

A stylized tree with a thick blue trunk and several branches. The leaves are represented by various colored ovals in shades of purple, green, orange, and yellow. The background is a solid dark blue.

Financing and Implementing the
Sustainable Development Goals:

IDEAS FOR ACTION

2018



WORLD BANK GROUP

Financing Sustainable Development

IDEAS for ACTION 2018

Edited by
Mahmoud Mohieldin
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*Innovative ideas from the youth
on food security, energy
efficiency, gender empowerment
and technological solutions for
implementing the SDGs*



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Overview

The Ideas for Action (I4A) initiative is a youth competition on financing and implementing the Sustainable Development Goals (SDGs). It is jointly organized by the World Bank Group and the Zicklin Center for Business Ethics Research at the Wharton School of the University of Pennsylvania. We are pleased to present the winners of this year's competition, which were selected from among 2,024 proposals from 124 countries.

We focus on youth for this competition because more than 3 billion people—42 percent of the world's population—are under the age of 25. Today's youth have the most at stake in achieving the 2030 Agenda for Sustainable Development and its associated SDGs. The world's youth will implement this global agenda, contributing their unique solutions and creating a more sustainable development path for themselves and for future generations.

The SDGs are a set of 17 global goals that seek to end poverty, promote peace, and preserve the planet for future generations, all by 2030. They cover a broad range of interconnected issues, such as ending hunger, promoting health, addressing inequality, creating jobs and sustainable economic growth, improving governance, and addressing climate change.

The I4A competition offers the winners a platform to share and discuss their ideas, and encourages young people to take ownership over implementation of the SDGs. It also provides the winners access to leading professionals in the global development field and the private sector.

The 2018 winning idea, **MINO Microbubble Technology**, from Indonesia, proposes a technology that increases dissolved oxygen in water to improve fish farm yields. The ASEAN (Association of Southeast Asian Nations) region, which has a high level of production in fishery products, plays a major role in meeting global food demand. However, a key challenge to expanding fish farming is the availability of land and fresh water. MINO Microbubble Technology claims its system can increase the amount of dissolved oxygen in water up to 7 parts per million (ppm), compared with other systems which reach up to 3–4 ppm. The group says this has been proved to increase fish yields by up to 40 percent when compared with existing aerator technology.

The second-place proposal, **Starlight**, from Rwanda, suggests a women-led business model to improve sustainable access to energy. In Sub-Saharan countries, electrification rates are low and the use of kerosene lamps is harmful to people's health and to the environment. With Starlight, the idea is to replace all kerosene lamps with solar-powered lanterns in Rwanda and neighboring countries. The proposal also aims to empower women microentrepreneurs by

creating a women-centered direct sales network to bring affordable and clean energy to their communities. They propose a system of recruiting, training, and supporting local women to become clean-energy microentrepreneurs, selling and delivering solar lights. Following a successful pilot project, the team is looking to scale the distribution and impact to schools across Rwanda.

The third-place winner, **Amal**, from the United States, proposes a new legal software program and digital platform that allows women in MENA (Middle East and North Africa) countries to understand their rights in their country of residence and to complete the paperwork required to secure access to these rights. Amal offers resources to legally secure these rights through central, automated document generation software.

The proposals that achieved runners-up status include (in alphabetical order) Al Derb (Mauritania/Qatar) and Pennepidemic (Republic of Korea/United States).

The proposals that received honorable mention status include (in alphabetical order) Credit Locus (Ghana), Ecopack (China), Green Power Group (Tanzania), Limitless (West Bank and Gaza), ROCAPET (Mexico), and SafePal (Uganda).

The winners were selected through a vigorous three-stage selection process evaluating the creativity, significance, feasibility, and clarity of the proposals. Reviewers included young World Bank Group staff members and Wharton students, along with technical experts and senior executives from the World Bank Group, the Wharton School, CitiGroup, GTIS Partners, PepsiCo, and the G-24 Secretariat. Other competition partners included the World Bank Group Youth to Youth Community, the Young Americas Business Trust, and the Organization of American States.

The I4A competition attracts engagement from young people across the globe, with about 43 percent of this year's submissions from Sub-Saharan Africa, 23 percent from Latin America and the Caribbean, 9 percent from South Asia, 6 percent from East Asia and the Pacific, 6 percent from North America, 6 percent from the Middle East and North Africa, and 5 percent from Europe.

Our hope is that I4A will combine the creative insights and thoughtful innovations of the next generation of business and public sector leaders with the implementation potential of development organizations. We further hope that it will foster a sense of ownership while incubating some exciting ideas that can shape our shared future for the better. The submissions included in this book, as well as the rest of the more than 2,000 submissions, have clearly demonstrated the innovative and creative potential of youth.

I4A is not exclusively an “essay competition.” It convenes several workshops, called IdeasLabs, as opportunities for interested young people to get

information and share knowledge and ideas. Equally important was the creation of several I4A clubs; among the most active of these clubs are the one at the Wharton School and those in Belgrade, Serbia; China; and Hong Kong SAR, China. These targeted activities have engaged young professionals who took part in the competition, as well as those who are simply interested in global development.

This book is launched at a side event at the World Bank Group–International Monetary Fund Annual Meetings in Bali, Indonesia, in October 2018, at which the winning teams present their proposals. The previous versions of this book have been used as teaching tools at undergraduate and graduate classes at Wharton as well as at several other schools throughout the world. In these classrooms, students had the opportunity to comment on the winning proposals and to share their ideas with the winning teams. To facilitate the use of the book, teaching notes will be made available to interested academics.

It is our hope that I4A will help the World Bank Group and other development partners recognize young people with bright ideas so they can participate more fully in solving the world's greatest challenges. Thus, by encouraging the next generation of global leaders to think beyond the existing approaches to development issues, we can help innovative solutions germinate and take root.

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Acknowledgments

Ideas for Action (I4A) is a joint initiative of the World Bank Group (WBG) and the Wharton School of the University of Pennsylvania and is in partnership with the WBG's Youth to Youth Community (Y2Y). Over the past four years, this initiative has benefited from the enthusiasm, commitment, and insightful feedback of the staff members of these organizations, as well as the dedicated champions of the initiative.

At the WBG, this initiative is coordinated by Arunima Dhar, senior operations officer, and Farida Aboulmagd, research analyst, from the Office of the Senior Vice President for the 2030 Development Agenda, United Nations Relations and Partnerships (SVPMM). The Wharton team was led by Dominic Johnson Director of Business Operations, Knowledge@Wharton.

The I4A team members would especially like to acknowledge the World Bank Africa Region External Communications team led by Haleh Bridi for its outreach efforts in the region.

The selection process was conducted in three phases. The first round of reviews was completed by reviewers from Y2Y, World Bank Africa Region, and the Wharton School: Agbannon Gbessi Yves, Aicha Boubakary Cheiffou, Alain Davy Wetie, Alex Sanchiz Vicente, Alexandre Hery, Alima Diakite, Alisha Pinto, Aliy Akbarov, Allyson Vaughan, Amina Naomi Idris, Ana Maria Gallego Restrepo, Anita Avery, Annick Nkunku, Anoud Salman Allouzi, Ariel Azria, Arpita Sarkar, Athalie Nkieri, Benjamin Bonge, Bianca Sical-Serle, Bitota Sparf, Camille Le Baron, Carlyn Hambuba, Catherine Rosemary Bond, Chancey Lee Pacheco, Charles Owens Ndiaye, Cheryl Khuphe, Chinh Tran Bui, Chris Avery, Ciliaka Gitau, Claudia Garavini, Constant Mudekereza, Cory Czuczman, Cynthia Song, Daby Diack, Daniel Gordon, Daniel Millan, Daniela Gorza, Daniella van Leggelo-Padilla, Dasan Bobo, Deepthi Rose Zacharia, Delphine Anglo, Demet Cabbar, Devy Damayanti, Diana Martinez Ramirez, Diana Styvanley, Diane Davoine, Dimitrios Rizos, Dina El-Bassiouny, Dominic Johnson, Dongnian Zhou, Dounia Terhmina, Dušan Stojaković, Eduardo López Romero, Ekaterina Svirina, Elena Queyranne, Elita Banda, Elizabeth Correa, Elizabeth Johnson, Erick Rabemananoro, Farida Aboulmagd, Ferran Pérez Ribo, Filip Jolevski, Filip G. Simeski, Frances di Cristina, Franck Sidney Chrysantheme Bitemo, Gamero Michel, Marcellin Noudéhouénou Gandonou, Gisele Fongang, Gustavo Mahoque, Habibatou Gologo, Harini Vadakkancheri Ravi, Helen Jeoung, Ifeka Bonkomo Nelson, Ivar Cederholm, Jacqueline Appel, James T. Johnson, Jannelle Muchai, Jean

Serge Bikoro, Joan Allmaras, Joe Kupferberg, John Hosung Lee, Jon di Cristina, Juliana Cristina da Silva Alves, Julius Gwyer, Kafu Kofi Tsikata, Karen Patricia Romaña Parra, Ke Yuan, Kehinde Temitayo Ajuwon, Kennedy Fosu, Keziah Muthembwa, Kim-Jamy Nguyen, Kolammal Sankaranarayanan, Leandre Nathan Ibouili Koumba, Lina Victoria Innocent, Lionel Yaro, Lisa Castro, Lucia Baltazar, Lucia CasapLuis De Pool, Lwanzo Amani, Lydie Sankara, Mabi Christelle, Madeleine Lukunda Lukusa, Mademba Ndiaye, Maha El Moaz, Mamadou Bah, Manasse Bashizi, Manuela Gómez Valencia, Margot Bokanga, Maria Zarama, Mariam El-Maghrabi, Marie Duffour, Marina Mavungu Ngoma, Marthe Bangda, Matilde Dueñas, Maysa Bedair, Melissa Jassir, Michael Nyumah Sahr, Michelle Jaffee, Mimie Modjaka, Mohamed Saadique A. Merchant, Mohit Bhatia, Monica Czuczman, Moses Alex Kargbo, Moussa Dieng, Murali Krishna Poondla, Mutsa Mambo, Nashwa Azzam, Ned Shell, Nenad Stojkovic, Nermeen Shehata, Nimarta Chugh Banga, Nora Ramadan, Oana Frant, Odilia Hebga, Olivia Hipkins, Otylia Babiak, Patrick Lukau, Paula Galilea, Paulina Nuñez Gomez, Pooja Kandappa, Priscila Vera Jibaja, Rafael Saute, Raphael Shepard, Reem Mikhail, Rogers Kayihura, Rohini Sunkara, Ruth Afandi Mulahi, Salma Mahmoud Fahmy, Saloni Paliwal, Samuel Udeji, Samweli Twesa Mwakisambwe, Sana Khan, Sarah Cussen, Sarah Farhat, Sarah Kambili Thontwa, Sebastian Toro, Serena Shi, Shruti Sadasivan Nair, Sifa Nduire Cornelie, Simon Liu, Sina Hbous, Sonja Probst, Stephanie Crockett, Sue Mohieldin, Swetha Maledath, Tabish Shariff, Nandjim Tchalla, Thanh Ta, Thilagam Deepan, Tiffany Yau, Tochukwu Nwokike, Valentina Gomez, Venchele Saint Dic, Walid Beramdane, Xingjun Ye, Yanbin Xu, Yuan Cao, and Zeria Banda.

The 60 English language proposals that qualified for the second round were reviewed in four working groups chaired by Marco Scuriatti, adviser, SVPMM, WBG; Mike Kelleher, adviser, SVPMM, WBG; Djordjija Petkoski, lecturer and senior fellow, Wharton School; and Jaehyang So, senior adviser, SVPMM, WBG.

Group A, chaired by Marco Scuriatti, comprised Filip Fidanoski, professor, University Diego Portales (UDP), Santiago, Chile; Heike Reichelt, lead financial officer and head of Investor Relations and New Product Development, Capital Markets Department, World Bank Treasury; Felipe Gonzalez, professor, UDP; and Victor Gabriel de Oliveira Rodriguez, professor, University of São Paulo (USP), Brazil.

Group B, chaired by Mike Kelleher, comprised Albena Melin, principal operations officer, International Finance Corporation; Gustavo Díaz, professor, UDP; and Maria-Alejandra Gonzalez-Perez, professor, Departamento de Organización y Gerencia, Universidad EAFIT, Medellín, Colombia.

Group C, chaired by Djordjija Petkoski, comprised Björn Gillsäter, special representative to the United Nations and manager, SVPMM; Christian Eigen-Zucchi, program leader, South Asia Region, WBG; Eduardo Saad-Diniz, USP; Sanda Savic, Senior Director of the Center for Corporate Affairs and Communications, Hemofarm; Dusan Stojakovic, Sustainable Development & Corporate Marketing Manager, Hemofarm; and Faquiry Diaz Cala, venture capitalist and private equity investor in Latin America and the United States.

Group D, chaired by Jaehyang So, comprised Lisa Chase, communications strategist associated with Harvard Business School; Marko Jakovljevic, POSTDOCTORAL RESEARCH FELLOW, Stanford University; Jiten Agarwal, USISEC (U.S. India Skills and Education Council), Cambridge Education Development, and Expedien Inc.; Bruno Vath Zarpellon, director of innovation and technology, the Brazil-Germany Chamber of Commerce and Industry, São Paulo, Brazil and Juliana Domingues, USP (Ribeirão Preto Law School).

The qualifying Spanish language proposals were reviewed by Sonia Plaza, senior economist, WBG, and Gonzalez-Perez. The qualifying French language proposals were reviewed by Sophie Sirtaine, director, strategy and operations, Independent Evaluation Group, WBG, and Caroline Vagneron, senior operations officer, WBG. The qualifying Arabic language proposal was reviewed by Heba Shamseldin Abdelhafez, lead private sector specialist, WBG, and Ahmed Rostom, senior financial sector specialist, WBG.

The final 14 proposals were reviewed by an expert panel, chaired by Mahmoud Mohieldin, senior vice president for the 2030 Development Agenda, UN Relations and Partnerships, WBG. The panel comprised Hafez Ghanem, vice president Africa Region, WBG; Luis Montoya, president, PepsiCo Latin America Beverages; Snezana Stoilkovic, vice president, Blended Finance and Partnerships, WBG; Marilou Uy, director, G-24 Secretariat; Mukul Pandya, editor-in-chief and executive director, Knowledge@Wharton; Thomas M. Shapiro, president and founder of GTIS Partners; and Petkoski of Wharton School.

The book was edited by Sara Proehl, Christine Stinson, and Marcy Gessel of Publications Professionals LLC. The Ideas for Action team members would also like to thank Adam Broadfoot for his excellent management of the publication process.

Finally, a very special thank you to the 7,000 young people from more than 124 countries who contributed to the innovative submissions highlighting the importance of reaching the United Nations' 17 Sustainable Development Goals by 2030.

