



AgriSCALE IN KENYA

Increase consumer awareness of bioethanol as a cooking fuel derived from invasive plant species

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EGERTON
UNIVERSITY



AgriSCALE
Scaling agro-entrepreneurship
through problem-based learning

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List of Abbreviations

ECF: Ethanol cooking fuel

EGU: Egerton University (Kenya)

ERC: Energy Regulatory Commission

HAMK: Häme University of Applied Sciences (Finland)

KES: Kenya Shilling

KNBS: Kenya National Bureau of Statistics

LPG: Liquefied petroleum gas

NBC: National Biofuels Committee

SDGs: Sustainable Development Goals

SGT: Sustainable Global Technologies (course in Aalto University)

VAT: Value added tax

Meet our team!

Sophia Rudolph

is from Hamburg. She has her background in industrial engineering with focus in renewable energies. Currently studying in the master program of environmental engineering at the LUH in Hannover, Germany. Her passions lie in renewable energy technologies, anything related to sustainability and art. On the weekends you can find her in the nature with her friends. In the project she will take the role of the external relation manager.



Pamela Ngui

is currently studying her master's in Creative Sustainability at Aalto University. She is originally from Singapore where she studied her bachelor's in Policy Economics. Social and environmental issues are close to her heart. In her free time, she enjoys outdoor activities, listening to music, doing handicrafts like knitting, and is also interested in different cultures and languages.



Minnami Henriksson

is making her master's degree in Landscape Architecture in Aalto University. She is especially interested in social and ecological questions. Creativity and sunny appearance can be seen as her superpowers. She loves to see her plants to grow and to eat and have naps in the nature. Her role in this project is to provide creativity and share her knowledge in landscape architecture.



Jouni Kärppä

is a Finnish master's degree student in water and environmental engineering in Aalto University. He has focused especially on topics such as plant-based diet, sustainability and global food systems in his studies. The things that keep him going are, for example, anything sports related, writing, painting and diving deep to psychological studies on human beings to understand world better.



Muhammad Iqbal Suleman

is a double degree student in the EIT Manufacturing Master program, majoring in Zero Defect Manufacturing for a Circular Economy. He is South African by ethnicity and multicultural by upbringing. Opportunistic and curious in his nature, always seeking to improve the world around him. His hobbies are snowboarding, go-karting, football, volleyball, and anything that gets his heart racing! His role in this project is the research manager.



Project Summary

This project is a part of a joint initiative called AgriSCALE, which aims to reform agri-entrepreneurship education in Sub-Saharan Africa using problem-based learning cases. The project is carried out by students from Sustainable Global Technologies (SGT) Studio course held at Aalto University, Finland. It is a collaborative effort between Aalto University in Finland, Egerton University (EGU) in Kenya and Häme University of Applied Sciences (HAMK) in Finland. Our project was established from January to May 2022.

The focus of this project is to deliver new customer insights to raise awareness of the use of bioethanol as a sustainable cooking fuel, replacing firewood, charcoal, and kerosene currently used in Kenya. The project started with learning about design tools and how to use them. From there the result chain, which included the output, outcome, and impact for the project, were developed. With workshops on communication and risk analysis we prepared for further interaction with e.g., our partner university in Kenya. To thoroughly understand and identify the obstacles of bioethanol adoption within Kenyan culture, the students organised a two-week visit to Njoro, Kenya. Several exercises were organised with EGU and HAMK students for a cultural and knowledge exchange. During the visit, interviews were conducted with a bioethanol production company and potential users of bioethanol. Furthermore, relevant information was sought to get more knowledge on using invasive plants as a feedstock for bioethanol and to control their growth. The aim of the trip was to scope current awareness and attitude of locals towards the use of bioethanol as a cooking fuel.

The output of this project is a report produced from the on-field scoping analysis, which will define a narrowed down target group to be addressed in the awareness raising campaign. Finally, the data gathered from stakeholders can supplement the campaign.

The direct beneficiaries of the results from this project are potential marketing experts who can utilize the data collected for an awareness raising campaign of bioethanol consumption. The indirect beneficiaries are the households in Kenya, fishermen, and farmers.

This report describes the key aspects and workflow of the project. In the first section, a brief introduction to the background is presented, followed by the beneficiaries, objectives, implementation, sustainability, risk analysis, budget, and lastly the communication and reporting plan. The second section records our field observations including our field trip activities, current awareness of bioethanol, target group, marketing in rural areas, and different views on water hyacinth. The third section goes through our recommendations for a marketing campaign, looking at the target group, media channels, message and design, costs, and suggestions.

1. Preliminary Research

1.1. Background

1.1.1. General Information on Kenya and Egerton University

With an area of 580,367 square kilometres, it is the 24th largest country on the African continent. Kenya has a population of 54 million, 10 percent of the country's population live in Nairobi and Mombasa. Swahili and English are the official languages however, the majority speaks Swahili [1]. Shown in Figure 1, Kenya is located in Eastern Africa. The north is arid, and to the southwest lies the Lake Victoria Basin, seen in Figure 2.



Figure 1. Map of Africa [17].



Figure 2. Map of Kenya [18].

The nominal GDP of Kenya is 109.49 billion USD (2021) and ranks sixth under the African countries. From 2015 to 2019, Kenya's economy achieved growth averaging 4.7 percent per year, which significantly reduced poverty. However, the current rate of poverty is 17 percent living in extreme poverty [2]. And the country development challenges continue to include inequality, transparency and accountability, climate change, weak private sector investment, and the economy's vulnerability to internal and external shocks [3]. On the Development Assistance Committee (DAC) list of Official Development Assistance (ODA) recipients, Kenya is included in the lower middle-income countries which represents a per capita Gross National Income (GNI) between \$1,046 and \$4,095 in 2020 [4].

The main industries are agriculture, forestry, fishing, mining, manufacturing, energy, tourism, and financial services. Agriculture is with 35 percent (2020) of the GDP one of the biggest economic sectors [5]. The Covid-19 pandemic hit the economy hard in 2020. It disrupted international trade and transport, tourism, and urban service activities. The agricultural sector was resilient [3].

The Kenya Vision 2030 targets the transformation of Kenya into a newly industrializing and middle-income country [6]. The three pillars are economic, social, and political with focus in economic growth with an annual rate of 10 percent, engenders just, cohesive, and equitable social development and an issue-based, people-centred, result-oriented, and accountable democratic system.

Our partner university, Egerton University, has its main campus located in Njoro, which is where we spent most of our time during our trip to Kenya. Njoro is an agricultural town 18 km south-west of Nakuru (Figure 2). Egerton University was founded in 1939 and is the oldest institution of higher education in Kenya. The main campus hosts the faculties of Agriculture, Arts & Social Science, Education & Community Studies, Engineering & Technology, Environment & Resource Development, Science & Veterinary Medicine [7].

1.1.2. Current sources of cooking fuels

Firewood, charcoal, and kerosene are still the dominant cooking fuels in Kenya (Figure 3). However, urban households are rapidly shifting their primary cooking fuels from kerosene and charcoal to cleaner fuels like liquified petroleum gas (LPG, 13.4%) [8]. In contrast, rural households have shown less shift and are still dominated by firewood.

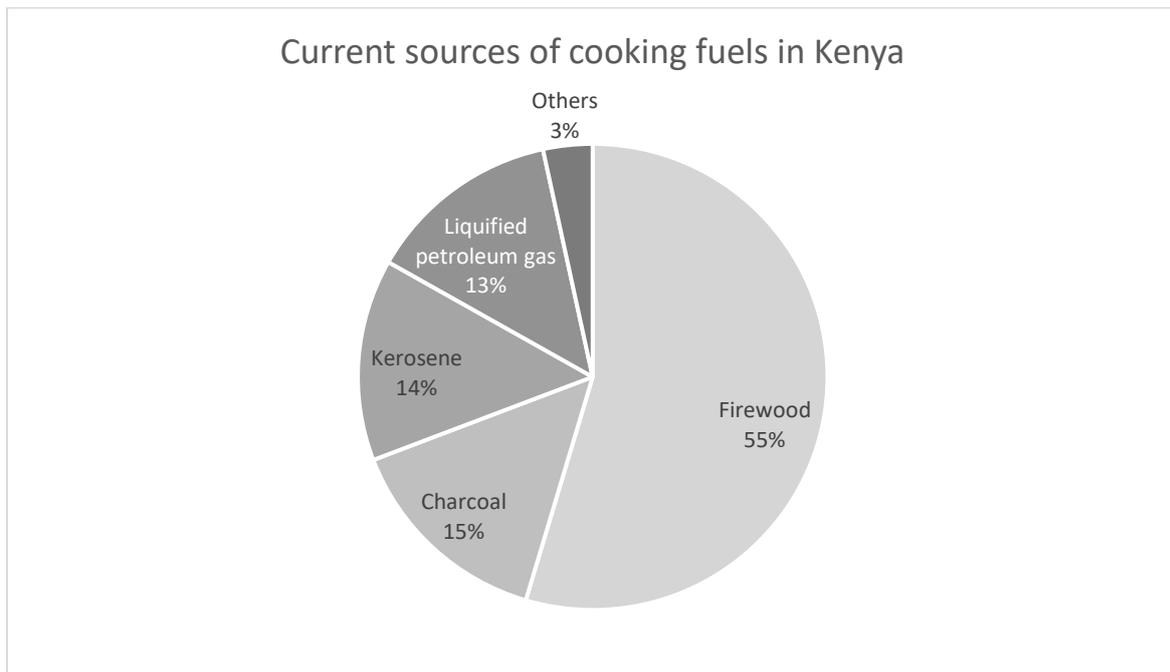


Figure 3. Distribution of cooking fuels used in Kenya.

1.1.3. Invasive species

Water hyacinth shown in Figure 4 is an invasive plant species from South America [9]. It disturbs marine life. Fishermen have less fish to catch because of the plant consuming more oxygen. This disrupts the entire supply chain of fish (restaurants, supermarkets, suppliers of fishing equipment). In addition, people are affected by its presence. Boats' navigation, movement, and fishing gear are affected by the plant. Water hyacinth attracts mosquitos, and people living near the plant report “skin rash, cough, malaria, encephalitis, gastro-intestinal disorders, and schistosomiasis (an illness caused by parasitic worms). Plant roots clog water treatment, irrigation, and water supply systems. [9]” Plant reproduction is fast, so it is difficult to control. The seeds can remain intact up to 21 years, and Kenya soil is fertile for its growth.

Controlling this species is difficult due to their nature of reproduction and spread, but steps are being taken to use them beneficially to make products, foods, and fuels. Water hyacinth is being converted into bioethanol, *Opuntia* leaves are fed to a biogester to make biogas, and charcoal is produced from *Prosopis juliflora* [9, 10, 11].



