduced pesticides use

Phytophthora infestans, the causal agent of late blight (LB), is a severe threat to Kenyan potato production, resulting in crop losses that vary between thirteen to sixty percent. If GMO potatoes are engineered to resist pests, chemical pesticides to control the late blight disease may be unnecessary. As a result, there may be fewer pesticide residues in the environment, less risk to species that are not intended targets, and a lower likelihood of chemical discharge into waterways. [1]Studies indicate that GM Potato can help cut pesticide use by up to 90%. In field testing, the genetically engineered potato variety has shown unparalleled resistance to late blight, according to numerous researchers in a report (Wall-Y, 2024).

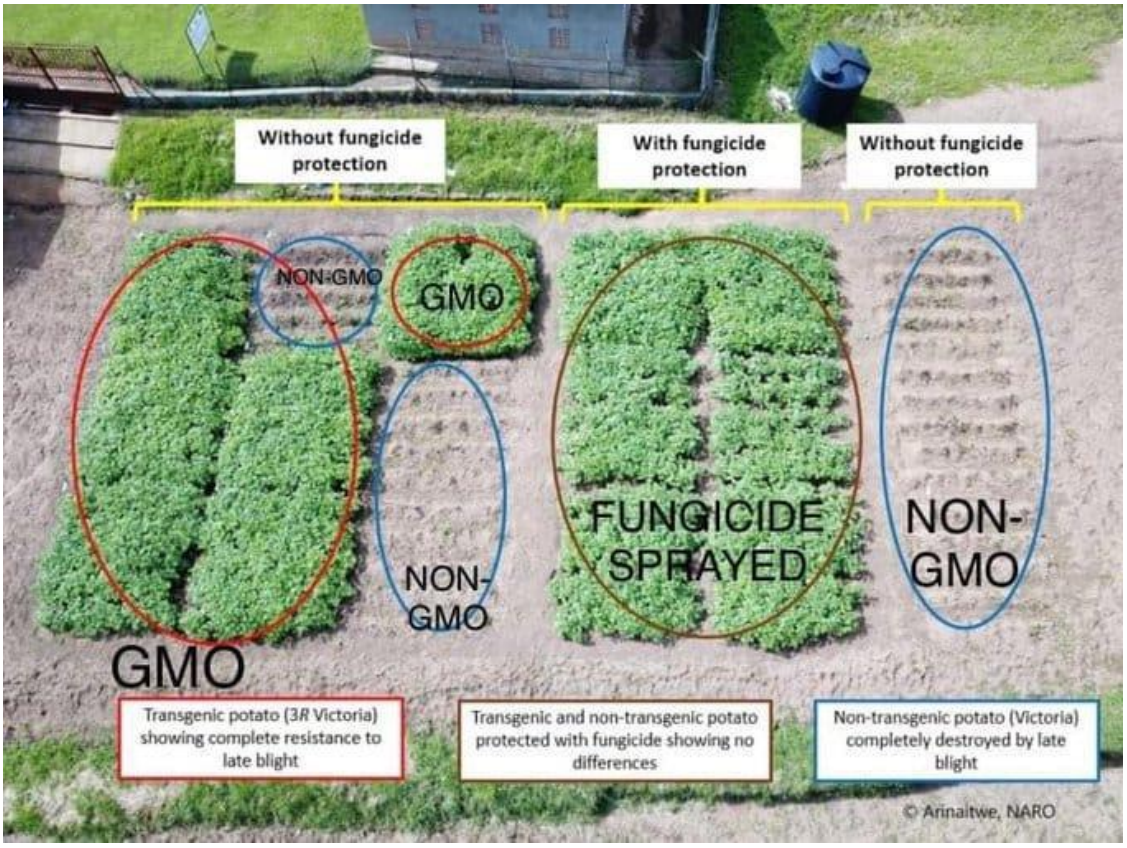

Figure 2-2: Efficacy and Regulatory Trials in Uganda 2019

The strain of the modified potato was compared in these field experiments, which were conducted in Uganda over the course of three seasons at three separate sites. Unlike the unmodified variety, where plants withered 60–80 days after planting, the modified variety showed complete resilience to LB throughout the growing period (Figure 2-1).

Spray-induced gene silencing as a novel approach to combat *Phytophthora infestans*, the pathogen responsible for late blight in potatoes. Furthermore, the potential of using RNA interference (RNAi) techniques to selectively silence genes critical for the pathogen's virulence and survival. By applying RNAi molecules via foliar sprays, the research demonstrates how this method can effectively reduce pathogen growth and mitigate disease symptoms in potato crops[1].

ii). Disease resistance

[1] Sundararajan, P. (2024). Spray Induced Gene Silencing in Phytophthora infestans.

This decreased need for fungicides spraying will lead to reduction in pollution in the air, thus promoting clean air and a healthier environment.

iii). Improved Yield

Increased resistance to pests and diseases can lead to improved yields or saved yields, thereby lowering the need to convert more area to agriculture. This can assist to conserve natural areas and biodiversity.

Potential negative impacts;

i. **Biodiversity loss:** Increased adoption of disease resistant potatoes and its widespread planting due to the advantage will now replace the obsolete late blight susceptible variety which will result in no loss or gain of biodiversity. The increased production per unit area may result in less land requirement which will reduce biodiversity loss.

ii. **Ecosystem disruption:** Late blight resistant potato will be grown alongside other varieties and farmer education will be required to assist farmers to differentiate the 3R-gene LBR resistant ones from the traditional variety. The reduced use of fungicide will not impact negatively on the ecosystem.

iii. **Resistance Development:** Although disease resistance breakdown is not expected to happen soon, the promise to farmers will require to be sustained through disease resistance management to prevent creating disillusion. Chances to overcome the 3 LBR gene is very remote whilst there are many gene editing possibilities available for exploitation already being explored at KALRO.

Potential social impacts;

Positive impacts;

Food security: genetically modified late blight resistant potatoes will result to increased yields because of reduced losses, enhancing food security.

Plate 2-1: Yield comparisons from 3 R-gene LBR potato vs non-GM potato in Indonesia 2022

Global potato production is severely hampered by late blight, which is projected to cause losses and management expenses of over $6 billion annually (Yuen, 2021). The image depicts the disparity in yield between standard and LBR potato varieties.

i. **Enhanced nutritional content:** Farmers and users will have more available staple foods due to increased potato yields, thus enhancing food and nutritional availability.

ii. **Increases economic benefits:** The late blight resistant potato will reduce losses caused by late blight disease and need for spraying. This will lead to increased production at lower cost and hence increased income for farmers.

Development of Bio Granola Using genetic engineering in Indonesian potato resistant to late blight caused by *Phytophthora infestans*.**,** improved the crop's durability against the disease. Key benefits included reduced use of fungicide and enhanced stable yields[2].

Potential Negative impacts;

i. **Cultural resistance/ Acceptance:** There is a gap in public awareness about the benefits of late blight resistant potato creating a perception that may affect its marketability opportunities. There is need for sufficient awareness and information to farmers.

ii. **Creating economic disparity:** The farmers adopting the 3R-gene LBR potato will be better off than the non-adopters. However, this may create disparity if misinformation continues to spread creating fear among some farmers.

iii. **Seed Access:** Farmer education will be required to ensure continuous seed availability without loss of the disease resistance trait. Potatoes are vegetative reproductive crops; certified seed generation will move from growers to the market.

iv. **The cost of introducing a genetically modified crop** compared to the conventional crop is slightly higher and this cost may be passed on to the farmers and users. This will however be regulated by relevant authorities including KARLO.

2.8 Recent development breeding of Genetically Engineered Indonesian Potato

The CRISPR/Cas technology to improve potatoes by enhancing disease resistance, nutritional value, yield, and stress tolerance. However, challenges include the potato's genetic complexity, potential off-target mutations, and regulatory hurdles. However, further research is needed to address these challenges and promote wider adoption[3]. Insights into the future potential of CRISPR in transforming potato breeding programs,

[2] Hadiarto, T., & Ambarwati, A. D. (2024). Breeding of Genetically Engineered Indonesian Potato, Bio Granola, Resistant to Late Blight Pathogen Phytophthora infestans. Potato Research, 67(2), 695-709.
[3] Beniwal, D., Chauhan, S., & Dhillon, H. K. (2024). Genome Editing in Potato Using CRISPR/Cas Technology: Applications and Challenges. Genetically Modified Organisms, 63.

improving crop quality, and ensuring food security. In addition, other studies highlight the use of molecular tools such as marker-assisted selection and genome editing technologies such as the CRISPR, to enhance disease resistance. They emphasize combining traditional breeding with biotechnological innovations for sustainable solutions. Challenges include pathogen evolution, the polyploid nature of potatoes, and regulatory issues surrounding genetically modified crops. Therefore need for an integrated breeding approach to achieve long-term resistance and ensure food security[4].

The role of potato genetics in enhancing crop improvement efforts, complex polyploid genome of potatoes aids in developing varieties with better yield, disease resistance, and stress tolerance. Key strategies include the use of traditional breeding, molecular markers, and genomic selection to accelerate improvements. This will enhance importance of wild potato relatives as genetic resources for introducing valuable traits[5]. Similarly, nutritional and anti-nutritional profiles of transgenic potatoes engineered for late blight resistance. The study analyzes key compositional elements, focusing on their implications for human health and agricultural sustainability[6]. However, potential of CRISPR/Cas to create potato varieties with tailored disease resistance but also raise concerns about the balance between susceptibility to different pathogens[7].

Recent research indicate that the application of fungicides can significantly influence the nutritional quality of potatoes by altering carotenoid concentrations, which are essential for human health due to their antioxidant properties. The study indicates that while fungicides can help manage diseases and improve yield, they may also have implications for the nutritional value of the harvested tubers[8].

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[4] Berindean, I. V., Taoutaou, A., Rida, S., Ona, A. D., Stefan, M. F., Costin, A., ... & Muntean, L. (2024). Modern Breeding Strategies and Tools for Durable Late Blight Resistance in Potato. Plants, 13(12), 1711.
[5] Bradshaw, J. E. (2024). Potato Genetics for Crop Improvement. In Approaches for Potato Crop Improvement and Stress Management (pp. 1-27). Singapore: Springer Nature Singapore.
[6] Moyo, M., Magembe, E., Mwaura, L., Byarugaba, A. A., Barekye, A., Nyongesa, M., ... & Ghislain, M. (2024). Nutritional and anti-nutritional compositional analysis of transgenic potatoes with late blight resistance. Frontiers in Bioengineering and Biotechnology, 12, 1432079.
[7] Nourozi, M., Nazarain-Firouzabadi, F., Ismaili, A., Ahmadvand, R., & Poormazaheri, H. (2024). CRISPR/Cas StNRL1 gene knockout increases resistance to late blight and susceptibility to early blight in potato. Frontiers in Plant Science, 14, 1278127.

[8] Tatarowska, B., Milczarek, D., & Plich, J. (2024). Changes in the content of carotenoids in potato tubers cultivated with or without the application of fungicides. Crop Science.

2.9 Conclusion

Late blight resistant potato possesses potential to give significant environmental and social benefits discussed above such as improved food security, lower human-wildlife conflict, lower pesticide uses and increased incomes. A recent Kenyan study on *ex-ante* benefits derived from cultivation of the 3R-gene LBR potato variety showed an annual benefit estimated at KES 845.9 million[9] The identified potential impacts such as cultural acceptance, economic disparity and increased seed costs will be remedied through proposed mitigation measures such as inclusive policy making, seed access program, capacity building and awareness campaigns. Overall, the benefits of the late blight resistant potato far outweigh the potential negative impacts.

[9] Kihiu E., Ghislain M., Anthony Kibe A.M., Nancy N., Gatto M., and Falck-Zepeda J.B., 2024. Ex ante economic impact assessment of the 3R-gene LBR potato in Kenya. PLOS One, *in press.*

3. BASELINE INFORMATION

3.1 Project Location

After Commissioning, the 3R variety will be grown in the Potato growing areas of Kenya including the Counties of Bomet, Bungoma, Elgeyo-Marakwet, Kiambu, Meru, Embu, Kirinyaga, Nakuru, Narok, Nyandarua, Nyeri, Taita-Taveta, Tans- Nzoia, Uasin Gishu and West Pokot but may include agro-ecological zones within the altitudes between 1,500m and 2800 m above sea level. The potato growing counties are in productive area with conducive agro-ecological zones within the main water towers as indicated in Figure 3.1 below.

