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CENTER FOR
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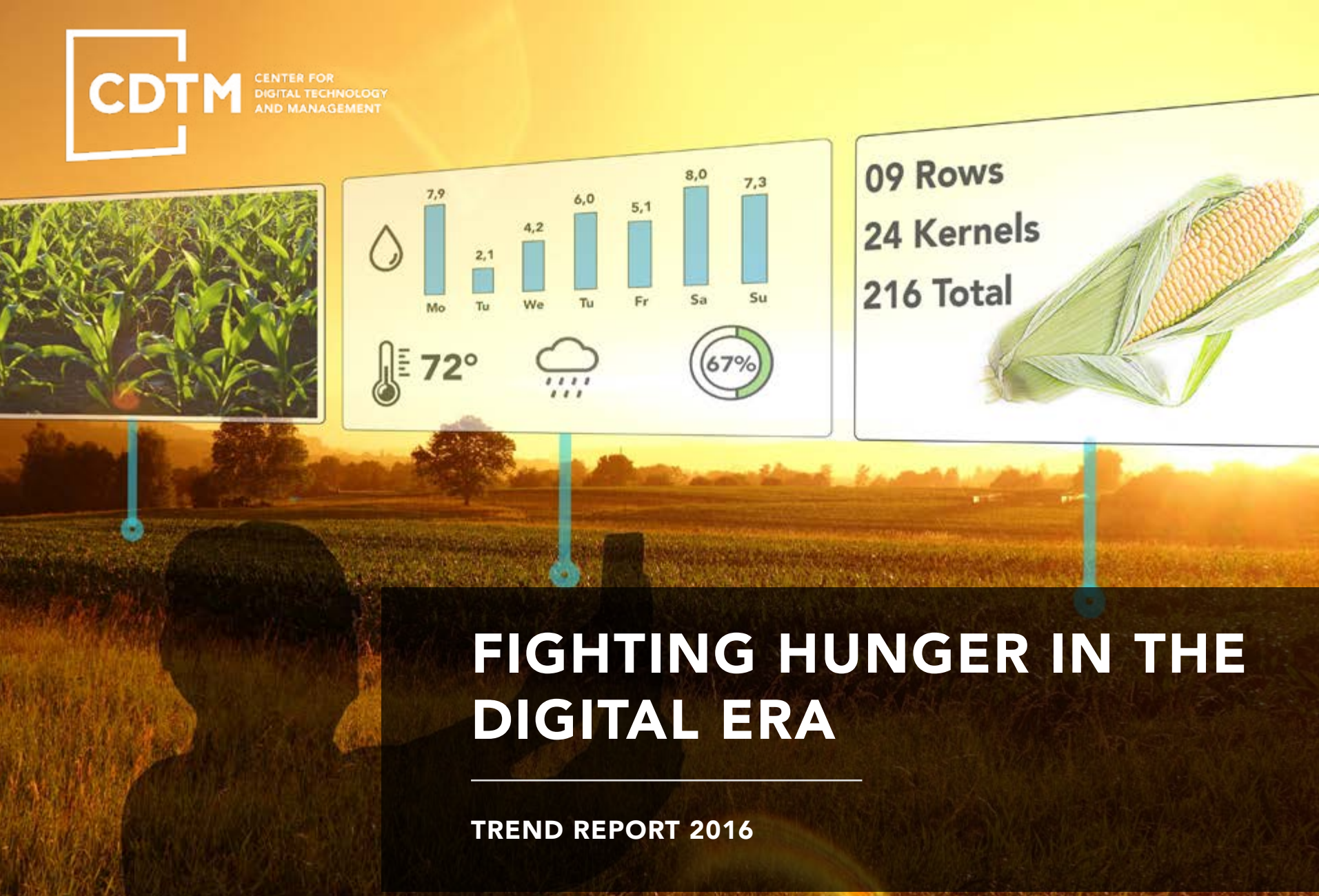

FIGHTING HUNGER IN THE DIGITAL ERA

TREND REPORT 2016

Kindly supported by the United Nations World Food Programme

To identify, nurture and scale-up bold solutions to challenges in humanitarian and development contexts, WFP's Innovation Accelerator supports internal innovations and external entrepreneurs across all WFP operations.

Based in Munich, the Accelerator provides funding for innovations and start-ups, brings in hands-on innovation expertise and links teams with experts from across the non-profit and private sectors as well as academia to develop high-impact innovations for a world without hunger.

WFP's Innovation Accelerator is a creative, collaborative and fast-paced environment that invites the private sector, civil society and WFP entrepreneurs to tackle humanitarian and development challenges together. It uses cutting-edge techniques and human-centred design to improve project sustainability and keep beneficiaries' needs in mind.

A project of the Center for Digital Technology and Management (CDTM)

The Center for Digital Technology and Management (CDTM) is a joint, interdisciplinary institution for education, research and entrepreneurship of the Ludwig-Maximilians-Universität (LMU) and the Technische Universität München (TUM).

It offers the add-on study program "Technology Management" for students from various backgrounds, which provides students with tools and knowledge at the intersection of business and digital technologies.

The entire trend report was written by CDTM students under the close guidance of research assistants in 2016.

For more information about the CDTM and its related projects, please visit http://www.cdtm.de

Fighting Hunger in the Digital Era

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Preface of the Editors

> “Everybody can learn from the past.
> Today it is important to learn from the future.”
>
> **Herman Kahn**

As Herman Kahn, one of the founding fathers of modern scenario planning, nicely states, it is tremendously important for strategy and policy makers to get a deep understanding of possible future developments in order to be prepared for them. The Center for Digital Technology and Management (CDTM) aims at developing innovators of the future. It is our mission to equip our students with the tools and knowledge they will need to become responsible leaders who actively shape their future environment, rather than only reacting to changes.

This report is the result of the Trend Seminar course, which is part of the interdisciplinary add-on study program in Technology Management at CDTM. About 25 selected students of various disciplines, such as Business Administration, Economics, Psychology, Computer Science, Electrical Engineering, and more work together on a relevant topic related to ICT. Over seven intense weeks of fulltime work, the participating students dive deeply into the topic of the Trend Seminar. Working in several interdisciplinary subteams, students apply the knowledge from their main studies and learn new perspectives from their team members. They conduct trend research, develop scenarios of the future, generate ideas for innovative products or services and detail them out to concrete business concepts.