Figure 4. Water hyacinth
(Credits: Jouni Kärppä)

1.1.4. Analysis of the operating environment

Ethanol has been produced from sugarcane since the early 1980s in Kenya [8]. Currently, bioethanol is exclusively produced using molasses feedstock which is a by-product of sugar production. Bioethanol offers a wide range of applications in multiple industries, including alcoholic beverages, pharmaceutical and industrial applications, and cooking fuel. All biofuels used in these industries must comply with local or international fuel quality standards developed or adopted by Kenya Bureau of Standards.

Considering the availability of bioethanol production, the increase in demand for ethanol cooking fuel (ECF) represents a significant opportunity for Kenyan farmers, ethanol producers, and distributors. In addition, environmentalists are pushing for the adoption of bioethanol as a cooking fuel since they have shown to be a viable alternative to LPG as a clean and affordable cooking fuel. The current goals are to spread awareness and manage communication campaigns to promote ECF and highlight the risk of traditional cooking fuels.

A major present impediment to bioethanol adoption as a cooking fuel is the value added tax (VAT) and when imported, a 25% import charge, which raises the price much above that of LPG, which is VAT and import duty free.

1.1.5. Policy guidelines

The Kenyan Energy Act of 2006 mandates that the government pursues and facilitates the production of biofuels but does not articulate how this shall be accomplished. The Energy Act of 2019 states that the Rural Electrification and Renewable Energy Corporation shall develop, promote, and manage in collaboration with other agencies, the use of renewable energy and technologies, including biomass [12]. Additionally, the National Biofuels Committee's (NBC) biodiesel strategy does not include ethanol. Therefore, the NBC has called for the adoption of new regulations and application of existing regulations regarding environmental impact assessments, child labour, penalties for non-compliance with Energy Act, handling safety standards, and the creation of material safety data sheets.

Currently the Kenyan Energy Regulatory Commission (ERC) has been given the explicit authority to regulate biofuels production and distribution, in addition to more traditional forms of energy. Moreover, the Industrial Alcohol (Possession) Act which required a license for the possession of power alcohol (ethanol) has been revoked. Current fuel taxes, their implications for biofuels and how they can be reduced or eliminated to promote the industry can be explored [13].

1.2. Beneficiaries

The direct beneficiaries are marketing experts who may implement the suggested marketing strategies. But also, the six university students and one doctoral student at EGU with whom we will share the awareness raising campaign suggestions. Through collaboration, we shared each other's findings and educated one other on the production and consumption of bioethanol derived from invasive plants. The other indirect beneficiaries are households in Kenya, more specifically the ones who cook, who are primarily women [13]. Over 80% of Kenyan households use less sustainable energy for cooking, see section 1.1.2. By increasing consumer awareness and reducing the barrier to bioethanol consumption, ideally consumers would replace their current cooking fuel to bioethanol.

The final beneficiaries are the fishermen and the local economy. When the invasive plants are used as feedstock to produce ECF, lakes can be cleared, and the fish population may increase. The local economy also benefits as ECF does not have to be imported but can be produced locally. As a chain reaction, the demand for bioethanol stoves would also increase, which could potentially be produced domestically and therefore be cheaper. In the long run, the environment would benefit the most. The use of invasive plants to produce bioethanol would give the space back to local flora and fauna and the shift from fossil fuels to sustainable fuels will reduce greenhouse gas emissions.

1.3. Objectives and result chain

The primary objective is to increase consumer awareness of bioethanol through enabling an awareness raising campaign. Consumer related data will be gathered and analysed for potential use in an awareness campaign.

The result chain includes the impacts, outcomes, outputs, activities, and inputs from the project shown in Figure 5. The impact we aim to achieve is reduced carbon emissions as people switch to bioethanol as a more sustainable cooking fuel, contributing to Sustainable Development Goals (SDGs) number 3, 5, 7, 14 and 17 which are good health and wellbeing, gender equality, affordable and clean energy, life below water, and partnership for the goals respectively. Switching to clean cooking fuel is linked to women's empowerment [14]. With women usually responsible for collecting the fuel as well as cooking, time is saved from switching to ECF since an average of 12 hours per week per household is spent on collecting fuelwood [13]. Such time constraints restrict their involvement in paid work, educational, political, and social activities [13]. Moreover, they are also disproportionately exposed to air pollution and its harmful health impacts when cooking [13]. Fish can thrive in lakes when the water hyacinth is extracted to be used as feedstock for bioethanol which also is the more environmentally friendly cooking fuel option. This impact may be realised by outcomes focused on the consumption of bioethanol such as increased consumer awareness of bioethanol through a marketing campaign to encourage people to switch to the use of bioethanol instead of firewood, charcoal, or kerosene. Our outputs include gathered data to enable a marketing campaign, delivered final project report, and a defined target group among the locals. Based on our desired outcome, we planned activities such as sharing our progress on social media, spontaneous and organised encounter with the locals, studied fuel usage forms and quantities in Kenya to identify a target group, and participated in workshops with EGU and HAMK teams.

Result chain to increase consumer awareness of bioethanol through suggesting awareness raising campaigns

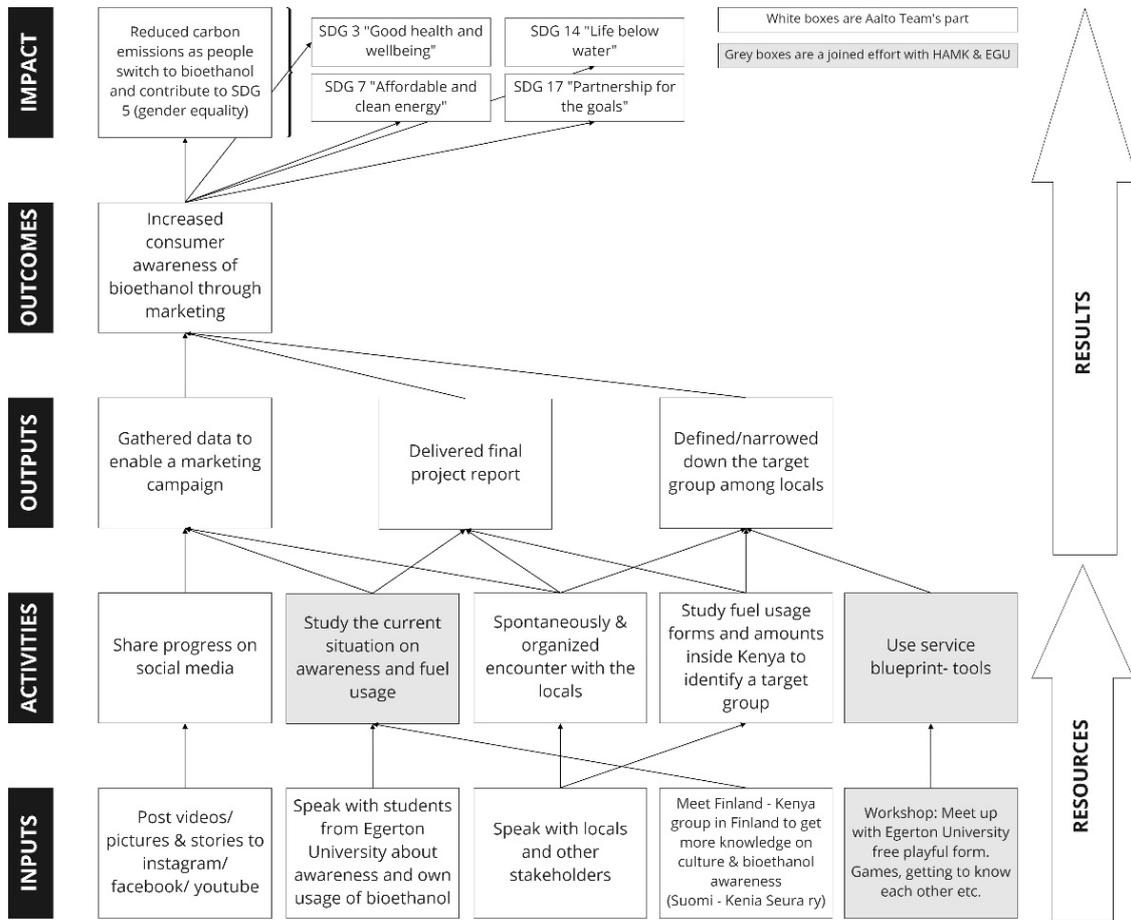


Figure 5. Result chain to increase consumer awareness of bioethanol through suggesting awareness raising campaigns

1.4. Stakeholders

The current section presents identified stakeholders shown in Figure 6 and their responsibilities on the implementation of the project.

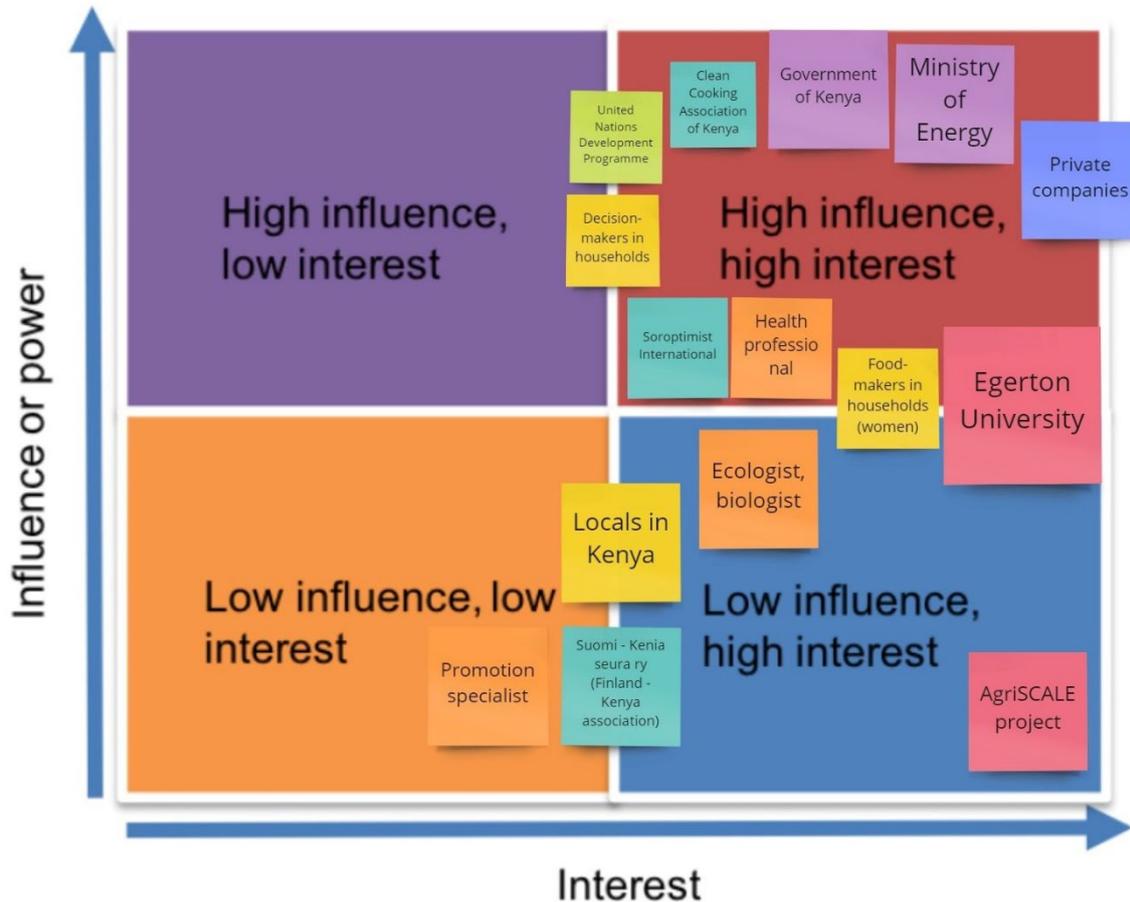


Figure 6. Stakeholder map classified by their potential interest and influence in achieving the outcomes of increasing consumer awareness of bioethanol as a cooking fuel derived from invasive plant species.