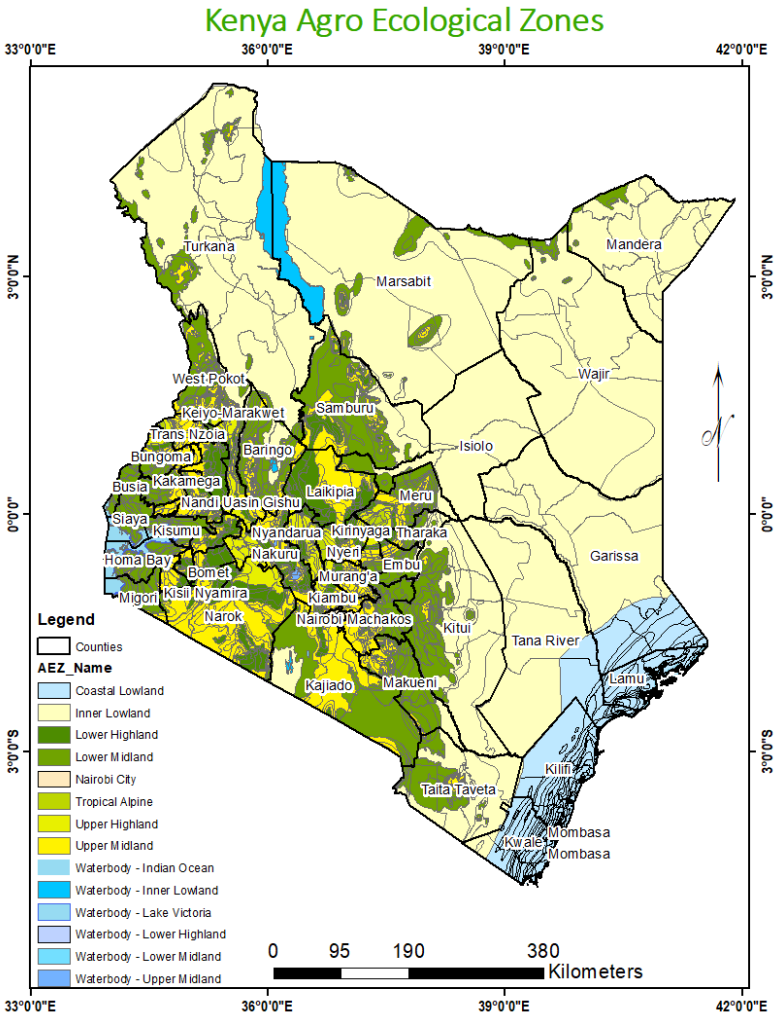

Figure 3-1: Agro-ecological zones in Kenya

3.2 Baseline Information of the 15Potato-Growingg Counties

Fifteen counties that are main potato producing were reviewed based on the Physiological and Topographical Features, Biodiversity and Climate Change impacts, and Socioeconomic aspects (table 3-1 below).

Table 3-1: Baseline information of the 15 counties growing potatoes

Physiological and Topographical Features	**Biodiversity and Climate Change impacts**	**Socioeconomic**
1. Elgeiyo Marakwet County		
The county is divided into three topographic zones namely: Highlands, Kerio Valley and Escarpment: all of them separated by the conspicuous Elgeyo Escarpment. Each of the three zones has attracted a different settlement pattern. The Highlands, which constitute 49 percent of the county area, is densely populated	Wildlife - The area has wildlife such as monkey, birds (horbil, eagle). These are the tourism attraction resources. Cherang'any ecosystem has over 73 forest-dependent species, none of which is presently globally threatened. Major threatened species include; *Gypaetus barbatus, Stephanoaetus coronatus, Glaucidium tephronotum, Campephaga quiscalina both found in Kapkanyar and Indicator conirostris. Non-bird fauna:* The ungulate *Tragelaphus*	The major land use in the County is mainly agricultural activities. Other uses include residential, commercial, industrial, recreational, educational, public purpose and public utility, and forest conservation. A majority of the County residents are small scale Farmers with an average of 2.9 hectares mostly used for food and

due to its endowment with fertile soils and reliable rainfall. The Escarpment and the Kerio Valley make up 11 percent and 40 percent respectively. These areas have low rainfall and are prone to natural disasters such as drought and landslides. Due to these harsh climatic conditions coupled with high levels of insecurity, these areas have high poverty levels and sparse population.	*eurycerus, Capys juliae* (butterfly) is endemic to the area. *Senecio johnstonii battiscombei var*. *Cherang'anyensis* and S. *johnstonii battiscombei var. dalei*, are endemic in the area. Elgeyo Marakwet ranks second County in Kenya with the largest Forest cover at 37%, The forest provides firewood, honey, herbal medicine, Shrine for prayers, circumcision sites. The forest has a lot of local trees for example Elgon teak, *Prunus africana*, muna, komm, mkorombozi (rose wood) Kaisakat, and wild fruits. Mkorombozi and Elgon teak are used for furniture. Botanical names of main tree species in the area include: *Podocarpus latifolius, Juniperus–Nuxia–Podocarpus falcatus, Juniperus–Maytenus undata–Rapanea–Hagenia, Cyathea manniana, Arundinaria alpine, Acacia abyssinica*, *Lobelia aberdarica* and *Senecio johnstonii.*	cash crop farming. Large scale farmers own an average of 6.7 hectares. The mean holding size in the county therefore is 4.8 hectares. The county has over 70 active cooperatives spanning different sectors. They include 45 Savings and Credit Cooperative Organization (SACCOs) classified as Rural SACCOs, Youth SACCOs, Matatu SACCOs, Urban SACCOs and Housing SACCOs. Similarly, there are 32 agro-based Cooperative Societies, i.e. Dairy Cooperatives, Coffee Marketing Cooperatives, Horticulture Cooperatives, Wool Marketing Cooperatives and Tea Marketing Cooperatives.

	Erratic rains, extreme temperatures and cyclic and prolonged droughts characterize the County. The variations in intensity and frequency of the droughts and floods may be manifestations of climatic changes whose full impacts are yet to be understood. The Sengwer people (also known as Cherang'any and previously as Sekker, Siger, Sigerai, Segelai, Senguer, Senguel, and Jangwel) are an indigenous community who primarily live in the Embobut forest which covers part of Elgeyo-Marakwet County.	
2. Bomet County		
A large part of the County is characterized by undulating topography that gives way to flatter terrain in the south. The overall slope of the land is towards the south, except the north eastern part which rises eastwards towards the	The county borders a long stretch of Mau Forest which is an indigenous forest and home to different species of animals and plants. However, due to human encroachment, animal life is threatened and certain species of animals, birds, insects and plants are already extinct. Rainfall in the county is highest in the lower	Agriculture is the main economic activity with over 80% of the total population engaging in crop and livestock production. The sector also provides raw materials to agro based industries in the county and therefore stimulates off-farm employment as

3,000m high Mau Ridges. The land slopes gently from Kericho Plateau to about 1,800m in the lower area where the land is generally flat with a few scattered hills in Chepalungu and Sigor plain.	highland zone with a recorded annual rainfall of between 75mm and 245mm. The upper midland zone which lies west of the Rift Valley experiences uniform rainfall while the upper midland zone on the southern part of the county experiences low rainfall. Forest cover has improved from 13% to 24.28% against a target of 22% from 2023. This is attributed to contribution from the county government and partners, Kenya Forest Service (KFS) and KEFRI that saw the planting of over 3.5 million trees. In addition, tree cover increased from 17.1% to 26.78% against a target of 19%. This is attributed to countywide environmental education and awareness, involvement of public institutions, Water Resources Users' Association (WRUAs) and CBOs. To protect riparian zones, the sector successfully planted bamboo along the riparian zones that saw an area coverage protected from 20% to 25%.	well as the use of local resources. Despite the county's favorable climatic conditions, 31% of the population lives below the national poverty line. In spite of good rains and soils, food insecurity is a critical issue in Bomet County with approximately 36.2% of households being considered food-poor. The county has a monetary poverty rate of 47.7% which is 12% higher than the national monetary poverty rate of 35.7%
3. *Bungoma County*		

The County lies within the Lake Victoria basin, rising from 1200M in the West and southwest to over 4000m to the North of Mt. Elgon. Apart from Mt Elgon, the rest of the County is underlain by granite which forms the basement system. The forest cover of the gazetted forest in Mt. Elgon is at 14.29%, whereas tree cover which represents trees on farm lands and trees in areas outside the gazetted forest stands at 7.9%. Mt Elgon forest Ecosystem support life systems in the County through hydrological cycle and plant production. The forests also provide soil nutrients through decomposition of biomass, consequently	The County covers a land area of 3,024 km^2, of which 618 km^2 is gazetted forest reserve (the Mt. Elgon Forest reserve), 61 km^2 is non-gazetted forest, and 50.7 km^2 is Mt. Elgon National Park. The altitude of the County ranges from 1,200m to 4,321m above sea level. The County's major physical features include Mt. Elgon; Chetambe, Sang'alo, and Kabuchai Hills; the Nzoia, Kuywa, Sosio, Kibisi and Sio-Malaba/Malakisi Rivers; and waterfalls like Nabuyole, Malakisi and Teremi. The County's topography is scenic and is home to tourist attraction sites, for instance, Mount Elgon forms one of Kenya's five water towers. Wind energy can be tapped in the hills and mountain top. However, the steep terrain in the highland areas of the County constrains infrastructural expansion. There is soil erosion during heavy rains from Mount Elgon slopes and other hilly areas. This is caused by human encroachment and poor farming practices on these fragile sites. The low-lying areas such as Bumula experience flooding from run-off from the hilly areas. Bungoma	The main economic activities are agriculture and transport and storage which contribute the most to the Gross County Product at 44.2% and 11.6% respectively. Other activities include public administration and defense, education, water supply and waste collection, wholesale and retail, real estate activities, Manufacturing, and construction. This is according to the contribution of the various economic activities in the County. The County is a member of the Lake Region Economic Bloc (LREB) which has a membership of 14 counties whose main objective is to have an integrated approach in

supporting both soil and terrestrial life. It should be emphasized that that the Mt. Elgon ecosystem is one of the five major water towers in the Country and is a source of many rivers that form the Lake Victoria basin which is a source of the River Nile.	houses Kitum cave where it is one of five named "elephant caves" of Mount Elgon where animals, including elephants, have been "mining" the rock for its sodium rich salts. The annual average temperature range for Bungoma is between 10-25°C with the annual average precipitation in the County being 1100-1700 mm. Most of the County receives an annual average precipitation of more than 1400 mm. The eastern part of the County, primarily Tongaren and Webuye sub-counties, is the driest, receiving less than 1000 mm of average rainfall every year. There has been a notable decline in maize, sorghum, and sweet potato production. The decline is attributed to changing weather patterns, shift in production to sugarcane in Tongaren and Mt. Elgon, the high cost of inputs and the low adoption of good agricultural practices.	bringing together all the available resources, identify opportunities and purposefully have all policies, programs and activities in the Lake Region aligned towards raising and sustaining the quality of peoples' life and ecosystems. The monetary poverty rate for Bungoma is 35.5% which is nearly the same as the national rate of 35.7% with approximately 525,509 people in the County being monetarily poor.
4. ***Kiambu County***		

Kiambu County is divided into four broad topographical zones; Upper Highland, Lower Highland, Upper Midland and Lower Midland Zones. The Upper Highland Zone is found in Lari subcounty and it is an extension of the Aberdare ranges that lies at an altitude of 1,800-2,550 metres above sea level. It is dominated by highly dissected ranges and it is very wet, steep and important as a water catchment area. The major forests in the County are also found in this zone, which are Kieni and Kinale with an acreage of 13,723.6 and 10, 504.87 hectares respectively. The lower highland zone is mostly found in Limuru and some parts of Gatundu North,	Kiambu is characterised by a variety of vegetation cover. Tree species reported to be dominant are: In low altitude area main species include; Thika Palm, Acacia species, *Azadirachta indica*, *Calliandra calothyrus*, *Senna siamea*, *Casuarina equisetifolia*, *Cordia africana*, *Croton megalocarpus*, *Cupressus lusitanica*, *Eucalyptus* species, *Ficus* species, *Grevillea robusta*, *Sesbania sesban*, *Terminalia brownie*, *Schefflera actinophylla,* and *Spathodea camulanata*, amongst others. This area is situated within a predominantly agricultural area; whereby human activities have altered the natural habitat for wildlife over the years. Consequently, there are no major animals in the environs except birds, insects, and small rodents. Some of the bird species in Kiambaa Sub-County include sparrows, doves and eagles, amongst others. With routinely high relative humidity Figures, Kiambu's climate produces much rain annually. In fact, based on records from the past 50 years, the expected amount of rain could be anywhere in the range of 500 to 1500 mm, with the average reaching about 900 mm. Majority of these	Proximity to the city of Nairobi and adequate transportation has attracted many people working in Kiambu in search of cheaper accommodation. While majority of the population here are formally employed, others are employed in the informal sector. The formal to informal sector employment is projected to change considerably by over the next 15 years (from 1:6.3 presently, to 1:2.5 by 2030). Qualifying as an agro-service town, the economy of Kiambu is characterized by farming and services. While 56.85% of the employed residents in Kiambu work in the agriculture sector another 50.35% are employed in the service (tertiary) sector. The remaining employed are engaged in transportation, manufacturing and

Gatundu South, Githunguri and Kabete sub counties. The area is characterized by hills, plateaus, and high-elevation plains. The area lies between 1,500-1,800 metres above sea level and is generally a tea and dairy zone though some activities like maize, horticultural crops and sheep farming are also practiced. The upper midland zone lies between 1,300-1,500 metres above sea level and it covers mostly parts of Juja and other sub counties with the exception of Lari. The landscape comprises of volcanic middle level uplands. The lower midland zone partly covers Thika Town (Gatuanyaga), Limuru and Kikuyu sub counties. The area lies between	rainfalls occur during the monsoon seasons. The major monsoon season occurs within the months of March to May and is called the "Long Rains". The minor monsoon season occurs within the months of October to December and is called the "Short Rains". The hottest months are January, February and March. The annual average temperature for the county is 15-23°C. The western areas of the county including the upper midland and the lower highland agro ecological zones experience annual average temperatures greater than 20°C. According to Kiambu County CIDP, (2013-2017), the degradation of the environment has resulted in soil erosion and decreased food production. The CIDP also cites is unpredictability of the timing and amount of rainfall received as the main effect of climate change in the County. In 2018, tree cover was at 16.5% and the current is 19.74%. This was achieved through raising and transplanting 556,948 tree seedlings and implementation of transitional Implementation Plan for forestry devolved functions. Mapped, Secured	construction sectors. The County further has quarrying and mining activities taking place such as in Juja and Thika Sub Counties The turnover of the Cooperative movement in Kiambu grew from Kshs. 13.79 billion to Kshs. 14.43 Billion translating to a 5% growth rate. This was attributed to the increased number of registered cooperatives from 553 in 2018 to 697 in 2022.