CHAPTER 1

The Implementation of Advanced Water Treatment Technology in Aquaculture to Ensure Sustainable Development for World Food Security

Team MINO Microbubble Technology

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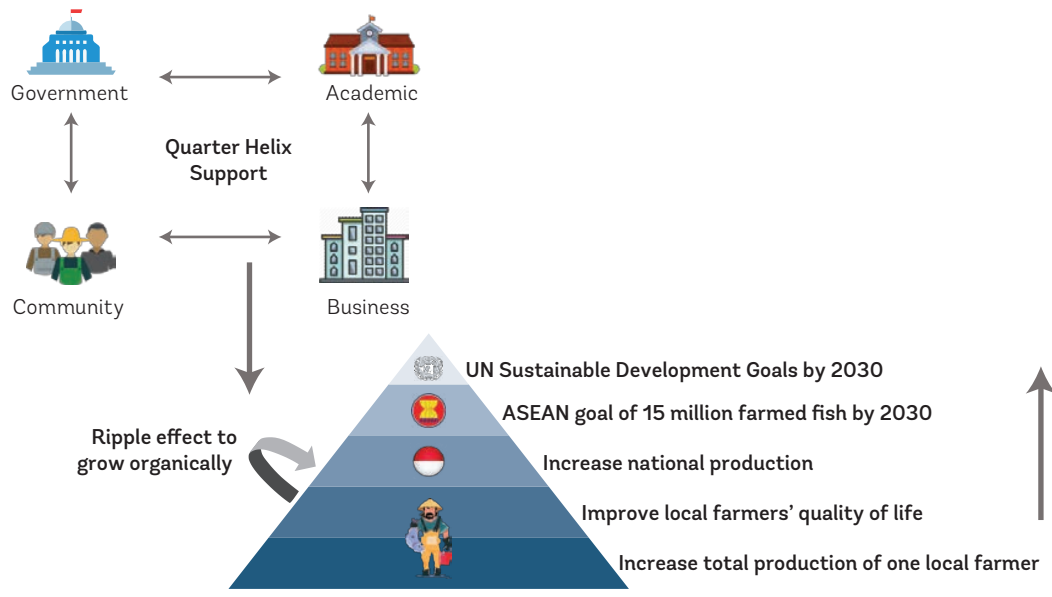
Muhammad Nabil Satria Faradis, Commissioner

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Abstract

Two-thirds of the people in Asia are undernourished, according to World Food Programme (WFP 2015). The Association of Southeast Asian Nations (ASEAN), a major contributor to aquaculture and to the production of fish, has a large role in addressing food security and malnutrition in the region. To address these issues, ASEAN has set a goal to increase the supply of farmed fish produced in the region from the current 10 million tons to more than 15 million tons by 2030. The current challenges the fish farming industry faces in meeting this goal include the availability of land for fisheries and the availability of fresh water. With these challenges in mind, we developed MINO Microbubble Technology, an advanced water treatment technology that increases the amount of dissolved oxygen in water by up to 7 parts per million (ppm). Fish farmers using this technology have up to a 40 percent increase in fish yield. We think the MINO Microbubble Technology will help ASEAN attain the goal of 15 million tons of farmed fish by 2030 (See figure 1.1). In doing so, ASEAN could meet the United Nations Sustainable Development Goals (SDGs) to end hunger and achieve food security.

Figure 1.1 MINO Microbubble Technology Plan to Help Attain Goals



Problem and Context

Zero Hunger

According to the United Nations, the vast majority of the world’s hungry people live in developing countries, where 12.9 percent of the population is undernourished. Two-thirds of the people in Asia are malnourished because the region’s food supply has not been able to keep up with the soaring food demand caused by the region’s rapid population growth. The Association of Southeast Asian Nations (ASEAN), a major contributor to aquaculture and to the production of fish, has a key role in ensuring global food security (World Bank 2014).

Aquaculture (farming in water) is an important source of livelihood for the rural poor that generates income through the direct sale of products. Indonesia, as part of ASEAN, is a major supplier of cultured fish, providing almost 74 percent of the total produced in the nation (Ministry of Maritime Affairs and Fisheries 2018). The major fish species farmed in this industry are carp, catfish, and tilapia. Tilapia is a successful example of aquaculture because of its strong economic value; its high levels of protein, carbohydrates, minerals, and vitamins; its ability to breed rapidly; and its high defense against disturbances and diseases (Widiarti 2015).

Map 1.1 Indonesia



Indonesia and the Philippines lead the industry in brackish water cultivation; however, productivity is hindered by several problems. Growth has been slow since the government in both countries put a moratorium on aquaculture to protect forest security (Hishamunda et al. 2009).

Despite its rapid growth, Indonesia's aquaculture sector is still held back by several weaknesses, such as disease outbreaks, environmental pollution, and inadequate transportation networks in rural areas, while fast-growing population and industrial areas are competing for the same land and water resources (Harkell 2017). In an interview with the team, Rustadi, a professor at Universitas Gadjah Mada, noted that the limited availability of land and fresh water is a major problem for the aquaculture industry. Changemakers must develop a solution to these issues that will catalyze the growth of the aquaculture industry.

We propose that our advanced water treatment technology, MINO Microbubble Technology, is a means to this end. By implementing this technology, farmers across ASEAN can multiply their yield without having to open more areas for extra ponds. Instead, they will be able to just make their ponds deeper, without having to worry about oxygen in the pond not being distributed properly to the bottom. Hence, the region can achieve the UN SDGs to end hunger, achieve food security, and promote sustainable water use that is environmentally friendly.

Solution

MINO is inspired by the story of Kustamin, the manager of a freshwater fish farm in the small village of Bokesan in Yogyakarta, Indonesia (figure 1.2). Bokesan, also known as “the Fish Village” because of its large fisher community, produces tilapia and gourami. These fish require well-oxygenated ponds to maximize their survival rate for harvesting. Currently, the aerating process that Kustamin and other fish farmers use in their ponds is called a “mini waterfall” system, which provides good oxygen distribution in large, shallow ponds. To increase fish productivity using this system, the fish farmers would need to purchase additional land to build more shallow ponds—an expensive and environmentally unfriendly endeavor.

Figure 1.2 Fish Farm, Bokesan, Yogyakarta, Indonesia



Kustamin, fish farmer
in Bokesan, Yogyakarta, Indonesia



Credit: MINO Team.

MINO Microbubble Technology

We developed the MINO Microbubble Technology to address the concerns of the fisher community. The MINO Microbubble Technology consists of two main components: a water pump and a microbubble generator. The technology includes the implementation of multiphase flow by varying the quantity of air pumped into the water to generate microdiameter bubbles the size of 40 μm (micrometer). This microdiameter size increases the amount of dissolved oxygen in the water, which is necessary for deeper ponds (See figures 1.3 and 1.4).

Figure 1.3 Microbubble Technology, Illustrated

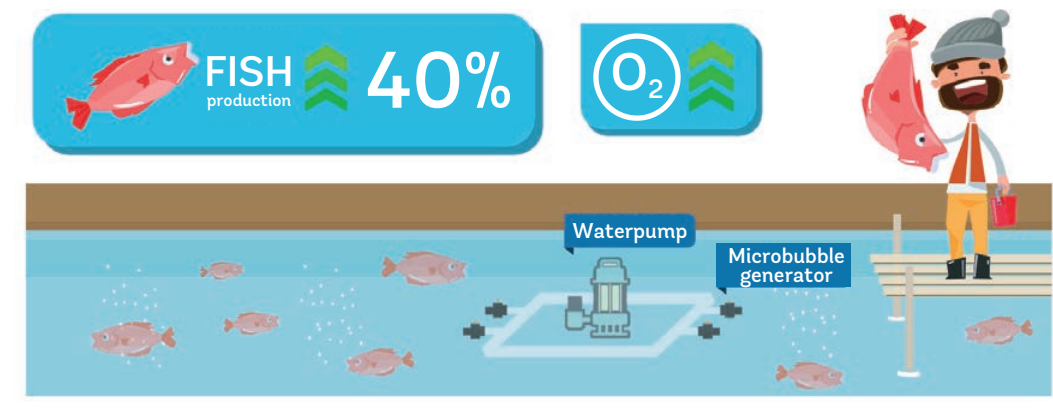


Figure 1.4 MINO Microbubble Generators in a Pond

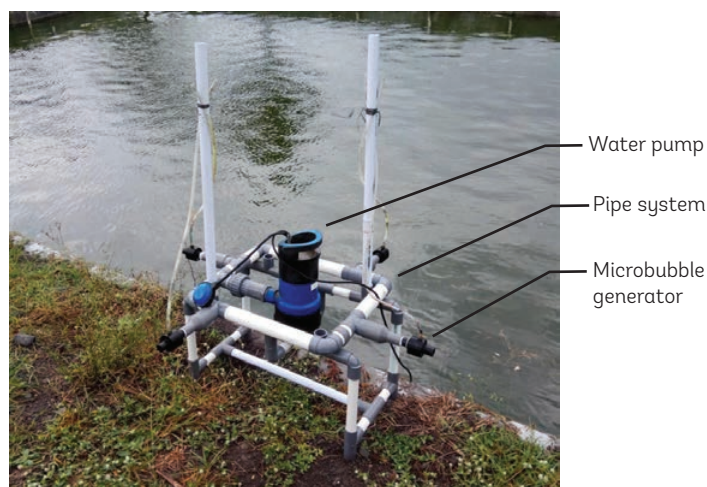


- **Increases** the amount of **dissolved oxygen** up to 7 ppm (other systems only increase to about 3–4 ppm)
- **Increased oxygen distribution** across the pond creates opportunity for fish to be more active, increasing metabolism of fish
- Can be **implemented in small areas**, making it possible to build deeper ponds without the need for more land
- Enables a **more efficient** use of water
- **Easy to assemble**, making it suitable for implementation in remote areas
- Relatively **low cost**; farmers see payback of startup costs in first season
- **Simple and easy to develop and to maintain locally**

MINO Microbubble Technology is a simple and affordable aerator technology. It provides good aeration with low energy consumption for use in small-scale farming by local fish farmers. MINO uses one 90-watt submersible pump to increase the dissolved oxygen level up to 7 ppm in water; in comparison, a paddle wheel aerator uses a 1-horsepower electric motor (equal to 746 watt) just to raise the dissolved oxygen level by 4–5 ppm in water. The low electricity consumption of MINO Microbubble Technology provides many opportunities for it to be combined with other technologies, such as solar panels and wind turbines, to produce affordable energy.

MINO has the lowest electricity consumption compared with all other existing aerator technology. It is a competitive and affordable technology that small-scale fish farmers everywhere can adopt to increase their yield and improve their quality of life.

Figure 1.5 MINO Provides New Aerator Technology



Implementation and Application

To test the feasibility of MINO Microbubble Technology use by fish farmers, we conducted a three-year experiment in fish farming ponds in the village of Bokesan, starting in 2016. For the field tests, one pond was designated as the control pond and the other two ponds were equipped with the Microbubble Technology. Each pond was filled with 60 kilograms of tilapia fry. We observed fish growth for three months, from October 1, 2017, to January 19, 2018.

We used two parameters in the experiment—water quality and fish growth. For water quality, we observed dissolved oxygen levels (see figure 1.6) and water temperature. Regarding fish growth, we observed length and weight (see figure 1.7).

According to our field application and observations, the use of the MINO Microbubble Technology had a direct effect on the water quality of the ponds. The water quality was significantly different in the MINO-applied environments compared with the water quality of the control pond. One of the most important differences was the amount of dissolved oxygen in the ponds. The ponds with the MINO Microbubble Technology had an increase in the dissolved oxygen levels in the afternoon and in the night. For the same time frame, the dissolved oxygen level in the control pond dipped to 0.00 ppm, which is detrimental to the health of the fish. We should note that this decrease in the oxygen level could have been a result of the presence of phytoplankton in the water.

According to our field application and observations, the use of the MINO Microbubble Technology had a direct effect on fish growth. The fish from ponds with the MINO technology weighed 40–50 percent more and were 20 percent longer than fish from the control pond.

Figure 1.6 Dissolved Oxygen Levels in Field Tests

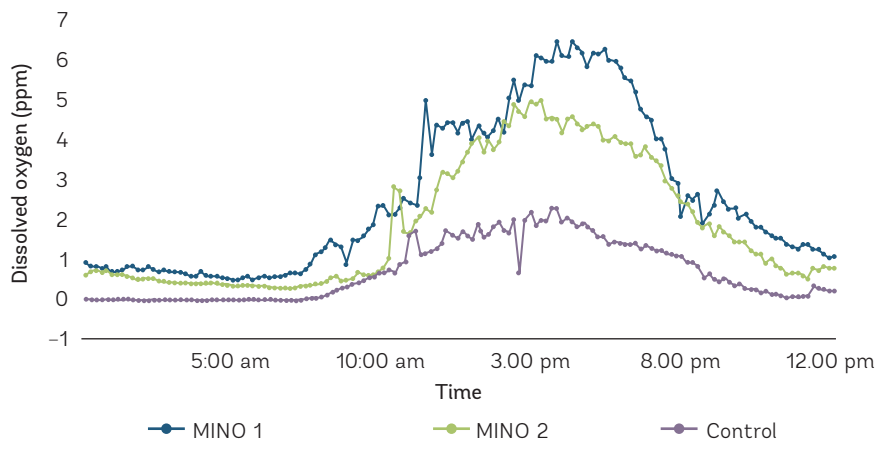
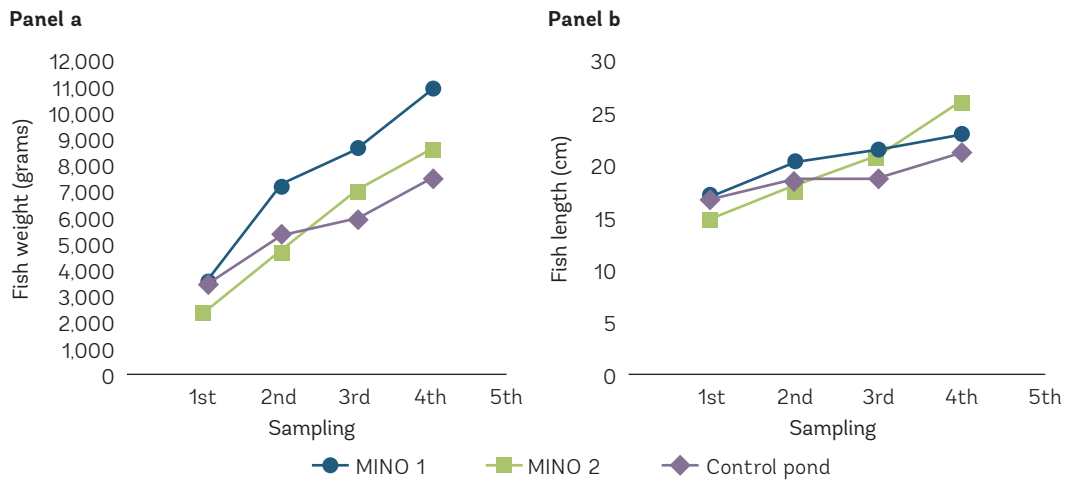


Figure 1.7 Growth of Fish in Field Tests



Note: Samples are 10 percent of the fish population (40 samples of fish from one pond).

On the basis of these promising results, we think the MINO technology is a catalyst of production for the tilapia industry. Currently, fish farmers harvest twice a year—with this technology we think the fisher community could harvest three times a year.

Financial Projection

In this section, we project the expected return that Kustamin and the local fisher community should expect to see if the MINO Microbubble Technology provides the same results for them as it did for us in the lab. Table 1.1 presents the 2017 income statement for Kustamin’s tilapia farm (before implementation of the MINO Microbubble Technology) and table 1.2 presents the costs of MINO Microbubble Technology.

Table 1.3 provides the income projections for Kustamin using MINO Microbubble Technology, and tables 1.4, 1.5, and 1.6 show the calculations that led to those conclusions.