AgriSCALE project (Figure 6. pink note):

- HAMK as a coordination organ.
- Aalto Global Impact coordinates AgriSCALE project in Aalto University.
- Aalto University as a home university and SGT programme provides support to the team through mentorship and knowledge sharing.
- EGU as main partner university, provides local and national information and facilitates the identification of key informants.
- SGT22 Kenya team designed the project and engaged relevant stakeholders.

Government of Kenya (Figure 6. purple note):

- Several ministries can be potentially interested in executing and providing support for the marketing campaign:
 - Ministry of Energy (key ministry) provision of data and information on households and use of their communication channels.
 - Ministries of Environment and Agriculture provision of documentation and use of their communication channels.
 - Ministry of Health provision of data on injuries and illnesses per type of fuel and use of communication channels.

Private sector (Figure 6. blue note):

Bioethanol suppliers can have an interest on a marketing campaign:

- CIST East Africa Limited is a private company producing bioethanol from water hyacinth and has information related to the processing of water hyacinth.
- KOKO is a private bioethanol supplier and stove seller and could provide information on design of stoves.

International institutions (Figure 6. green note):

- United Nations Development Programme (UNDP) Kenya — they piloted a project on the production of bioethanol from water hyacinth, seen as an important source of already existing knowledge will provide information on barriers and gaps on their project and guide on possible donors.

Civil Society (Figure 6. turquoise note):

- Soroptimist International Kenya offers information of gender equality through educating, empowering and enable women and girls. Provision of data and use of their communication channels.
- Clean Cooking Association of Kenya (CCAK) provides valuable information of their projects and results and existing network.

Experts (Figure 6. orange note):

- Marketing head from Nyalore Impact shared information on marketing in rural areas in Kenya
- Promotion specialist (marketing expert from Aalto Ventures Programme) provided knowledge on marketing strategies.

Local people (Figure 6. yellow note):

- Decision-makers and food-makers in households provides information on preferences, consumption habits and barriers of bioethanol use.
- Other local people provide general information on fuel use and awareness on bioethanol which can be used to identify the target group.

Peer students:

- EGU students share local knowledge and professional knowledge on their fields of expertise.
- HAMK students accompany Aalto students on the field trip to Kenya.

1.4.1. Project timetable

The current section presents key milestones and their time of implementation, development, and finalization. The aim was to guide the work of the SGT team in developing the AgriSCALE project.

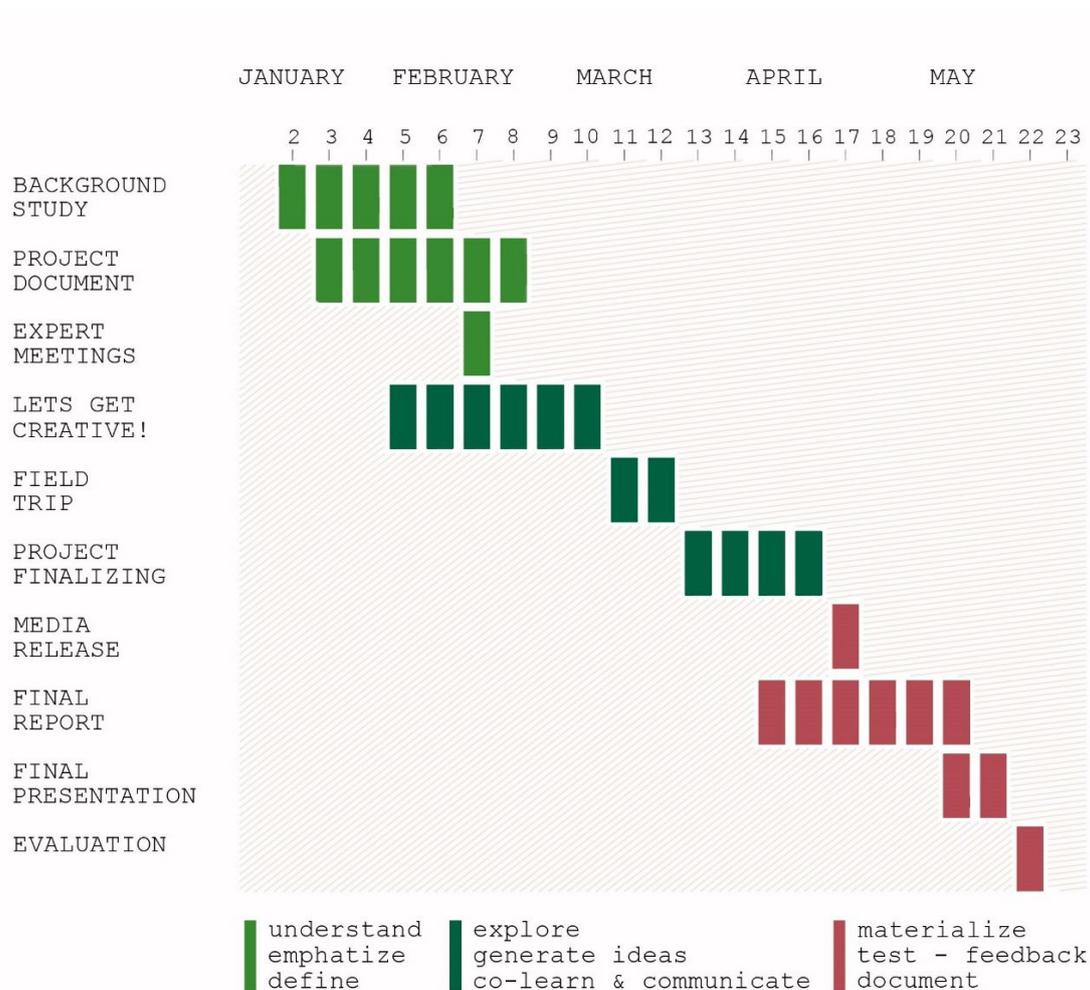


Figure 7. AgriSCALE project timeline with weeks.

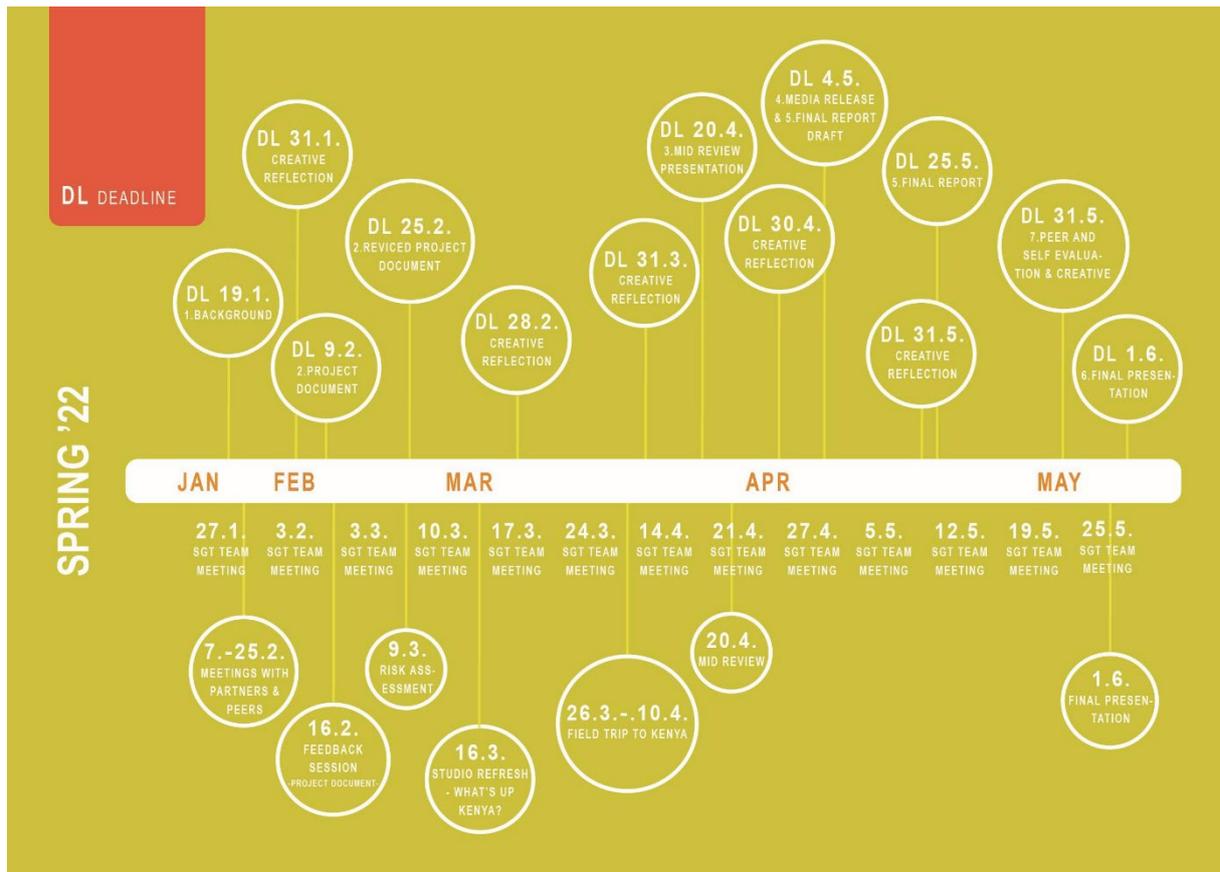


Figure 8. AgriSCALE project, detailed timeline with dates.

1.5. Sustainability

According to the United Nations Brundtland Commission (1987), sustainability is “meeting the needs of the present without compromising the ability of future generations to meet their own needs [15]”. In our project, we look at institutional, social and cultural, financial, technological, and environmental sustainability (Figure 9).