1,200-1,360 metres above sea level. The soils in the midland zone are dissected and are easily eroded. Other physical features include steep slopes and valleys, which are unsuitable for cultivation. Some parts are also covered by forests.	and Conserved water sources and catchment areas through awareness creation, planting trees in water catchment and riparian areas.	
5. Meru County		
The natural conditions of the county are significantly influenced by its position on the eastern slopes of Mt Kenya and the equator. Altitude ranges from 300m to 5,199m above sea level, which influences the atmospheric conditions and leads to a wide variety of microclimates and agroecological zones. The drainage pattern in the county is	The distribution of rainfall ranges from 300mm per annum in the lower midlands in the North to 2500mm per annum in the South East. Other areas receive on average 1250mm of rainfall annually. There are two seasons with the long rains occurring from mid-March to May and short rains from October to December. Temperatures range from a low of 8ºC to a high of 32ºC during the cold and hot seasons respectively. To ensure well-managed water catchment areas,	The county has high agricultural potential which has attracted various commercial banks and other financial institutions. There are sixteen commercial banks, eight microfinance institutions, four village banks and a number of SACCOs. There are five main urban centres and forty-nine trading centres in the county. Meru Town, Nkubu, Laare, Timau and Maua are the major urban

characterized by rivers and streams originating from catchment areas such as Mt. Kenya and Nyambene ranges in the North of the county. The rivers cut through the hilly terrain on the upper zones to the lower zones and drain into the Tana and Ewaso Nyiro Rivers. The rivers form the main source of water for both domestic and agricultural use.	increased forest cover and remedying impact of climate change through enhancing carbon sinks, 0.013% increase in forest cover was achieved against a target of 1% due to impact of drought and lack of reliable rainfall occasioned by climate change; 7 fresh water and wetlands were rehabilitated, a total of 368,000 trees seedlings were planted and nurtured, 163 Workshops conducted on climate change safeguard mechanisms to increase environmental sensitive communities. 39 hills were gazzeted and 3 forest management plans were developed. A Bamboo and assorted tree nursery at KFS Meru station with total seedling of 14,000 seedlings to support department in reforestations and afforestation of wetlands and riverine was established. The county forest cover totals 1,776.1 km2, which is 25.6 per cent of the total county area. There are ten gazetted forest, with Mt Kenya and Imenti forest being the major ones and occupying 63,358 ha in the county. The ungazetted forests are 19 with 345	centres. The major land use in the county is mainly for agricultural activities for both crops farming and livestock-keeping. Other uses include cultural and forestry conservation. There is large scale farming carried out by private companies in Timau area of Buuri constituency. These are mainly for wheat farming with Kisima farm being the largest in the county. Livestock farming is also being practised on group ranches in Tigania and Igembe areas. The county has a number of factories mainly owned by the various tea, coffee and dairy cooperatives societies that process tea, coffee and milk respectively. The county has adequate raw materials for value addition across

	ha coverage. Encroachment of forested areas has resulted to major human wildlife conflicts in the region such as destruction of farm crops by elephants.	various sectors. With its strategic location, proximity to the LAPSSET and increasing urbanization, this sector stands to boost the economy of the county immensely as a centre of commerce. There are unexploited mineral resources such as iron ore deposits in some parts of the county. Iron is the foundation of industrial development.
6. Embu County		
Embu County is characterized by highlands and lowlands and slopes from North-West towards East and South-East with a few isolated hills such as Kiambere and Kiang'ombe. It rises from about 515m above sea level at the River Tana Basin in the East to 5,199m at the top of Mt. Kenya in the North West. The	The average annual rainfall reflects this contrast: from more than 2200 mm at 2500 m to less than 600 mm near the Tana River at 700 m. The main types of fish in the county include; trout, tilapia, mud fish and cat fish which are available mostly in the hydroelectric dams.	The County is characterized by a predominantly rural settlement pattern. There is a concentration of people along the major permanent water sources such as rivers and dams where irrigation, farming and fishing are carried out. The county has three major urban centres, namely Embu, Siakago and Runyenjes towns. There are also major market

southern part of the county is covered by Mwea plains which rise northwards, culminating in hills and valleys to the northern and eastern parts of the county. There are also steep slopes at the foot of Mt. Kenya. The County is served by six major rivers which are Thuci, Tana, Kii, Rupingazi, Thiba and Ena. There are also some major dams which generate hydroelectric power for the country that are partly in the county. These include Masinga, Kiambere, Kindaruma and Gitaru dams which are situated along the Tana River. The most conspicuous physical features in the county are Mt. Kenya, Kiang'ombe Hills, Kiambere Hills, Mwea Game Reserve, River Tana, Masinga Dam, Kamburu dam, Kindaruma Dam, Kiambere dam and Gitaru dam.	Mwea game reserve is home to species such as the Elephant, lesser kudu, Nile crocodile, hippo, giraffe, Burchell's zebra, buffalo, leopard, grey duiker, black-backed jackal, bushbuck, waterbuck, olive baboon, sykes' monkey, serval cat, spotted hyena, warthog, rock hyrax, bush pig, impala and hartebeest. Rare animals like; Stripped ground squirrel, Genet cat and Black backed jackal yellow baboons. Mwea game reserve is the only protected area in which the globally threatened and Kenyaendemic Hinde's babbler is known to occur. The reserve also shelters two other rare species; Pel's fishing owl and the white-backed night heron. In Mt. Kenya National Park, wildlife species include Elephants, tree hyrax, white-tailed mongoose, suni, black fronted duiker, mole rat, bushbucks, water buck and Elands. Animas rarely seen include leopard, bongo, giant forest hog and rhino. Over 130 bird species are also available in the National	centres like Ishiara, Karaba, Kiritiri, Gachoka, and Kianjokoma. These areas have relatively better developed infrastructure and therefore have good potential for business enterprises. Agriculture is the backbone and livelihood of the people of Embu County. The sector employs 70.1 per cent of the population and 87.9 per cent of the households are engaged in Agricultural activities. The upper part of Embu County relies mainly on cash crops such as coffee and tea while the lower part mainly produces cash crops such as miraa (*khat*) and food crops such as maize, beans, cowpeas, bananas, sorghum, tomatoes, pawpaw, avocado, and citrus fruits. Livestock farming is gaining popularity with the revival of milk cooperatives and investment by the private sector in milk processing plants. Two National reserves namely;

	park.	Mwea and Mt. Kenya that are managed by KWS have great potential for the tourism industry in the county. Other potential tourist attractions include the Nthenge Njeru water falls near Kirimiri.
7. Kirinyaga County		
The County is in the central region, and it covers a total area of 1478.1 km2, of which 308.2 km2 are under forest cover. The total land area under agricultural production is 801.7 km2. Kirinyaga County is home to 610,411 people. The county lies between 1,158 metres and 5,380 metres above sea level in the South and at the Peak of Mt. Kenya respectively. Mt. Kenya which lies on the northern side greatly influences the landscape of the county as well as other	The main tourist attractions in Kirinyaga County are physical attractions (Mt Kenya forest; Mt. Kenya National Park; Daraja ya Mungu ("God's Bridge"); numerous waterfalls; Water sports (Sagana white water rafting). Wildlife in Mt. Kenya Forest. The county has indigenous natural forests covering an area of 35876 Ha. which support eco-tourism product. There are several Heritage and cultural sites including Kirinyaga Mass Grave in Kerugoya; Muringa wa Giacai in Kanyekiini ward 'Darasa ya Ngai' (Gods bridge) in Murinduko ward; Munyu wa Ngungu and	Crops and livestock production account for a significant share of the economic activity of Kirinyaga County. Rice, tea and coffee are the principal crops grown in the County influenced by various ecological zones. Other crops grown include bananas, tomatoes, beans, mangoes and maize, in addition to horticultural crops such as avocados and macadamia nuts. Key agricultural value chain commodities in the County include maize, beans, bananas, kales, sweet potatoes, potatoes, rice, cassava, coffee, macadamia, tea, avocado, mangoes,

topographical features. The mountain area is characterized by prominent features from the peak, hanging and V-shaped valleys. The snow melting from the mountain forms the water tower for the rivers that drain in the county and other areas that lie south and west of the county. The Snow flows in natural streams that form a radial drainage system and drop to rivers with large water volumes downstream	Ngungu fall in Kabare ward; Initial Kabare church; Munyu wa Kabonga in Kabare ward; Castle forest lodge in Kabare ward; Karaba prison; a mass grave site in Wamumu ward; Old structures within Wamumu rehabilitation school; Sagana old bridge in Kariti ward; Mugumo wa Kiini in Kiini ward; Shrine area at Kadongu. Kirinyaga County has also embraced aquaculture; it has 1,281 fishponds (County Government of Kirinyaga, 2018). In 2014, 23 tons of tilapia and catfish were harvested, an amount valued at KSh 7 million. This was an increase over 2013, when 20 tons were harvested, with a value of KSh 6 million (KNBS, 2015). Fishing is also carried in the town of Sagana, which lies along the Tana River; river fisher folk use hooks to catch fish, primarily tilapia, catfish, and mudfish. The county has two rainy seasons, the long	cattle, goats, sheep. The County has promoted poultry production and bee keeping (apiculture)

	rains which average 2,146 mm and occur between the months of March to May and the short rains which average 1,212 mm and occur between the months of October to November. The amount of rainfall declines from the high-altitude slopes of Mt. Kenya towards the Semi-arid zones in the eastern part of Mwea constituency. The temperature ranges from a mean of 8.10C in the upper zones to 30.30C in the lower zones during the hot season. The start of the growing season is determined based on when climatic conditions become suitable for crop growth. Historically, the start of the growing season in Kirinyaga County has varied widely between March and April. However, future climate projections suggest that the start of the growing season in the northern regions will move earlier by a month, while some areas in the southern regions will face delays of up to 10 days. Climate advisory services will become	

	critical to inform farmers about the optimum planting window and avoid crop loss.	
8. Nakuru County		
Nakuru County is located within the Great Rift Valley and lies approximately between 1,500-3,000 meters above mean sea level (amsl) with a mean elevation of 2,237 metersamsl.The western escarpment comprises of the Mau Hills lying 3,000 meters amsl. The valley floor comprises of the Ol-Doinyo Eburru Volcano, Akira Plains and Menengai Crater. The eastern valley escarpments consist of Bahati and Marmanet lying approximately 2,500 meters amsl. The County is endowed with an elaborate drainage system	The rainfall pattern for Nakuru is bi-modal with the short rains falling between October and December and the long rains falling between March and May. The mean annual rainfall is highest on the Mau Forest which receive over 1600mm and decreases to between 1200 mm and 1600 mm in Kuresoi region. The central parts of the County receive between 800mm to 1200mm. The areas around Lake Elementaita southwards receive moderate rainfall of between 600 and 800 mm. The drier parts of the County within Akira and parts of Naivasha receive low rainfall of between 400 mm and 600 mm annually. Average temperatures in the County range from a high of 29.3oC between the months of December to early March, to low	About 72.5% of lands in the county have title deeds. Less than 20% of the households in the county are considered to be landless. The Acreage under food crops and cash crops in Nakuru County is 243,711.06 (Ha) and 71,416.35 (Ha) respectively. The average farm size for cash crops and food crops per household is 0.77 ha. The main modern storage facility in the county is Silos which are properties of NCPB. Dairy farming under zero grazing system is emerging as an important economic activity due to diminishing land size, favourable weather environment and

consisting of a number of surface and underground water sources. The County has six inland lakes namely Lake Nakuru, Lake Naivasha, Lake Elementaita, Lake Oloiden, Crater Lake and Lake Solai. Underground water sources include; Menengai Crater groundwater system, Lomolo Mogotio groundwater, Lomolo-Olobanita aquifer system, North Solai regional aquifer system and Rongai regional aquifer system. The main rivers include: Little Gilgil, Malewa and Karati (seasonal) that drain into Lake Naivasha; Njoro and Makalia (seasonal) that drain into Lake Nakuru; and Molo that drains into Lake Baringo. Other rivers in the county include; Turasha, Nyairoko, Kiriundu, Little Shuru, Chania,	temperatures of up to 12^{o} C during the month of June and July. Molo, Kuresoi North and South Sub-Counties are relatively cold while Naivasha, Gilgil, and parts of Rongai Sub-Counties experience hot weather. Extreme weather conditions culminated to incidences of drought, desert pest invasion, rising lake levels and floodings. This led to decline in productivity in agriculture and other related sectors. Further, excess rainfall in selected regions affected routine maintenance and/or construction of roads. The county has a robust ecological system that the residents depend on for agriculture, tourism, energy and many other benefits. Mau Escarpment is the source of Njoro River that drains into Lake Nakuru which is inhabited with flamingos, making it one of the premium parks in Kenya. The county has a bimodal rainfall pattern with a high of 1800mm and a low of 500mm. The County's topographic features namely Menengai crater, Longonot crater and	ready market for milk. About 0.09% of the area is considered to be gazetted forest. Major social economic development challenges that the county faces are; high level of insecurity, high poverty levels, poor infrastructure, educational needs, high rates of accidents, rural urban migration, and inaccessibility of health services and inadequate energy supply. Cross cutting issues in the county are; poverty and unemployment, environmental pollution, global warming & climate change, gender inequality, disaster management, HIV/AIDS, youth, people with disabilities and ICT, Disaster management.