Summary

From our calculations, we predict that the net present value of Kustamin’s investment would be US\$2,030.85, and the payback period of his investment would be 51 days. Kustamin would see an increase of 36 percent in

Table 1.1 2017 Income Statement for Kustamin's Tilapia Farm

| Income statement for the year of 2017 | |
|---------------------------------------|--------------|
| Account | |
| Revenue | |
| Tilapia sales | Rp30,000,000 |
| Expenses | |
| Operational cost | |
| Fish fodder | Rp8,424,000 |
| Water bill | Rp1,200,000 |
| Electricity bill | Rp600,000 |
| Fry | Rp1,680,000 |
| Fish medicine | Rp1,200,000 |
| Depreciation | |
| Pond | Rp400,000 |
| Other expenses | Rp2,400,000 |
| Total expenses | Rp15,904,000 |
| EBT | Rp14,096,000 |
| Tax | Rp140,960 |
| Annual net profit | Rp13,955,040 |
| Annual net profit in dollar | \$1,038.25 |

Table 1.2 Costs of MINO Microbubble Technology

| No. | Item | Quantity | Unit price (in Rupiah) | Total price (in Rupiah) |
|-----|-------------------------------|----------|------------------------|-------------------------|
| 1 | Submersible pump krisbow 200w | 1 | Rp648,000 | Rp648,000 |
| 2 | Pipa 1.5" AW | 1 | Rp30,000 | Rp30,000 |
| 3 | Shockdrat dalam 1.5" | 1 | Rp10,000 | Rp10,000 |
| 4 | Over shock 1.5"-0.75" | 1 | Rp10,000 | Rp10,000 |
| 5 | Knee l 1.5" | 4 | Rp13,000 | Rp52,000 |
| 6 | Tee 1.5" | 5 | Rp18,000 | Rp90,000 |
| 7 | Watermoor 1.5" | 1 | Rp50,000 | Rp50,000 |
| 8 | Selang 5/16 | 4 | Rp5,000 | Rp20,000 |
| 9 | Microbubble generator | 4 | Rp300,000 | Rp1,200,000 |
| 10 | Jig microbubble generator | 1 | Rp250,000 | Rp250,000 |
| | | | TOTAL | Rp2,360,000 |
| | | | | \$175.58 |
| | | | 2 SET | Rp4,720,000.00 |

Table 1.3 Income Projection Once Kustamin Implements MINO Microbubble Technology

| Projected Income Statement after MINO Installation | | | | | | | | |
|--|-------------|-------------|--------------|--------------|--------------|--------------|--------------|--------------|
| Account | 2018 Q1 | 2018 Q2 | 2018 Q3 | 2018 Q4 | 2019 Q1 | 2019 Q2 | 2019 Q3 | 2019 Q4 |
| Revenue | | | | | | | | |
| Tilapia sales | | Rp9,000,000 | Rp12,600,000 | Rp12,600,000 | Rp12,600,000 | Rp12,600,000 | Rp12,600,000 | Rp12,600,000 |
| Annual sales | | | | Rp34,200,000 | | | | Rp37,800,000 |
| Expenses | | | | | | | | |
| Operational cost | | | | | | | | |
| Fish fodder | Rp2,106,000 | Rp2,106,000 | Rp2,106,000 | Rp2,106,000 | Rp2,106,000 | Rp2,106,000 | Rp2,106,000 | Rp2,106,000 |
| Pond maintenance | Rp300,000 | Rp300,000 | Rp300,000 | Rp300,000 | Rp300,000 | Rp300,000 | Rp300,000 | Rp300,000 |
| Water bill | Rp300,000 | Rp300,000 | Rp300,000 | Rp300,000 | Rp300,000 | Rp300,000 | Rp300,000 | Rp300,000 |
| Electricity bill | Rp150,000 | Rp373,087 | Rp373,087 | Rp373,087 | Rp373,087 | Rp373,087 | Rp373,087 | Rp373,087 |
| Fry | Rp840,000 | Rp840,000 | Rp840,000 | Rp840,000 | Rp840,000 | Rp840,000 | Rp840,000 | Rp840,000 |
| Depreciation | | | | | | | | |
| Microbubble generator unit | Rp236,000 | Rp236,000 | Rp236,000 | Rp236,000 | Rp236,000 | Rp236,000 | Rp236,000 | Rp236,000 |
| Pond | Rp100,000 | Rp100,000 | Rp100,000 | Rp100,000 | Rp100,000 | Rp100,000 | Rp100,000 | Rp100,000 |
| Other expenses | | | | | | | | |
| Total expenses | Rp4,432,000 | Rp4,655,087 | Rp4,655,087 | Rp4,655,087 | Rp4,655,087 | Rp4,655,087 | Rp4,655,087 | Rp4,655,087 |
| Annual EBT | | | | Rp15,802,740 | | | | Rp19,179,653 |
| Tax | | | | Rp158,027 | | | | Rp191,797 |
| Annual net profit | | | | Rp15,644,712 | | | | Rp18,987,857 |
| Annual net profit in US\$ | | | | \$1,163.97 | | | | \$1,412.70 |

Table 1.4 Assumptions

| Assumption table 1 | | |
|--|-------------|--------------|
| Fish weight increasing WITH MINO | 40% | |
| Assumption table 2 | | |
| Straight line depreciation | 10% | |
| Tax | 1% | |
| Electricity bill per month | Rp373,087 | |
| Conversion rate USD to IDR exchange rate | 13440.86 | |
| Assumption table 3 | | |
| Account | Amount (kg) | Price per kg |
| Fish fodder | 324 | Rp13,000 |
| Fry | 60 | Rp28,000 |
| Tilapia sales 2018 Q1 | 360 | Rp25,000 |
| Tilapia sales 2018 Q2-2019 Q4 | 504 | Rp25,000 |

* Assumption table 3 is measurement to be used for EACH Farming Season.

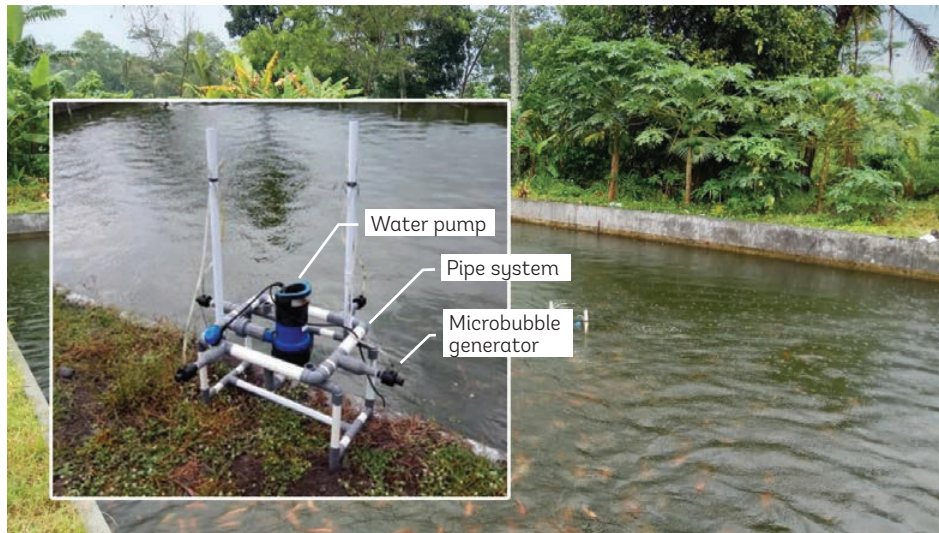
Table 1.5 Net Present Value (NPV)

| NPV | |
|--------------------------------|--------------|
| Indonesia annual discount rate | 6.50% |
| Initial investment | -Rp2,360,000 |
| 1st year return | Rp15,644,712 |
| 2nd year return | Rp18,987,857 |
| NPV | Rp27,296,423 |
| | \$2,030.85 |

Table 1.6 Payback Period (PBP)

| PBP | | | |
|----------------------|--------------|--------------|--------------|
| Year | 0 | 1 | 2 |
| Initial investment | Rp2,360,000 | | |
| After-Tax cash flow | | Rp16,588,712 | Rp19,931,857 |
| Cumulative cash flow | -Rp2,360,000 | Rp14,228,712 | Rp34,160,569 |
| Payback period | | 0.14 | year |
| | | 51 | days |

Figure 1.8 MINOs Installed at Fish Farmer's Fish Pond, Bokesan, Yogyakarta, Indonesia



annual net profit after he installs the Microbubble generator, going from an annual net profit of US\$1,038.25 to an annual net profit of US\$1,412.70.

These calculations confirm that it is quite feasible for the MINO Microbubble Technology to be developed and applied.

Development Plan



We developed the business model (figure 1.9) for the MINO Microbubble Technology project using the “9 building blocks,” which is a tool that can be used to provide a logical overview of how an organization creates, delivers, and captures value.

Milestones

2016–2017

We applied for a patent for the MINO Microbubble Technology that we developed for the aquaculture industry.

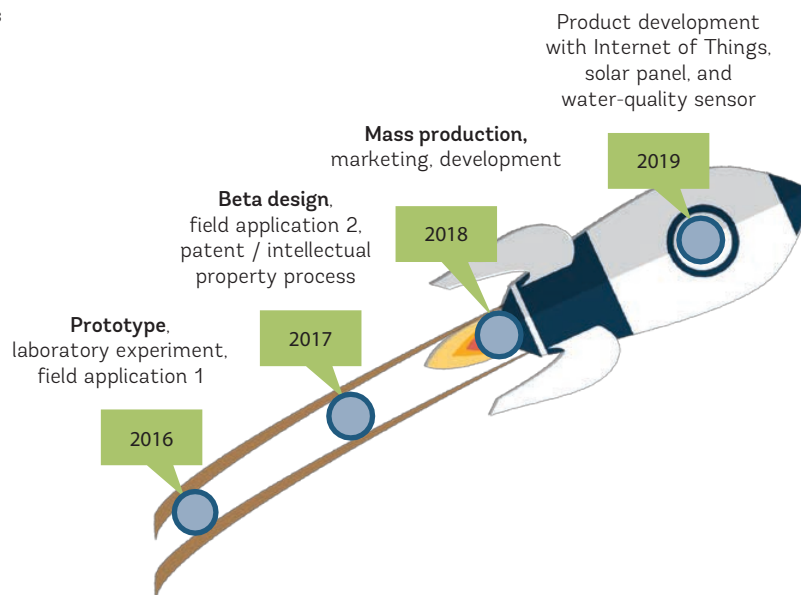
2018

The goal is to commercialize the Microbubble Technology by the end of the year so that the technology can be implemented across Indonesia and

Figure 1.9 MINO business model



Milestones



even Asia. Without commercialization, distribution becomes a challenge. Students, researchers, and lecturers from Universitas Gadjah Mada have focused on the research and development aspect of this technology; we must collaborate with others to develop and commercialize this technology.

2019

We will develop an application that will detect the oxygen levels and adjust the microbubble generator using online and real-time systems. We plan to engage with interested manufacturers and investors to commercialize the applied microbubble generator technology model, especially for the micro-bubble unit, to mass produce it. For the system, we plan to engage with a local integrator to be our distributor and service provider for installation and maintenance.

We plan to develop the technology using solar panels, which will make the technology more energy efficient and will mean cheaper operational costs for fish farmers. We will continue our partnership with the fisher community in the village of Bokesan. We hope to adapt our technology and create the best model for small- to medium-scale aquaculture industry.

Risk Management



Operational Challenge

The fisher community will need to consult with us regarding installation and maintenance issues. Accessibility will be an issue for the fish farmers who reside outside of Yogyakarta. To address this issue, we will engage with local integrators as our distribution partners to handle distribution, installation, and service.



Technology Challenge

Competitors will try to imitate this system and commercialize it as theirs. Therefore, we will submit a patent for the MINO Microbubble Technology in 2018 to protect the intellectual property of our system. In addition, we will focus on innovation so that the system will not become outdated and will remain sustainable.

Management Challenge

As students, researchers, and lecturers we have limited resources to fully immerse ourselves in the business process. Therefore, we will focus on research and development and hire a third party to manage the manufacturing, distribution, and sales of the system.

Social and Economic Impact

Benefit for People

If the MINO Microbubble Technology can be applied as we have proposed, we think the system could improve the quality of life of many people, especially the quality of life of small-scale fish farmers such as Kustamin. If the system really does help fish farmers increase their production of freshwater fish, it may create more job opportunities and create equal opportunity for all (figure 1.10).

Benefit for the Planet

The MINO Microbubble Technology has a “cleansing mechanism” that will improve water quality. By implementing our technology, fish farmers can reduce some of the waste (and with it the harmful effects to the environment) that is a byproduct of the industry. In addition, by providing fish farmers the ability to increase their productivity without having to use more land for their farming activities (because they can make the ponds deeper without any oxygen distribution issues), we help lessen the environmental degradation.

Benefit for Profit

We believe this system will improve the welfare of fish farmers. In addition, we believe this system will open up more job opportunities in other sectors. The manufacturing and service sectors could benefit from the technology because we plan to engage with third parties to manufacture the microbubble unit and to engage with local integrators to help with the distribution of the system. Also, we hope it will open more opportunities for investors—making a profit from their investment while helping make the world a better place.

Figure 1.10 Triple Bottom Line: People, Planet, Profit



Annexes

Annex A. Media Coverage



Metro TV News—Metro Business

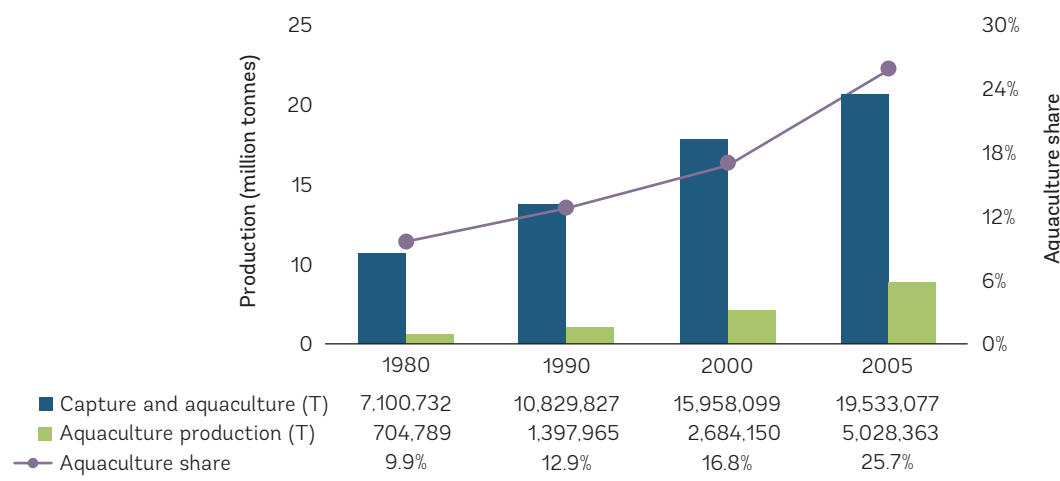
<http://video.metrotvnews.com/metro-bisnis/GbmJg4ok-budidaya-ikan-microbubble-generator>



CNN Indonesia

Annex B. Aquaculture Data

Figure B.1 Contribution of Aquaculture to Region's Total Fish Supply, 1980–2005



Source: Hishamunda et al. 2009.

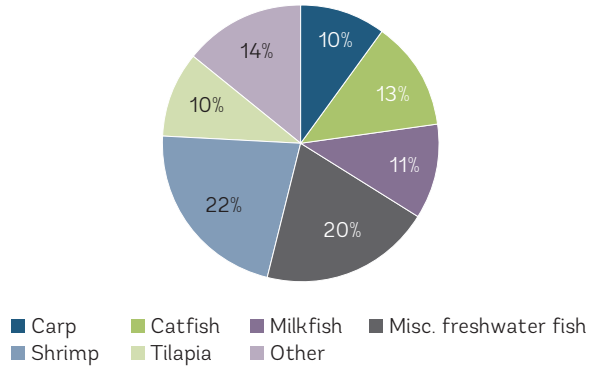
Table B.1 Relative Importance of Aquaculture in Fish Production by Country, 2000 and 2005

| Country | Total fish production (tonnes) | | Aquaculture (tonnes) | | Share of Aquaculture in total fish production (%) | |
|-------------|--------------------------------|------------|----------------------|-----------|---|------|
| | 2000 | 2005 | 2000 | 2005 | 2000 | 2005 |
| Cambodia | 298,798 | 410,000 | 14,430 | 26,000 | 4.8 | 6.3 |
| Indonesia | 4,872,079 | 5,594,767 | 788,500 | 1,213,457 | 16.2 | 21.7 |
| Malaysia | 1,445,098 | 1,394,097 | 151,773 | 175,834 | 10.8 | 12.6 |
| Myanmar | 1,192,112 | 2,217,466 | 98,912 | 474,510 | 8.3 | 21.4 |
| Philippines | 2,292,905 | 2,806,149 | 393,863 | 557,251 | 17.2 | 19.9 |
| Thailand | 3,735,279 | 3,743,398 | 738,155 | 1,144,011 | 19.8 | 30.6 |
| Vietnam | 2,121,829 | 3,367,200 | 498,517 | 1,437,300 | 23.5 | 42.7 |
| Total | 15,958,099 | 19,533,077 | 2,684,150 | 5,028,363 | 16.8 | 25.7 |

Source: Hishamunda et al. 2009.

Figure B.2 Major Fish Species Cultivated; Their Share of Region's Fish Aquaculture Output, 2005.

Total output = 5,028,363 metric tons



Source: Hishamunda et al. 2009.