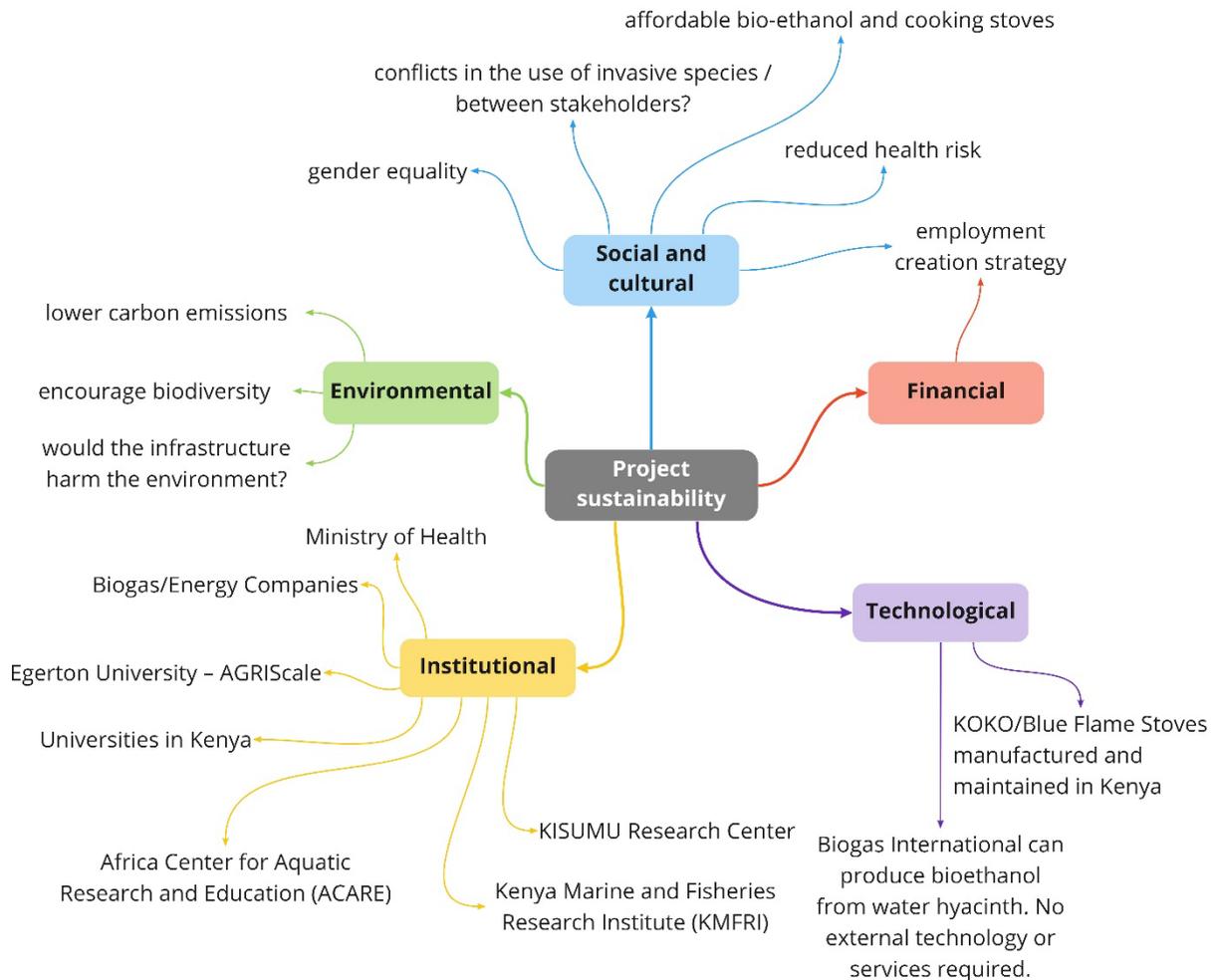


Figure 9. Summary of sustainability in AgriSCALE project.

1.5.1. Institutional sustainability

To ensure institutional sustainability of the project, we look at who takes care of the project and its activities after our project. Below are the various entities which can be involved after our project.

- EGU
- AgriSCALE
- Kenya Marine and Fisheries Research Institute (KMFRI)
- Africa Center for Aquatic Research and Education (ACARE)
- Ministry of Health
- KISUMU Research Center
- Biogas/Energy Companies
- Universities in Kenya

Capacity building activities exist in the project; with more research and partners to help with the funding and production.

1.5.2. Social and cultural sustainability

We hope to address the local needs such as reducing health risks that arise from indoor air pollution from the use of firewood, charcoal, and kerosene by encouraging people to switch to bioethanol as a more sustainable cooking fuel.

Conducting interviews and surveys for quantitative analysis on invasive species and bioethanol as a cooking fuel is essential to understand social and cultural factors.

Gender equality is crucial. Since cooking stoves may be used mostly by women, we should get to know their thoughts and opinions about switching to bioethanol cooking stoves. However, the cooking stove user may vary according to the household. Another important note is to consider who makes the decisions in the household. Nevertheless, women should be given a safe space to share their thoughts on the topic and they should not be left out of the decision-making process.

1.5.3. Financial sustainability

Our project is part of AgriSCALE which is co-funded by the Erasmus+ Programme of the European Union.

1.5.4. Technological sustainability

Technology, spare parts, and maintenance are available locally. Bioethanol is produced by a biogas company in Kenya, known as Biogas International, which is a Kenyan energy technology company. They have partnered with drugmaker AstraZeneca (AZN.L) and the Institute for Sustainability Leadership at the University of Cambridge. Another company is CIST East Africa Ltd which produces ECF using water hyacinth as feedstock. Stoves are also available for use with biofuel (KOKO stoves, blue flame stoves, and Safi stoves).

1.5.5. Environmental sustainability

Environmental sustainability is one of the key topics in our project. One of our project aims is to allow the people to easily switch to bioethanol as a more sustainable cooking fuel as it produces less carbon emissions compared to the current prevalent methods in Kenya such as firewood, charcoal, and kerosene. Moreover, the use of invasive species in the production of bioethanol can increase biodiversity in the area.

1.6. Risk analysis and risk management plan

To assess the risks related to our project we went through some of the most important risks that were internal and external. The risks were assessed on a scale of 1-3 to indicate both their likelihood of happening during our project and the potential impact the risk would have on the outcome of the project.

We found most crucial to consider possible scenarios, that would lead us to function in such way that we would not be able to achieve our objectives for the project. Such risk would be, for example, creating a project that is too broad and complex for us to finish in the limited time frame (Table 1). The most efficient way to address this risk would be to set clear milestones, so that focus is not lost during the project.

Therefore, responsibilities were divided within the team so that there are people focusing deeply on the assignments and others are considering the bigger picture for the project to meet its objectives at the end.

The most important external risks of the project were those that we could not always control, such as current unstable situation with COVID-19 around the world (

Table 2). Then, we thought of ways to mitigate the risks so that we would have a plan B, if something happened outside of our control. For example, we thought that if COVID-19 pandemic worsened, it would help us a lot if we had already figured out alternative plan for our contact sessions with the locals, students, and university staff.

The key elements in managing the main risks related to our project are open and safe communication inside our group and preparing ourselves to find alternative solutions for events that hold external risk that we could not control at the end. Before our field trip we also did a risk assessment session, where also some HAMK students attended. In a relaxed environment we were given possible scenarios and collaboratively found possible solutions.

Table 1. Collection of internal risks regarding the completion of our project.

Internal risk	Likelihood (1-3)	Impact (1-3)	Mitigation
Inside our group: boredom, conflict, covid-19 or other illness and aiming towards perfection	2	2	Multiple team responsibility roles, open communication, clear goals that lead us to do this mainly to the benefit of our skills and secondary to offer a valuable product at the end
Too broad and complex project idea	3	3	Making it clear for us to what we want to focus on. Not possible to battle with all the problems at once
Trying to solve every detail of the project by ourselves	1	2	We will ask help early, and we will try to keep regular contact with our mentor and our main stakeholders to stay up to date
We would prepare a project that would not consider the needs and culture of the people of Kenya	1	3	We will keep ourselves focused on the target that is to provide a solution for them. Also, we will try to gather as much information on their needs as possible, so that we will know what they want us to achieve

Table 2. Collection of external risks regarding the completion of our project.

External risk	Likelihood (1-3)	Impact (1-3)	Mitigation
Other industry opposes our project objectives	1	2	Learning from them and reflecting our project with the information given. Also, we could try to work towards same goal
Community does not want us to help them this way	1	3	Interviewing and involving the community from the start. Furthermore, learning the most important aspects of the project from the local students.
Worsening covid-19 situation prevents us from meeting physically with stakeholders	2	2	Acquiring multiple ways to communicate. Plan B for virtual platform and meetings if the field trip would get cancelled.
The knowledge of the use of water hyacinth and other invasive plants for biofuel is hard to find.	2	2	We will use multiple sources, not just few. Also, we will ask help from our main stakeholders if we feel ourselves stuck with some aspect.
Funding limits our project from going towards our objectives	2	2	We will structure a realistic budget for our project. Also, we will build our project objectives so that they are achievable with the budget we are given.

1.7. Budget

This budget calculation refers to the planned trip to Njoro in Kenya from 27 March to 9 April. The costs are divided into four categories: Travel, accommodation, food and others (this includes unexpected expenses). The calculation was made for 14 days and five travellers.

Table 3. Budget calculation for our field trip to Kenya.

Category	What?	daily [€/d]	Total [€]	Total percentage [%]
Travelling	Visa		225 €	57%
	Flights (Helsinki - Nairobi)		2.759 €	
	Flights (Nairobi - Helsinki)			
Accommodation	Airbnb		700 €	13%
Meals	Daily meals (3x) outside	50 €	700 €	13%
Others	Unexpected expenses		877 €	17%
SUM			5.261 €	100,00%

The accommodation and flights were covered by Aalto Global Impact. Each student from Aalto University had costs covered of up to €2,000. All other expenses such as daily expenses were covered by the students themselves.

1.8. Communication and Reporting plan

Our final product is suggestions for marketing campaigns to increase consumer awareness and reduce the barriers to bioethanol consumption in Kenya by using invasive plants. This will be targeted towards the Kenyan population.

Multiple channels were utilized for various communication purposes. Our internal communication within our Aalto Team was over the Telegram chat platform. To collaborate on work files, we used Microsoft Teams. As already seen in the timetable (chapter 1.4.1), we have fixed weekly meetings and if needed we schedule more meetings throughout the week. To visualise our thoughts more clearly, we utilised Miro, an online whiteboard, as a useful tool. With our partners from EGU and HAMK, we communicated by email, and on Whatsapp when in Kenya. The Aalto and HAMK teams travelled to EGU in Njoro, Kenya from 27 March to 9 April and had two intensive weeks of communication, working together, and learning from one other.

The external communication was done on the social media platform Instagram. The overall AgriSCALE project uses Facebook as a channel to communicate, but it was more convenient for us to use Instagram. Also, we thought it would be a good addition next to the already existing Facebook page. The highlight was the field trip, which we documented through Instagram. This also gave us the opportunity to share our process more freely and personally. Our Instagram channel is: [@SGTKenya](#)

Our prior research and final product will be shared with the students of EGU. The final marketing suggestions will be shared with HAMK and EGU students, and the bioethanol production company CIST whom we talked to during the field trip.