We would like to take the chance to thank everyone who contributed and made this CDTM Trend Report possible: We want to thank the UN WFP Innovation Accelerator for initiating and jointly organizing the project. Furthermore, we want to particularly thank Hila Cohen, Mario Merino, Bernhard Kowatsch, and Alex Sloan who took a great interest in the topic and provided valuable insights and feedback

Last but not least, we would like to thank the CDTM students of the class of Spring 2016. They put great energy and enthusiasm into this project, which made it a pleasure for us to supervise the course and coach the individual teams.

Laura Bechthold and Florian Lachner
Center for Digital Technology and Management

In addition, we very much thank all of our lecturers who shared their knowledge and contributed to this project’s success:

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Preface of the Project Partner

Unleashing innovation for a world with zero hunger

15 years ago, only 1 in every 7 people had a mobile phone and few people owned a laptop. Since then, new technologies have rapidly and radically transformed our world: drones are being used to deliver blood and plasma to remote communities in Rwanda; a team of social and computer scientists at Stanford University is researching how satellite images can gather crucial data to map poverty - from space.

Yet despite our advances in the world of technology, some of the most pressing global problems such as hunger and malnutrition remain. We need to unlock the power of innovation for sustainable development and use it to accelerate our efforts to eradicate poverty and hunger in the world
At the World Food Programme (WFP), innovation is a cornerstone of our efforts to provide food assistance to over 80 million people worldwide, each year. In the past, WFP has delivered food by plane, train or truck. Today, we distribute e-cards so that people can buy what they need, when and where they need it; and for the first time in the history of the retail industry, Syrian refugees in Jordan can use an iris scan as a method of payment.

These are just some of the innovations that have transformed the way WFP serves the most vulnerable people worldwide. And we are pushing even further. To create an environment that supports and nurtures innovative thinking and the development of innovative approaches, WFP launched an Innovation Accelerator based in Munich, Germany, that uses best practices from the private sector and leading scientists.

The Accelerator supports innovations along the entire value chain: it runs internal and external challenges to brainstorm innovative ideas for Zero Hunger. It supports rapid testing and prototyping and provides thought leadership on bold, cross-disciplinary ideas.

Innovations supported to date range from a "Green Box" which enables staff in the field to measure energy consumption, to the Zero Post Harvest Losses program that sells low cost, locally produced silos and provides training to smallholder farmers in developing countries, eliminating food loss that destroys up to 40 percent of a family's harvest.

In Colombia, WFP is working on an app that trains food insecure communities on nutrition and healthy eating habits, through a number of mobile e-learning modules. CDTM has helped WFP staff kick-of this innovation.
We live in exceptional times, in which we have the opportunity to end poverty once and for all. If we work together with partners such as the CDTM and learn from their experiences, bring in new technologies and crowdsource skills and contributions, we can eradicate hunger.

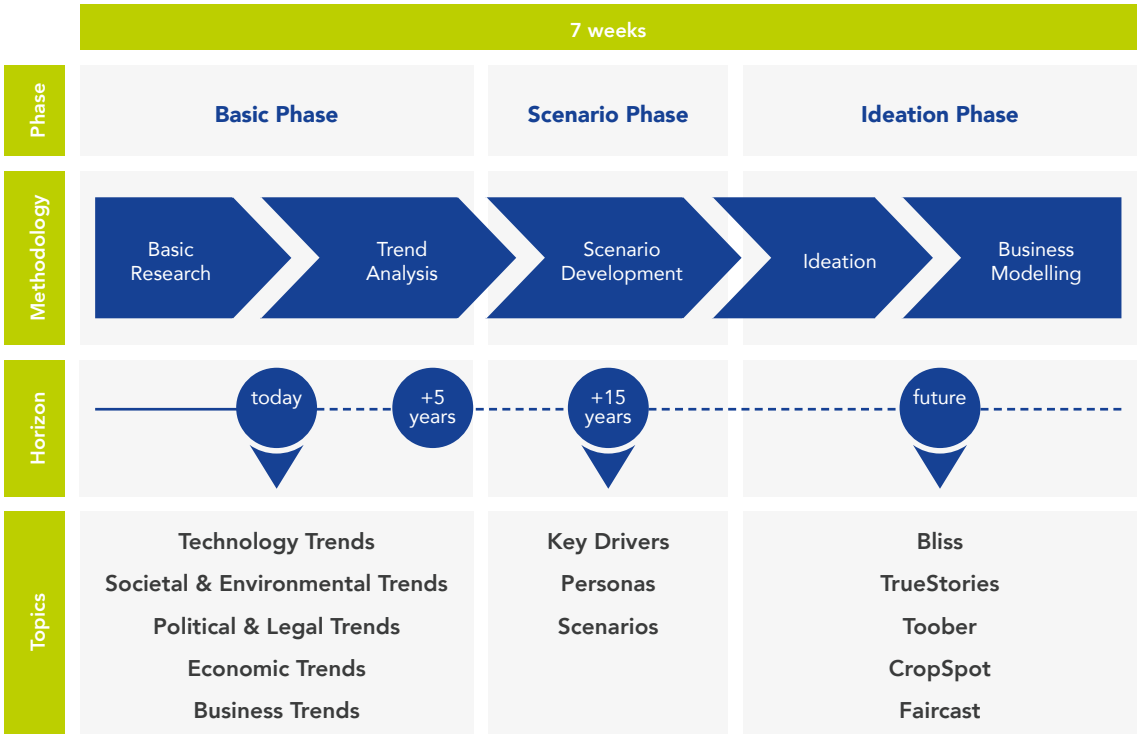
Bernhard Kowatsch

METHODOLOGY

- To analyze the status quo, recent developments, and to identify important trends
- To develop extreme scenarios of the future in order to be prepared for upcoming challenges
- To develop future-proof product and service ideas and detail them into business concepts

These goals are represented by the three phases of the trend seminar, the Basic Phase, the Scenario Phase and the Ideation Phase. 26 students, supervised by two doctoral candidates, pursue the Trend Seminar in seven weeks of intensive full-time work. In each phase, interdisciplinary subteams are formed with students from technology and business backgrounds.