Ruiru and Kipsonoi that are perennial and Mereroni, Nderit, Lamudiac, Naishi, Ngosur, West Acre, Rongai, Swamp Canal, Subukia, Olbanita and Maji Matamu that are seasonal. Topographic features in the County include; Mt. Longonot, Hyrax hills, Hells Gate gorges, Menengai crater, honeymoon hill among others. These topographic features create an interesting niche that allows opportunities for research, biodiversity conservation, and tourism. The gazetted forests include; Mau Complex, Dundori, Eburru, Kiptunga, Bahati, Bararget, Logoman, Molo, Likia, Saino, Mariashoni, Menengai West and Subukia Shrine covering 73,462 hectares. These forests provide a natural habitat for a variety of flora	Hell's gate among others are an interesting niche for research. The county is estimated to have about 220 tourism related hotels with a capacity of 12,000 beds. Tourism is an important sub-sector in the development of the county. However, the county fortunes in tourism might be adversely affected by the widespread changes in climate. Extremities in weather conditions have led to reduction in volume of river flows and caused serious decline in water levels in Lake Nakuru, Elementaita and Naivasha threatening the future of these sites as major tourist attractions. Changes in climate also has huge ramification in agricultural and rural development sector.	

and fauna and opportunities for biodiversity conservation.		
9. Narok County		
The county lies within the Great Rift Valley, and is serviced by several rivers, flowing from highlands through arid and undulating landscapes. It is home to numerous volcanic landforms with areas of potential geothermal activities. The highland areas of Mau escarpments, rising to an altitude of 3,100m above sea level provides fertile ground for farming and source to major rivers like Mara and Ewaso Nyiro with Mara River being the single major river that passes through Maasai Mara Game Reserve. Narok County is home to the world-renowned	Two-thirds of the county is classified as semi-arid. Temperatures range from 200C (January-March) to 100C (June- September) with an average of 180C. Rainfall amounts are influenced by the passage of inter tropical convergence zones giving rise to bi-modal rainfall patterns. Long rains are experienced between the months of February and June while the short rains are experienced between August and November. Rainfall ranges from 2,500 mm in wet season to 500 mm during the dry season. A historical trends analysis done in collaboration by Biodiversity International, Internationale Center for Tropical Agriculture, National Government and World Bank shows that during the long rainy season, most of the county experiences fewer than 25 consecutive	Due to large numbers of tourist flocking the Masai Mara each year, tourism operators, the county Government of Narok and other stakeholders of good will have formed the Mara Corporate Social Responsibility Committee to consolidate efforts for greater gains in conservation of the ecosystem. Additionally, the County government in collaboration with Maasai Mara Wildlife Conservation Associations (MMWCA) supported the development of two plans focused on improvement of the ecosystem. These are the Maasai Mara Game Reserve Management Plan (MMGRMP) and

Maasai Mara Game Reserve which is considered Kenya's jewel when it comes to wildlife. The reserve sitting on 1,510 km^2 hosts 25% of Kenya's big cats and has one of the highest wildlife densities in Africa. It is characterized by Savannah plains and woody shrubs which provide an ideal home for the 95 species of mammals, amphibians and reptiles and over 400 bird species found in the park and its environs. Over 158,000 tourists visit the park each year with the peak season for the park coinciding with the Great Wildebeest Migration that occurs between July and September of every year.	dry days (CDD). In the future, the county will experience an overall increase up to 10 CDD, suggesting a slightly greater risk of dry spells. The two dominant vegetation types in the county include forest land in the Mau area and grasslands and shrubs in the lowland areas of Suswa, in Narok North, Osupuko and Loita divisions in Narok South as well as the Mara sections in Transmara. Grasslands are suitable for livestock rearing and wildlife survival. A major threat to the vegetation cover is the destruction caused by human activities including grazing, charcoal burning, extraction of wood fuel and cutting down of trees without replacement resulting in adverse ecological effects. Maasai Mara Game reserve is home to the country's highest wildlife density and as such is Africa's premium wildlife destination. The reserve is home to a variety of wildlife including Wildebeests, Rhino, Buffalo,	the Greater Mara Ecosystem Management Plan (GMEMP). The plans were launched in 2023 together with the County Spatial Plan CSP). Aside from the high agricultural potential in highlands and tourism economic activities in the lowlands, the county is endowed with numerous natural resources. Exploration of geothermal power in the Suswa area has shown positive prospects, in Talek harnessing of solar power is ongoing. Wind power is used in pumping water from boreholes in Mara area and adjacent areas. Other resources found in the county include vast deposits of sand in Suswa, Mara, Siana and Naikarra wards. Narok is one of the few counties with gold deposits. This is found in Transmara South Sub- County at Kilimapesa.

	Hippopotamus, Gazelles, Zebras, Warthogs, Hyenas, Giraffes, Elephants, Lions, Leopards, Cheetah, and Elands. With increasing human encroachment activities to the reserve, cases of human wildlife conflict have been on the rise and thus threatening sustainability of the reserve and the tourism sector at large.	
10. Nyandarua County		
The formation of the County was greatly influenced by volcanism and faulting that created the major landforms namely: The Great Rift Valley to the west and the Aberdare Ranges to the east. The County's topography is characterized by a mix of plateaus and hilly areas. At 3,999 metres above sea level, the Aberdare Ranges is the highest point in the County while the lowest parts include Lake	There are eight permanent rivers; Malewa, Ewaso Narok, Pesi, Turasha, Chania, Kiburu, Mkungi, and Kitiri. Lake O1'Bo1osat which is the largest water mass in the County is fed by streams and underground water seepage from the Aberdare and Dundori hills. Human activities and clearing of the catchment areas for settlement have affected its natural refilling system and its existence is threatened. The Aberdare Ranges is one of the country's major water towers. Moreover, the Aberdare ecosystem constitutes a dense forest with	The main economic activity in Nyandarua is farming (crop cultivation and dairy farming). In late 1990s Nyandarua was a leading producer of pyrethrum, however Kenya Pyrethrum Board the parastatal that was given the role of purchasing, processing and marketing the crop collapsed because of poor management and corruption, severely undermining the livelihood of many farmers. Nyandarua county is well

Ol'Bolossat, Leshau and the northern part of Ndaragwa Central Ward, lower Kaimbaga, and the western parts of Kipipiri, Githioro and Murungaru Wards. The flat areas include Kinangop and O1'Ka1ou/O1'Joro Orok plateaus.	several animal species including elephants, baboons, Columbus monkeys, tree and ground squirrels, porcupines, and many bird species. On the slopes of the Aberdare Ranges are also the Mau Mau caves in Geta and Kimathi. The ranges offer great potential for local and foreign tourism in the County as they border the Aberdare National Park to the east and can be developed as nature trails and for mountain climbing. The temperature in the County ranges between 12°C in July and 25°C in December. Maximum rainfall of about 1700 mm is received during March and May which coincide with the wet season, (also known as the second season) and minimum rainfall of about 700 mm during September- December (coinciding with the dry season, also known as the first season). The rainfall decreases from East to West. Nyandarua County has had reliable rainfall which is generally well distributed throughout the year but is starting to be erratic due to climate change. The Aberdare	known as a giant in potato farming. However, there has been a number of challenges that are associated with farming such as fluctuation of the market, poor roads, and crop diseases. Aberdare forest which covers a larger area of the country, attract local and international tourist who make a positive income to the local society. Constituencies like Ndaragwa should initiate Agribusiness that does well in semi-arid areas like mangoes, millet, cassava, pumpkins and other such crops and a processing factory should be established so that the farmers get maximum returns. Climate change has had a huge toll on agriculture production in the County. For instance, some parts of the County have been a recipient of relief food from the National Government

	Ranges and the Dundori Hills influence rainfall distribution in the area, with areas like Njabini and South Kinangop receiving higher amounts of rainfall while areas of Ndaragwa and Ol'Kalou receive comparatively low rainfall. Some areas in the County are in the highland savannah zone, characterized by scattered trees with expansive grass cover. In elevated areas, tree cover increases forming thick forests with thick undergrowth. However, most of the natural vegetation has been cleared leading to environmental hazards such as environmental degradation which has claimed large portions of arable land. This has had some negative effects such as reduced rainfall, soil erosion, reduced soil fertility, poor health and reduced food production.	in the recent past. Nyandarua county is famous for various tourism destination sites attracting both local and international tourists. This includes; the Aberdare National Park, Mount Kipipiri, Lake Ol Bolossat, Kinangop Plateau and Elephant Hill Hiking Trail. Climate change has also affected other productive sectors such as tourism.
11. Nyeri County		
Nyeri County lies within the central highlands of Kenya and is divided	There are two gazetted forests, Mt. Kenya Forest, and the Aberdare Ranges. In each of the	The County lies between two water towers i.e., Mount Kenya and the

into two main topographic regions which are plains and highlands. The topographic features in the county include the mountain, rivers, water bodies and hills. The highest point in the County is Mount Kenya which is 5199m above sea level while the lowest point is at Sagana river in Mukurweini Central ward which is 1192m above sea level. The County has an average slope area of 8.8%. The main physical features of the county are Mount Kenya at the eastern side and the Aberdare Ranges (3,999m above sea level) to the west side of the County. The northern part is flat (Kieni East and Kieni West Sub counties), whereas the southern part of the county has steep ridges and valleys, with a few hills such as Karima, Nyeri and Tumutumu. The	forest, there are various forest sub stations which include Nanyuki, Gathiuru, Naromoru, Kabaru, Hombe, Ragati and Chehe in Mt. Kenya and Muringato, Kabage, Zaina, Zuti, and Kiandongoro in the Aberdares. However, the forest cover is under threat of decreasing due to increased deforestation and human encroachment. The major rivers found in the county are Ewaso Ng'iro, Chania, Gura and Amboni from Aberdare Forest and Nairobi River from Mt Kenya. Sagana river is jointly fed by rivers from both Mt. Kenya and Aberdare rivers. Among other rivers found in the county are Ragati river. The permanent and seasonal rivers in the County are the main source of water for agricultural, domestic, and industrial development across the County. The annual rainfall ranges between 1,200mm-1,600mm during the long rains and 500mm1,500 mm during the short rains. In terms of altitude, the county lies between 3,076 meters and 5,199 meters above sea level. The	Aberdare ranges with agriculture as the main economic activity. The County is renowned for horticultural farming. Other agricultural activities which act as a source of income include dairy farming and fish keeping. There are a number of light industries, tea and coffee factories providing a market and employment to the locals. Most of the inhabitants of the County are from the Kikuyu community who are predominantly farmers growing tea and coffee as cash crops. They also engage in subsistence farming of crops such as maize, beans, assorted vegetables, and sweet potatoes as well as small scale livestock farming. Nyeri County forms part of the Central Region Economic Bloc (CeREB) that is made up of 10 counties. The regional block provides a means of

county has a forest coverage of 38% which is above the recommended minimum level of 10%.	precipitation is highest in the month of April and lowest in the months from June to September. The County's monthly mean temperature ranges from 12.8 0 C to 20.8 0 C with February and March being the hottest months while July is the coldest month of the year. However, areas around Mount Kenya experience low temperatures throughout the year.	promoting harmonized trade and economic development within the region. Nyeri County Enterprise Development Fund was established and derives its authority and accountability from Nyeri County Enterprises Development Act, 2018. The fund is wholly owned by the County Government of Nyeri and is domiciled in the department of Trade, Tourism, Culture and Cooperative development. The fund issues loans that are currently attracting an interest rate of 5%.
12. Taita -Taveta County		
Taita Taveta County is classified into three major topographical zones, namely Upper zone – which comprises Mwambirwa, Taita and	The size of the county arable land is 2,055 km^2 while non-arable land is 14,307 Km^2. There are 48 forests in Taita Taveta County, 28 of which are gazetted and managed by the national	The main activity in the County is crop farming; food crops and cash crops. The total acreage under food crops is 44787.85 acres and 8144.59

Sagalla Hills regions with altitudes ranging from 304 meters to 2, 208 meters above sea level. The zone is suitable for horticultural farming. Lower zone includes plains where the national parks, mines and ranches are found. Volcanic foothills zone covers the Taveta region with underground water and springs sourcing from Mt. Kilimanjaro. The county covers a total area of 17,084.1km^2 with 10,649.9 km^2 (62.3%) being within Tsavo East and Tsavo West National Parks, providing a major tourism destination. Water bodies within the county occupy 106 km^2 comprising of Lakes Jipe and Chala in Taveta sub-county. The rest of the area is spread within public and private land such as ranches. Sisal estates	government. The size of the gazetted forests is 1,489.80 ha, non-gazetted forests is 9,000 ha and the approximate forest cover is 3.41%. The forests range in size from 500 m^2 to 2 km^2 encompassing both exotic and indigenous forest mountains. In addition, they form part of a unique Eastern Arch range of forests made up of the Taita Hills and Eastern Tanzania mountains. The Taita Hills have a unique biodiversity of flora and fauna with 9 species of animals and 13 species of plants exclusively found within the region. The water mass of the County is 106 Km^2. Long rains are usually experienced between March and May – where on average, highlands record 265 mm as opposed to the 157 mm in lowlands. Short rains are anticipated between October and December, with annual rainfall being recorded at 1,200 mm (highlands) and 341 mm (lowlands). Average temperature in Taita Taveta County is 23^{0}C, with lows of 180C in hilly areas (Sagalla, Taita and Mwambirwa)	acres under cash crops. The main food crops are maize, beans, rice, green grams and bananas while the main cash crops are macadamia, avacadoes, assorted vegetables, mangoes, sisal and French beans. In sustaining growth in the Manufacturing, Trade and MSMEs sector, the County established an emergency rescue package for businesses and traders hard-hit by the effects of COVID-19. The emergency Fund, supported by development partners and other stakeholders was used to identify and support the most vulnerable businesses further, the County to injected some stimulus to cushion the businesses and traders through affordable credit; waiver of some County taxes, cess, and other charges. The county productive population stood at 203,156 in 2019

and hilltop forests occupy less than 100 km^2.	and rising to about 250C in lower zones. The population distribution in the county is influenced by cultural heritage, rainfall and terrain. The main ethnic groups in the county include: Taita, Taveta, Kambas, Maasai, Luos, Kikuyu and Somalis. Loss of wildlife habitats in most parts of the county has led to the increase in human-wildlife conflicts. Wildlife such as elephants invade private lands in search of water which in turn lead to crop destruction; this affects the county's food security and endangers human and livestock life.	making up 59.6 percent of the county population. Land available for household farming activities is further reduced drastically due to the presence of a total of 28 ranches which combined, cover an approximate area of 773.5 2 Km. The land in the County is communally owned with approximately 35% having title deeds. Sisal estates and 2 hilltop forests occupy less than 100 km. Current estimates indicate that Taita Taveta is one of the leading producers of minerals produced in Kenya. There is need for local industries which will carry marketing and value addition for minerals like Tsavorite (green garnets), ruby, sapphire, rhodolite, tourmalines, red garnets etc.