2.1.2. Exercises

We had various exercises in mixed teams to develop our projects further. To evaluate the sustainability of our projects, we brainstormed what sustainability meant, did a value mapping exercise for each of our projects, and looked at the hidden costs of bioethanol as a cooking fuel. In the value mapping exercise, we looked at our target group, the environment, society, and other stakeholders, and wrote down how our project would benefit, negatively affect, miss out on certain opportunities, and how we could then tackle the negative effects and missed opportunities for each group. These exercises helped us to understand the bigger picture and various relationships between stakeholders, to ensure our project was going in the right direction, to evaluate its sustainability and find ways to improve. We also had an exercise on “How short can you go?” which allowed us to practice our communication skills, capturing the idea of our project, group, and field trip to Kisumu in a concise manner.

2.1.3. Content

The Aalto, EGU and HAMK teams presented our respective projects (Figure 12), and at the end, consolidated all our findings after our field trip to Kisumu (Figure 13) where we met the various stakeholders – CIST East Africa Ltd., fishermen from Dunga, and crafters from Kisumu Innovation Centre of Kenya (KICK). Presenting our projects allowed us to practice our communication skills. We also gained a lot of insight from the EGU and HAMK teams as we had a clearer understanding of the bigger picture and how our projects came together and supported one another. The findings after the stakeholders meeting contributed to refining our projects as we gained valuable perspectives.

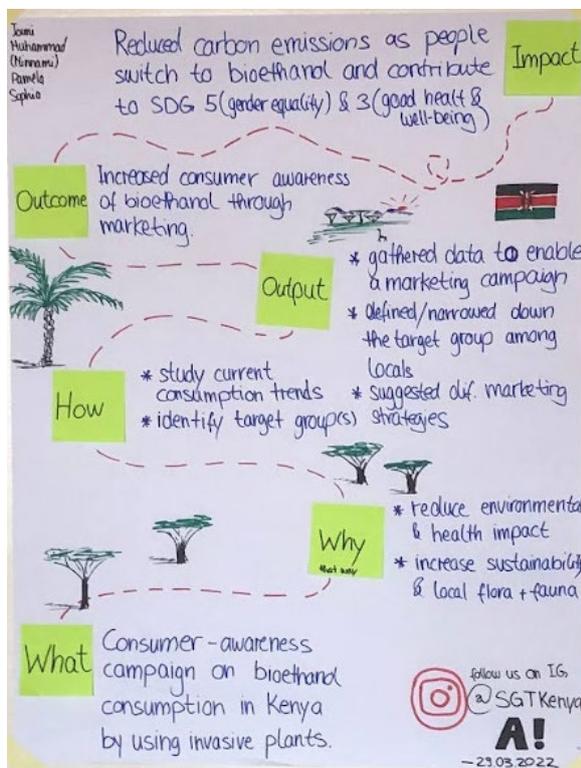


Figure 12. Project clinic conducted during our field trip in Kenya (here: Aalto University's project).



Figure 13. Collected findings during our field trip in Kenya.

2.2. Findings

2.2.1. Current awareness of bioethanol

To begin with, we found out that the rural and peri-urban areas of Kenya are highly dependent on such cooking fuels as firewood, charcoal and kerosene. Therefore, it is very difficult to break the habit of using these as a primary source of energy for cooking purposes. Usually, these alternatives are easily accessible and affordable on local markets, and furthermore, they offer more reliable availability than bioethanol.

Even people who are aware of the current environmental, economic and health issues related to water hyacinth use other cooking fuels than bioethanol. This is mainly because of costly price compared to the other alternatives, the need to buy new stove with it and that bioethanol's availability is not reliable enough. Also, the concept of sustainability may not be that known and valued as people in the rural areas are more focused on short-term solutions to their day-to-day challenges. For example, a bioethanol marketing expert said to us that if people face a situation where their resources are very limited, they will likely make decisions first on what they cook rather than how they cook it. The marketing expert also said, that if there happens to be outages on a certain cooking fuel, people in the rural areas are very reluctant to trust it in the future. According to their marketing study, less than 1% of Kenyans in the rural areas used bioethanol for cooking purposes before their marketing activities.

We visited one of the bioethanol producers, CIST East Africa Ltd, in Kisumu. CIST produces their bioethanol using various raw materials, such as water hyacinth and molasses. They told us that people are very interested in their product in their demonstration and education events, where they show people how to cook food with bioethanol on their stoves and educate people on different aspects of bioethanol compared to the more common alternatives. People who got a chance to try the cooking process themselves were also likely to return to it later.

Regarding demand, CIST told us that their demand exceeds their supply. They concluded that they currently struggle with their warehouse capacity for the raw materials, which decreases their growth potential. Therefore, it seems that the most efficient way of delivering the message of bioethanol out in the rural areas is through demonstrations, as people are eager to learn about new technologies and try them out themselves. At the moment, CIST lacks investor funding for scaling up their operations through more costly marketing strategies and offering customers refill stations, which would provide a sustainable and available way to bring the product to the customers. Additionally, one of the key challenges they face regarding their growth is the Kenyan government's actions on subsidizing other cooking fuel alternatives and possibly putting up some regulations on biofuels in near future.

To conclude, the current awareness of using bioethanol as a cooking fuel in the rural areas of Kenya is fairly low compared to the time it has been produced and used in Kenya. This is most likely due to long history of people using more local and available sources of energy to cook food and Kenyan government's policy actions that complicate bioethanol's growth potential through making bioethanol a more costly

option. So, to increase the awareness of bioethanol in Kenya, bioethanol companies need to focus on creative and educative marketing and finding investors.

2.2.2. Target Group

Cooking households are the primary target group for bioethanol as a cooking fuel, including both genders equally. Feedback from interviews conducted indicates women are believed to be the cooks at home, and men are the ones who make purchases for the household. Thus, both must be targeted and educated equally.

When women are responsible for the cooking in the household, they are more affected by the fumes from cooking when charcoal or firewood is being used. Therefore, the live demonstrations are tailored toward women; if they can understand the health benefits for them, their children, and possibly environmental benefits of cleaner cooking solutions, they could persuade their husbands more easily in purchasing bioethanol.

It is highly encouraged for women to bring along their husbands to the live demonstrations. A marketing expert explained that in Kenyan culture, a male sales agent is tasked with pitching to potential male clients. The men or husbands are more likely to have rapport and trust with a male sales agent rather than a saleswoman, and it is difficult for a saleswoman to win a male customer. However, it is still possible for a salesman to win a female customer. Consequently, both genders are targeted equally, and the demonstrations are tailored toward each gender to accommodate their different ways of understanding.

2.2.3. Marketing in Rural Areas

We noticed there is a lack of electronic and social media advertising in rural areas. Their lifestyle is different, and their sources of information are different too. Understanding the difference and catering for it is necessary to direct endeavours of initiating an increase in awareness efficiently. The most prevalent forms of entertainment, news, and advertising is radio, live demonstrations, roadshows, and television (TV).

A local mentioned that during the coronavirus pandemic when people had to stay at home due to government restrictions or quarantine, radio was the primary source of news and entertainment. Live updates on the situation were broadcasted on the radio, and it was also a prime time to play advertisements. A marketing expert for bioethanol said that they had enough funding for radio advertisements in a certain rural area. They said it was effective in that community while it lasted. The pandemic destabilized everything, and contracts ended, so the project was discontinued there. The marketer further explained that in rural areas, when something is repeated often, people tend to believe and trust in it. When it is no longer heard, it fades away as people tend to think it was not good enough to stay on the radio — even though this may not be true. Therefore, for this to work, they would need to advertise it on the radio frequently and over a long period of time.

Live demonstrations are a common way for introducing a new concept or product in rural areas. People gather to see and learn what is shown and can ask questions about

it. Usually, the product can be purchased there as well. With regards to bioethanol fuel, live demonstrations are a necessity because the fuel cannot be sold alone, it must be sold in combination with a stove that can process the bioethanol fuel. Thus, people need to be educated on how to use the stove properly and why they need to change their traditional cooking style.

We also noticed roadshows as a common means of advertising in rural areas. A roadshow is a car, van, or truck with loudspeakers at the back and can be seen in the figure below. They drive around slowly and sometimes stop by at places to advertise something. It is either a pre-recorded playing, or a microphone being used, and they advertise live. Finally, there are quite a few TVs in rural areas and sometimes the people watch together at a location where they pay to watch. Advertisements are also played between movies or shows and is a channel that can be used to market bioethanol fuel.



Figure 14. A roadshow, live demonstration in a Kenyan rural area (Credits: Silvia Kaiwitha).

2.2.4. Different views on water hyacinth

Water hyacinth has various uses and impacts when analysed from different aspects, depending also on the stakeholder. Different tools are helpful to get more insights into the project and change the perspective on the topic. Tools like value mapping by Bocken et al. (2013) [16], where both positive and negative value propositions for all relevant actors are captured, give a more detailed view, while hidden costs in the supply chain can give a broader viewpoint on one's project.

Value mapping starts with the purpose in the centre. From there it goes to value captured, value destroyed, value missed and wasted and finally value opportunities [16]. Each value is looked at in the categories of environment, society, target group and other stakeholders.

Value captured shows the positive impact our project will have in the four main categories. For society this can be employment, equality, health, and happiness. In value destruction, one looks at negative social impacts, depletion of non-renewables

and environmental damage. With the success of the project, it will have a negative impact on charcoal and stove sellers. The value can be missed and wasted if assets, resources, and capabilities are under-utilised or if the value is failed to be captured or by not utilising the waste streams. This can be e.g., the end of the other products made by water hyacinths. Value opportunities would create new forms of value for existing stakeholders, such as recycling of old stoves that are made of clay. More can be found in Figure