References

- Harkell, Louis. 2017. "Nine Million Tons of Farmed Fish in Indonesia by 2019?" *Undercurrent News*, August 18. www.undercurrentnews.com.
- Ministry of Maritime Affairs and Fisheries. 2018. "Produktivitas Perikanan Indonesia," January 19. <http://kkp.go.id/wp-content/uploads/2018/01/KKP-Dirjen-PDSPKP-FMB-Kominfo-19-Januari-2018.pdf>.
- Hishamunda, Nathanael, Pedro Bueno, Neil Ridler, and Wilfredo G Yap. 2009. "Analysis of Aquaculture Development in Southeast Asia." FAO Fisheries and Aquaculture Technical Paper 509. Food and Agriculture Organization of the United Nations, Rome. <http://www.fao.org/docrep/012/i0950e/i0950e00.pdf>.
- Widiarti, Artati. 2015. "Indonesia Tilapia Production and Trade." Ministry of Marine Affairs and Fisheries Republic of Indonesia, April. <http://www.infopesca.org/sites/default/files/complemento/actividadesrecientes/adjuntos/1369/5%20Indonesia-Tilapia%20Production%20and%20Trade.pdf>.
- World Bank. 2014. "ASEAN Cooperation Is Crucial to Global Food Security." *East Asia and Pacific on the Rise: Making Development Work for All* (blog), May 25. <http://blogs.worldbank.org/eastasiapacific/asean-cooperation-crucial-global-food-security>.
- WFP (World Food Programme). 2015. "10 Facts about Hunger," September 30, <https://www.wfp.org/stories/10-facts-about-hunger>.

Additional Reading

- Association of Southeast Asian Nations (ASEAN). 2010. Invest in ASEAN. Association of Southeast Asian Nations. <http://investasean.asean.org>.
- Liu, Chun, Tai-Min Xiao, Jing Zhang, Ya-Nan Yang, and Jing-Liang Yang. 2014. "Influence of Microbubble Aeration on Start-Up and Performance of a Biofilm Reactor." *China Environmental Science* 34 (12): 3093–98.
- Liu, Xingqiao, Hailei Chen, and Chengyun Zhu. 2016. "Design of Self-Learning Cruising Type Water Quality Monitoring System Based on GPS." *Transactions of the Chinese Society of Agricultural Engineering* 32 (1): 84–90.

Note

This project has been supported by the Department of Mechanical and Industrial Engineering, the Department of Chemical Engineering, the Department of Management, the Department of Fisheries, the Food

Technology and Bioprocess Laboratory, and the Center for Energy Studies of the Universitas Gadjah Mada, Yogyakarta, Indonesia, as well as the Center for Fry Development (Balai Benih Ikan), Cangkringan, Yogyakarta, Indonesia, and the Group of Fish Farmers in Bokesan, Yogyakarta, Indonesia.

CHAPTER 2

Starlight: A Start-Up Company Based in Rwanda That Aims to End the Use of Kerosene Lamps in Rural Villages by Providing Solar-Powered Lanterns to These Communities and by Rolling Out a STEM Program That Empowers Female Students

Team Starlight

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Alice Mukashyaka, Sinhgad Technical Education Society, Class of 2017; African Leadership University, Class of 2020

Pamela Kyomugisha, Sinhgad Technical Education Society, Class of 2017; African Leadership University, Class of 2020

Abstract

Rwanda's population has more than doubled over the past decade and is expected to reach 16 million by 2032 (National Institute of Statistics of Rwanda 2017). This population growth means that more people will need access to affordable energy to light their homes and streets, to use phones and computers, and to conduct business. At issue is how that energy should be produced—fossil fuels and greenhouse gas emissions are making drastic changes in the climate, leading to big problems.

Government data show that Rwanda's national electrification rate has reached 41 percent (11 percent off-grid, 30 percent on-grid). Over 7 million people still lack access to electricity. The government is targeting 100 percent electricity access by 2024. To reach this target, off-grid solutions will be used in remote areas, far from the on-grid network. (Rwanda Development Board 2018). According to the Economic Development and Poverty Reduction Strategy II (EDPRS2), the government was targeting 70

percent rural households with access to electricity (MINECOFIN 2013). (The government has not met this goal).

We believe solar energy is the way to provide greater access to affordable, clean energy. And Rwanda must harness the power of its youth (68.7 percent of the country's population was below the age of 30 in 2015) to figure out how to increase access to this energy (National Institute of Statistics of Rwanda 2017). As a social enterprise, Starlight started a STEM initiative in high schools to encourage students to explore circuitry and to develop technical skills, with the hope to empower Rwanda's youth (and especially young women) to become a part of the solution.

Our STEM program and our products play a big role in the eradication of poverty through advancements in health, education, industrialization, and combating climate change. The Starlight team's mission is to empower people by providing them access to light.

This report describes how Starlight can ensure access to affordable energy in rural villages and how Starlight's initiative can empower Rwanda's youth to make change happen.

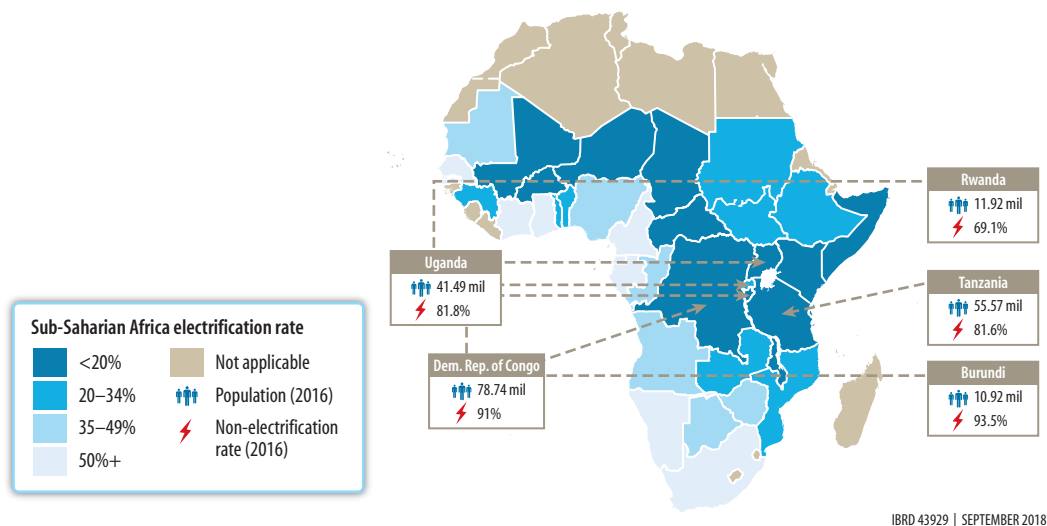
Problem and Context: Low Electrification Rates and the Subsequent Use of Kerosene Lamps Cause Health Issues and Drastic Changes in the Climate

Rwanda's population has more than doubled over the past decade and is expected to reach 16 million by 2032 (National Institute of Statistics of Rwanda 2017). This population growth means that more people will need access to affordable energy to light their homes and streets, to use phones and computers, and to conduct business (figure 2.1).

Currently in the rural villages, people use kerosene lamps to light their houses; with no electricity in the home, they must travel three to four miles just to charge a cell phone. It is estimated that 400–500 liters of kerosene are burned every day in one village, which amounts to about 1.5 tons of carbon dioxide being emitted per day. The inhalation of these toxic fumes can cause dizziness, headaches, respiratory illnesses, cardiac problems, and cognitive function illnesses. There is also a fire risk when burning kerosene. And there is the financial burden on households of regularly purchasing kerosene.

People spend more than half of their monthly income on kerosene to light their homes. Because the majority of households are run by women,

Figure 2.1 Sub-Saharan African Countries Suffer from Low Electrification Rates



Source: World Bank 2016.

we believe that women have an integral role in finding an alternative to the use of kerosene. This is why we started Starlight STEM, an initiative that aims to create a women-centered network to bring life-changing, affordable, clean energy to communities.

Solution: Replace Kerosene Lamps with Solar-Powered Lanterns That Are Cheaper, Safer, and More Accessible

We came up with the solution of providing locally made solar lanterns with the aim of making solar products affordable (figure 2.2). We adopted a new business model that would make it very easy for the rural population to switch from kerosene to solar power.

We are the only manufacturer of this type of product in Rwanda; we believe our product will contribute to the vision for our country.

The way the lantern works is very simple—the user exposes the lantern to outside light for four hours; it is then fully charged and has the capacity to emit light for 10–12 hours. The solar-powered lantern is four times

Figure 2.2 Solar-Powered Lantern Meets Market's Needs



We developed a product with specifications that meet the needs of the market

-  High-efficiency solar panel
4 hours of charging time
-  LED light
10–12 hours of light
4X brighter than kerosene lamps
-  Metal handle
Portable for indoor and outdoor use
-  Multicharge functionality
Solar, manual, and AC
-  Selling price of 7,000 RwF
Equivalent to 1 month of kerosene fuel, but with an estimated 15-year product life cycle

starlight
SHINE WITH US 

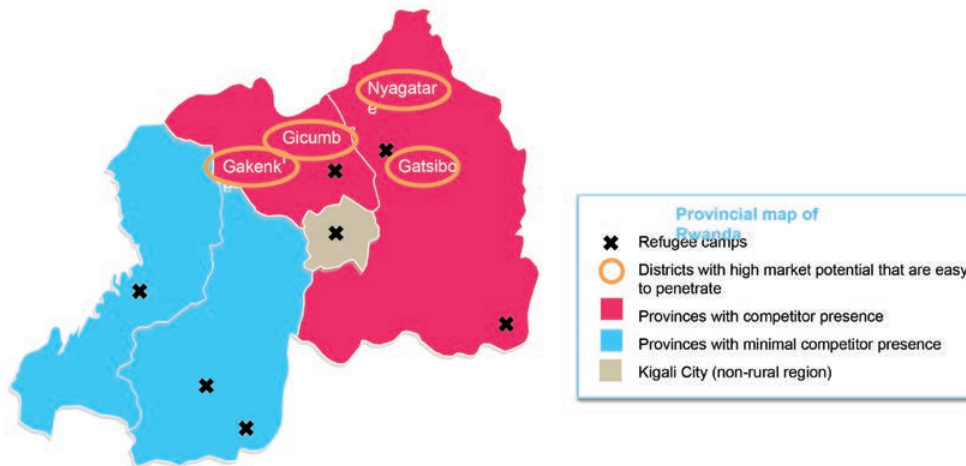
brighter than a kerosene lamp, it is portable, and it has multiple functionality in the winter season. The lantern can be charged by AC current; in an emergency, the lantern can be manually charged by hand, providing 10 minutes of power. The selling price of the lantern is equivalent to the cost for one month of kerosene fuel, but the lantern has an estimated life cycle of 15 years.

Target Market

Our initial target market is Rwanda, with a focus on the northern and eastern provinces (see figure 2.3). These areas are prime markets for us because there are no direct competitors in the identified regions—the other solar companies are selling solar systems, not individual solar lamps. Our product will meet the needs of our target audience—students and families in poorer households and in refugee camps in the rural districts. For example, the Nyagatare and Gatsibo districts have a high proportion of private schools where we can introduce the product to the communities through our STEM programs.

In addition, we have already seen a demand for the product in the Gicumbi refugee camps in the northern province.

Figure 2.3 Target Market for Solar-Powered Lanterns



Pilot Distribution Plan

The pilot plan for Starlight is to distribute solar-powered lanterns to rural homes in neighboring countries (Burundi, the Democratic Republic of Congo, Tanzania, Uganda), as well as nongovernmental organizations (NGOs), schools, and refugee camps in the identified target areas (figure 2.4).

Ignite Power, Solar Sisters, EzyLife, and Lighting Global/Africa are based in Rwanda, Tanzania, Uganda, Congo, Democratic Republic of Congo, respectively. These companies export their solar lights abroad and distribute them in rural villages. Starlight plans to partner with these companies/distributors to reach a bigger market. Starlight will be selling the products to these companies and they will distribute the lanterns using their own models.

Impact

Our solar lanterns will create a positive cycle of economic growth that will revolutionize a family's financial well-being (figure 2.5). At the same time, the use of Starlight products will provide health benefits to each person in a household and the production and use of the Starlight lanterns will support intrinsic changes in women's self-image and perceived agency.

Figure 2.4 Distribution to Nearby Countries with Establishment of Sales Strategy

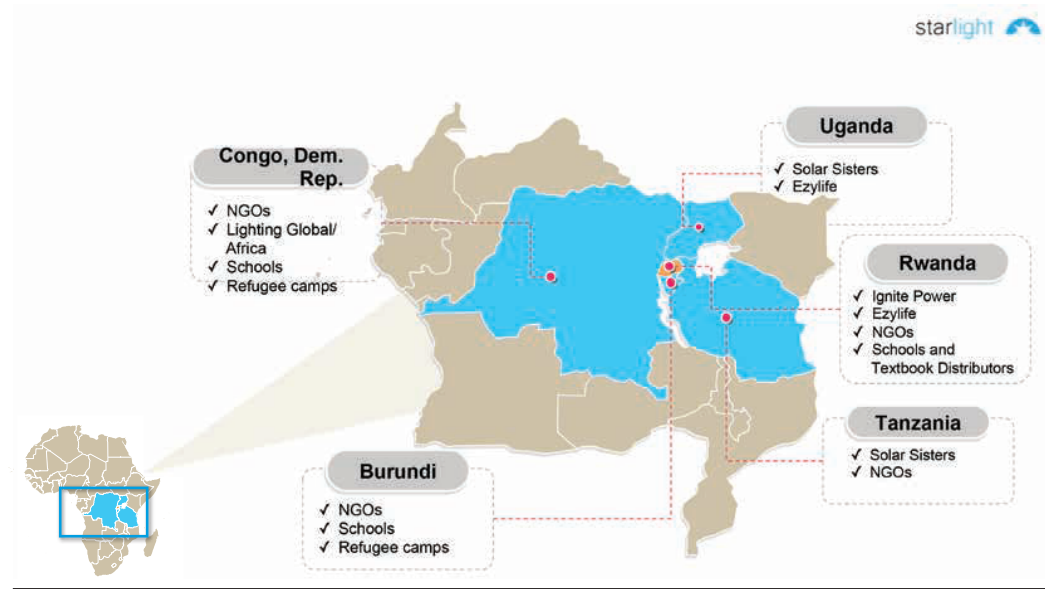


Figure 2.5 Starlight's Social Impact



The positive effects of the solar lanterns go beyond providing a sustainable form of light. Solar-powered lighting is a technology central to the development of rural villages that transforms the education, health, time, finances, and sense of power in every household it reaches. As women invest 90 percent of their income in community and families through their involvement with Starlight, they gain not only technical skills but also social and entrepreneurship skills. The Starlight STEM program provides female students with an improved education program that empowers them to create economic and social opportunities and to bring about social change in their communities.

Competitor Analysis

There are various solar companies that offer lighting systems for individual homes and office buildings in Rwanda and in the region at large. However, Starlight offers products that have competitive advantages over the other companies' products that include the quality of our product (battery life, charging methods), our pricing, and our distribution model (see tables 2.1 and 2.2).

Key Milestones and the Projection for the Next Three Years

Currently, the Starlight team is building out the distribution network by partnering with more advanced injection molding companies to produce

Table 2.1 Comparison of Starlight with More Expensive Alternatives on the Market








| | d.light | Wakawaka | Starlight |
|--------------------------|--------------------------------------|--|---|
| Model | S2: The Learning Light | Wakawaka Light | Starlight Lantern |
| Selling price/unit (RwF) | 3,500/month (2 year payment plan) | 3,400/month (with deposit of 3,500) | 7,000 per lantern (to be lowered to 5,000 following in-house production) ★ |
| | 11,000 per lantern | 33,000 per lantern | |
| Charging time | 4 hours ★ | 8 hours | 4 hours ★ |
| Battery life | 4–12 hours | 16 hours ★ | 10–12 hours |
| Charging methods | Solar and AC | Solar and AC | Solar, manual, and AC ★ |

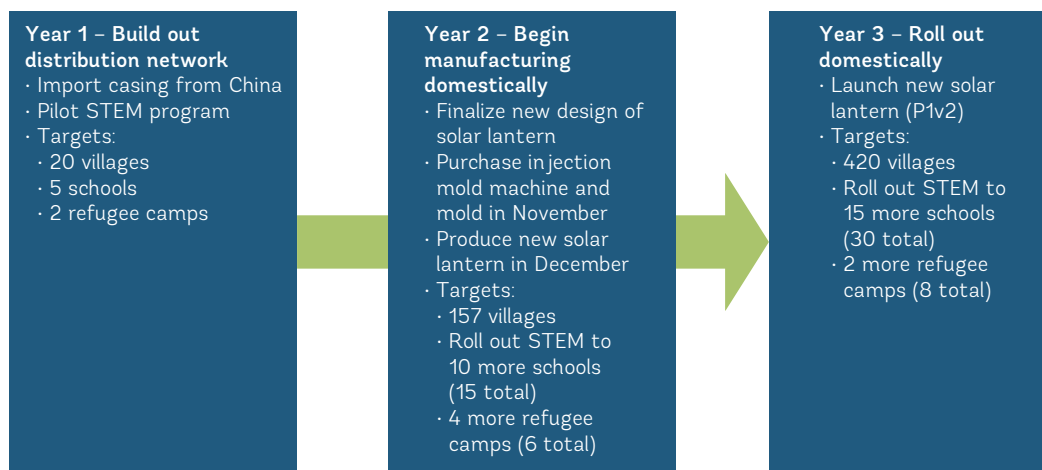
★ = best option.