13. Trans - Nzoia County		
The County is generally flat with gentle undulations rising steadily towards Cherang'any Hills to the east and Mt. Elgon in the northwest. Mt Elgon is the second highest mountain in Kenya with an important ecosystem shared between Trans Nzoia and Bungoma Counties and Bukwo district in the Republic of Uganda hence it is a unique resource for environmental and wildlife conservation. The altitude ranges from the lowest point 1660 in Sikhendu Ward at 34.811877°E and 0.812766°N at to 4299 metres above sea level at the peak of Mt. Elgon in the Kenya with undulating terrain across the County.	The county has two National parks of Mt.Elgon and Cherangany and is home to two of the five Kenyan Water towers, the Mt..Elgon and Cherang'any Hills. The County boasts of both indigenous and exotic forests. Compared to the 10% tree cover required nationally, the County's tree cover currently stands at 17%. This has been achieved by the presence of major forest covers such as Mt..Elgon, Kapolet, Sikhendu and Kitale town. Other smaller covers include: -Saboti, Sosio, Kitalale, Suam, Kimothon and Kiptogot forests. Human activities significantly affect negatively the forest cover which continue to reduce from 17% in 2013 to the current 15.1%. The forests are critical to the climatic conditions of the territorial boundaries of the County and beyond as they are the water catchments. Trans Nzoia, Kenya is blessed with unique climatic and soil conditions that foster the growth of diverse	Trans Nzoia County's arable land makes agriculture the top economic activity, where maize farming is widely practised, and mostly at a commercial level. Tea, coffee, horticulture and commercial businesses are also very significant to the county's economy. There's dairy farming and booming tourism – owing to an array of touring sites and touristic activities within the county. A number of companies such as Kenya Seed company, Elgon Tea Factory, Western Seed Company, K.C.C and various government institutions provide employment to many people living in the urban centers. In the County land is held both

Trans Nzoia County is strategically located as the gateway and link to the Southern Sudan through West Pokot (Kapenguria Town) and Turkana County (Lodwar town) and Uganda through the Suam Border.	native trees. Among these trees are Guava, Giant fishtail palm, and orange cestrum. These trees hold significant symbolic, cultural, and ecological importance within the state .There are 15 rivers in the County with the main ones being Sabwani, Rongai, Noigamaget, Suam Kaptega and Losourwa rivers. Nzoia rivers draining into Lake Victoria and Lake Turkana. Tributaries of river sabwani are Kiptogot, Kaibei. Kimothon, Sinyerere, Tongaren and Kabuyefwe, while tributaries to Noigamaget (Kapolet) are River seum, and Kapterit. The level of devastation due to drought, dry spells and floods are becoming increasingly severe with loss of livelihoods and negative impacts to key sectors within the County. Farmers have experienced an upsurge in pests like the fall armyworm, and they have attributed disease incidences hitherto unheard of in the County to changes in the weather patterns. Farmers have also experienced additional occurrences of unusually heavy rainfall, which	publicly and privately. Public land is under ownership of public institutions while private land is owned by individuals or registered private groups, organization or companies. Majority of land in the County is under private ownership as either leasehold or freehold. In addition, some land in urban areas is also held on temporary basis under Temporary occupation Licenses (ToLs).

	have led to flooding along the River Sabwani in Kwanza sub-county that displaced people, destroyed crops, and caused losses in livelihoods.	
14. Uasin- Gishu County		
Uasin Gishu County is a highland plateau with altitudes falling gently from 2,700 meters above sea level to about 1,500 meters above sea level. The topography is higher to the east and declines gently towards the western border. The county's name comes from the Maasai word Illwuasin-kishu. The land was the grazing area of the clan, which they surrendered to the colonial government in the Anglo-Maasai agreement of 1911. It was subsequently pushed towards the Trans Mara region. The plateau	It experiences much cooler temperatures ranging between 18°C to 21°C and receives an annual average rainfall of 1500 mm per year. The county is characterized by four distinct seasons, dominated by two rainfall periods: January to March, which is generally considered the 'warm dry season', April to June known as the 'long wet season', July to September the 'cool dry season', and October to December as the 'short wet season'. The county is in the Lake Victoria catchment zone as all the rivers from the county drain into Lake Victoria. The permanent rivers include Moiben, Little Nzoia, Sergoit, Elegarini, Sosiani and Kipkaren rivers. There are three non-gazetted	The county boasts a vibrant economy driven by agriculture, agro-driven processing and manufacturing industrial activity, trade and commerce, tourism, and the services sub-sector. According to the GCP report of 2021, the county's economy contributed 2.3 percent of the national GDP, of which the services subsector accounted for 50 percent, agriculture accounted for 39 percent, while manufacturing and other industries accounted for 6.3 percent and 4.9 percent, respectively, showing the county`s heavy reliance on the

they once occupied was then registered in its Anglicized version, Uasin Gishu. The plateau was then settled by Afrikaans-speaking South Africans in 1908, leading to the emergence of Eldoret town amid the farms they created. Uasin Gishu County is centrally located and is a gateway to the East Africa region as it is linked to the capital cities of Kenya, Uganda, and Rwanda by the Trans-African highway passing through it and directly to South Sudan through Kitale and Lodwar towns and to the lake region through Kisumu city	water towers in the county, namely Kaptagat, Timboroa and Kapchemutwo forests. The county has 29,802 Ha of gazetted forests out of which 56 per cent are under indigenous forest cover while 44 per cent is under plantations. Uasin Gishu, Kenya, boasts a unique climate and soil composition that offers optimal conditions for the growth of native trees. Within this land, three standout trees, Guava, Royal poinciana, and Rubber tree, anchor themselves and contribute to the ecological essence of the state. From 2002 to 2023, Uasin Gishu lost 585 ha of humid primary forest, making up 5.1% of its total tree cover loss in the same time period. Total area of humid primary forest in Uasin Gishu decreased by 8.6% in this time period whilst the top 1 regions were responsible for 56% of all tree cover loss between 2001 and 2023. This region had the most tree cover loss at 6.69 kha compared to an	agriculture and services sub-sector. The county has a mild and temperate climate favorable for large-scale production of maize and wheat as well as livestock production. It can also support cash crops such as vegetables, coffee, flowers, pyrethrum and horticulture. It also produces sizable quantities of milk, horticultural produce, and a wide variety of other crops and animals in smaller amounts. The National Cereals Board has one of the largest cereal storage depots in the country located at Moi's Bridge town, which consists of eight large silos with a capacity of approximately 5 million tonnes of grain, showing the significant role the county plays in Kenya`s food security. The county is home to a vibrant textile industry as well as East

	average of 2.00 kha.	Africa's only manufacturer of small arms and ammunition, among other industries. The county's capital, Eldoret town, is a major commercial center in western Kenya. Service industries like wholesale & retail trade, auto repair, entertainment centers, and various IT services abound within and outside the town. Further, almost all Kenyan banks have a presence in the town, and these act to service the region. The county also prides itself as the "champion" as it is home to record-breaking world athletes who have put Kenya on the international map. These achievements have continued to position the county as an athletics superpower. The county will therefore harness this rich potential in sports and exploit it for tourism, along with the beautiful sceneries and diverse

		cultures it is endowed with. The county has its headquarters in Eldoret town and is one of the eight counties in the North Rift Economic Regional Bloc (NOREB). The county is cosmopolitan, with the Kalenjin community majorly inhabiting it.
15. West Pokot County		
The County is characterized by a variety of topographic features. The Northern and North Eastern parts are the dry plains, with an altitude of less than 900 meters above sea level. The south eastern part is Cherangani Hills with an altitude of 3,370 meters above sea level. Landscapes associated with this range of altitude include spectacular escarpments of more than 700 meters. The high-altitude areas have high agricultural	The county has a bimodal type of rainfall. The long rains fall between April and August while the short rains fall between October and February. There is, however, great variation in the total amount and distribution of rainfall received in the county. The lowlands receive 600 mm per annum while the highlands receive 1,600 mm per annum. The county also experiences great variations in temperature with the lowlands experiencing temperatures of up to 30° C and the highlands	The county is mainly inhabited by the Pokot community with the minority community of Sengwer. The County is known for its rich cultural heritage that includes Simar, Sintagh annual cultural festivals and Sapana. The County is a home to the famous Kapenguria six cells which is found in Kapenguria Museum. It has three main livelihood zones namely pastoral, Agro-pastoral and mixed farming. Livestock keeping and farming are key economic activities

potential while medium altitude areas lie between 1,500 meters and 2,100 meters above sea level and receive low rainfall in addition to being predominantly pastoral land. The low altitude areas include major parts of Pokot North and Pokot Central. These areas are prone to soil erosion due to flash floods. The mountains and hills found in the County are; Mtello, Chachai, Kogh, Murpus, Kamolokon, Ptabar, Cherangani Hills, Lorsuk, Kachakalau, Korokow, Kapchok and Masol Hills. Other small hills found in the County are Pong'ogh, Kber, Chesuko, Kauk and Chebon. These mountains and hills are found both in the highland and lowland parts of the county providing beautiful scenery for tourist attractions.	experiencing moderate temperatures of 10° C. These high temperatures in the lowlands cause high evapo-transpiration which is un-favourable for crop production. The high-altitude areas with moderate temperatures experience high rainfall which is suitable for crop production and dairy farming. The main forests in the county are found in Cherangani Hills. The gazetted forest, which forms part of the Cherangani Hills in Lelan including Kapolet forest, covers area of 20,857 ha. The un-gazetted forest covers 15, 719 ha and consists of rain forests blocks scattered all over the county. These are natural forests dominated by tree species which are cedar (*Juniperous procera*) and bamboo (*Aredinaria alpina*). Plantation forests cover an area of 662 ha of which approximately 34 ha has indigenous trees while the rest has exotic.	within the county supporting livelihoods of more than 80 per cent of the county population. The Turkwel Dam located in the county with its main source of river Suam serves as hydroelectric power production, and fisheries and tourist attraction site is the only largest water body in the county. The County economy is estimated at Kshs.46.8 billion. The County is a member of the North Rift Economic Block (NOREB) which comprises Elgeyo Marakwet, Uasin Gishu, Nandi, Baringo, Turkana, Trans Nzoia and Samburu Counties. The Bloc was established and strnctured as an overarching platform to facilitate favourable economic, social and cultural cooperation of member counties that enhance sustainable development within the region.

4. METHODOLOGY

4.1 The Environmental and Social Impact Study Design

The environmental and social impact assessment study employed a descriptive design as existing variables were not to be changed or manipulated.

4.2 Data Collection

This environmental and social impact assessment study utilized both primary and secondary data. Secondary data derived from available technical reports, publications and other available relevant documents regarding the proposed introduction for cultivation of potato *(Solanum tuberosum L.)* with resistance to late blight *(Phytophthora infestans)* developed through modern biotechnology. Ideally, the extent of compliance that must be prioritized on issues raised in the ESMP as well as issues raised during trials, and relevant project reports were interrogated. Primary data helped to capture new changes that have taken place and helped to incorporate recommendations from potential beneficiaries based on user activities in the ESMP implementation, all of which were accommodated in the ESIA.

4.3 Primary Data Collection and Tools

Key informant interviews, Focus Group Discussions and observations were made during the field visits to the selected counties. Biophysical and social impacts that could occur during the project implementation were captured in the tools as well as the challenges and lessons learnt during trials.

i. ***Key informant interviews (KIIs)*** **-** were administered to relevant government officers of line ministries working in the selected counties and national government. The key informants presented their views and also gave recommendations from their experiences on the ground;

Plate 4-1: ESIA, Lead Expert interviewing Dr Kwambai of KALRO, Kitale County

ii. ***Focus Group Discussions (FGDs) and Community Consultative Meetings/barazas*** - Sampled individuals participated in focus group discussion sessions. These comprised; both men, women, vulnerable Marginalized Groups (VMGs), Indigenous People (IPs) who were identified in accordance with agreed sampling methods. The FGDs were conducted in the sampled counties among men, women, and youths. The Qualitative data collection method was applied, whereby the data was descriptive and therefore, could not be measured numerically. The FGDs helped the team get more in-depth information on their perceptions, insights, attitudes, experiences or beliefs on the proposed introduction of potato with resistance to Late Blight (*Phytophthora infestans*) developed through modern biotechnology for cultivation.