The Basic Phase yields a holistic overview on recent developments and trends in the environment of the overall topic. Based on the commonly used STEP approach, the status quo and trends in the fields society and customer needs, technology, corporate education and lifelong learning, politics and law, as well as emerging business models are analyzed. Knowledge is gathered through a literature review, preceded by a series of input presentations by experts on the topic.



The class is split into five teams, each working on one of the thematic scopes. At the end of the Basic Phase, teams present their key findings to each other in order for everyone to get a holistic view on the topic to build upon in the following phases.

The Scenario Phase builds upon the analyzed trends in order to create four extreme scenarios of different possible futures that could be seen in twenty years. Driving forces behind developments are identified and specified as drivers with bipolar, extreme outcomes. Once specified, all drivers are ranked according to their respective impact on the overall topic and the perceived degree of uncertainty regarding their outcome. Two key drivers that are independent from each other and have both a high impact and a high degree of uncertainty are chosen and, with their bipolar outcomes, span a scenario matrix creating four extreme scenarios. A timeline for each of the scenarios is created and the scenarios are sketched out using persona descriptions and visualizations.

The Scenario Phase starts with a two-day workshop followed by group work in four teams. Teams are newly formed in order to include experts from each subtopic of the Basic Phase in each new Scenario Team.

In the third phase, the Ideation Phase, the goal is to develop innovative business and educational concepts, which are then tested against the previously developed scenarios. Within a two-day workshop on structured ideation following the STEP approach, a large number of business ideas are developed.

Out of these, the most promising five ideas are selected and further developed into detailed business concepts. The business model canvas by Alexander Osterwalder and Yves Pigneur serves as base structure.

At the end of the seminar, the business model concepts are presented to the project partner and guests.

TRENDS

The following chapter lists currently observable trends with a strong impact on the fight against hunger in the digital era. In accordance with the Basic Phase methodology, trends and related driving forces are structured in five areas: technology, societal and environmental, economic, political and legal, and business models.

TECHNOLOGY TRENDS

Power for Development

Bridging the Global Digital Divide

Cutting Through Complexity

Computing Power on Demand

Printing Progress - Layer by Layer

> **Technology is the real game changer in the fight against world hunger.**
>
> Josette Sheeran, Eleventh Executive Director of the United Nations World Food Programme

TECHNLOLOGY TRENDS

The only constant in life is change. Considering the present technological advances in almost all areas of human life, this change is no longer occuring at a constant pace. It happens faster and more extensively than ever before. Technological revolutions are highly disruptive to economies and societies.

The current transformation of society towards a digitized meritocracy is not the first to bring fundamental modifications to how we live, work, and interact: electric power, internal combustion engines, and other life changing innovations ultimately benefited everyone. Yet, for the workers who made them happen, the experience of industrialization was undeniably harsh. Right now, humanity navigates through a similarly transformative period, in which the breadth and scope of possible developments is equal to the aftermath of the political and economic revolutions of the late 18th and 19th century. Evidently, the digital revolution brings serious challenges along with its multitude of benefits. According to Josette Sheeran, Executive Director of the United Nations World Food Programme, technology is the real game changer in the fight against world hunger.

So which technologies can ultimately alleviate hunger? Primarily, reliable access to energy and the electrification of rural areas in developing countries. Their implications on agricultural productivity, health, education, safety, reliable water supply, and communication are fundamental. Without a sufficient energy supply, providing Internet as a platform for innovation on a large scale is very difficult. Currently, the transition from personal computers to affordable mobile devices makes the Internet more inclusive, proving access to an abundance of free knowledge and communication tools. In particular, Cloud Computing simplifies the introduction of new IT services and fosters the genesis of an entrepreneurship culture. Big Data Analysis condenses complex and comprehensive volumes of information and supports both the private sector and governments, but also local farmers to increase productivity and make deliberate decisions. Additionally, 3D Printing technologies have been introduced in developing countries, aiming for increased self-sustainability and agricultural output. Finally, synthetic food engineering and microbes help in fighting malnutrition and optimize nutrition values.

All technologies described here are true game changers. But how exactly can we utilize them to make a difference? What are the specific needs that we have to address? And ultimately, how long will it take until the efforts yield results?

We need to understand how to best leverage our promising technologies to help create a better world for the Base of the Pyramid (BoP). In the beginning of the year, a group of technology leaders and intellectuals wrote the Open Letter on the Digital Economy [35]. It states that, while "the digital revolution is the best economic news on the planet, the evidence is clear that this progress is accompanied by some thorny challenges" [35]. It is critical to identify and analyze those challenges and come up with innovative ideas on how to match the needs of the people suffering from hunger with these progressive technologies.

The following sections explain relevant technological trends in detail and point out their influence on the future of fighting hunger.

POWER FOR DEVELOPMENT

Sustainable Energy Revolutionizes Agriculture and Increases Productivity along the Entire Value Chain

Reliable energy systems have a large effect on agricultural productivity, health, education, safety, water supply, and communication (Gaye, 2007). This is why providing electricity in all regions of developing countries is critical to reduce poverty, promote economic growth, and hence eradicate extreme forms of hunger (United Nations Development Program [UNDP], 2001). Especially through new forms of energy storage and transmission, power grids can deliver affordable electricity even to rural parts of developing countries. This has implications on infrastructure, the installation of smart electricity grids, and the creation of jobs in the digital sector (UNDP, 2015). The majority of people affected by hunger depend on agriculture for their livelihoods. Hence, they benefit from long term sustainable energy solutions that make farming easier and more effective (United Nations Environment Program [UNEP], 2013). Furthermore, investing in long term renewable energy solutions can prevent problems that developed countries face right now in their dependency on fossil fuels. Amongst them are carbon emissions as well as difficulties of transitioning from fossil fuels to renewables. Finally, dependable energy grids are crucial to set up ICT infrastructure in developing countries, which in turn enable fighting hunger through digital applications.

Facts:

- Energy supplies in the majority of the developing countries are incompatible with their development needs, highly priced and unstable (UNEP, 2015).
- Approximately 1.3 billion people on our planet live entirely without electricity (UNEP, 2015).
- More than 95% of those living without electricity are located in rural areas of Sub-Saharan Africa and the developing parts of Asia (Centurelli, 2010).
- Half of the renewable energy potential is located in developing countries (Renewable Energy Policy Network for the 21st Century [REPN], 2010).