Table 2.2 Starlight and Its Direct and Indirect Competitors

| |   | |   | |  |
|-----------------------------|---|--|--|--|---|
| | Indirect competitors | | Direct competitors | | |
| Target market | Households with higher income, schools, hospitals | Households with higher income, schools, hospitals | Households with lower income in rural regions | Households with lower income in rural regions | Low-income households, schools, refugee camps |
| Market penetration (Rwanda) | Eastern province of Rwanda (Bugesera, Rwangera) | Northern Rwanda | Nyagatare, Gatsibo, Kayonga, Rwamagana, Rulindo, Gakenke, and Kamonyi. | Gicumbi, Kamonyi and Rulindo (pilot markets) | Northern and eastern provinces |
| Product (basic) | 3 LED lamps wired to solar panel and 1 torch | Battery and the solar panel | 3 LED lamps and solar panels, battery, USB cable with multiple points charger | Individual products (e.g., Solar Lamp, battery bank) | Lamp, STEM program |
| Other value-added services | Installation and warranty | Installation and maintenance for 10 years, 1-year warranty | Installation, 2-year product warranty | Unknown | Single purchase 7,200/unit |
| Price model (RwF) | 399/day (-12,000/month); deposit: 19,999 | 5,700/month; deposit: US\$100 for basic installation of system | 3,500/month | 850/week; 3,400/month; deposit: 3,500 | Single purchase 7,200/unit |
| Business model | Solar systems provider | Solar systems provider | Lateral distribution | Direct sales | Direct sales |
| Distribution strategy | Owned | Owned | Partner with systems provider | Owned | Owned and partnership |

the casing parts that make up the outer body of the lanterns (figure 2.6). We are also piloting the STEM program. Our target is to have our product in 20 villages in Rwanda and 2 refugee camps and to roll out the STEM program in 5 schools. In 2019, we will begin to manufacture the entire lantern domestically, we will finalize the new design for the lantern, and we will purchase the injection molding machine. Our target is to have our product in 157 villages and 4 more refugee camps in Rwanda and to roll out the STEM program in 10 more schools. For 2020, Starlight will roll out domestically manufactured products, launch the new solar lantern (P1v2), have our product in 420 villages and 2 more refugee camps, and roll out the STEM program in 15 more schools.

Figure 2.6 Key Milestones for the Next Three Years



Challenges and Mitigations

Table 2.3 outlines the risks to the Starlight project and potential actions to mitigate risks.

Table 2.3 Risks to Starlight and Options to Ensure Success

| | Risks | Mitigants |
|-----------------------|--|--|
| Uncontrollable | <p>Seasonality</p> <ul style="list-style-type: none"> • Our sales are likely to fluctuate, with higher demand around the harvest time in January and July and also around the school terms in February, May, and August. <p>Weather</p> <ul style="list-style-type: none"> • During the rainy season, low levels of sunlight will reduce the lantern's capacity to fully charge. <p>Domestic Policy</p> <ul style="list-style-type: none"> • Current and future success will depend on favorable domestic economic policies that support local manufacturers and alternative power. | <ul style="list-style-type: none"> • Sell the products to NGOs throughout the year to offset the seasonality effect. • Manage production and stock to meet demand levels. • Provide additional charging methods, such as manual and AC. • Increase the battery life. • Continue to base the Starlight team in Rwanda, drawing from experience operating within the country, and actively keep up to date on key developments. |

(continued on next page)

Table 2.3 Risks to Starlight and Options to Ensure Success (continued)

| | Risks | Mitigants |
|----------------------|--|--|
| Manufacturing | <p>Sales Growth</p> <ul style="list-style-type: none"> We may not be able to produce enough to meet sales growth. | <ul style="list-style-type: none"> Maintain and monitor a sales expansion plan in conjunction with a production schedule. On receipt of goods from suppliers, a quality check is performed. Plan stock levels to ensure there is a buffer of stock on hand. With purchase of the injection mold machine, supplier risk is minimized to just the solar cells. |
| | <p>Supplier Risk</p> <ul style="list-style-type: none"> The quality of goods supplied may not meet our quality standards. Goods received from suppliers could be delayed. | |
| Market | <p>Price Competition</p> <ul style="list-style-type: none"> Competitors could drop prices to squeeze us out of the market. | <ul style="list-style-type: none"> With purchase of the injection mold machine, we are able to reduce our price and focus on our made-in-Rwanda brand. Be diligent in our research and vetting processes when determining whom to partner with; monitor partners' ongoing operations. |
| | <p>Distributor Risk</p> <ul style="list-style-type: none"> Our success is tied to the competency and success of our partners in distribution (such as schools, NGOs, and individual entrepreneurs). | |
| Financing | <p>Finance</p> <ul style="list-style-type: none"> If we are unable to secure financing, we will be unable to scale our company to meet the demand. | <ul style="list-style-type: none"> Prepare financial models, a three-year cash flow model, and an investment plan to pitch to potential investors. |

Bibliography

- Bebarta, V., and C. DeWitt. 2004. "Miscellaneous Hydrocarbon Solvents." *Clinics in Occupational and Environmental Medicine* 4: 455–79, vi.
- Henry, J. A. 1998. "Composition and Toxicity of Petroleum Products and Their Additives." *Human and Experimental Toxicology* 17: 111–23.
- Koschier, F. J. 1999. "Toxicity of Middle Distillates from Dermal Exposure." *Drug and Chemical Toxicology* 22: 155–64.
- Mann, M. D., D. J. Pirie, and J. Wolfsdorf. 1977. "Kerosene Absorption in Primates." *Journal of Pediatrics* 91: 495–98.
- Mattorano, D. A., L. L. Kupper, and L. A. Nylander-French. 2004. "Estimating Dermal Exposure to Jet Fuel (Naphthalene) Using Adhesive Tape Strip Samples." *Annals of Occupational Hygiene* 48: 139–46.
- MINECOFIN (Ministry of Finance and Economic Planning). 2013. *Economic Development and Poverty Reduction Strategy II, 2013–2018*. Kigali: Republic of Rwanda.
- National Institute of Statistics of Rwanda. 2017. "Unlocking Rwanda's Potential to Reap the Demographic Dividend." <http://www.statistics.gov.rw/publication/demographic-dividend>.
- _____. 2018. "How Many Are We in Rwanda?" <http://www.statistics.gov.rw/about-us/news/how-many-are-we-rwanda>.
- National Poisons Information Service (NPIS), Public Health England. 2003. Kerosene, TOXBASE database. <http://www.npis.org/toxbase.html>.
- Risher, J. F., and S. W. Rhodes. 1995. "Toxicological Profiles for Fuel Oils." Atlanta: U.S. Department of Health and Human Services, Public Health Service.
- Ritchie, G. D., K. R. Still, W. K. Alexander, A. F. Nordholm, C. L. Wilson, J. Rossi, and D. R. Mattie. 2001. "A Review of the Neurotoxicity Risk of Selected Hydrocarbon Fuels." *Journal of Toxicology and Environ Health, Part B, Critical Reviews* 4: 223–312.
- Riviere, J. E., J. D. Brooks, N. A. Monteiro-Riviere, K. Budsaba, and C. E. Smith. 1999. "Dermal Absorption and Distribution of Topically Dosed Jet Fuels Jet-A, JP-8, and JP-8 (100)." *Toxicology and Applied Pharmacology* 160: 60–75.
- Rwanda Development Board. 2018. Energy Investment Opportunities. <http://rdb.rw/investment-opportunities/energy/>.
- Santhanakrishnan, B. R., and S. Chithra. 1978. "Accidental Kerosene Poisoning in Infants and Children." *Indian Journal of Pediatrics* 45: 265–73.

- Seymour, F. K., and J. A. Henry. 2001. "Assessment and Management of Acute Poisoning by Petroleum Products." *Human and Experimental Toxicology* 20: 551–62.
- Singh, S., K. Zhao, and J. Singh. 2003. "In Vivo Percutaneous Absorption, Skin Barrier Perturbation, and Irritation from JP-8 Jet Fuel Components." *Drug and Chemical Toxicology* 26: 135–46.
- USAID (United States Agency for International Development). 2018. Power Africa Rwanda Fact sheet. <https://www.usaid.gov/powerafrica/rwanda>.
- Wolfe, B. M., A. E. Brodeur, and J. B. Shields. 1970. "The Role of Gastrointestinal Absorption of Kerosene in Producing Pneumonitis in Dogs." *Journal of Pediatrics* 76: 867–73.
- Wolfsdorf, J., and D. Paed. 1976. "Kerosene Intoxication: An Experimental Approach to the Etiology of the CNS Manifestations in Primates." *Journal of Pediatrics* 88: 1037–40.

CHAPTER 3

Automated Legal Document Generation: Empowering MENA Women to Exercise Their Legal Right

Team Amal

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Abstract

During the past several decades, the world has seen improvements in legal gender parity, but the full adoption and application of women's rights remains unseen. Although gender inequality is a global problem, women in the Middle East and North Africa (MENA) face greater gender inequality than their counterparts in other parts of the world. According to the World Bank's *Women, Business and the Law* report, over the last four years, MENA has implemented only 23 out of 181 global reforms toward increasing women's opportunities (WBG 2018a). On average, MENA performs worse than any other region across most of the report's indicators measuring women's agency. MENA countries continue to reform regulations to improve gender equality but laws can only go so far. When it comes to enabling women's full economic, political, and social participation, many women are faced with barriers such as lack of financial resources, lack of know-how, and fear of retaliation should they exercise their rights. Amal, a new legal software program and platform, is proposed as a contributory solution for "achiev[ing] gender equality and empower[ing] all women and girls." (United Nations 2015) Women in MENA countries can use Amal to learn more about the legal rights granted to them in their country of residence and to secure and submit the documentation needed to gain access to these basic rights. Such rights are crucial for women to further their economic, educational, and social opportunities.

Problem

Even though legal gender disparity is a global problem, women in MENA face greater gender inequality than women in most other places in the world (Trister 2010). Recently, policies have shifted, coming to be more gender inclusive; however, even with these legal reforms, there are not as many women acting upon their newfound rights because of systemic and individual barriers (OECD 2014). Poor implementation and poor enforcement of the laws are two of the many obstacles that keep MENA women from realizing their rights. Lack of awareness of gender-inclusive policies and lack of resources including time, money, and transportation, can also keep women from completing the necessary paperwork to obtain their rights, such as owning personal identification cards and bank accounts, which are crucial to pursuing economic and social opportunities (Kelly 2014). For women in MENA, laws on paper often do not reflect their reality, making it crucial for mechanisms for legal implementation to be in place to improve livelihoods. Amal provides a step in easing these issues by offering a central platform to explain women's rights in each country, to streamline the steps and requirements for acquiring basic registrations and rights, and to complete and submit required documentation with confidence and ease.

Solution

Amal is a digital platform allowing women in MENA countries to understand and to streamline the steps and requirements for acquiring basic registration. Amal's central, automated document generation software provides resources for women to legally secure their rights.

Stakeholders

The target populations for Amal are women living in MENA countries, specifically literate women with access to a computer, smartphone, or tablet. Additionally, Amal will be useful to pro bono attorneys and organizations that work with illiterate or low-income women. Securing women's rights provides women the opportunity to make the choices that are best for them, their families, and their communities. Lack of an identification card, a passport, a driver's license, or land title, among other documentation, prevents many women in MENA countries from making economic decisions, and has far-reaching consequences that create disparities throughout a woman's life. Access to these rights determines whether women pursue an education,

become employed, or run a business, and it can have a trickle-down effect on their children (Khayria and Feki 2015). Amal will assist women in MENA countries in retaining their access to legal rights in a simple and clear manner that offers them an improved quality of life with reduced stress. Amal will simplify legal work for pro bono attorneys and organizations—saving them time and resources and multiplying their potential for impact. By providing women better access to their rights, Amal will assist the global development community in empowering women and girls in promoting more inclusive economies and reducing inequality, and in promoting more just societies (Lawson-Remer 2012).

Founders Soha Eshraghi and Negah Nafisi are incentivized to produce a working prototype for Amal from their personal connection and experiences with MENA and with women from MENA countries. Additionally, they are motivated by their personal interest in combating socioeconomic injustice.

Amal will assist national and local governments in increasing the impact of their legal policies and in creating a larger sense of unity and equality in these countries. In addition to increasing economic output, Amal has the potential to assist in bridging social, political, and economic unrest. Amal will assist women's rights organizations in acting on newfound women's rights in MENA countries. On a global scale, Amal will assist the World Bank Group and other development actors in reaching the United Nations' Sustainable Development Goals, specifically goal 5 (achieve gender equality and empower all women and girls), goal 8 (promote inclusive and sustainable economic growth, employment, and decent work for all), goal 10 (reduce inequality within and among countries), and goal 16 (promote just, peaceful, and inclusive societies) (United Nations 2015).

Design

Front-end Design

Amal will be accessible by website; there is the potential to make it accessible via a mobile application. The website will be available in English, Arabic, French, and Farsi—the four most spoken languages in MENA (Globalization Partners International 2014). On the Amal website, women can select their country of residence and learn more about their legal rights and about the steps they need to take to secure their access to various rights. They can sign up for Amal, enter their personal information, and have the legally required documents generated before saving and printing the documents to drop off or send to the appropriate government office. Alternatively, users can

electronically file the documents directly with the appropriate office, simplifying the filing process further. Once filed, users can track the progress of their submission directly through their Amal dashboard. Amal will begin in one country; expanded functionality in additional languages and countries will be added once the initial launch of Amal proves successful in contributing to gender equality in the initial country.

Interface Design

Amal has a clean, simple interface designed to mimic the simplicity of use that it offers in completing paperwork. In addition, its uncomplicated design refutes the common notion that legal paperwork is overwhelming and confusing. The accent color of choice used in the design of Amal is a deep purple, which is often identified in congruence with other women's rights campaigns, causes, and organizations (such as International Women's Day).¹ Amal's logo is a tulip, a flower originating in the Middle East and an accepted symbol for love and peace (ProFlowers 2016). The name Amal is a traditionally female name in Arabic, meaning hope.²

Back-End Design

Amal requires a web domain and a back-end server to host its site, gather data, and automate legal documents. Amal's interface will take users' personal information and input the data into the back-end software. The software will insert users' information into preloaded templates and "return" completed document sets to users.

Implementation

To Amal, collaboration among a team of knowledge leaders is needed. At a minimum, this team must include a MENA women's rights policy expert, a government liaison for each country being added to Amal, an English–Arabic translator, an English–Farsi translator, an English–French translator, and a full-stack engineer. Once the basic framework is complete, the website can be deployed. Multiple rounds of internal beta tests will be followed by a small round of real-use case tests. Iterations and changes will be made swiftly after feedback is received from each round of testing. After this testing

¹ For more information about International Women's Day 2018, see the website at <https://www.internationalwomensday.com/>.

² For more information on the meaning of the name Amal, see the "Name Meaning" website at <https://www.thenamemeaning.com/amal/>.

period, Amal can be deployed publicly in one country in MENA, with internal metrics to measure the effectiveness of the program in achieving higher rates of gender equality. Once Amal is successfully up and running in the initial country, it can be implemented in additional countries.

Examples

United States

E-filing and legal document automation software are available both as standalone software and through a website. Companies such as TurboTax (turbotax.com) and H&R Block (hrblock.com) offer software whereby individuals input personal information and have tax documents automated for them, with the option to file them electronically. Clerky (clerky.com) is a website through which individuals with start-up companies can input their company's information and can request to have all required legal documents generated and submitted.