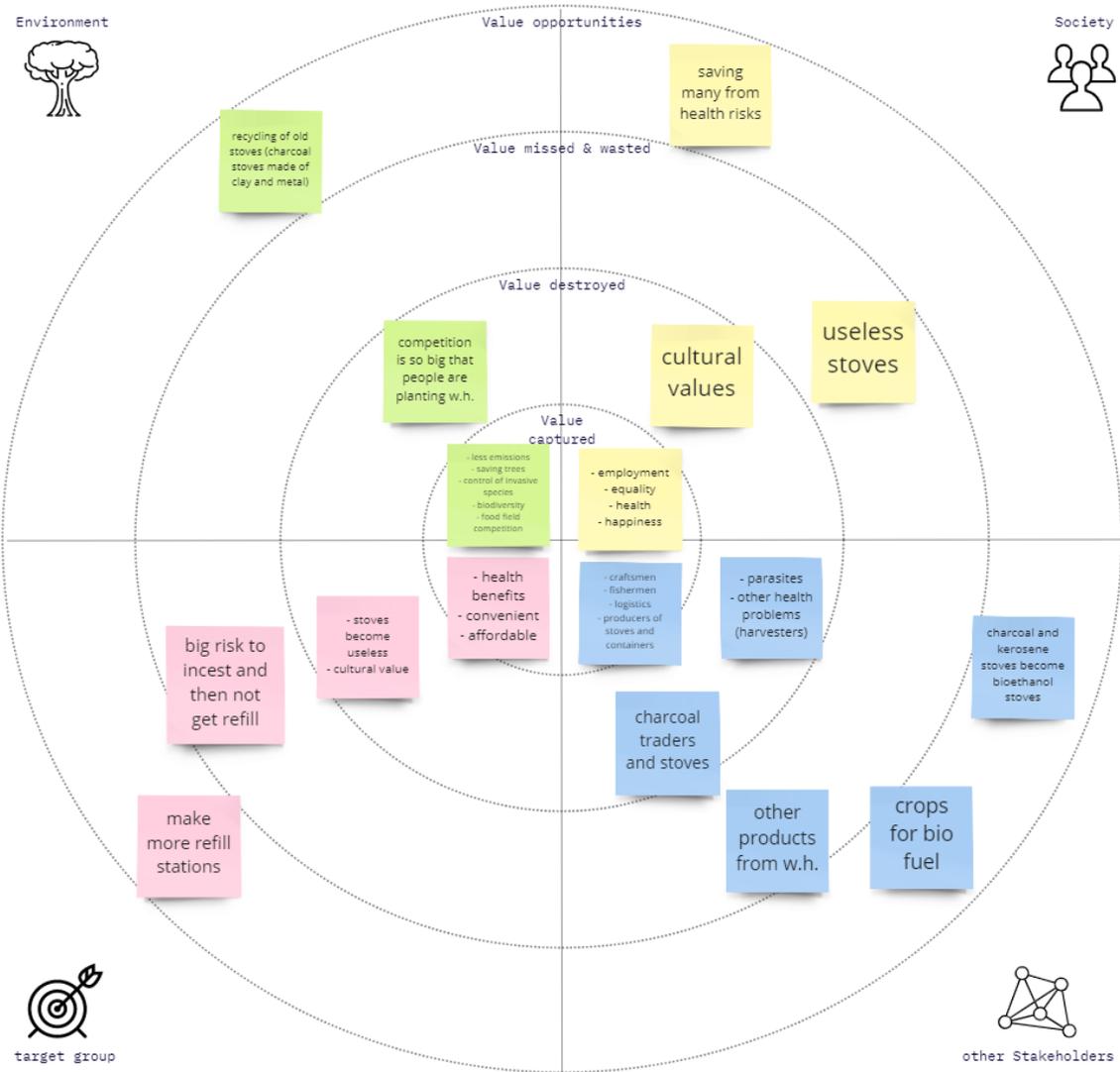


Figure 15. Value mapping exercise on increasing bioethanol consumption in Kenya.

Thinking about the hidden costs in the supply chain gives a broader picture of what goes in and what is emitted throughout the whole process. Especially when it comes to emissions of greenhouse gases, it becomes visible where they are being emitted. This supply chain is based on information from the company CIST East Africa based in Kisumu, Kenya.

The inputs for bioethanol are far more than just the feedstock such as water hyacinth. Due to the dominance of water hyacinth, it comes not only with biodiversity loss and loss of nutrition in the water, but also an increase in mosquitoes. This, together with the decreased mobility in lakes, results in a declining fishing industry and tourism in areas affected by water hyacinth. For the production, water hyacinths need to be harvested. Parts of the plant are not needed and are left at the beach where it composts, resulting in CH₄-, NO₂- and CO₂-emissions. In addition, the transportation to the production site emits CO₂ as well. To transform the plant into bioethanol, the plant needs to be shredded. This process emits a lot of noise. Next, the cellulose is fermented, distilled, and purified. The heat needed for those processes comes from fire, made by burning wood or charcoal which emits CO₂. For the distribution of the bioethanol, marketing campaigns such as with speaker cars or demonstrations emits greenhouse gases as well as noise. The bioethanol is then transported for commercialisation in shops or refill stations in the future which emits greenhouse gases again. From there the consumer picks up the bioethanol. The consumption is where the cooking fuel is used. For that a cooking stove is imported by ship, which emits again greenhouse gases. Although using ECF has lower carbon emissions compared to firewood and coal, hard foods still must be cooked with firewood or coal which again emits CO₂. The last step in the supply chain is the waste. The bioethanol is transported and distributed in a plastic bottle which can be in the best-case scenario recycled but is most likely not.

Even though the bioethanol has a rather low distribution price, the costs for the environment are high. Throughout the whole supply chain of bioethanol, greenhouse gases are being emitted regularly. That can be improved by cutting down the use of plastic bottles and increasing refill stations for example. Also, a bottle return system could be introduced to reduce waste streams.

3. Recommendations for Marketing Campaign

This section describes suggestions to support the selection of a possible marketing strategy. The aim is to increase consumer awareness on the use of bioethanol as a cooking fuel derived from invasive plant species. The observations were done during the field trip in Kenya from March until the beginning of April 2022 and complemented with a desk review. We also conducted interviews with a marketing expert from Kenya who currently markets ECF in rural areas in Kenya, and with a marketing representative from Aalto Ventures Program who has knowledge of various marketing strategies. This section details a potential target audience, media channels, message and design, costs, and potential channels such as the use of a vehicle with loudspeakers or roadshows, radio, billboards, and social media.

3.1. Target group

The campaign is targeted to rural households in Kenya. According to Kenya National Bureau of Statistics (KNBS) [19], Kenya has 11,415,000 households out of which 6,442,000 (56.4%) are rural. In 2019, 91.8% of rural households still used firewood and charcoal while 1.6% used kerosene as a main type of cooking fuel [20, Page 340]. Therefore, there is 93.4% of rural households to be potentially targeted by the campaign. This makes over 6 million potential rural households that could switch to bioethanol. Considering that the mean household size is 4.5 people [19, Page 14] the campaign could target over 27 million rural Kenyans of all range of ages.

According to KNBS [19, 20, 21] rural households seem to follow a hierarchical structure with the household head being on the top. The head is “a member of the household who makes key day to day decisions pertaining to the household and whose authority is recognized by all other members of the household.” So, we can assume that the head will also decide on the choice of cooking fuel. The household heads (Figure 18) are mostly more than 65 years of age, representing a total of 16.4% or 1,055,000 of all rural households. From those households, 570,000 are male and 485,000 are female [19]. The second most prominent age group for the head is 30-44 years old, making up around 12% of the rural households. In this age group, men headed households represent around 70% (500,000 households) and women 30% (250,000 households). Therefore, narrowing down to the most common households the campaign would target 3,086,870 men and women from the age of 30 onwards.

Percentage distribution of households in rural areas by sex of household head and age group

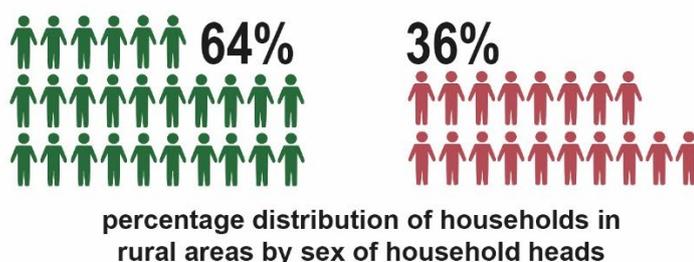
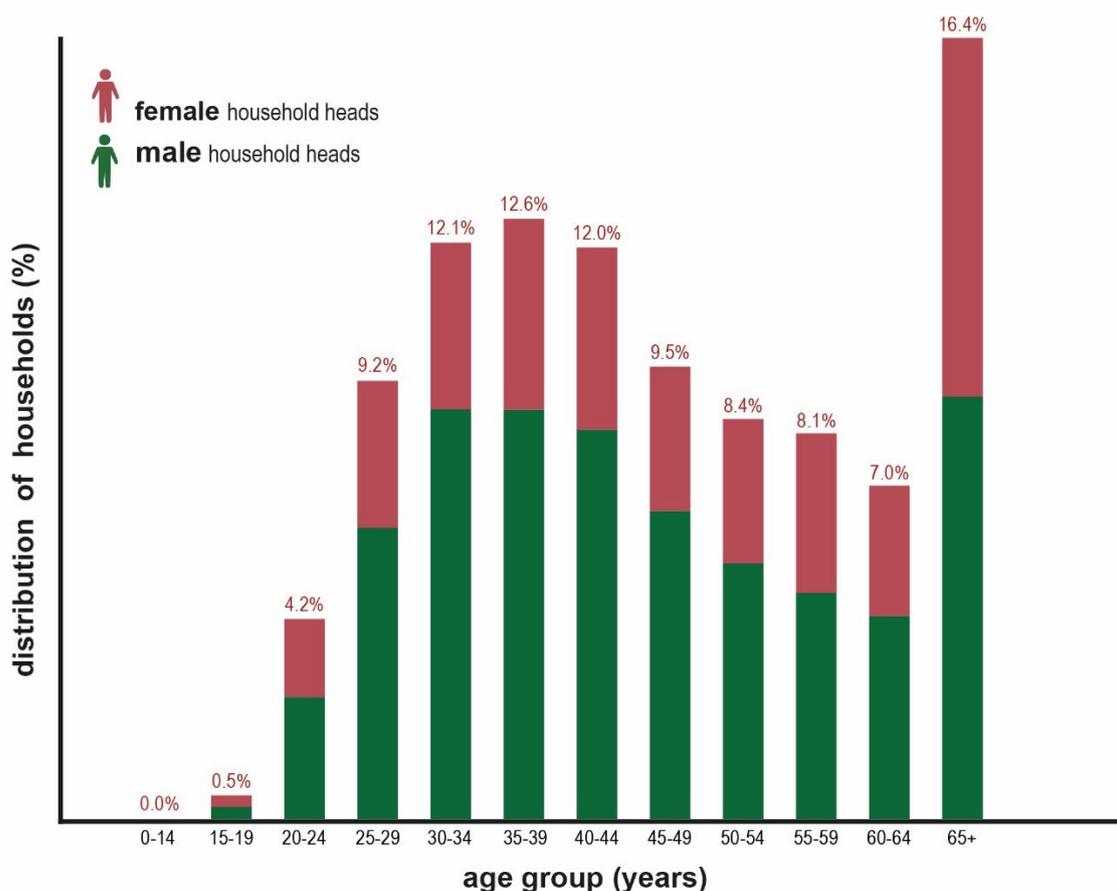


Figure 16. Percentage distribution of households in rural areas by sex of household head and age group. Adapted from KNBS 2015/2016. [19]

3.2. Media channels

The communication channels actively used for marketing in Kenya can be divided between traditional and social network channels. Traditional channels are in-person events, direct marketing in malls or shops, using cars with loudspeakers, television, radio, magazine, newspaper and mail. Social network channels are social media, search engine ads, websites, newsletters and email. [22]

Due to the increase of social network advertising in Kenya, the communication channels' importance is shifting. Kenya has one of the highest internet usage rates in

Africa due to the growth of mobile phones [23] and its young population. Nevertheless, traditional communication channels as radio, tv and print still are the most used [24]. Also, according to the marketing expert from Kenya, the population in rural areas are less likely to use social media as they may not have smartphones.