Key Drivers:

- Paradigm shift regarding the environmental effects of burning fossil fuels pave the way for low carbon impact solutions, indefinite supply and price stability (World Economic Forum [WEF] 2011) (UNEP & Bloomberg, 2015).
- Feed-in tariffs, subsidies at the research and development stage, and large volumes of venture capital as incentives for investments in renewable energy (Jha, 2009).
- Scaling potential in renewable energy at low cost facilitates the expansion of green energy structures in rural areas (UNEP & Bloomberg, 2015) (Blum, Wakeling & Schmidt, 2013).

Challenges:

- Absence of long term collective planning and coordination among relevant authorities and decision makers (WEF, 2011).
- Complex grid connection procedures, technical standards and certifications require specific know-how and limit the possibilities of including local people (WEF, 2011).
- Governments need to introduce sustainable energy policies, minimum efficiency standards, and reforming subsidies to phase out fossil fuels (Ahuja & Tatsutani, 2009).
- The lack of private sector engagement requires the installation of investor friendly structures (Lopes, 2014) (Blum, Wakeling & Schmidt, 2013).
- Patent restrictions from developed countries for renewable energy technologies can limit progress (Jha, 2009).

Impact:

The use of solar energy applications, wood- and domestic waste-produced electricity, and other sustainable energy forms can revolutionize and industrialize agriculture and increase productivity along the entire value chain (Lopes, 2014). In addition, smallholder farmers can circumvent harvest losses through access to information and maximize returns on investments (Lopes, 2014). Including renewable energy solutions in the livelihoods of people also improves the preparation of food by replacing traditional stoves. Moreover, food can be stored longer and kept clean with new refrigerating systems (International Monetary Fund [IMF], 2006) (Ighodaro, 2005). Energy systems are also critical for supplying fresh water systems, which are used for food processing. Finally, reliable energy systems are the fundament for ICT, which accounts for further progress in reducing hunger through digital applications as well as infrastructure in emergency situations.

BRIDGING THE GLOBAL DIGITAL DIVIDE

Accelerated ICT Penetration is Driving the Digital Revolution in Developing Countries.

Information and Communications Technology (ICT) has dramatically shaped the global landscape in recent decades and will certainly become even more important in the future. With increasing mobile and Internet penetration in the developing world, many countries are already leapfrogging traditional technologies, thus facilitating faster growth. Nevertheless, two thirds of the population in developing countries (i.e., over 4 billion people) still do not have access to the Internet (Sanou, 2015). This unequal distribution of ICT across nations is called the digital divide, generally defined as "the gap between the information haves and have-nots" (Yu, 2002, p. 2).

Excluding a big part of the world population from the tremendous political, social, economic, educational, and career opportunities created by the digital revolution can cause underdeveloped countries to drift even further behind the rest of the world. To avoid this, it is possible that ICT could be better implemented to foster inclusive development, allowing policymakers and international development organizations to empower the population of the developing world - potentially solving fundamental issues such as world hunger. Addressing the digital divide by not only focusing on physical Internet access, but also by gaining insights on how ICT is used in these countries, plays a critical role in bridging this gap.

Facts:

- In 2014, already 84% of the population in emerging and developing nations owned a cell phone (Poushter, Bell, & Oates, 2015).
- Smartphone penetration in developing countries is currently only at 24% (Poushter et al., 2015).
- The proportion of the world population covered by a 2G network grew from 58% in 2001 to 95% in 2015 (Sanou, 2015).
- The average mobile subscriber cost per megabyte decreased by 99% between 2005 and 2013 (Bezerra et al., 2015).
- Between 2000 and 2015, global Internet penetration grew from 6.5% to 43%. Today, 2 billion people from the developing world are using the Internet (Sanou, 2015).

Key Drivers:

- Awareness of the broadband impact on national goals among policymakers is increasing (ITU, 2015) (Albirini, 2008).
- The progressing urbanization in developing countries is a major driver for mobile and Internet adoption (Sprague et al., 2014).
- Western corporations increase efforts to bring Internet connections to the developing world (see Google's "Loon for All" or Facebook's "Internet.org").
- Cheap smartphones are getting more common, with devices such as the "Freedom 251" in India being purchasable for as low as $5 (Swain, 2016).

Challenges:

- Creating a stable, predictable, and clear regulatory environment for the telecommunications sector and sectors connected to it (GSMA, 2015).
- Difficulty to implement cross-border connections and services (African Development Bank Group, 2013) (Moyo, Rehak, & Union, 2014).
- The majority of content is still available in English and distributed in high traffic smartphone applications (GSMA, 2015).
- In many parts of the developing world, broadband connections are still unaffordable (Calandro, Gillwald, Mariama, & Stork, 2012) (ITU, 2015).
- Developing countries can become dependent on the technology industry of foreign nations and might not be able to provide decent career opportunities to local talents (Albirini, 2008).

Impact:

Increasing ICT penetration in developing countries already has a far-reaching impact on world hunger with further hidden potential. Mobile services empower regional farmers, to increase their local food production by delivering information, such as weather forecasts and market trends (Aker & Mbiti, 2010) (Sanou, 2015) (Veldanda, 2012). In addition, the rapid growth of mobile money services facilitates financial inclusion and replaces cash-based transfers to beneficiaries (Sanou, 2015). The organized analysis and distribution of information can also help in disaster response and supports the Vulnerability Analysis and Mapping (VAM) process. This ensures that the food is being distributed as quickly and as efficiently as possible (GSMA, 2015) (Simon, Daniel, Hadid, & Adini, 2015).

CUTTING THROUGH COMPLEXITY

Big Data Analysis Will Provide Valuable Insights and Supports Decision Making.

Big Data Analysis is a broad field that includes the process of extracting information from large scale data sets, which are too complex to handle in a common way. It combines various methods to gather, manage, and analyze data (Snijders, Matzat & Reips, 2012).

The general goal behind Big Data is improved decision making by providing additional and condensed information. This can then be used to better understand and judge current situations or to predict future events and then perform optimal actions (ITU, 2016).