Plate 4-2: Members of the Focus Group Discussion (FDG) in Mt. Elgon, Bungoma County

4.4 Secondary Data Collection and Tools

Review of Secondary Data

A checklist was developed and used to analyze proposed introduction of potato with resistance to Late Blight (*Phytophthora infestans*) developed through modern biotechnology for cultivation. Further, policy regulatory documents and reports provided more secondary data in addition to guiding on regulatory requirements. Relevant project documents, policies, frameworks and reports were reviewed. Some of the documents considered for this study included relevant acts of parliaments and Confined Field Trial (CFT) reports.

4.5 Sampling Procedures

4.5.1 Inception Report Purpose

The inception report proposed to carry out an ESIA Study on the proposed introduction of potato with resistance to Late Blight (*Phytophthora infestans*) developed through modern biotechnology for cultivation. Eleven locations representing the Counties in the agro ecological zones where potatoes are grown both for local consumption and commercial purposes were selected. The proposed locations included; Kitale, Elgeyo Marakwet,

Bungoma, Nakuru (Njoro), Nyandaru (Ol Kalou), Kiambu (Limuru), Nyeri, Kirinyaga, Meru (Kibirichia), Embu and Taita Taveta (Wundanyi).

Plate 4-3: Members of the Focus Group Discussion in Kerugoya, Kirinyaga County

Plate 4-4: Stakeholder's sensitization before the FDG and KII interviews in Mwatate, Taita Taveta County

Plate 4-5: Stakeholder's sensitization before the FDG and KII interviews in Nakuru County

4.5.2 Sampled Counties and Proposed Centres

The study

Informed and collected opinions from at least **268** stakeholders; and developed the study report to be submitted to NEMA for review and approval an Environmental and Social Impact Assessment study report.

Table 4-1: Locations visited during the ESIA study for Potatoes with resistance to Late Bright based on potato growing agro-ecological zones

Region	Counties	Location	Centre	Justification/ Rationale
North Rift (Cluster 1)	West Pokot Trans Nzoia	1	Kitale	• Location was central and accessible by most stakeholders.
North Rift (Cluster 2)	Elgeyo Marakwet Uasin Gishu	1	Iten	• Potato Production area with arid neighborhoods • Address the indigenous community e.g. Segwer, Ogiek
Western	Bungoma	1	Bungoma	• Potato Production area near Mt. Elgon.
Mid Rift (Cluster 3)	Bomet Nakuru	1	Njoro	• Njoro is central • The two counties are among the

				leading producers of potatoes in the region.
Central (Cluster 1)	Nyandarua Kiambu	2	Ol Kalou Lari	• Nyandarua is the leading producer of potatoes in Kenya • Close to the Tigoni Research Centre
Central (Cluster 2)	Nyeri Kirinyaga	2	Nyeri Kerugoya	• The two counties are major producers of potatoes in the region
Central (Cluster 3)	Meru Embu	2	Meru Embu	• Meru is among leading potato producing counties in Kenya
Coastal Region	Taita Taveta	1	Wundanyi	• County in Coastal Region. • County experiencing human wildlife conflicts especially elephants on potatoes.
Total	**14**	**11**		

Plate 4-6: ESIA Team conducting a FGD in Mwatate, Taita Taveta

Table 4-2: Sampled Counties and a list of main Consultative Public Meetings

S/No.	County	Venue	Nature of Meeting	Date	No of Participants
1.	Nakuru	Nakuru	Public Baraza	1/7/2024	22
2.	Bungoma	Bungoma and Mt. Elgon	Public Baraza	2/7/2024	31
3.	Tranzoia	Kitale	Public Baraza	3/7/2024	24
4.	Elgeyo Marakwet	Iten	Public Baraza	4/7/2024	21

S/No.	County	Venue	Nature of Meeting	Date	No of Participants
5.	Embu	Mountain Breeze Hotel	Public Baraza	7/18/2024	22
6.	Nyeri	Ibis Hotel	Public Baraza	7/16/2024	26
7.	Kirinyaga	Bekam Hotel	Public Baraza	7/15/2024	24
8.	Meru	North Imenti CDF Hall	Public Baraza	7/17/2024	26
9.	Nyandarua	Empress Gardens Hotel	Public Baraza	7/29/2024	24
10.	Kiambu	County Commissioner's Hall	Public Baraza	7/30/2024	26
11.	Taita Taveta	Danida Hall Mwatate	Public Baraza	8/1/2024	22

Plate 4-7: ESIA Team with FDG in Embu County

Plate 4-8: ESIA Team with FDG in Nyandarua County

Plate 4-9: ESIA Team with Nyandarua County CEC and CO Agriculture prior to public engagement

Plate 4-10: ESIA Team with FDG in Nakuru County

Plate 4-11: ESIA Team with FDG in Trans-Nzoia County

4.6 Data Processing and Analysis

Focus Group Discussion (FGDs) are a useful way of collecting data as group dynamics play a powerful role in understanding broader topics and generating new ideas. Data collected from the Focus Group Discussions will first be checked for completeness and comprehensiveness. The open-ended questions contain qualitative data that was analyzed through conceptual content and presented through narration.

5. POLICY, LEGAL AND REGULATORY FRAMEWORK

5.1 Introduction

This chapter outlines and highlights the relevant policy, legal and institutional framework in Kenya which has a direct bearing on the proposed 3 R-gene LBR biotech potatoes project. The ESIA study team reviewed various relevant Acts of parliament required under the Environmental Management and Co-ordination Act No. 8 of 1999 (Amendments, 2015)/ Cap 387 and Environmental (Impact Assessment and Audit) Regulations 2003; 2018 to carry out an Environmental Impact Assessments (EIA) as per Section 58 of the EMCA for all projects in the second schedule. The institution charged with overseeing the implementation of Cap 387 is the National Environment Management Authority (NEMA). The team also reviewed relevant Constitutional Provisions, Policy and Acts that are relevant and the rules and regulations are related to the project.

List of Relevant Policies;

1. The National Productivity Policy No. 3 of 2013;
2. The National Agricultural Sector Extension Policy No. 04 of 2011;
3. The Agricultural Transformation and Growth Strategy;
4. National Gender and Development Policy 2019;
5. National Food and Nutrition Security Policy 2011;
6. Kenya National Youth Policy 2018;
7. National Biotechnology Development Policy 2006; and
8. National Potato Strategy 2021-2025

List of Relevant Local Acts of Parliament;

Relevant Legislation;

1. Constitution of Kenya (2010).

Relevant Acts of Parliament;

1. Environmental Management and Coordination Act, 1999 (amended 2015);
2. Crops Act, No. 16 of 2013;
3. The Kenya Plant Health Inspectorate Service Act, 2012
4. Access to Information Act, 2016;

5. Agricultural, Fisheries and Food Authority Act No. 13 of 2013;
6. Children Act, 2010;
7. Climate Change Act 2016;
8. Community Land Act (No. 34) 2016;
9. Co-operative Societies Act Amended, 2004;
10. County Government Act 2012;
11. Employment Act 2019;
12. Forest Conservation and Management Act 2016;
13. HIV/AIDS prevention and control Act, 2006;
14. Fisheries Management and Development Act, No. 35 of 2016);
15. Land Act, 2012;
16. Livestock Act 2020;
17. National Museums and Heritage Act 2006;
18. Occupational Health and Safety Act 2007;
19. Persons with disabilities Act, 2014;
20. Pest Control Products Act, Cap 346;
21. Physical Planning Act (CAP) 286;
22. Plant Protection Act (CAP 324);
23. Public Health Act (CAP 242) 2012;
24. Seeds and Plants Variety Act, 2012;
25. Sexual offences Act 2006;
26. The Animal Diseases Act Cap 364;
27. Water Act (No. 43) 2016;
28. Water Resources Management Rules, 2007; and
29. Wildlife Conservation and Management Act 2013.

International Conventions;

1. Convention on Biological Diversity (1992);
2. Cartagena Protocol on Biological Diversity, (2003)
3. International Plant Protection Convention of FAO (1952); and
4. United Nations Framework Convention on Climate Change (1992).

5.2 Relevant Agriculture Sector Policies

5.2.1 Kenya Vision 2030

The Sessional Paper Number 10 of 2012 on the Kenya Vision 2030 under the economic pillar identifies specific interventions which in the agricultural sector include increasing productivity of crops and livestock, introducing land use policies for better utilization of high and medium potential lands, developing more irrigable areas in arid and semi-arid lands for both crops and livestock, and improving market access for smallholders through better post-harvest and supply chain management. It also prioritizes flagship projects in the sector, specifically: enactment of the consolidated agricultural reform bill, fertilizer cost-reduction investment, disease-free zones, land registry, land-use master plan and arid and semi-arid lands development project. The Policy makes reference to climatic change and directs responses. The Policy under the social pillar, with respect to environmental management proposes to intensify conservation of natural resources, such as establishing voluntary carbon markets, intensify research on impact of and response to climatic change and pilot adaptation programmes.

5.2.2 National Policy on Environment and Development Sessional Paper No. 6 Of 1999

Currently, a far-reaching initiative towards an elaborate national environmental policy is contained in the Sessional Paper No. 6 of 1999 on Environment and Development. It advocates for the integration of environmental concerns into the national planning and management processes and provides guidelines for environmentally sustainable development. The challenge of the document and guidelines is to critically link the implementation framework with statutory bodies namely, the National Environmental Management Authority (NEMA), Kenya Wildlife Service (KWS), Kenya Forestry Service (KFS); the National Environment Complaints Committee (NPCC) and the National Environmental Tribunal (NET).

5.2.3 Agricultural Sector Transformation and Growth Strategy

The Agricultural Sector Transformation and Growth Strategy (ASTGS) 2019-2029 sets out to implement the Kenya Vision 2030 in the agricultural sector. It identifies two strategic thrusts for its vision of a food-secure and prosperous nation, i.e., increasing productivity,

commercialization and competitiveness of agricultural commodities and enterprises and developing and managing the key factors of production. It commits government to implement "National Climate Change Response Strategy" which would include mainstreaming of early warning and mitigation systems, identification of priorities for climate adaptation and mitigation with specific measures for vulnerable groups, awareness creation, conducting of periodic climate change threat and risk assessments and their mitigation as well as research and development in the area.

5.2.4 National Climate Change Strategy

The Strategy sets out to reduce the vulnerability to impacts of climatic change and to catalyze transition to cleaner, lower emission and less carbon-intensive development in the country. The Government commits in the Strategy to enhance climatic resilience and adaptive capacity and put in place mechanisms for sustainable utilization of natural resources. The Strategy directs integration of climate change risk and vulnerability assessment in the Environment Impact Assessment and the Strategic Environment Assessment. It lays the blame for emissions of green-house gases largely to agriculture, more so livestock, and in land-use change and suggests deterrent taxation and friendly regulatory environments for low carbon-pollutant activities.

5.2.5 Kenya Climate Smart Agriculture Strategy - 2017-2026

The overall objective of this strategy is to build resilience and minimize emissions from agricultural farming systems for enhanced food and nutritional security and improved livelihoods. FSRP is designed to address the objectives of this strategy, through development, validation and dissemination of CSA TIMPs with the aim of attaining triple wins of increased productivity, build resilience and reducing greenhouse gases.

5.2.6 National Agricultural Research Systems Policy

This policy provides the foundation for research in the agricultural sector. It aims at achieving reforms in the Kenyan agricultural research systems to support the development of an innovative, commercially oriented, and modern agricultural sector. The Policy aims at achieving objectives that include problem-solving and impact driven research agenda, fast-tracking national adoption of available technologies and knowledge and enhancing capacity to access and adopt knowledge and appropriate technologies available world-wide. It directs

re-focusing of research to solve problems, the harnessing of indigenous knowledge while upholding professional ethics and the adoption of innovative methods of knowledge transfer.

5.2.7 National Productivity Policy

The Sessional Paper Number 3 of 2013 on the National Productivity Policy responds to low productivity and directs corrective measures. The Policy aims to achieve accelerated economic growth through high investment and productivity growth, being the incremental growth of 5% per year up from current less than 1%. It also aims to increase productivity awareness and consciousness level in the country from the current level of about 1 percent to 60 percent of the population. It proposes training programmes outside the formal education system for skills transfer to the labor force. It will also support technological change and innovation.

5.2.8 National Food and Nutritional Security Policy

The Sessional Paper Number 1 of 2012 on the National Food and Nutritional Security Policy aims at achieving safe food in sufficient quantity and quality to satisfy the nutritional needs for optimal Agricultural Policies and Legislation: The Policy directs the promotion of sustainable food production systems with particular attention to increasing soil fertility, agro-biodiversity, organic methods and proper range and livestock management practices. The Policy also directs that different approaches to food production are adopted based on the agro-ecological diversity which should include promoting.