Middle East

Meezan Bank in Pakistan opened online bank account applications in June 2015 (Meezan Bank 2015). The Department of Zakat and Income Tax in Saudi Arabia launched an income tax e-filing program in early 2016, titled Erad.³ As of September 2017, the Intellectual Property Office of Egypt accepts patent application filings online (Akpotaire 2017). The Trademark Office of Kuwait processes trademark applications online as of early January 2018 (SABA Intellectual Property 2018). Other similar electronic filing programs have been suggested by various federal departments and companies throughout the Middle East and North Africa.

Impact

Securing women's rights provides women the opportunity to make the choices that are best for them, their families, and their communities. Greater gender equality will lead to more just and inclusive economies and societies, benefiting not only MENA but, in fact, the whole world (Khayria and Feki 2015). Lack of an identification card, a passport, a driver's license, or

³ For more information about Erad, see the PricewaterhouseCoopers website at <https://www.pwc.com/m1/en/services/tax/me-tax-legal-news/2016/ksa-implementation-of-new-electronic-filing-requirements.html>.

land title, among other documentation, prevents many women in MENA from making economic decisions and has far-reaching consequences that create disparities throughout a woman's life (BBC News 2001). Access to these rights determines whether women pursue an education, become employed, or run a business, as well as having a trickle-down effect on their children (Hill and King 1995). Securing an identification card will allow women to more easily enter the labor force or access finance and choose opportunities that are best for them and their families (OECD 2017). Securing land and property gives women financial security and a sense of independence, allowing them greater bargaining power in the household (OECD 2017). With access to an identification card, women can secure and exercise their right to vote and in doing so influence legislative decisions that can lead to improved outcomes in important areas such as public health and child welfare. Elected officials will better incorporate women's preferences within their legislative agendas once women become a significant part of the electorate in MENA countries (Lynch et al. 2016). By providing better access to rights, Amal will assist the global development community in empowering women and girls, in promoting more inclusive economies and reducing inequality, and in promoting more just societies.

Challenges

Some countries may lack the legal framework and legislation that sponsors gender equality. As legal indicator indexes such as the World Bank's *Doing Business 2018: Middle East and North Africa (MENA)* (WBG 2018b) show, there is a certain domino effect with good regulatory reforms, and as more countries see their neighbors adopting and implementing gender-inclusive reforms, hopefully they too will move in that direction. Additionally, some countries may lack the digital infrastructure or financial means to support an online document submission process. Technology has become increasingly accessible and affordable; setting up a cloud-based system is now a matter of will and not a matter of financial resources (Rosoff 2015). If the cost proves too much, institutions such as the World Bank may be able to assist in providing financial coverage to a country for it to not only expand its technological experience but also for the country to test Amal's potential for improving gender equality.

On a more singular scale, women may lack access to a printer and be unable to print the automated documents; this problem can be solved by directing these women to a local print shop or facility with public printers. Women may lack access to a computer, smartphone, or tablet through which to use Amal; this challenge can be solved by directing them to a

facility with public computers. Women who are illiterate and who are unable to use Amal themselves can have pro bono attorneys and women's rights organizations use Amal for them. In addition, women may lack confidence or fear outlash if they use Amal. As Amal continues to develop partnerships in MENA countries, it can garner the support of other women's rights organizations to help these women use Amal without fear of retaliation and violence.


Annex

Amal User Interface Mock-Ups

English | Français | العربية | فارسي

About Countries Resources For Attorneys Sign Up Log In

Amal



Helping MENA women to empower themselves.

Amal helps women in the Middle East and North Africa get legal paperwork done safely and swiftly.

From passport applications to voter registration, Amal empowers its users to live a life with more freedom and opportunity.

- Birth Registration
- National ID Card
- Driver's License
- Passport
- Voter Registration
- Bank Account
- Land Ownership

See what is available in your country [Learn more →](#)

[Get Started](#)

English | Français | العربية | فارسي


حول بلدان مصادر للمحامين سجل تسجيل الدخول

أمل

مساعدة النساء في الشرق الأوسط وشمال أفريقيا تمكن أنفسهن.

أمل تساعد النساء في الشرق الأوسط وشمال أفريقيا الحصول على الأوراق القانونية القيام به بأمان وسرعة.

من طلبات جواز السفر إلى تسجيل الناخبين، أمل تمكن مستخدميها من العيش حياة أكثر حرية وفرصة.



- ولادة التسجيل
- بطاقة التعريف الوطني
- الساكنين رخصة
- جواز سفر
- تسجيل ناخب
- بنك الحساب
- أرض ملكية

اطلع على ما هو متاح في بلدك [أعرف أكثر](#)

[البدء](#)

References

- Akpotaire, Ufuoma. 2017. "Egypt Intellectual Property Office Launches Electronic Filing System for Patent Applications." *Nigerian Law Intellectual Property Watch Inc.*, September 19. <https://nlipw.com/egypt-intellectual-property-office-launches-electronic-filing-system-patent-applications/>.
- BBC News. 2001. "Saudi Women Get Identity Cards." *BBC News*, December 10. http://news.bbc.co.uk/2/hi/middle_east/1702342.stm.
- Hill, M. Anne, and Elizabeth King. 1995. "Women's Education and Economic Well-Being." *Feminist Economics* 1 (2): 21–46. <https://www.tandfonline.com/doi/abs/10.1080/714042230>.
- Globalization Partners International. 2014. "Middle East Languages and Locales: Essential Facts." *Globalization Partners International Translation Blog*, August 28. blog.globalizationpartners.com/middle-east-languages-and-locales-essential-facts.aspx.
- Kelly, Sanja. 2014. "Recent Gains and New Opportunities for Women's Rights in the Gulf Arab States." *Solutions* 5 (3). <https://www.thesolutionsjournal.com/article/recent-gains-and-new-opportunities-for-womens-rights-in-the-gulf-arab-states/>.
- Khayria, Karoui, and Rochdi Feki. 2015. "Gender Inequality and Economic Development." *Business and Economics Journal* 6 (4). <https://www.omicsonline.org/open-access/gender-inequality-and-economic-development-2151-6219-1000180.pdf>.
- Lawson-Remer, Terra. 2012. "Gender Equality Matters for Development Outcomes." *Council on Foreign Relations, Development Channel* (blog), August 21. <https://www.cfr.org/blog/gender-equality-matters-development-outcomes>.
- Lynch, Marc, Vickie Langohr, and Lauren Baker. 2016. "The Changing Face of Women's Political Participation in the Middle East." *Washington Post*, May 10. https://www.washingtonpost.com/news/monkey-cage/wp/2016/05/10/the-changing-face-of-womens-political-participation-in-the-middle-east/?noredirect=on&utm_term=.aa51ca7ebaef.
- Meezan Bank. 2015. "Meezan Bank Introduces Online Account Opening Form." Press Release, June 16. <https://www.meezanbank.com/meezan-bank-introduces-online-account-opening-form/>.
- OECD (Organisation for Economic Co-operation and Development). 2014. "Women in Public Life: Gender, Law, and Policy in the Middle East and North Africa." OECD, MENA-OECD Governance Programme. <https://www.oecd.org/mena/governance/women-in-public-life-mena-brochure.pdf>.
- . 2017. *The Pursuit of Gender Equality: An Uphill Battle*. Paris: OECD Publishing. <https://www.oecd.org/education/the-pursuit-of-gender-equality-9789264281318-en.htm>.

- ProFlowers. 2016. "The Surprising History and Meaning of Tulips." *ProFlowers* (blog), November 7. <https://www.proflowers.com/blog/the-surprising-history-and-meaning-of-tulips>.
- Rosoff, Matt. 2015. "Why Is Tech Getting Cheaper?" *World Economic Forum*, October 16. <https://www.weforum.org/agenda/2015/10/why-is-tech-getting-cheaper/>.
- SABA Intellectual Property. 2018. "Kuwait: E-Filing with New Scale for Filing and Registration Numbers." Press Release, January 11. <https://www.sabaip.com/en/News/Kuwait-E-Filing-and-New-Scale-for-Filing-and-Registration-Numbers>.
- Trister, Sarah. 2010. "Women's Rights in the Middle East and North Africa: Supporting the Fight for Freedom and Equality." *Huffington Post*, March 10. https://www.huffingtonpost.com/sarah-trister/womens-rights-in-the-middle_b_493714.html.
- United Nations. 2015. "Sustainable Development Goals." United Nations. <https://www.un.org/sustainabledevelopment/sustainable-development-goals/>.
- WBG (World Bank Group). 2018a. *Women, Business and the Law 2018*. Washington, DC: World Bank. License: Creative Commons Attribution CC BY 3.0 IGO.
- WBG (World Bank Group). 2018b. "Doing Business 2018: Middle East and North Africa (MENA)." Washington, DC: World Bank Group. <https://www.doing-business.org/reports/~media/WBG/DoingBusiness/Documents/Profiles/Regional/DB2018/MENA.pdf>.

CHAPTER 4

Crowdfunding Can Serve as a Pathway to Higher Education

Team Al-Derb Platform

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Abstract

The Al-Derb platform¹ provides a way for individual and group funding (crowdfunding) to help young people obtain grants for high-quality online education and training courses offered by universities and training centers.

The availability of high-quality education in the Arab world is low, which affects the development of young people's potential and limits their opportunities in the job market. As a result of the crises and wars that have occurred in the region, many young people do not have opportunities to obtain formal continuing education or to develop their skills; and for most of them, the high cost of education in developed countries is prohibitive. But as the digital world advances, solutions to these problems can be found.

Digital universities provide high-quality courses that are open to students around the world, and such institutions help bridge the gap between education levels and provide equal opportunities for a good education to all students and young people. By offering such courses online, digital universities offer large numbers of people access to education worldwide.

This past year, the Al-Derb team members have noted in youth seminar discussions that young people are enthusiastic about the educational opportunities available online, but many find it difficult to pay for enrolling in courses. Although the fees are relatively low for those in developed countries, the economic situation and low levels of income in the Arab world—in addition to lack of access to electronic payment—have made it impossible for many young people to take advantage of those opportunities.

¹ The literal meaning of Al-Derb is “the pathway,” and alternate spellings are Al-Darb or Ad-Darb. ALDERB is the spelling used in the platform's web user interface, found on the last page of this report.

Problem and Context

The difficulty of obtaining a good education and the low skill level that young people in the Arab world have are major obstacles to entering the job market and to earning an income that can provide a decent standard of living. But the digital transition and technical developments have contributed greatly to sharing information and providing opportunities for acceptable and even high-quality education and training. Many distinguished global universities such as Harvard, Stanford, and Massachusetts Institute of Technology offer massive open online courses (MOOCs) on large electronic platforms such as Coursera, Udemy, and edX. Owing to the widespread popularity and development of these courses, such learning platforms have started to be recognized by academic institutions. Academic degrees such as a master's can be earned by completing a series of online courses. The learning platforms also have started to be recognized in the job market, and some large companies such as Amazon and others provide training to their staff on them.

The dynamic nature of the current job market gives priority in competition for jobs to workers who gain skills and participate in continuous learning. Such educational demands are difficult to achieve in the developing world in general and in the Arab world in particular. But online education provides an acceptable solution for bridging the gap between the capacities of Arab young people and the requirements of the job market.

The Al-Derb platform is also trying to solve a problem that most Arab young people have: how to pay for tuition at online education platforms. This difficulty results not only from the economic situation of young people, but also from the obstacle of electronic payment. Electronic payment is linked to bank accounts and credit cards, which few young people in the Arab world have.

The Al-Derb platform provides opportunities for individual and group funding from charitable institutions and individuals. Al-Derb enables such institutions and individuals to transfer the course fees to their Google Pay or PayPal accounts and to specify the course and beneficiary. This payment method helps young people enroll in education and training courses on the best global platforms provided by the most distinguished universities, training centers, and trainers who have high levels of expertise.

Solution

With such third-party payment, young people who want to enroll in online courses and universities but cannot afford to can complete a short application form on the platform. There, they indicate the desired course or degree, the source of the degree, and its cost. As these application forms appear on

the web interface, institutions or individuals who want to help can pay the expenses of young people who are unable to do so.

Platform Interfaces

The platform will have two main interfaces:

- The first one targets young people and students seeking help in paying for the cost of online courses.
- The second one targets institutions or individuals that want to provide educational grants on electronic platforms for those people in need who have submitted applications on the platform.

The platform has two main products that are compatible with different types of customers and business models of approved education platforms. Some models provide free instruction but require a fee to obtain a certificate of course completion. Some models charge a fee to use them, regardless of whether the person wants a certificate. Tables 4.1 show the steps involved in the way these two products work.

We hope that through this platform, thousands of Arab young people will have the opportunity to continue their education and training to build their skills. On the basis of current capabilities, the target is to provide 500 grants a year, but this number could increase if we are able to convince other donors to help a larger number of young people.

Progress toward Sustainable Development Goals

The great advancements of technology and its applications have created many opportunities to obtain high-quality education and training at

Table 4.1 Steps for Students to Apply for Online Course Funding

- 1 The student fills out an application for a grant to cover the cost of a certificate when the student has completed the course.
 - 2 The Al-Derb platform verifies the accuracy and credibility of the grant application.
 - 3 The grant application is shown on the interface for supporters who require that the student must have completed the course.
 - 4 Electronic donation is received from a supporter on the platform for the submitted application.
 - 5 The Al-Derb platform makes the payment for applications that received grants, and sends a confirmation to the donor.
-

relatively low cost. It is the responsibility of all concerned with international development to reduce the remaining obstacles that prevent thousands of young people from taking advantage of the knowledge revolution (box 4.1).

Box 4.1 Alignment of Al-Derb with Sustainable Development Goal 4

Our concept is largely consistent with the United Nation's Sustainable Development Goal 4: "Ensure inclusive and equitable education for all and promote life-long learning opportunities," including many of Goal 4's specific targets, such as the following:

- **By 2030, ensure equal access for all women and men to affordable quality technical, vocational and tertiary education, including university.** The Al-Derb platform provides a way to help obtain grants to cover the cost of education. By doing so, the platform helps solve problems of unequal access to vocational and higher education that young people in developing countries and the Arab world have, compared with young people in developed countries. Electronic education platforms such as edX, Coursera, and Udemy are an important part of the solution for providing these opportunities, but their cost remains an obstacle for large numbers of young people.
- **By 2030, eliminate gender disparities in education and ensure equal access to all levels of education and vocational training for the vulnerable, including persons with disabilities, indigenous peoples, and children in vulnerable situations.** The platform will facilitate access to grants for vulnerable groups, enabling them to learn and acquire skills from the best universities and global institutions available online. Such courses have become easy to access with smartphones, tablets, and so forth.
- **By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and nonviolence, global citizenship, and appreciation of cultural diversity and of culture's contributions to sustainable development.** To achieve this objective, learners in developing countries and the Arab world must have access to the sources of knowledge referred to in the targets. But universities and local academic centers are rare in the Arab world, and most sources of knowledge are from universities in the developed world. Those universities are accessible through the Internet. Although the costs are usually nominal, they are still beyond the reach of many in the Arab world because those individuals have low levels of income and do not have access to electronic payment methods.
- **By 2020, substantially expand globally the number of scholarships available to developing countries, in particular least developed countries, small island developing States and African countries, for enrolment in higher education, including vocational training and information and communications technology, technical, engineering and scientific programmes, in developed countries and other developing countries.** By facilitating the mechanism of electronic payment and group funding, the platform will make the process of providing grants to individuals and groups in the targeted regions easier than at any time in the past.

Source: United Nations Sustainable Development Goals: 17 Goals to Transform Our World, <https://www.un.org/sustainabledevelopment/education/>.

Therefore, we at the Al-Derb platform believe that we need to form a bridge between supporters and the needs of young people in this area.

Comparable Projects

There are a number of platforms for group funding at the global and regional levels and in the Arab world, but they are generally concerned with funding ideas, entrepreneurship projects, and social entrepreneurship. The Al-Derb platform offers a particular feature for group and individual funding of education and capacity building on electronic platforms. The following are examples of global and Arab platforms for group funding:

- **Kickstarter**
(kickstarter.com/projects/search?page=37&term=Education&utf8=%2593)
This U.S. crowdfunding platform finances innovative projects. It is the largest and most important crowdfunding platform in the world, and education is one of the areas for which it collects funding.
- **Indiegogo**
(indiegogo.com/explore/education?project_type=all&project_timing=all&sort=trending)
This crowdfunding platform allows people to obtain funding for an idea, for charitable activities, or to start a business.
- **YouCaring**
(youcaring.com/c/fundraising-ideas/education)
This free crowdfunding platform allows people to help others overcome misfortunes and enjoy a happier life and health. It provides opportunities to help young people pay their student loan debts.
- **Zoomaal**
(<http://ar.zoomaal.com>)
This platform aims to support Arab innovation. Through Zoomaal, anyone can obtain funding for a project such as publishing a book, manufacturing a preliminary model for a product, making a documentary film, or starting a development project.
- **Kiva**
(www.kiva.org/lend?sector=15)
This platform is different from the others because it is based on interest-free loans in a cooperative community that helps others improve their lives or complete their education. Individuals can obtain personal loans to start a new business, to complete their university education, or to pursue any other activity to improve their lives. People can pay

any amount to support those in need, and the money will be returned to them after the specified period of time.