The subfield of data mining involves the intention driven collection of new data sets using arbitrary sources of information (Hastie, Tibshirani, Friedman & Franklin, 2005) (Armstrong, Diepeveen & Maddern, 2007). Application areas are machine learning algorithms, which are able to learn underlying, generalized hypotheses about given data sets and help to extract hidden features (McBride and Nichols, 2015). To condense information and make it more intuitively understandable by humans, the results of the analysis are aggregated using data visualization techniques (Friedman, 2008). In developing countries for instance, Big Data is used to monitor the results of the data analysis using many decentralized data sources. This allows gathering insights with a high frequency and in real-time, which is not possible by using common monitoring tools, such as surveys. (UN Global Pulse, 2012).

Facts:

- In 2013, developing countries accounted for 40% of newly generated data worldwide. By 2020, the share is expected to rise up to 60% (Turner et al, 2014).
- Sources for data mining include satellite images, telecommunications and phone data, the Internet of Things (IoT) and Social Media (Schneider, 2002) (UN Global Pulse, 2015a) (UN Global Pulse, 2015b).
- Data collection is getting easier with passively generated data by smartphones or Social Media (Kitchin, 2014).
- The number of connected devices, as part of the IoT, is expected to increase up to 26 billion connected devices by 2020 (Siemens AG, 2014) (ITU, 2016).

Key Drivers:

- Governments and Non-Governmental Organizations (NGOs) are interested in improving their decision making and planning processes, fueling Big Data innovations (Yiu, 2012).
- Big Data Analysis can be part of the business of large corporations or a by-product of the data they are generating (Chen, Chiang & Storey, 2012).
- The cost of sensors, bandwidth and processing power has dropped significantly in the past ten years (The Goldman Schs Group, Inc., 2014) (Greenough, 2014).

Challenges:

- Chance of violating privacy or discrimination as a consequence of automated processing of collected or inferred data (Katal, Wazid & Goudar, 2013).
- Increasing analytical complexity of problems due to the huge number of datasets (Katal et al, 2013).
- Dependence of Big Data on the quality of the underlying data can lead to reduced reliability (Katal et al, 2013).

Impact:

Big Data can increase the efficiency and reliability of food production by supporting farmers in making decision on how to manage, and when to plant and harvest their crops (Mayer-Schönberger & Cukier, 2013). High-frequency, real-time monitoring allows governments and NGOs to understand situations and processes better and faster. This information is critical for making better decisions in emergency situations, where information, time, and resources are limited (UN Global Pulse, 2014). Among many others, Big Data Analysis leads to foresighted hunger prevention and an improved distribution of food aid (UN Global Pulse, 2015a).

COMPUTING POWER ON DEMAND

Ever More Access to Cloud Computing Resources Increases Productivity.

Cloud Computing, also known as On Demand Computing, provides usage of software and hardware that is managed by third parties at remote locations (Huth & Cebula, 2001). Users pay service charges depending on usage which enable clear estimations of IT-costs (NIST Computer Security Division [CSD], 2012). The underlying computing principle of sharing resources (in this case computing capacity) can achieve economies of scale (CSD, 2012). The different forms of clouds (public, private and hybrid) deliver tailored products to individuals, businesses, and also governments. To adjust the service to one's specific needs, the user can choose from infrastructure as a service, platform as a service, and software as a service solutions (Huth & Cebula, 2001). Advantages of Cloud Computing are reduced up-front acquisition costs, no need for own computing infrastructure, enhancing organizational flexibility, resource orientated subscriptions, third party assistance, and more information security (IBM, 2009). Those advantages foster local entrepreneurs and businesses and stimulate start-up cultures in developing countries - including the agricultural sector. In addition, a lot of applications that speed up business processes and therefore productivity, run in the cloud on servers. Especially through applications in the agricultural sector, this will lead to an increased and more stable food supply in developing countries.

Facts:

- By 2015, global Cloud Computing traffic has increased twelve-fold compared to 2010 (Cisco, 2015).
- 55% of the consumer Internet population and 2 billion people in total will use cloud services for their personal data storage by 2019 (Cisco, 2015).
- Developing countries observe a steadily increasing use of cloud services due to the spread of ICT (Lazauskas, 2013).
- Especially young and small businesses can profit from using US or European based servers to avoid the unreliable electrical grids from local energy systems (Lazauskas, 2013).
- Developing nations can leapfrog the obstacles of transforming old and rigid IT-infrastructures and save costs (Fong, 2009).

Key Drivers:

- The rising affordability of smartphones increases the adoption of cloud services for both individuals and governments (Hardy, 2012)
- High funding potential of Information and Communication Technology for Developing Countries (ICT4D), especially in service and production throughout the coming years, enabled by the involvement of the private sector (Heeks, 2009).
- Engagement of global players such as Google, Amazon, Facebook, and Microsoft implicate a rising adoption of cloud services by the BoP (Heija, 2015).

Challenges:

- Data sovereignty laws in some countries restrict data flow across borders, which hinders the server capacity usage from foreign cloud providers (Berry & Reisman 2012).
- Weak data policy standards regarding security and privacy can reduce the acceptance of cloud solutions, as users fear the abuse or loss of their personal information (Cowhey & Kleeman, 2012).
- The volume and affordability of broadband plans limits the scalability of cloud services (Cowhey & Kleeman, 2012).

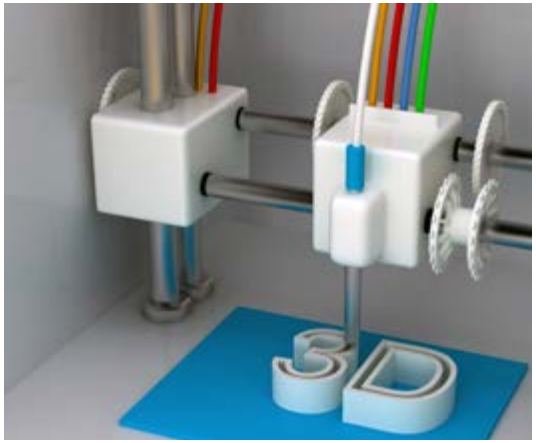
Impact:

Regarding the success of solutions in the fight against hunger, becoming sustainable in the long term is greatly increased by attention to regional, cultural, and social norms (Minasyan, 2015) (Oino, 2015). Giving local people a voice in the implementation, and collective decision-making will make solutions more likely to be adopted successfully. Regional knowledge is crucial to finding solutions to hunger (Pearce et al., 2012), as well as preserving traditions and local culture for future generations. Empowerment of local leadership additionally decreases dependence upon foreign aid, and enables local actors to tackle hunger themselves (Kent et al., 2013).