For choosing the right communication channel it is important to understand the suitability of the channels for the identified target audience. Therefore, rural households' preferences and accessibility should be studied in more depth.

3.3. Message and design

The two main languages used in the media are English, the official language of government, and Swahili, the national language which is spoken and understood by nearly everyone (Swahili is the language used for aid-agencies when targeting broad sectors of Kenya's population. [23]. According to the Afrobarometer [25], 16% of the rural people use Swahili as the primary language at home, followed by Kikuyu and Kalenjin (11%) and Luhya (10%).

GeoPoll found that the most liked and influential ads are lifestyle images and videos of real people, such as influencers, using a product, as well as creatively designed banners [26].

The material could be produced in Swahili for a broad audience. However, developing materials in other local languages could provide a higher effectiveness in rural areas. Also, the materials could portray people enjoying the benefits of clean cooking.

3.4. Costs

The goal is that advertising reaches as many relevant people as possible at the lowest cost. That is why it is very important to consider the costs of the different communication channels when designing a marketing campaign. Tables (5, 6, 7, 8) present estimations on the publishing prices and a non-exhaustive list of prices to develop graphic materials (videos are excluded). The prices were collected through a desk review of available sources online. Our direct requests for pricing to media companies were not answered before the submission of the document. Therefore, the prices represent real prices from a small sample.

Further costs associated with each media channel and not included are:

- Direct mail includes print and mailing costs
- TV and radio have different prices during peaks times (like rush hours and popular shows)
- Billboard prices can range based on quality of traffic and location
- Social media personnel cost need to be considered

The estimated costs of different media channels serve to compare the ranges of investment needed. However, the costs are not detailed enough. Therefore, the selection of marketing channels to be prioritized did not use the costs as decision factor. The costs (Table 4) should be revised when the marketing campaign is implemented.

To reduce the prices, the campaign could create materials which could be used for both traditional and social network channels.

Table 4. Comparison between estimated costs in advertising through different media channels.

Media channel		Price (KES)	Considerations
Television	4 ads per day during one week	868,750	Price does not include spot ad development
Radio	30 seconds commercial ad (1 run)	77,800	Adding a run is 25,200 KES
Social media			
Facebook	CPM**	5,628	Graphic material (not video)
Instagram	CPM**	5,691	Graphic material (not video)
LinkedIn	CPM**	5,576	Graphic material (not video)
Twitter	CPM**	5,564	Graphic material (not video)
Magazine	1 half page in one number	185,750	
Billboard	8-meter single billboard	650,000	Not reference to time and location
Vehicle with a loudspeaker	One day running with an external branding vehicle	27,300	Using the same ad as for the radio. Each extra day will cost 9,100 KES

*For reference, the exchange rate at 17th of May it is 1 EURO=122.48 Kenyan Shillings.

** CPM is an advertising metric which reflects how many Kenyan Shillings must be spend in advertising to reach 1,000 people.

3.5. Suggestions

The selection of potential media channels was done considering the target audience and the field trip direct observations. Furthermore, the aim is to create an integrated campaign, mixing traditional and social network channels for 4 months, following on the success and approach of previous marketing campaigns in the energy sector. [27, 28, 29, 30, 31, 32] The 4-month period can serve as a pilot phase to be extended if successful.

The target group is rural household heads aged between 30 and 44 years old and more than 65 years old residing in households using firewood or kerosene as cooking fuel.

3.5.1. Vehicle with loudspeakers / roadshows

Vehicles with loudspeakers could be considered as mass media communication channels. Therefore, it will target all age segments and population in rural areas who can hear the message. The car may also be parked in selected areas, providing on-site exchanges to increase the bilateral communication. Such can be considered as roadshows. In addition, this can be complemented by cooking demonstrations using the bioethanol cooking fuel which can be an effective way to market the product.

Table 5 presents the estimated costs of advertising with a vehicle advertisement or loudspeaker [25]. Running the campaign for 4 months with a car branding (18,200 KES/ year) and the loudspeaker (9,100 KES/day) running all days for 4 months will cost 1,110,200 KES.

Table 5. Costs estimation for advertising with a vehicle ads and loudspeakers. [33]

Product	Description	Quantity	Total Cost, KES
Advertisement	By the loudspeaker in a vehicle	1 day	9,100
Advertisement	External vehicle branding - 4 wheelers	1 year	18,200
Advertisement	External vehicle branding - 3 wheelers, wheelers & pushcarts	1 year	9,100

*For reference, the exchange rate at 17th of May it is 1 EURO=122.48 Kenyan Shillings.

3.5.2. Radio

The most popular Swahili radio stations (Figure 19) in Kenya are Radio Citizen, Radio Maisha, Jambo and Milele FM. These stations have big audience in rural Kenya and among elder populations [38].

Radio ads should be targeted at the population older than 65 years old. The messaging e.g., could appeal to the grandson’s health, family well-being, etc.

To develop the costs of advertising on the radio (Table 6), radio Hope FM from HOPE media group (a faith-based broadcaster) prices were used as an example. Hope FM is not among the top ten most listened national broadcasters ¹, running a daily ad for 4 months would cost 3,076,600 KES [39]. It is expected that radio stations with higher audiences will have higher prices.

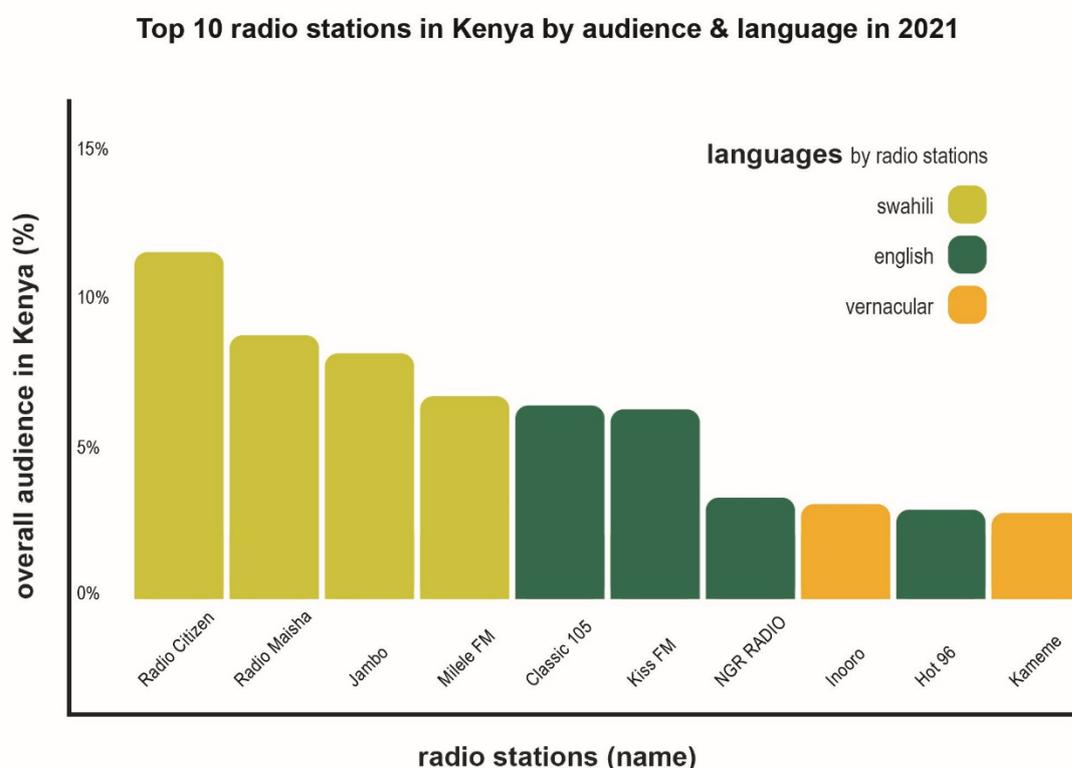


Figure 17. Top radio stations in Kenya by audience and language in 2021. [38]

¹ Hope FM was used as a reference because the most listened national broadcasters do not provide an open list of prices. Direct requests for prices were not answered before the submission of this report.

Table 6. Cost estimation for radio advertising. [39]

Services	Description	Duration	Total Cost, KES
Commercial Ads		15 sec	14,250
		30 sec	25,200
		45 sec	35,200
		60 sec	44,000
Classifieds	Maximum of 60 words 3 runs	5 days (Minimum)	9,000 per day
Presenter mention	A single mention done by a presenter	60 sec	15,750 per mention
Activation (Mon-Fri)	Minimum 1 week	5 min	750,000 per week
Infomercial	Per single run	1-2 min	100,000 per run
Features		2 runs of 4 minutes each	300,000 per day
Interviews		30 min	120,000
Production	Production of commercials, features, infomercials. The cost includes scripting, voice overs, sound effects.		44,800
Studio hire	Voicing, Promos & Recording	1 h	7,800

*For reference, the exchange rate at 17th of May it is 1 EURO=122.48 Kenyan Shillings.

3.5.3. Billboards

The billboard could be considered a mass media communication channel. Therefore, it would target all age segments. Nevertheless, it should include a messaging appealing to the age range from 35 to 44 years old, so the campaign will cover all range groups identified. The base price for a billboard is 650,000 KES.

The printing costs and pole costs are presented in Table 7. However, the time that the billboard is up should be also considered. Billboard operators will charge between 160,000 to 200,000 KES a month. The amount varies depending on the location, size, and the demand. Advertising firms usually pay an annual tax of 350,000 KES for each billboard. [40]

Table 7. Cost estimation for Billboards as a marketing campaign. [37, 40, 41]

Product	Description	Quantity	Total Cost, KES
Printing	size 12m * 10m	1 meter	650
Creative artworks for traditional media such as billboards	-	-	30,000-50,000
Single-Sided Billboard	8 meters	1 pole	600,000
Double-Sided Billboard	8 meters	1 pole	1,200,000

*For reference, the exchange rate at 17th of May it is 1 EURO=122.48 Kenyan Shillings.

3.5.4. Social media

Facebook (Figure 20) should be the main social media as it has the highest usage rate among social media in Kenya [34]. In Figure 21 the potential advertising reach across Facebook and Instagram by age and gender in Kenya 2021 is presented. The age group between 25 to 34 years old is among the age groups having the highest advertising reach. Therefore, social media can be used to target the segment between 30 to 34 years old (see section 3.1 target group).

A potential approach could be showing an influencer portraying their “daily-life” using bioethanol. Considering that 50% of household heads have access to Facebook, the price of reaching them with one single ad will be 476,340 KES.

Social media has a considerable amount of audience in younger generations. Therefore, they could be a potential indirect target group influencing current household heads or as future household heads themselves.

Estimating the cost of social media ads is very complicated as many different aspects come into play. The cost estimation in Table 8 is based on different sources and presented as Cost per Thousand Metric (CPM). CPM is an advertising metric which

reflects how many Kenyan Shillings (KES) must be spend in advertising to reach 1,000 people.