Challenges

As we consider the challenges ahead for this project, we identify two main areas:

- *Obtaining funds for providing grants to young people.*
In light of the reasonable cost of operating the platform and the commitment of its team members to bear this cost, funding for the continued operation of the platform is not a challenge. The real challenge is obtaining sufficient funding to achieve the platform's objective of providing grants for online education to Arab young people, and its vision of becoming a major platform for funding education in the Arab world.
- *Convincing some donors of the value of online education and training.*
Through the surveys and questionnaires that the platform's team has carried out on a limited scale, we have become aware that some people are not convinced of the value of online education. We find many hold the erroneous view that certificates for online education are not recognized by the official academic institutions and the job market. Nevertheless, this issue has been overcome throughout the world, in both the job market and the academic sector. Leading companies around the world use online education to train their staff. One example is PayPal, whose chief learning officer, Derek Hann, said that a platform like Udemy gave the company the opportunity to provide better training that meets the needs of their workers. (For Hann's statement, see the Udemy for Business website, "The Destination for Workplace Learning," https://business.udemy.com/?ref=ufb_header.)
Academic authorities in many countries, including Arab countries like Qatar, have approved a list of universities and academic programs that students can enroll in online and obtain recognition and the academic equivalent. (See a list of authorized online universities and education programs in Qatar on the government website, <http://www.edu.gov.qa/En/ServicesCenter/Pages/Supported-Universities.aspx>.)

To meet these challenges, we will focus on conducting a media and marketing campaign to correct erroneous ideas about online education programs and the advantages they offer, such as high-quality education and a relatively low cost compared with attending courses in person.

AI-Derb Platform Team: Progress to Date

As a team, we completed the technical concept for building the electronic platform in cooperation with a company specializing in web software; the platform includes a web interface, databases, and an integrated application of electronic payment. We have begun programming the initial model, which will take three months and will be delivered in early November 2018.

CHAPTER 5

Ensuring Food Safety in China and Beyond through Blockchain Technology

Team Pennepidemic

Yoo Jin Jang, University of Pennsylvania College of Arts and Sciences

Seunghyun Hah, Yonsei University, business administration

Yeonoo Kim, Yonsei University, French language and literature

Abstract

Addressing food safety is not only a serious global health issue but also an important step to sustainable development. As the world becomes more interconnected, the global food supply chain is exposed to a greater number of possible threats. With more than 20,000 foodborne diseases reported each year, China has made it a priority to safeguard its food security (Lam et al. 2013).

We believe a digital ledger system known as blockchain technology is the most effective solution in tackling the issues of food safety and food fraud. The transparency and traceability of blockchain technology connects all parties (producers, retailers, consumers) in the blockchain network and ensures an improved food supply chain. In addition, the implementation of blockchain technology will have positive ripple effects on growth and development.

Explanation of Problem and Context

One of the United Nation's Sustainable Development Goals is to "ensure healthy lives and promote well-being for all at all ages" (United Nations 2015). Humans are constantly exposed to the dangers of infection and disease through food. According to former UN Secretary General Ban Ki-Moon, "more than 200 diseases . . . can come from contaminated food" and there is a "constantly evolving threat from new production, distribution, and consumption methods" (UN News 2015). These threats lead to a global food supply chain that is growing more complex by the second.

The issue of food safety is certainly a global concern. In 2010 alone, there were 582 million cases of 22 different foodborne diseases that resulted in

more than 350,000 deaths (UN News 2015). One of the most recent and noticeable cases occurred at the 2018 PyeongChang Winter Olympics when more than 200 people were diagnosed with norovirus (Brueck 2018). However, throughout the world, many will agree that China's incidents are the most infamous of the food safety issues reported.

Ensuring food safety is a major concern in China; however, the nation has a long way to go to totally eliminate fraud in the food industry. Fraud within China's food industry, specifically fake food and food contamination, is most often associated with the country's food staples, such as rice and powdered milk, as seen in the Chinese milk scandal of 2008 (BBC 2010) and the fake rice scandal of 2011 (*Korea Times* 2011).

Unfortunately, the problem is not limited to rice and milk. Reports of fake eggs, fake beef, and other artificial "food" have raised global awareness of the issue. Countless posts about chemically created products masquerading as edible food—many of them true, many others spreading alarmist rumors—are posted daily on Weibo, China's main social networking site. These posts create an air of anxiety among the public, with people not knowing what to believe or what to do.

Unhygienic environments also contribute to the food safety issue. According to Whitworth (2013), 56.6 percent of the sundry foodborne illnesses in China are caused by unhygienic practices. The concern lies in the unhygienic environments implicated in the transportation of the product from the producer to the buyer, including the locations involved and the vehicles used to transport the product.

Thankfully, people in China now are more curious about what it is that they are eating. They want to know what is in their food, who is overseeing the production of the food, and what is used in the production of the food.

However, it is not an easy task to track down the origins of our food as it is produced and disseminated. Usually, this information is not disclosed to customers. Adding to the difficulty of keeping tabs on foods' origins is a global food chain—the buyer may live in a different country from the producer. Thus, a global system that provides details on the production and the transportation of the food that we eat and that ensures food safety is essential not only for the population of China but also for the world's population.

Understanding Blockchain and Its Relevance to the Food Supply Chain

The soaring value of bitcoin has driven a growing global interest in cryptocurrency. Cryptocurrency's underlying technology—blockchain—can provide solutions to many global issues, including the food safety issue.

Blockchain technology can be simply understood as a system of digital ledgers. It marks the transition from manually written records to records that are digitally processed, safeguarded, and distributed through a network. Within the “chain,” each “block” will contain three features: data, hash, and hash of the previous block. The data will consist of a record of any transaction. The hash is a unique identity code that is given to each block. This hash will change if there are any changes to the block. The hash of the previous block connects to the other blocks to form a “chain” of all of the transactions. A blockchain is distributed to everyone in the network. When there is a change or addition to the chain, all parties of the respective blockchain network must approve of the transaction. Blockchain technology retains four main characteristics: consensus, immutability, provenance, and privacy (McDermott 2017).

The underlying problem in the issue of food safety is the food industry’s capacity to cheat consumers. Using fake materials and falsely recording the details of food harvesting and processing can hide significant faults in the food from consumers. In short, the industry and its complex food supply chain must become transparent. Transparency is the key to eliminating such irresponsibility.

Nevertheless, we need more than just transparency. Not all food safety issues can be blamed on food fraud. If ensuring transparency is the precautionary measure, traceability plays a vital role in postdisaster management. When there is a fault identified in a food, we must trace back to where the food came from (Aitken 2017).

Blockchain technology can offer both transparency and traceability for the food industry. The use of blockchain technology in the food industry will allow producers and consumers to trace every component of the food supply chain. Information regarding where the food was produced, who produced it, and how it was processed and delivered can be found with a barcode, for example, on the respective food (Aitken 2017).

Application of Blockchain Technology to the Food Supply Chain

Policies can be implemented in the development of the blockchain to achieve traceability and transparency. First and foremost, consumers should have access to the food blockchain to help with quality approval. Implementation of the blockchain by the food industry will allow for quick and easy exchange of information. Because the same record of information is stored in each digital block, producers and consumers will be able to easily access the information through their devices. As the information flows across the chain, there will be validation through each other’s shared

information. When new information is introduced in the chain, each participant will go through the approval (or denial) process by evaluating the other participants' assertions. The food that "travels" through the blockchain will be called the "food bundle," which will be equivalent to a summary of all of the information contributed by different people and organizations involved in the production (Rose 2017). This food bundle will contain subcategories including the origin of food production and the quality and the taste of the food itself.

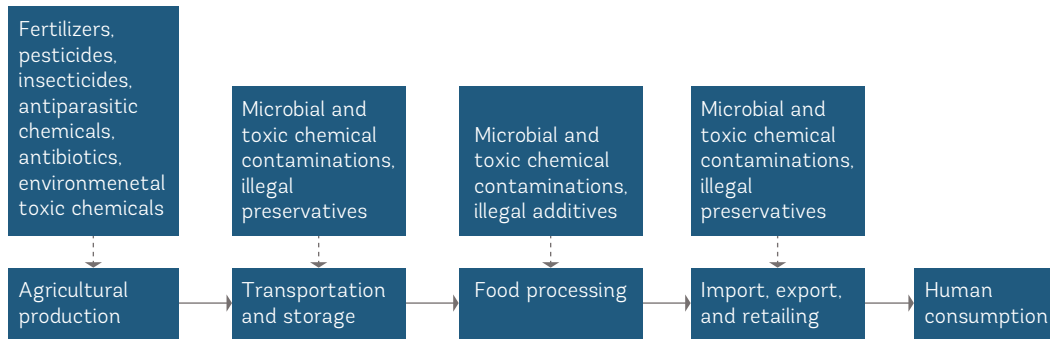
The quality approval (also known as provenance) process is more transparent than merely labeling food packages. Through a chain of approval by all participants (such as the producer, processor, and supervisor), the entire food production process can be revealed to the consumer via health or diet applications and by way of completed grocery purchasing and managing requirements. For example, if the producer and the processor of pork both want to assert that their product is free of antibiotics, the food processor can post the official certification on the blockchain; this action also builds trust within the supply chain. Another example of transparency is a food processor posting a list of vaccinations its livestock received. Such step-by-step revelation lowers the health risks that are often posed by nontransparency.

Combining an Endpoint Food Control System and a Risk-Based Food Safety Control System through Blockchain

Various systems are used to decrease cross-contamination and the spread of foodborne illnesses. In the 1990s, industrial countries began reviewing their food safety policies. The endpoint food control system provided for the inspection of final products. This command and control system evolved into a hazard analysis and critical control point system, which aims to prevent hazards by conducting risk and cost-benefit analysis. The blockchain that we are proposing will be a solution of both the endpoint food control system and the risk-based food safety control system.

Rather than a rapid shift from one system to another, which China has been trying to do, the blockchain technology will allow participants to find a solution using both systems. By combining the systems, participants will have more control over the process. For example, the blockchain technology will require both the inspection of and the presentation of each step of food processing. To discover a contaminant and its source, distribution records available in the blockchain will allow participants to determine at which point a shipment could have been exposed to a contaminant (see figure 5.1). This digital and ubiquitous footprint will prevent further contamination. Companies and public health officials will be able to determine

Figure 5.1 Causes of Foodborne Disease during Production



Source: Lam et al. 2013.

the approximate number of people who may become infected sooner and without the hassle of analyzing all hospital records. Lessening the bureaucracy should also shorten the response time in developing a treatment and decrease the time it takes to stop the spread of foodborne diseases.

Another food safety issue in China is the addition of illegal additives to food (see table 5.1). Recurrent incidents of these additives in the food supply have caused public health hazards and social distrust of the Chinese food industry, which in turn has led to economic loss. To address these concerns, China has implemented the Animal Labeling and Disease Traceability System, the National Monitoring and Control Plan on Animal Drug Residues in Animals and Animal Products, and the Surveillance Plan on Drug Resistance of Animal-Origin Bacteria. These tracing programs can also be embedded in the blockchain because they are already required by the government (Lam et al. 2013).

Putting the System into Action

To maintain the blockchain system, a standard-based method of the highest caliber will need to be developed that determines the data to be shared along the blockchain. The first step in applying this method will be to recruit major retailers to collaborate with IBM, the main provider of the blockchain system. As companies with the biggest market share devote data, food alliances will slowly expand. Possible companies include JD, the largest Chinese retailer with approximately 266 million active users, and McCormick and Company, one of the major grocery stores in China. These food alliances will be the starting point for blockchain expansion. Employing a top-down business model to the market, major companies' involvement will encourage smaller retailers and local groceries to participate.

Table 5.1 Incidents of Illegal Chemical Food Additives

| Selected incidents of illegal chemical food additives in China that were extensively covered by the media | | |
|---|------|---|
| | Year | Details |
| Ractopamine | 2011 | Ractopamine is a β -adrenoceptor agonist. Although it is allowed to be used to promote leanness of meat in some countries, such as the United States, high doses of ractopamine might have harmful side effects. Ractopamine was reported to have caused an outbreak of food poisoning in 2001, and was subsequently prohibited in animal husbandry in 2002 and stopped from being imported into China in 2009. After discovering the use of ractopamine in pig rearing in Henan province in 2009, the government launched an extensive investigation to remove ractopamine from animal feed. In 2011, a new law was passed to ban the sale and manufacturing of ractopamine in China. |
| Ditch oil | 2011 | Ditch oil is produced by recycling waste oil from hotel and restaurant drainage pipes for human consumption, which is believed to be a widespread illegal activity. For example, in 2011, joint action by detectives from Zhejiang, Shandong, and Henan provinces successfully tracked down a criminal network that sold ditch oil to restaurants. 60,000 tons of ditch oil were recovered. |
| Melamine | 2008 | In 2004, a severe incident involving fake formula milk that did not contain sufficient amounts of protein was reported in China. Babies affected by malnutrition as a result of consuming the milk were noted as having abnormally large heads in comparison with their malnourished bodies, and some sustained permanent damage. Since then, the government has implemented a stringent standard for the protein content of milk (by measuring total nitrogen content). In 2008, criminals invented a new way to fake the detection of protein by adding melamine to milk and infant formula. Melamine caused the formation of kidney stones in babies, resulting in several hundreds of hospital admissions and a few fatalities. |
| Sudan IV | 2006 | Due to its potential carcinogenic effects, the dye Sudan IV has been banned from use in food coloring. In 2006, the Chinese General Administration of Quality Supervision, Inspection and Quarantine announced that Sudan IV had been detected in the eggs of poultry. Some farms had illegally added Sudan IV to poultry feed to stain the egg yolk with an attractive red color. |

Source: Lam et al. 2013.

Similar Examples

Because blockchain technology is essentially a digital ledger, depending on what type of transaction or information users want to store, it can be used in various fields. We focused on blockchain implementation in the food sector.

In 2017, IBM and Walmart ran a successful test on their blockchain system on two food items: Chinese pork and Central American mangoes. The final products that arrived on Walmart's distribution shelves had left a digital footprint on their respective blockchains. Although the specifics are not disclosed regarding the success of digitalizing Chinese meat distribution, the implementation of blockchain technology is predicted to save billions of dollars in the industry. For the sliced mangoes, every aspect of their production, processing, and distribution was available within 2.2 seconds of scanning the code on the packaging, a significant improvement

from what used to take them a week (Wong 2018). Now, more international retailers are joining the quest to blockchain the world's food chain. Nestle, Unilever, and Dole are already partnering with IBM and Walmart in this next generation of food supply. These retailers' success in digitizing their products increases the feasibility of creating a blockchain of the entire network of food suppliers, retailers, and consumers.

Challenges and Ways to Overcome Them

As inscrutable as the blockchain technology sounds, there are still challenges to overcome in guaranteeing its success. Possible problems may include “visibility gaps in the supply chain,” lack of infrastructure, and digital security (Rose 2017).

The aforementioned solution is outlined with the assumption that when the blockchain of food is established, all related parties are part of the network. This may not be true in the real world. Unless stated, it is essentially up to the individuals whether they wish to partake in the network. If some parties in the supply chain are left out, then a gap of information might result (Rose 2017). For instance, if the farmer, retailer, and consumer are part of the blockchain but the trucking company that delivers the goods from the farm to the shop is not, then information regarding the transportation of these goods may be missing. The simplest solution is to require all parties that are under a food supply contract to join the blockchain network. This requirement benefits all parties because there is a greater degree of trust and responsibility among the parties because of transparency within the system.