PRINTING PROGRESS - LAYER BY LAYER

3D Printing Unleashes New Opportunities to Improve Food Production and Self-Sustainability.

3D printing (3DP), an Additive Manufacturing (AM) method, describes a procedure where material is added to the product layer by layer, instead of subtracting it from a larger piece (Gibson, 2015). 3D printers are able to manufacture products in one single process and often render complicated supply chains and inventories redundant (Mellor, 2014). This has the potential to revolutionize the global economy towards de-globalized production (Campbell, 2011) (Hu, 2013). While 3DP is slower than standardized mass production, it compensates this drawback with an increased flexibility in production, a more efficient use of materials, increased possible part complexity, and significant savings resulting from reduced logistic requirements (Campbell, 2011). These advantages also fit the increasing demand of customized products, for which conventional mass production is unsuitable (Campbell, 2011) (Reeves, 2011). As a consequence, 3DP fulfills a high variety of demands with minimal means of production: one single printer (Campbell, 2011). Especially in developing countries, 3DP can help address multiple problems simultaneously without the need for high investments (Birtchnell, 2014) (King, 2014). For instance, food printing is a special branch of 3DP that enables the production of customized meals out of basic ingredients, offering new opportunities for food production and cooking (Lipton, 2015).



Facts:

- Global revenues from 3D printer sales amounted to approximately $1.3 billion in 2014 (Wohlers, 2015).
- Estimated global revenue of 3DP industry was $7.3 billion in 2016. For 2018, $12.7 billion are forecasted and $21.2 billion for 2020 (Wohlers, 2015).
- 3D printers built from waste cost as little as $100 and make printing more affordable for the BoP (Gordon, 2015).
- Food printing allows personalized nutrition, which counteracts malnutrition (Sun, 2015).
- Small scale 3DP factories "are increasingly being adopted in developing countries" (Ishengoma, 2014, p. 31).
- 3D printers using recycled plastics can produce up to "40 times more economical" (Baechler, 2013, p. 124).

Key Drivers:

- Maker spirit and maker community can bring 3DP to everybody (King, 2014) (Gebler, 2014).
- 3DP enables efficient small scale production and prototyping, making it an option for Small and Medium Enterprises (SMEs) (Gibson, 2015).
- Big companies are building local AM factories to reduce their costs by simplifying the supply chain and logistics, spreading 3DP in developing countries (Campbell, 2011).
- To make their countries self-sustainable and to accumulate production capacities, governments - also in the developing world - create laws and conditions to promote 3DP (Wohlers, 2013).
- More affordable 3D printers will increase their spreading (Berman, 2012) - especially in developing countries.

Challenges:

- Current laws are insufficient to handle intellectual property and piracy (Campbell, 2011).
- Global standards for 3D printers and designs are needed to assure compatibility and optimal cooperation (Campbell, 2011).
- 3DP could cause the loss of jobs in developing countries, because it relocates production capacity back to developed countries (Campbell, 2011) (Gebler, 2014).
- Non-ecologic or dangerous products - such as weapons - can be produced by everyone. This generates risks and will require new means of regulation and contol (Campbell, 2011), (King, 2014).

Impact:

3DP can increase the efficiency of farming through printing equipment and tools (Pearce, 2015) and enable new farming techniques such as using 3D printed greenhouses (Hoyle, 2013). Furthermore, food printing can produce optimized food in terms of nutrition (Коротка, 2014) (Lipton, 2015). Ultimately, this generates healthier food and makes optimal use of the provided ingredients, making it possible to feed more people. It further unlocks new sources of food supply by e.g. using insects, which are considered ecologically sustainable (Soares, 2011). By empowering local entrepreneurship and self-sustainability through decentralized production, 3DP increases the local wealth of communities and hence creates multiple opportunities for solving local problems, including the possibility to buy food.

OPTIMIZING NUTRITION VALUES

Specially Designed Food and Microbes Support the Fight Against Malnutrition.

Synthetic food is engineered to fit the specific demands of nutritional needs. It is a fast growing trend in the developed world with examples like the meal-replacement beverage Soylent (The New Yorker Magazine, 2014). Soylent is designed to meet the complete nutritional demands of an average adult (Rosa Labs, 2015). While it was designed to reduce preparation - and eating time, its balanced nutritional features show great potential in emerging countries. Plumpy'nut and F75 or F100 however is therapeutic food designed as an acute treatment for malnutrition. Plumpy'nut has a very high nutritional value (Guimón, 2009) and can be eaten without any supervising medical personnel. This is an advantage over conventional medical nutrition food such as F75 or F100, which has to be given by a medical professional. However, if a patient is in really poor health and they cannot swallow or chew, then they need to be treated in the hospital (The San Diego Union-Tribune, 2016). Another novel approach to enhancing both the quality and quantity of food and animal fodder is the use of microorganisms. Microbial tools help with food preservation, provide food elements and minimize the waste within the food supply chain (Nezhad, 2015).

Facts:

- 25% of all Plumpy'nut is produced in developing countries (Nutriset, 2014).
- With 3.1 million child deaths per year, poor nutrition is with 45% the single biggest contributor to child mortality per year (European Parliament Research Service, 2013).
- One serving of Soylent contains 400 kcal and 20% of the recommended daily amount of vitamins and minerals (Rosa Labs, 2015).

Key Drivers:

- Human aid organizations such as the WFP greatly profit from the improved efficacy that easier food transport and storage provide.
- Patients' unsupervised use of therapeutic food relieves overcrowded and underfunded hospitals and protects what is increasingly recognized as essential: the dignity of beneficiaries.
- Evermore capable genetic engineering technologies allow the purposeful modification of microbe traits (Nezhad, 2015).

Challenges:

- Preparing and eating food is an important cultural element which might be difficult to transform.
- The market leader product Plumpy'nut is patented, which makes fighting undernutrition expensive. However, ten African NGOs were provided with a free manufacturing license (Nutriset 2016).
- More investment and research is needed to better understand how microbial communities influence plant and animal productivity as well as biotechnological food production (Nezhad, 2015).