5.3 Kenyan Constitution 2010 Provisions

Kenya has a National Constitution promulgated on the 27th of August 2010, and which takes supremacy over all aspects of life and activity in the Country. With regard to environment, the Constitution states as follows: -

In Sections 69 and 70, the Constitution has inter alia identified National Obligations in respect of the environment and Enforcement of Environmental Rights respectively as follows:

Section 69 (1): The State shall:

i. Ensure sustainable exploitation, utilization, management and conservation of the environment and natural resources, and ensure the equitable sharing of the accruing benefits;

ii. Work to achieve and maintain a tree cover of at least ten per cent of the land area of Kenya;

iii. Protect and enhance intellectual property in, and indigenous knowledge of, biodiversity and the genetic resources of the communities;

iv. Encourage public participation in the management, protection and conservation of the environment;

v. Protect genetic resources and biological diversity;

vi. Establish systems of environmental impact assessment, environmental audit and monitoring of the environment;

vii. Eliminate processes and activities that are likely to endanger the environment; and

viii. Utilize the environment and natural resources for the benefit of the people of Kenya.

Section 69 (2) States that: -Every person has a duty to cooperate with State organs and other persons to protect and conserve the environment and ensure ecologically sustainable development and use of natural resources.

Section 70 provides for enforcement of environmental rights thus:

If a person alleges that a right to a clean and healthy environment recognized and protected under Article 42 has been, is being or is likely to be, denied, violated, infringed or threatened, the person may apply to a court for redress in addition to any other legal remedies that are available in respect to the same matter.

Essentially, the new Constitution has embraced and provided further anchorage to the spirit and letter of EMCA 1999 and EMCA (amendment) Act, 2015 whose requirements for environmental protection and management have largely informed Sections 69 through to In Section 72 however, the new constitution allows for enactment of laws towards enforcement of any new provisions of the Supreme Law.

5.4 List of Relevant Local Acts of Parliament

5.4.1 Environment Management and Coordination Act (No. 8 Of 1999), Emc Act 2015

This is an Act of Parliament providing for the establishment of an appropriate legal and institutional framework for the management of the environment and for matters connected therewith and incidental thereto. This Act is divided into 13 Parts, covering main areas of environmental concern as follows: Preliminary (I); General principles (II); Administration (III); Environmental planning (IV); Protection and Conservation of the Environment (V), Environmental impact assessments (EIA), audits and monitoring (VI); Environmental audit and monitoring (VII); Environmental quality standards (VIII); Environmental Restoration orders, Environmental Easements (IX); Inspection, analysis and records (IX); Inspection Analysis and Records (X); International Treaties, Conventions and Agreements (XI) National Environment Tribunal (XII); Environmental Offences (XIII). The Act provides for the setting up of the various ESIA Regulations and Guidelines which are discussed below:

Environmental (Impact Assessment and Audit) Regulations, 2003

This Subsidiary legislation under the Environmental Management and Coordination Act, provides the framework for the conduct of the ESIA study and consequent Audit. In particular:

Regulation 3 ad 6: Specifies the scope of application

Regulation 4. Specifies the ESIA approval process and limitation of Projects required undertaking ESIA. The regulation specifies that: No licensing Authority under any law in force in Kenya shall issues a licence for any Project for which an ESIA is required under EMCA unless the proponent produces a licence of EIA issued by the NEMA

Regulation 11, 12, 16 and the second schedule. Guide on the development of Terms of reference and conduct of the ESIA.

Regulation 17. Describe the nature of public participation

Regulation 18. Guides on the contents of an Impact assessment study report

Regulation 31 to 36. Spells out the requirements for ESIA Audit.

The ESIA study report is prepared pursuant to a recommendation under sub regulation (3) (a), shall specify - (a) the nature of the project; (b) the location of the project including — (i) proof of land ownership; (ii) the Global Positioning System coordinates; and (iii) the physical area that may be affected by the project's activities; (c) the activities that shall be undertaken during the project construction, operation and decommissioning phases; (d) a description of the international, national and county environmental legislative and regulatory frameworks on the environment and socio-economic matters; (e) the preliminary design of the project; (f) the materials to be used, products and byproducts, including waste to be generated by the project and the methods of their disposal; (g) the potential environmental impacts of the project and the mitigation measures to be taken during and after implementation of the project; (h) an analysis of available alternatives including an alternative - (i) project site; (ii) design; (iii) technologies and Kenya Subsidiary Legislation, 2019 (iv) processes and the reasons for preferring the proposed site, design, technologies and processes; (i) an action plan.

The proponent of the proposed 3 R-gene LBR biotech potatoes project is conversant with this statute that the Environmental (Impact Assessment and Audit) regulations, cluse 4(2) requires that... No licensing authority under any law in force in Kenya shall issue a license for any project for which an environmental impact assessment is required under the Act unless the applicant produces to the licensing authority a license of environmental impact assessment issued by the Authority under these Regulations. It is with this reason that the proponents is seeking the EIA license to enable them proceed with initiation of the project.

Environmental Management and Coordination (Waste Management) Regulations 2006;

The proposed project will have to abide by these regulations in dealing with waste management, especially the provisions of wastes which may be generated during the construction, operation and decommissioning phases of the sub-project investments including pesticide wastes.

Environmental Management and Coordination, (Water Quality) Regulations 2006

. These Regulations apply to drinking water, water used for agricultural purposes, water used for recreational purposes, water used for fisheries and wildlife and water used for any other purposes. This includes the following:

- Protection of sources of water for domestic use;

- Water for industrial use and effluent discharge;
- Water for agricultural use.

These Regulations outline:

i. Quality standards for sources of domestic water;

ii. Quality monitoring for sources of domestic water;

iii. Standards for effluent discharge into the environment;

iv. Monitoring guide for discharge into the environment;

v. Standards for effluent discharge into public sewers;

vi. Monitoring for discharge of treated effluent into the environment.

In fulfilling the requirements of the regulations, the project proponent will have to undertake monitoring of both domestic water and wastewater and ensure compliance with the acceptable discharge standards.

Environmental Management and Coordination, Conservation of Biological Diversity (BD) Regulations 2006

These Regulations apply to conservation of biodiversity which includes Conservation of threatened species, Inventory and monitoring of BD and protection of environmentally significant areas, access to genetic resources, benefit sharing and offenses and penalties.

Environmental Management and Coordination (Wetlands, Riverbanks, Lake Shores and Sea Shore Management) Regulations 2009

These regulations provide for the protection and management of wetlands, riverbanks, lakeshores and sea-shore management and detail guidelines on the same. The project will not support any investments that contravene these regulations.

Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009

These regulations prohibit making or causing any loud, unreasonable, unnecessary, or unusual noise which annoys, disturbs, injures or endangers the comfort, repose, health or

safety of others and the environment. It also prohibits the contractor from excessive vibrations which annoy, disturb, injure, or endanger the comfort, repose, health or safety of others and the environment or excessive vibrations which exceed 0.5 centimeters per second beyond any source property boundary or 30 meters from any moving source. Under the regulation the contractor will be required to undertake daily monitoring of the noise levels within the project area during construction period to maintain compliance.

5.4.2 Biosafety Act, 2009

The Biosafety Act, Cap 320, 2009 is an Act of Parliament to regulate activities in genetically modified organisms, to establish the National Biosafety Authority, and for connected purposes. This Act concerns the control of genetically modified organisms and related risks. Transgenic events of the so-called 3R-gene LBR potato varieties have been tested in the lab, greenhouse, and confined fields (CFTs) supervised by the National Biosafety Authority (NBA) in accordance with the Biosafety Act 2009. Section 18(1) of the Biosafety Act which provides that a person shall not conduct any activity involving genetically modified organisms (GMOS) without the written approval of the Authority. These activities include research, placing on the market, import, transit or export of GMOs.

5.4.3 The Kenya Plant Health Inspectorate Service Act, Cap 349, 2012

The Directorate is established pursuant to KEPHIS Act, no. 54, part II, section 5 (a, b, g, h, i, j, k & l) and international requirements by providing strategic leadership on plant health matters. It ensures implementation of import and export regulation, pest identification & diagnostics, pest risk analysis, pest surveillance, quarantine regulation.

5.4.4 Occupational Safety and Health Act, Cap 236a, 2007

This is an Act of Parliament to provide for the safety, health and welfare of workers and all persons lawfully present at workplaces, to provide for the establishment of the National Council for Occupational Safety and Health and for connected purposes. The Act has the following functions among others:

i. Secures safety and health for people legally in all workplaces by minimizing exposure of workers to hazards (gases, fumes and vapors, energies, dangerous machinery/equipment, temperatures, and biological agents) at their workplaces.

ii. Prevents employment of children in workplaces where their safety and health is at risk.

iii. Encourages entrepreneurs to set achievable safety targets for their enterprises.

iv. Promotes reporting of work-place accidents, dangerous occurrences and ill health with a view to finding out their causes and preventing similar occurrences in future.

v. Promotes creation of a safety culture at workplaces through education and training in occupational safety and health.

5.4.5 Pest Control Products Act Cap 346, 2012

This Act covers the use, application, importation, and trade in pest products. It includes regulation on:

i. Prescribing for the purposes of this Act the nomenclature of pests, classes and kinds of pests and pest control products;

ii. Prescribing the form in which applications for registration shall be made and the information to be furnished therewith;

iii. Respecting the registration of pest control products and establishments in which any pest control products are and led by manufacturers or dealers and prescribing the fees therefore, and respecting the procedures to be followed for the review of cases involving the refusal, suspension or cancellation of the registration of any such product or establishment;

iv. Prescribing the form, composition, and all other standards relating to the safe use of pest control products, including toxic residue effects;

v. Respecting the manufacture or treatment of any pest control product to facilitate its recognition by change in coloration or other means;

vi. Respecting the standards for efficacy and safety of any pest control product;

vii. Respecting the manufacture, storage, distribution, display and use of any pest control product;

viii. Respecting the packaging, labeling and advertising of pest control products;

ix. Respecting the taking of samples and the making of analyses for the purposes and provisions of this Act.

5.4.6 Sexual Offences Act, Cap 63a, 2006

An Act of Parliament that makes provision about sexual offences aims at prevention and the protection of all persons from harm from unlawful sexual acts, and for connected purposes. Section 15, 17 and 18 below are mainly focused on sexual offenses against minor (children).

Under Section 15 it is an offense for Any person who -

a) knowingly permits any child to remain in any premises, for the purposes of causing such child to be sexually abused or to participate in any form of sexual activity or in any obscene or indecent exhibition or show;

b) acts as a procurer of a child for the purposes of sexual intercourse or for any form of sexual abuse or indecent exhibition or show;

c) induces a person to be a client of a child for sexual intercourse or for any form of sexual abuse or indecent exhibition or show, by means of print or other media, oral advertisements or other similar means;

d) takes advantage of his influence over, or his relationship to a child, to procure the child for sexual intercourse or any form of sexual abuse or indecent exhibition or show;

e) threatens or uses violence towards a child to procure the child for sexual intercourse or any form of sexual abuse or indecent exhibition or show;

f) intentionally or knowingly owns, leases, rents, manages, occupies or has control of any movable or immovable property used for purposes of the commission of any offence under this law,

Under Section 17 it is an offence for Any person who -

a) intentionally causes or incites another person to become a prostitute; and

b) intentionally controls any of the activities of another person relating to that person's prostitution; and does so for or in expectation of gain for him or herself or a third person, is guilty of an offence and is liable upon conviction to imprisonment for a term of not less than five years or to a fine of five hundred thousand shillings or to both.

5.4.7 Labor Relations Act, Cap 233, 2012

An Act of Parliament to consolidate the law relating to trade unions and trade disputes, to provide for the registration, regulation, management and democratization of trade unions and employers organizations or federations, to promote sound labor relations through the protection and promotion of freedom of association, the encouragement of effective collective bargaining and promotion of orderly and expeditious dispute settlement, conducive to social justice and economic development and for connected purposes. This Act in Section II Part 6 provides for freedom of employees to associate; section 7 provides for protection of rights of employees; Part 9 provides for adjudication of disputes and Part 10 provides for protection of the employees to hold strikes and lockouts.

5.4.8 Persons with Disabilities Act, Cap 133 2003

This Act of Parliament prohibits discrimination in employment under section 15, education under section 18, accessibility, and mobility under section 21. Section 16 (1) obligates all private employer's persons with a disability with the required skills or qualifications either as a regular employee, apprentice or learner shall be entitled to apply for a deduction from his taxable income equivalent to twenty-five per cent of the total amount paid as salary and wages to such employee.

5.4.9 Children Act, Cap 141, 2010

The Children Act is an act of parliament that addresses provision for parental responsibility, fostering, adoption, custody, maintenance, guardianship, care and protection of children; provision for the administration of children's institutions; and giving effect to the principles of the Convention on the Rights of the Child and the African Charter on the Rights and Welfare of the Child.

5.4.10 National Museums and Heritage Act Cap 216, 2006

The National Museums and Heritage Act 2006 is an act of Parliament that consolidates the law relating to national museums and heritage; to provide for the establishment control, management and development of national museums and the identification, protection, conservation and transmission of the cultural and natural heritage of Kenya; to repeal the Antiquities and Monuments Act and the National Museums Act.

5.5 Relevant Institutions Responsible for Environmental Issues

National Environment Management Authority (NEMA);

The responsibility of the National Environmental Management Authority (NEMA) is to exercise general supervision and coordination over all matters relating to the environment and to be the principal instrument of Government in the implementation of all policies relating to the environment.

County Environmental Committees;

The County Environmental Committees also contribute to decentralized environmental management and enable the participation of local communities. These environmental committees consist of the following:

i. Representatives from all the ministries;

ii. Representatives from local authorities within the county

iii. Two farmers / pastoral representatives;

iv. Two representatives from CSOs (NGOs and Faith-led Organizations) involved in environmental management in the county;

v. A representative of each regional development authority in the province/district.