Another more fundamental problem is the lack of infrastructure to support the system. Because the implementation of blockchain technology is a relatively new concept in the food supply industry, new mechanisms must be drafted and followed. Decisions regarding what information is to be stored in the block must be clearly identified. In addition, a user-friendly platform (perhaps that which is accessible through PCs and mobile phones) must be designed. Lastly, those participants who wish to read the information on the blockchain must have devices to access the information. In China, this will not be an issue—more than 70 percent of Chinese use mobile payment (Wenyu 2017). This familiarity with a mobile, or cellular, network system suggests that interested participants in China would be in favor of a food blockchain if it were commercialized in the near future. However, if we plan to turn this food blockchain into a global phenomenon, we must take into account that there are many regions with weak mobile service penetration, such as Africa and Southeast Asia. Perhaps for these areas, a public device can be installed at retail locations for consumers to use.

References

- Adepoju, Paul, and Yemisi Adegoke. 2016. “‘Plastic’ or Not? Over 100 Bags of Fake Rice Seized in Nigeria.” CNN, December 24. <https://edition.cnn.com/2016/12/23/africa/nigeria-fake-plastic-rice/index.html>.
- Aitken, Roger. 2017. “IBM and Walmart Launching Blockchain Food Safety Alliance in China with Fortune 500’s JD.com.” *Forbes*, December 14. <https://www.forbes.com/sites/rogeraitken/2017/12/14/ibm-walmart-launching-blockchain-food-safety-alliance-in-china-with-fortune-500s-jd-com/#3f520b797d9c>.
- BBC. 2010. “China Dairy Products Found Tainted with Melamine.” BBC, July 9. <https://www.bbc.com/news/10565838>.
- Brucek, Hilary. 2018. “A Highly-Contagious Stomach Virus Is Sweeping the Olympics.” *Business Insider*, February 16. <http://www.businessinsider.com/norovirus-at-pyeongchang-winter-olympics-what-it-is-2018-2>.
- Korea Times*. 2011. “Chinese Fake Rice Is on Shelves.” *Korea Times*, January 20. koreatimes.co.kr/www/news/biz/2011/01/182_80040.html.
- Lam, Hon-Ming, Justin Remais, Ming-Chiu Fung, Liqing Xu, and Samuel Sai-Ming Sun. 2013. “Food Supply and Food Safety Issues in China.” *Lancet* 381 (9882): 2044–53. [https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(13\)60776-X/fulltext](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(13)60776-X/fulltext).
- McDermott, Brigid. 2017. “Improving Confidence in Food Safety with IBM Blockchain.” *IBM Blockchain Unleashed* (blog), September 5. <https://www.ibm.com/blogs/blockchain/2017/09/improving-confidence-in-food-safety-with-ibm-blockchain/>.
- Oaklander, Mandy. 2015. “2,500 Tons of the Food We Eat Is Fake.” *Time*, February 17. <https://www.time.com/3711938/food-fraud-interpol/>.
- Rose, Michael. 2017. “The Blockchain of Food.” *Forbes*, October 23. <https://www.forbes.com/sites/themixingbowl/2017/10/23/the-blockchain-of-food/#4600dd5b775f>.
- South China Morning Post*. 2017. “Global Food Safety Efforts to Accelerate Using Blockchain Platform.” *South China Morning Post*, August 22. <https://www.scmp.com/tech/enterprises/article/2107847/coalition-drive-global-food-safety-efforts-blockchain-platform>.
- United Nations. 2015. “Sustainable Development Goals.” United Nations. <https://www.un.org/sustainabledevelopment/sustainable-development-goals/>.
- UN News. 2015. “UN Stresses Importance of Food Safety—from Farm to Plate—on World Health Day.” UN News, April 7. <https://news.un.org/en/story/2015/04/495232-un-stresses-importance-food-safety-farm-plate-world-health-day>.

- Wenyu, Sun. 2017. "Mobile Payments Penetration Highest in China." *People's Daily Online*, September 7. <http://en.people.cn/n3/2017/0907/c90000-9266025.html>.
- Whitworth, Joe. 2013. "Human Factors Main Reasons for Foodborne Illness in China, Says Review." *FoodNavigator*, February 5. <https://www.foodnavigator.com/Article/2013/02/05/An-analysis-of-2-387-incidents-of-acute-foodborne-illness-in-China>.
- Wong, Joon Ian. 2018. "The World's Biggest Retailer Wants to Bring Blockchains to the Food Business." Quartz Media, February 21. <https://qz.com/se/perfect-company-2/1146289/the-worlds-biggest-retailer-wants-to-bring-blockchains-to-the-food-business/>.

APPENDIX: HONORABLE MENTION

The appendix presents abstracts of the submissions among the finalists that received honorable mentions. They appear below in alphabetical order of proposal title.

Concrete from Plastics? Preserve Natural Resources and Produce Sustainable Construction Materials

Team ROCAPET

Ernesto Alonso López de la Cruz, CEO/executive director

José Luis García Hernández, CAO/administrative director

Tilo Daniel Hernández Cadea, CTO/technology director

Abstract

Every year, more than 8 million metric tons of plastic are deposited into the ocean, the equivalent of emptying a garbage truck full of plastic every minute into the ocean (World Economic Forum 2016).

The construction sector is responsible for 40 percent of the virgin materials extracted from the earth, 40 percent of the energy consumed on earth (including energy in use), 20–30 percent of total greenhouse gas emissions, and 50 percent of the total waste generated (UNEP-SBCI 2014).

The construction sector's exploitation of sand and gravel, which are non-renewable resources, represents the largest volume of material extraction worldwide after water. The carbon dioxide emissions generated by the extraction and the transport of sand and gravel affect biodiversity, water turbidity, erosion of the earth's crust, and the climate (UNEP 2014).

According to the United Nations' Environment Program, to mitigate these problems, it is necessary to do the following:

- Reduce the consumption of sand or gravel; optimize existing infrastructures, recycle concrete debris, or use alternative construction materials such as wood.
- Establish taxes on the extraction of sand and gravel to encourage the use of economically viable alternatives.
- Reduce the negative effects of extraction: adapt the extraction rate to the rate of renewal of resources and establish an acceptable extraction limit.

To reduce the exploitation of sand and gravel, we propose that the construction industry use polyethylene terephthalate (PET), which is a plastic, instead of gravel, to manufacture concrete.

With ROCAPET, PET is used as a coarse aggregate for the manufacture of concrete. Replacing a minor percentage of gravel with PET in the manufacturing process reduces the annual tonnage of postconsumption PET, preserves a natural resource, and produces a sustainable concrete with lower volumetric weight. This method also reduces the cost of manufacturing ready-mix concrete and benefits the environment.

With ROCAPET, it is possible to produce concrete for structural use. Using PET as a minor percentage to the gravel makes the concrete's resistance go from $f_c = 250 \text{ kg / cm}^2$ to $f_c = 350 \text{ kg / cm}^2$, which fulfills the quality requirements of workability (slump), compression, bending, and temperature. In addition, the following results are attained:

- Slump from 10 to 18 cm
- Compression resistance: $f_c = 150$ to 350 kg / cm^2
- Resistance to bending: $MR = 41$ – 52 kg / cm^2
- Resistance equal to a traditional concrete subjected to temperatures up to 280° C

The product is suitable for structural use in office buildings, sports facilities, housing, and singular constructions.

We must note that these tests are preliminary and that we are still testing new materials to replace the stone aggregates (gravel and sand) because we have not been able to replicate the results from the first tests. We will continue working to optimize the results.

References

- UNEP (United Nations Environment Programme). 2014. *The Emissions Gap Report 2014*. Nairobi: UNEP.
- UNEP-SBCI (United Nations Environment Programme-Sustainable Buildings and Climate Initiative). 2014. *Greening the Building Supply Chain*. Paris: UNEP.
- World Economic Forum. 2016. *The New Plastics Economy: Rethinking the Future of Plastics*. Geneva: World Economic Forum.

Effort Provides Sustainable Energy by Turning Biomass to Charcoal in Tanzania

Team Green Power Group

Iddi Hamisi Nyachenga, Inventor of charcoal briquettes machines

Consolata Lihepa, Environmental engineer

Malili Lubasha, Accountant

Abstract

Wood and charcoal are major sources of domestic energy in Tanzania. According to the Tanzania Forest Services Agency, 350,000 to 400,000 hectares (915,000 acres) of forest are harvested each year in Tanzania, mainly for fuel. Studies indicate that about 70 percent of the charcoal produced in the country is sold in the city of Dar es Salaam. Residents of the city have access to both electricity and gas for fuel; however, gas is not a popular option (at least to the majority of Dar es Salaam residents). In Dar es Salaam, about 300,000 bags of charcoal are used daily, the effects of which pose a major threat to the environment in Tanzania.

With these challenges in mind, Green Power Group designed an alternative source of domestic energy. We created a simple electric machine with the capacity to produce 3.5 tons of charcoal briquettes per day. Our product, called MKAA WA IDRIS, is a carbonized charcoal briquette that is manufactured from biomass wastes such as peanut shells, rice husks, coconut shells, sawdust, and other agricultural byproducts. In Tanzania, 85 percent of waste comes from the agricultural sector, mainly food and postharvest waste.

Many middle- and low-income families use charcoal as their primary cooking fuel in Tanzania, especially in rural areas. This puts tremendous stress on the environment. By providing these families with access to an alternative source of domestic energy, such as MKAA WA IDRIS, we would contribute to the fight against climate change, as described in goal 13 of the United Nations' Sustainable Development Goals (SDGs).

Our innovation is more than just the production of charcoal briquettes; it is a contribution to environmental conservation. The protection and conservation of our natural environment is the cornerstone for the future of humanity. We are passionate in environmental conservation and we use our social media and other platforms not only for customer acquisition but also to advocate for environmental conservation. We encourage young people to use adaptive technology available online to create sustainable solutions for environmental challenges and to create more job opportunities in Tanzania and Africa.

In Ghana, Data Analytics Will Match Business Enterprises with Lending Institutions

Team Credit Locus

Charles Mensah, Cofounder and CEO, Credit Locus, Accra, Ghana

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Daniel Mantey, Senior software engineer, Credit Locus, Accra, Ghana

Salami Abdul Mohammed, Operations associate, Credit Locus, Accra, Ghana

Rita Yeboah, Lead, business development, Credit Locus, Accra, Ghana

Abstract

Credit Locus is a virtual platform that matches credit-seeking micro, small, and medium enterprises (MSMEs) in Ghana with lending institutions. For lenders, it is a customer onboarding channel that offers more precision and efficiency in acquiring “qualified” borrowers. For microbusiness owners, this platform offers access to tailored credit facilities as well as to share power with lenders by allowing them to choose which loan offer to accept. The platform uses traditional and alternative data to create a hybrid scorecard that serves as an efficient alternative to traditional credit appraisal mechanisms. It prioritizes a lending model (supply-chain financing) that ensures that loan defaults are minimized, especially the ones that are induced by diverted funds. Shrewd data analytics on the platform also reduce the loan turnaround time as the volume of lending increases.

Comprehensive research conducted by the Credit Locus team indicated that financial institutions constantly develop cold feet when varying their credit appraisal process to suit the needs and structure of MSMEs. However, with the formal lending market gradually becoming saturated in Ghana and with nonperforming loans hitting the roof, lenders are on the lookout for ways to enter the informal market, which has great potential for returns but disproportionate market data. The solution we came up with, Credit Locus, intends to bridge this gap by focusing on complementarity rather than disruption. In essence, we are not replacing the traditional system but providing an answer to the often-asked question: How can we improve it?

We have built a balanced team to suit the impending demands of running this business. With solid individual backgrounds in software development, social entrepreneurship, and investment banking, coupled with our collective desire for continuous learning and lifting others, the team is well equipped to execute every mandate we have set for ourselves. In carrying out our work, we will generate credit footprints for microbusinesses, which is essential to create an all-inclusive financial sector in Ghana.

Mentorship Mobile App to Support Entrepreneurs in West Bank and Gaza

Team Limitless

Hasan Qasem, Founder/CEO, Limitless KWB (Knowledge Without Borders)

Dina Shakir, Partner/head of business development, Limitless KWB

Abstract

One of the biggest challenges faced by entrepreneurs and small and medium enterprises (SMEs) in the West Bank and Gaza is the lack of access to international expertise caused in part by the Israeli occupation of the region. Under the occupation, it is difficult for entrepreneurs to obtain visas to other countries, and traveling costs are high. Without access to outside business coaches and mentors and other knowledge-building opportunities, entrepreneurs in the West Bank and Gaza struggle to grow their startups into successful sustainable businesses.

Limitless addresses the challenges that face entrepreneurs and SMEs in the West Bank and Gaza. It is a cost-effective and easy-to-use platform delivered through a mobile application that will accommodate a diverse set of mentorship and coaching needs among entrepreneurs. Through the Limitless platform, entrepreneurs and SMEs have access to a pool of international and national experts and to these experts' knowledge, insight, support, guidance, and field experience. With Limitless, entrepreneurs in the West Bank and Gaza can gain access to knowledge-building experts who otherwise are only available across the borders.

Reduce Trash from E-Commerce Packaging and Improve China's Environment

Team EcoPack

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Abstract

In the past decade, there has been a rapid growth in retail e-commerce sales worldwide. Between 2014 and 2018, sales grew by more than 20 percent annually. Packaging waste is a major byproduct of this rapidly growing market. China's e-commerce market—the largest in the world with nearly half of all sales globally—produces as much as 160,000 tons of trash daily from e-commerce delivery packaging. This poses a great threat to the sustainability of this market. Overpackaging is a major factor leading to the severity of the problem. It is estimated that in 2011 more than 50 percent of all packages sent in China were subject to overpackaging. This phenomenon may be caused by the high number of damaged products delivered by low-cost couriers. For online retailers, the durability of their packaging became a priority over environmental concerns.

EcoPack proposes an artificial intelligence-based optimal packaging system that seeks the best compromise between reducing packaging and maintaining adequate protection for products. Backed by data obtained from users' feedback and online data sources, EcoPack's solution would apply machine-learning algorithms to generate the best packaging method with the least amount of material while ensuring sufficient protection. EcoPack's solution would then send the optimized plans to the e-commerce application programming interface, helping sellers to optimize their packaging.

We think the EcoPack solution will remove thousands of tons of trash annually and impel significant environmental improvements in China. The EcoPack team firmly believes that the adoption of this solution will reduce excess packaging waste not only in the e-commerce market of China but also in the global e-commerce market.

With SafePal, Confidentially Report Gender Violence and Access Health and Social Services

Team SafePal

Nantume Nurah Shariff, SafePal, Reach a Hand Uganda

Rachael Monica Achen, SafePal, Reach a Hand Uganda

Kateregga Emmanuel, SafePal, Reach a Hand Uganda

Gitta Brian, SafePal, Think-It, Matibabu

Jingo Kisakye, SafePal

Joshua Okello, SafePal Cypher 256, Winsenga, Andela

Abstract

Discrimination against women and girls and gender-based violence severely affect women and girls' health. Gender-based violence (GBV) is not only abuse but also a human rights violation and a public health challenge. It is also a barrier to civic, social, political, and economic participation. GBV results in a number of negative consequences for women, including adverse physical and mental health outcomes, limited access to education, increased costs related to medical and legal services, lost household productivity, and reduced income.

Cultural norms and practices that emphasize women and girls in subordinate positions perpetuate GBV and other harmful practices including FGM (female genital mutilation), child marriage, and teenage pregnancies; these norms and practices also limit access to decision making, to information, and to SRH (sexual and reproductive health) services.

It is common for victims and survivors of abuse to not report these attacks because of the social stigma surrounding sexual violence. According to the Uganda Police Crime Report 2017, 30 percent of victims of sexual violence report the incidents within 72 hours, and 70 percent do not receive emergency assistance within 72 hours. This delay has contributed to an increase in new HIV (human immunodeficiency virus) infections, teenage and unwanted pregnancies, and other sexually transmitted diseases and infections.

SafePal is a platform that people can use to confidentially report cases of GBV and to get access to service providers including health centers, psychosocial support, legal education and mediation, shelters, the police, and local government departments for community development and probation.

SafePal will reduce the time between when a violence is perpetrated and when the survivor reports the attack and receives assistance and access to service providers by providing an accessible reporting platform. Through

SafePal's web application and unstructured supplementary service data system, people can use their mobile device to report cases of abuse anonymously into the system. The system will also provide a dashboard through which service providers can view survivors who have reported abuse and have requested assistance.



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