Impact:

The introduction of foodstuffs that are specifically designed as emergency relief allow easy, quick, and effective help against malnutrition (Guimón, 2009). Synthetic food such as Soylent has the potential to provide greatly improved nutritional quality (Rosa Labs, 2015) and hence better health, particularly compared to a partly prevailing unbalanced diet. Reduced storage costs due to lower temperature susceptibility is a further requirement in the design of these foods. Lastly, microbial technology promises innovative solutions in the bioconversion of agro-industrial wastes to useful nutrients and fertilizers (Nezhad, 2015).

SOCIETAL & ENVIRONMENTAL TRENDS

Burgeoning Environmental Crises

The Changing Face of Hunger

The Growth Explosion

Recently Displaced Populations

Education and Women's Empowerment

SOCIETAL & ENVIRONMENTAL TRENDS

The global population currently stands at over 7.3 billion people. 1.3 billion of which make their living from agriculture. While research shows a shift away from agriculture-based livelihoods, it is estimated that food production will have to increase by 70% to feed the expected additional 2.3 billion people by 2050 (FAO, 2009). Nearly 90% of these additional 2.3 billion will be concentrated in regions that already experience food instability (UN, 2014). By the year 2100, the planet will have to feed an estimated 11 billion people. Already one in nine people on earth suffer from hunger and while hunger may be decreasing overall, malnutrition is on the rise.

Food security remains closely connected to societal and environmental problems. Climate change has led to an increase in natural catastrophes and creates millions of refugees fleeing from unstable climate conditions (UNHCR, 2016). Industrial monoculture agriculture causes further land degradation, depleting soil of nutrients, and creating long term pollution of resources. The major challenge will be to achieve both ecologically and economically sustainable growth: that is, for an economic growth without corresponding environmental or social degradation (UNIDO, 2011). Transforming our sources of energy offers a major potential towards achieving the goals of economic prosperity and social inclusion. Yet, the success of these endeavors will largely depend on intra-governmental support and local leadership (UN, 2013).

Despite progress on many fronts, emerging countries face major societal challenges in the coming years. In the first instance, less economically developed countries are witnessing a stage of demographic transition: despite lower fertility rates, their populations continue to grow. Population growth poses a serious threat to global food security, especially for less developed countries that are already suffering from severe malnutrition and where existing infrastructure is likely to become overstrained. At the same time, rapid urbanization reflects a worldwide exodus from rural poverty. While urbanization rates in developing countries remain under 50% (with some Sub-Saharan countries under 25%) by 2050, it is estimated that developing countries will face urbanization at a rate of over 60% (UN, 2014). People tend to leave the countryside in search of economic opportunity, improved access to housing, education, and transportation. Nonetheless, the cost of living rises significantly in cities, often producing a correlated growth in urban poverty. Changes in global consumption resulting from economic growth and urbanization stand to have an even further, more colossal impact on global hunger and sustainable development.

The most promising solutions will be those that address these crises on a local scale, using culturally sensitive approaches supported by the input and agency from local actors. Cultural, digital, and political literacy must be a priority in the fight to eradicate poverty and hunger. Increased attention to education and women's empowerment is particularly vital to break cycles of hunger and to provide tools to build a better future. Women with education, and an improved status within their communities tend to have better-nourished children (FAO, 2015) (UNDP, 2015). If women and communities are offered the opportunity to run their own farms or enter decent employment, agricultural productivity will rise and developing economies will grow. To reach the UN Millennium Development Goals of #ZeroHunger by 2030, we should focus on initiatives that "think local, and act global".

BURGEONING ENVIRONMENTAL CRISES

The Rising Problem of Natural Resource Exploitation and Ecosystem Degradation.

Global environmental crises present a major challenge to achieving the millennium goal of Zero Hunger by 2030. Statistical weather patterns over the last 200 years reflect mankind's significant influence on average global temperature, as a consequence of carbon emissions (IPCC, 2014). Not only has the planet experienced an increase in average temperatures across the board, but also the parallel increase in extreme weather conditions, such as floods or droughts (Riebeek, 2005). Further repercussions range from glaciers' retreat to rising sea levels, and ecosystem degradation. Land degradation alone directly affects the nutrition of 1.5 billion people on a global scale; 52% of the land currently used for subsistence agriculture is moderately or severely affected by degradation (UNCCD, 2008). Natural disasters, droughts, and biofuel competition contribute to volatile food prices and create food insecurity. Feedback loops of fossil fuel pollution compound already soaring global temperatures. Climate researchers report that only slightly warmer conditions would be sufficient to induce an extensive thawing of permafrost regions across the northern hemisphere (Vaks et al., 2013). This has the potential to cause unretractable CO_2 and CO_4 emissions, driving several hundred gigatons of methane into the atmosphere, and increasing warming effects (Shakhova et al., 2008).

Facts:

- Without intensified efforts to mitigate emissions, average global temperature will increase by a range of 3.7°C to 4.8°C by 2100 (IPCC, 2014).
- With significant mitigation it may be possible to limit global temperature increase to 1.5°C (IPCC, 2014).
- As a result of the melting of polar ice caps, the predictions of rising sea levels range from 0.15 to 0.7 meters (Riebeek, 2005).
- Climate related disasters and degradation may increase hunger and child malnutrition by up to 20% until 2050 (McColl, 2015).
- Agriculture accounts for 14% of global CO_2 emissions (World Research Institute, 2000).

Key Drivers:

- Population growth accelerates climate change (depending on the fossil fuel dependence, and CO_2-emissions of energy sources).
- Current human activity contributes to land degradation, including unsustainable agricultural land use and poor soil and water management practices (UNEP, 2016).
- Land degradation is driven by market incentives, such as deforestation, frequent use of heavy machinery, overgrazing and monoculture crop use (UNEP, 2016).
- Genetically Modified Organism (GMO) technology has reduced pesticide spraying by 503 million kg and its associated environmental footprint by 19%, significantly reducing the release of greenhouse gas emissions (Brooks & Barfoot, 2015).

Challenges:

- Facing market incentives for misuse / appropriation of traditional agricultural land.
- Degradation of ecosystems by industrial and monoculture crop growth.
- Numerous positive feedback loops might cause an even higher increase in temperature: thawing of permafrost in Siberia would release large amounts of greenhouse gases (Vaks, 2013) (Shakhova, 2008).
- Halting global warming will require zero annual CO_2 emissions later this century (Rogelj, 2015).