National Environment Complaints Committee on Environment;

The National Environmental Complaints Committee (NECC) was established under Section 31 of the Environmental Management and Co-ordination Act, 1999. It was formerly known

as the Public Complaints Committee (PCC), but its name changed in the EMCA (Amendment) No. 5 of 2015). It is an important institution in the assessment of the condition of the environment in Kenya. It plays an important role in the facilitation of alternative dispute resolution mechanisms relating to environmental matters. The NECC makes recommendations to the Cabinet Secretary and thus contributes significantly to the formulation and development of environmental policy.

National Environmental Tribunal;

The NET is established under Section 125 of EMCA for the purpose of hearing appeals from administrative decisions by organs responsible for enforcement of environmental standards. An appeal may be lodged by a project proponent upon denial of an EIA license or by a local community upon the grant of an EIA license to a project proponent. NEMA may also refer any matter that involves a point of law or is of unusual importance or complexity to NET for direction. The proceedings of NET are not as stringent as those in a court of law and NET shall not be bound by the rules of evidence as set out in the Evidence Act. Upon the making of an award, NET's mandate ends there as it does not have the power to enforce its awards. EMCA provides that any person aggrieved by a decision or award of NET may within 30 days' appeal to the High Court.

6. CONSULTATION AND PUBLIC PARTICIPATION

6.1 Introduction

The Public Participation Process is a policy requirement by the Government of Kenya (CoK, 2010) and a mandatory procedure as stipulated by EMCA 1999 section 58, on ESIA. It is an important process through which stakeholders including beneficiaries and members of public living within the project sites, both public and private, are given an opportunity to contribute to the overall project undertakings by making recommendations and raising project concerns before they are implemented. In addition, the process creates a sense of responsibility, commitment and local ownership for smooth implementation. The role of public consultation and involvement in ESIA process is to assure the quality, comprehensiveness and effectiveness of the assessment and ensure that the public views are adequately taken into consideration in the decision-making process. This chapter describes the process of the public consultation and participation that was followed in order to identify the key issues and impacts of the proposed introduction of genetically modified Potatoes resistant to late blight.

6.2 Objectives of Consultation and Public Participation

The objectives and purpose of the stakeholder's consultation and participation was to:

i. Disseminate and inform the stakeholders about the project with special reference to its key components and location,

ii. Create awareness among the public on the need for the ESIA for the proposed 3 LBR potato project,

iii. Gather comments, suggestions and concerns of the interested and affected parties,

iv. Enhance ownership of the project by local leadership, the community and local potato farmers,

v. Understand and characterize potential environmental and socio-economic impacts of the 3 LBR potato growing agro ecological zones

vi. Incorporate the information collected in the ESIA study, and

vii. Comply with EMCA 1999 (Amended, 2015) Section 58 regulations.

In addition, the process enabled the establishment of communication and the fostering of a synergy channel among the general public, consultants, project proponent and both county and national governments. The views collected were very crucial in helping decision makers to fully understand the concerns of the stakeholders and the anticipated impacts of the project at the early phase of project planning.

6.3 Consultation and Public Participation

Stakeholder's engagement started from an early stage of the scoping and continued throughout the assessment to ensure legislative requirements and standards were met. Just as the degree of stakeholder relevance may vary throughout the potato project life cycle, the most appropriate communication and consultation method also vary between stakeholders. Consultation with stakeholders was initiated by undertaking stakeholder analysis and identification. The stakeholder identification and analysis were undertaken by the consultant in close collaboration with the proponent (KALRO, AATF and CIP).

The stakeholders were categorized into two major groups;

a) ***Primary Stakeholders*** - Those directly affected by the project such as potato farmers in the target potato counties and the KALRO staff within the selected project areas.

b) ***Secondary Stakeholders/ Key Informants (KI)*** **-** Those indirectly affected by the project but who influence development as part of its project implementation. They included the responsible agencies of the County and National Government as well as civil organizations and academia.

Both participatory methods and analytical tools were applied to ensure the inclusion of the opinions of all stakeholders. Data collection involved consultation meetings held with Potato farmers, County, line ministry and KALRO staff, discussions and interviews with key informants and administration of questionnaires.

6.4 Questionnaire Administration

6.4.1 Introduction

The consultant prepared questionnaires which were administered to potato farmers and key informants within the target potato counties. The questionnaires were mainly open-ended in order to give the target groups an opportunity to express their views and concerns

appropriately and widely. These instruments of data collection were then analyzed, and information synthesized in this ESIA study report.

6.4.2 Public Fora (Barazas)

Public participation meetings were held in selected locations within the potato growing counties as a way of reaching as many stakeholders as possible. The meetings aimed at giving an opportunity to the stakeholder community to express their views, fears and expectations, if any, about the proposed introduction of the LBR potato. The main objective of the meetings was to share information on the proposed project with the farmers and stakeholders within the stations and also accord them the chance to further express their views about the undertaking.

Table 6-1: A list of main Consultative Public Meetings

S/No.	County	Venue	Nature of Meeting	Date	No of Participants
1.	Nakuru	Nakuru	Public Baraza	1/7/2024	12
2.	Bungoma	Bungoma and Mt. Elgon	Public Baraza	2/7/2024	11
3.	Trans-Nzoia	Kitale	Public Baraza	3/7/2024	12
4.	Elgeyo Marakwet	Iten	Public Baraza	4/7/2024	11
5.	Embu	Mountain Breeze Hotel	Public Baraza	7/18/2024	11
6.	Nyeri	Ibis Hotel	Public Baraza	7/16/2024	11
7.	Kirinyaga	Bekam Hotel	Public Baraza	7/15/2024	8
8.	Meru	North Imenti CDF Hall	Public Baraza	7/17/2024	8
9.	Nyandarua	Empress Gardens Hotel	Public Baraza	7/29/2024	10
10.	Kiambu	County Commissioner's Hall	Public Baraza	7/30/2024	12
11.	Taita Taveta	Danida Hall Mwatate	Public Baraza	8/1/2024	11

6.4.3 Key Informants Interview

These interviews aimed at obtaining responses from both National and County Government officials from the 14 counties where the potato variety will be grown. These officials included representatives from the Ministry of Interior and Coordination of National Government particularly the ACCs and DCCs as well as selected county departmental representatives within the target potato counties. Some of the sub-county departments visited included; Agriculture, Water; Environment, Lands and Physical Planning, Public Health and Trade. A total number of eighty-six (86) key stakeholders were interviewed during the consultation and public participation process.

Stakeholders comments were sought through questionnaire administration and engaging them in discussions about the proposed project and the impacts likely to occur as a result of its implementation. This kind of engagement gave the respondents the opportunity to give insights and details about the issues at hand. A list of Key Stakeholders interviewed has been attached (Annexure 10.7 and 10.8).

7. ANALYSIS OF PROJECT ALTERNATIVES

7.1 Introduction

This chapter examines and analyses feasible alternatives to the proposed project, location and management. The benefits of the proposed project will be considered against any potential environmental cost. The general principle involved in identifying alternative option(s) to a proposed development is to ensure that the option chosen would result in optimal social, environmental and capital benefits not only for the farmers and proponent but also for the environment and other stakeholders in the sector. These take into account the cost and benefit criteria: environmental impacts, social acceptability, economics (including productivity of land-use) and design feasibility.

7.2 The "No Project" Alternative

Under the "No Project" alternative, the proponents will not carry out the intended introduction of the late blight resistant Potato into the environment; the anticipated impacts resulting from introduction would thus not occur. Additionally, the resultant socio-cultural/economic benefits that would be created by the proposed development would also be foregone. The "No Project Alternative" option would imply that the Potato production that is currently challenged by the devastating late blight continues to cause sustained losses to potato farmers as has been the case in the recent past as farmers spend huge amounts of chemical pesticides to control the disease.

Further, considering potato is an industrial crop, lack of its production/low quality production will be a big blow to the manufacturing sector that highly depends on it for production of livestock feed, starch binder, texture agent and filler, and fuel grade ethanol. The No action Alternative is the least favorable to the proponent, farmers, investors and the government.

7.3 The "Proposed Project" Alternative

This option means that this ESIA study report will be presented to the NEMA for approval to facilitate initiation under the Biosafety Act and Seeds and Plant Varieties Act. This way, NEMA would approve for the implementation of the project subject to compliance with all environmental and safety measures and legislations. The alternative consists of the proponent's final proposal with the inclusion of the NEMA guidelines and regulations and procedures as stipulated in the Environmental Management and Co-ordination Act, 1999,

subject to conditions in the Environmental (Impact Assessment and Audit) Regulations, 2003 (Revised 2019). With this alternative, the selection of the best varieties suitable for different agro-ecological zones for placing in the market will be actualized.

7.4 Relocation Option

This project will be located in areas where potato farming is already practiced hence the project will be consistent with the activities in the surrounding areas and is not likely to result in increased negative environmental impacts as opposed to implementing the project in a virgin land.

7.5 Solid Waste Management Alternative

The Project does not lead to solid waste generation since it is essentially not focused on a site. The focus is variety introduction and the construction stage will only be carried out by KEPHIS when the biosafety of the potato has been determined under the Biosafety Act. Potato peels and ware are consumed entirely as human or animal feed.

Adherence to waste guidelines outlined by KEPHIS

In this case, during the construction stage particularly the harvested potato will be managed by KEPHIS in a similar manner to other National evaluations of other crops considered safe for human consumption.

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8. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

8.1 General Overview

An Environmental and Social Management Plan (ESMP) for developing projects is used to provide a logical framework within which identified negative environmental impacts can be avoided, mitigated and monitored. In addition, the ESMP assigns responsibilities of actions to various actors and provides a time-frame within which mitigation measures and monitoring can be done. The ESMP is a vital output of an ESIA Study as it provides a checklist for project monitoring and evaluation. The ESMP outlined below addresses the identified potential environmental and social impacts emanating from the project activities as also highlighted in the chapters of Key anticipated potential impacts.

8.2 Mitigation Measures of the Environmental and Social Impacts

Potential impacts were identified in this ESIA study that required management measures. They are presented below in Table 7-1 alongside the proposed mitigation measures.

8.2.1 Environmental Impacts

The following are the main environmental impacts of the proposed project;

i. Seed production fields: Seed production fields will follow the best practices to ensure pure seed is realized for multiple generations.

ii. Practice crop rotation and diversity: Crop rotation will be encouraged to reduce the risks associated with monocultures and hence promote ecosystem resilience.

iii. Since potato is vegetatively propagated, farmer education will be part of the introduction so that the benefit of the late blight resistant potato can be sustained for longer

iv. Potato Seed Certification and Quality Control: There is a strong emphasis on proper seed certification and quality control measures to protect farmers from

counterfeit seeds and ensure the purity and reliability of the biotech potato seeds. This would involve mandated bodies overseeing seed multiplication and distribution.

8.2.2 Social Impacts

i. Capacity building and awareness campaigns: Sharing accurate information to the public through the media (Radios, TV, magazines and social media) about the benefits of late blight resistant potato.

ii. Inclusive policy making: Public participation by engaging all farmers (large and small scale), the community and all stakeholders in decision making process can help in its management and use.

iii. Seed access programs: Developing a program to ensure seed availability at reasonable cost to farmers which can help reduce any gaps in seed access. This can be done by the government seed production agencies and quality regulation by the existing regulatory organization.

Table 8-1: Environmental and Social Management Plan

No.	Impact	Mitigation Measures	Responsibility	Cost (KES)
1.	**Cost and Accessibility:**	Post release to support seed multiplication, and make seeds available to farmers at the right time.	KEPHIS, KALRO	30,000,000
2.	**Knowledge and Awareness:**	Public education to improve understanding and acceptance of LBR potato among farmers and the general public	KARLO, Local and National Governments	15,000,000
3.	**Environmental and Health Issues:**	Monitor the reduction in use of pesticides as a result of the introduction of the LBR potato.	KALRO, PCPB,	4,000,000
4.	**Seed Viability and Sustainability:**	Continuous research, policy reviews and adaptation to Facilitate adoption of LBR potato and address emerging challenges	MOALD, NBA, KARLO	37,000,000
5.	**Market and Adoption Issues:**	Allocation of funds for regular demonstration activities. This includes supporting field days, and agricultural shows to educate farmers and the community about the benefits and use of LBR potato.	KALRO, Proponents and users	7,000,000
6.	**Need for Research and Regulation:**	Stakeholders should work together to formulate and implement policies that support the responsible adoption of biotech potatoes. There is need for regular monitoring to address potential risks	KALRO, NEMA, NBA,	11,000,000
7.	**Violation of the principles of "food sovereignty":**	The perception should be included in economic assessment of LBR adoption to ascertain level of adoption.	KALRO, proponents, MOALD, NBA, KEPHIS	13,000,000
8.	**Ethical Concerns**	Public education to dispel misconceptions and build trust.	KARLO, Local and National Governments	3,000,000

9. CONCLUSION AND RECOMMENDATIONS

9.1 Conclusion

The introduction, of the new late blight resistant potato referred to as 3 R-gene LBR Biotech Potato is unlikely to pose a significant risk to the environment relative to conventional potato. The establishment of the 3 R-gene LBR Biotech Potato will go a long way in addressing the fundamental constraints of potato production in Kenya. This is projected to substantially enhance smallholder incomes, health and their general well-being.

9.2 Recommendation

Collectively, the data presented in this ESIA study report has not identified any significant environmental hazards and/or health and safety concerns. This leads to the conclusion that 3 R-gene LBR Biotech Potato is safe and thus not likely to cause an altered risk to the environment relative to conventional potato. It is our strong recommendation that NEMA issues a license to allow the commencement of the Project.

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11. ANNEXURES