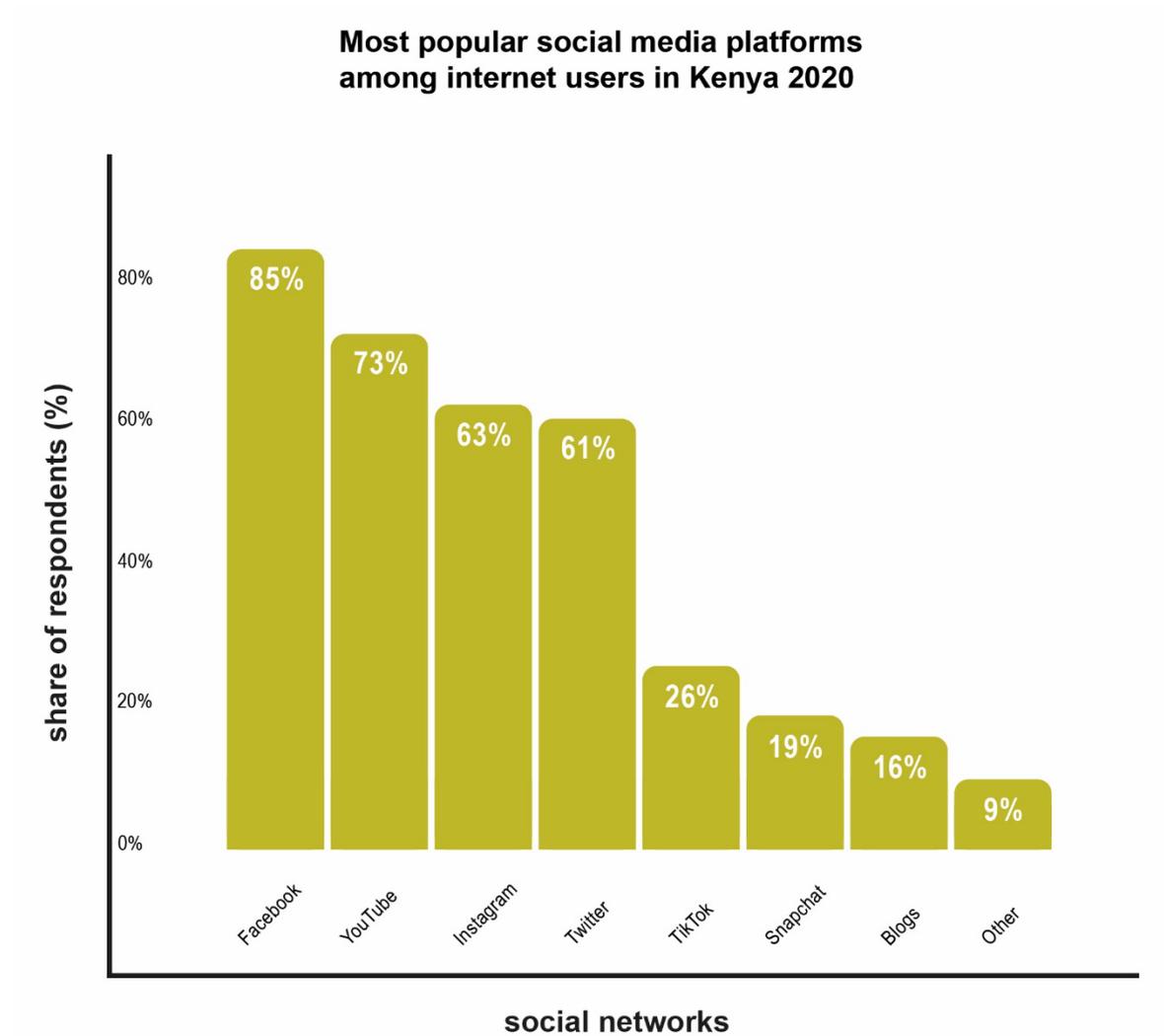


Figure 18. Most popular social media platforms among internet users in Kenya 2020. [34]

Potential advertising reach across Facebook and Instagram by age and gender in Kenya 2021

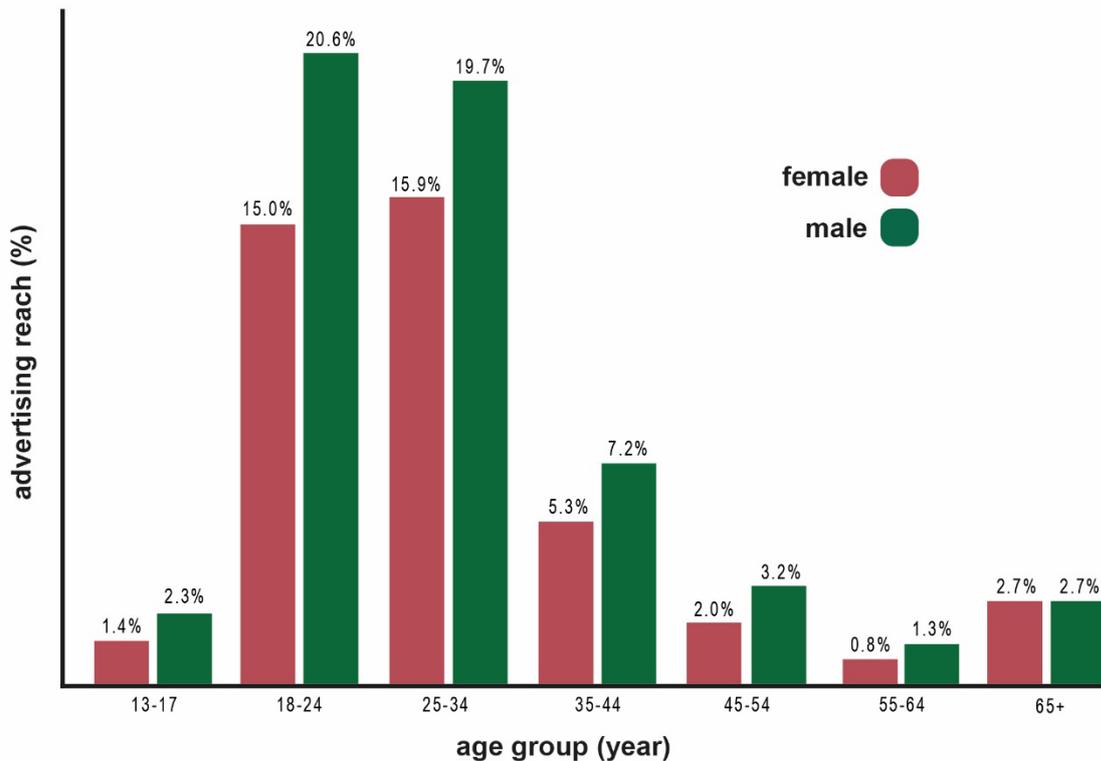


Figure 19. Potential advertising reach across Facebook and Instagram by age and gender in Kenya 2021. [35]

Table 8. The cost estimation for social media usage measured by CPM. [36, 37]

Services	Description	Total Cost, KES
Illustration	Developing a social media banner	5,000
Facebook	CPM	628
Instagram	CPM	691
LinkedIn	CPM	576
Twitter	CPM	564

*For reference, the exchange rate at 17th of May it is 1 EURO=122.48 Kenyan Shillings.

An integrated approach mixing traditional and social network channels, using a vehicle with loudspeakers, social media, radio and billboards, is expected to provide access to all the segments of the identified target audience. The costs for running the campaign for 4 months start at 5,313,140 KES. To reduce costs, communication materials could be used in chosen channels and developed only in Swahili or targeting more local market areas.

3.6. Social sustainability implementation

To strengthen the effectiveness of our project after us, we focused lastly on social sustainability implementation aspects. In this plan, we describe such social sustainability elements as inclusion, cohesion, capital, participation, and safety. By inclusion, we mean the inclusion of women, minorities, such as non-common tribes, in the communities. Cohesion indicates the community's resilience and understanding of the background of the project with its local stakeholders. By capital, we mean the possibility to educate more people on how to grow capital by doing such business as our bioethanol company is doing. Participation considers the measures to reassure that people in the community are heard regarding the topic of our project. And lastly, the aspect on safety sums up the possibilities on increasing safety issues related to our project. To be clear, this plan consists of purely our own thinking and knowledge of our project and its surrounding topics.

Below, in table 9, we present a social sustainability implementation plan, which considers multiple aspects of our project regarding bioethanol marketing and consumption. In the table, "Stage(s)" means the different stages one can take to make sure the element is taken care of. "Who" represents the different stakeholders that are relevant to an element. "Method/tool" consists of the most influential measures one can take to make sure the element is strengthened. By "Resource", we mean the available time and other resources needed to accomplish each element goal. Lastly, "Limitation(s)" describes the potential drawbacks one could face while trying to strengthen the element in question.

Table 9. Social sustainability implementation plan for marketing bioethanol.

Element	Stage(s)	Who	Method/ Tool	Resource	Limitation(s)
Inclusion	Invitations to a marketing event, discussion with locals	Minorities among the rural citizen, Egerton University students, bioethanol company	Using local languages, talk show	Pamphlets, Post Office, market spaces (during rush hours)	Events and commercials from competitors
Cohesion	Presenting the use of invasive plants, work effort of crafters and fishermen	Rural citizen, fishermen, crafters, bioethanol company	Talk show, interviews	Market spaces (during rush hours)	Language barriers
Capital	Providing an example on how to make money by using local resources	Rural citizen, bioethanol company	Talk show (radio/tv/ local event)	Bioethanol company knowledge, market spaces (during rush hours)	Lack of knowledge on entrepreneurship
Participation	Gathering feedback	Rural citizen, bioethanol company	Feedback template	Time at the end of the events, paper and pens	Lack of interest
Safety	Presenting safer way to cook food by using bioethanol	Rural citizen, bioethanol company, Egerton University students	Comparison on firewood, coal and bioethanol for example, demonstration	Research results	Changing habits, lack of interest

Conclusion

Throughout our project, we have learnt immensely from our partners, and are grateful for this collaboration. Empathy was crucial in understanding the various stakeholders and how the production to the consumption of ECF would affect their lives. Conducting various interviews with stakeholders and experts and interacting with EGU students in Kenya also helped us to gain better understanding.

As we are part of a bigger project under AgriSCALE, the above marketing suggestions can be considered by the other groups, such as EGU, or future teams from Aalto or HAMK, who will continue to work on this. Besides marketing, there can be other ways to increase consumption of ECF. For example, nudging consumers by making the process for obtaining and refilling ECF simple and convenient. While price may also play a big role in the consumption of ECF, the other teams have discussed a policy brief to reduce taxes on ECF, and the reconstruction of cooking stoves for ECF using locally sourced materials to reduce prices.

We are once again thankful towards our partners, all who were part of this project, and everyone who have helped us along the way.

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Pictures

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