Impact:

Climate change impacts the state of global food supply and agricultural production. If current patterns continue, warming feedback loops will quickly increase the impact upon human life. Melting glaciers raise global sea levels, affect ocean salinity, and ocean currents, which in turn affect the global climate. These changes have the potential to turn huge populations into environmental refugees. GMOs, and local, organic farming techniques could reduce certain pesticide-related greenhouse gas emissions. Yet, technologies such as GMOs face a lingering uncertainty about the long term impact upon ecosystems, biodiversity and human health. There is no easy solution: at best, we will have to enact significant shifts in production and consumption to save our planet and its human population.

THE CHANGING FACE OF HUNGER

Hunger Is Decreasing and Is Being Replaced by Malnutrition.

More than a billion human beings emerged from extreme poverty since 1990 (defined by living on less than 1.25 USD per day). Additionally, two billion more have seen their living conditions improve substantially (UNDP, 2015). From 1990 to 2000, the per capita income in low-income countries increased at a higher rate than seen in high-income countries (WTO, 2014). Overall, people tend to live longer and healthier lives and enjoy more freedom than previously. Many families have diversified their income-generating activities, further opening new opportunities for growth in emerging markets (GFN, 2014). Moreover, emerging countries have improved their technological and administrative infrastructure (Rasper, 2015). There are progressive shifts towards a more labor-ethical production (FairTrade, n.b.).

With these developments the number of hungry people in the world has fallen sharply. However, 805 million, or one out of nine global citizens, still do not receive proper nutrition and suffer from malnutrition. Despite significant progress overall, several regions and subregions, especially in Sub-Saharan Africa (SSA) and South Asia, continue to lag behind in food security. Malnutrition, also understood as "hidden hunger", has developed into a broader issue than undernourishment alone and takes many forms, i.e. stunting, wasting, and obesity (The World Bank, 2011a).

Facts:

- 63 countries have reached the Zero Hunger Millennium Development Goal target (Hunger And Malnutrition, 2012).
- Over 25% of SSA remains chronically undernourished (Hunger And Malnutrition, 2012).
- 2 billion people experience micronutrient malnutrition while 1.9 billion adults are overweight or obese (WHO, 2015).
- 161 million children under the age of 5 are too short for their age, 51 million do not weigh enough for their height (UNICEF, WHO & The World Bank, 2015).
- Nearly 80% of the people with diabetes now live in developing countries (IDF, 2010).
- 794 million people are estimated to be calorie deficient (FAO, 2015).
- With an increased income, new diets with high fat, sugar and animal source foods are introduced, which require more energy to produce (FAO, 2012).

Key Drivers:

- Formal education and access to relevant knowledge about the importance of nutrition and balanced diet, especially for women (Smith, 2015).
- Safe access to water and sanitation (Smith, 2015).
- Droughts, rainfalls and other natural catastrophes which endanger crops.
- Short sighted and "surviving only" mindset: physiological and safety needs are the most important needs according to Maslow's hierarchy of needs.
- Major role of unemployment rate for income distribution.
- Access to health care is decisive for human development and eradicating malnutrition (Klugman, 2010).

Challenges:

- The poorest in developing economies barely profit from economic growth (Rasper, 2015).
- Lack of awareness for equal rights and fair resource distribution.
- Limited Internet and electricity access as well as language barriers in reaching the masses with correct information about nutrition (FAO, 2012).
- Significant inequalities persist in access to water, sanitation, and parental education depending on area of residence (Cleaver, Okidegbe, & De Nys, 2006).
- Estimated $3.5 to 4.5$ trillion needed annually to implement the Sustainable Development Goals stipulated by the UN (UNTT, 2013).
- Epidemics like Ebola and Malaria endanger harvests, boost food prices and create major food crises (FAO, 2012).

Impact:

Human development has led to a reduction of hunger on a global scale. Agricultural productivity has generally improved, although further improvements are possible. This is largely dependent on local leadership, but also global governance. There are many challenges in regions like SSA and South-East Asia, where natural catastrophes due to climate change are becoming more frequent. While obesity creates an unhealthy workforce, malnutrition creates a reinforcing cycle of hunger and poverty, both of which have a significantly negative impact on the economic productivity rates. With additional support in the form of microfinance and digital solutions, smallholder farmers could achieve increased productivity and greater access to local markets.

THE GROWTH EXPLOSION

Populations are Growing, Resulting in Urbanization and Increasing Consumption.

Within the last two centuries, the global population exploded from one billion people to 7.3 billion. By 2100, that number is expected to increase to 11 billion human beings that live on our planet's increasingly scarce resources (UNDESA, 2015). Population growth has also been particularly concentrated in areas of the developing world (UNDES, 2015). Urbanization is a further demographic shift taking place on a global scale. The majority of the world's population already lives in urban areas. By 2050 that share is projected to grow to 70% (UNDESA, 2012). Urbanization also happens to be increasingly concentrated in Africa and Asia, regions which already face food scarcity (UNDESA, 2014). This also indicates a shift away from traditional ways of life, further impacting global sustainability and food security (Wurwang, 2013). With increased purchasing power of the globally growing middle class, we also stand to witness increased demand and consumption (Euromonitor Research, 2013) (Westcott & Trostle, 2013). Given global food demand already being on the rise, the pace of the rising agricultural productivity does not seem to be able to keep up with the population growth (Global Harvest Initiative, 2014). This implies further challenges to sustainability and our limited global resources (GRID-Arendal, 2014).

Facts:

- Global population growth is decelerating (Mcdevitt & Christenson, 2004). Yet even with a slower growth rate, the demand of global food supply will be increased.
- Middle-Income Countries' demand is now leading the world economy (The World Bank, 2011a) with developing countries' growth rate twice as high as the rest of the world (The World Bank, 2011b).
- Rapid urbanization and the emerging middle class has led to a diversification of food consumption, which in turn is less sustainable (Okonjo-Iweala 2010) (Westcott & Trostle, 2013).
- Human development has seen 200 million people rise from slums since 2010, but the worldwide population of slums is still rising (UN, 2010).
- Despite improvements, 73% of all people in poverty worldwide are living in middle income countries (The World Bank, 2011a).

Key Drivers:

- Global decrease in fertility rates, while average lifespan continues to increase, alongside improved access to health, education, and contraceptive methods (Rosling, 2014).
- Developing countries experiencing rapid and accelerating growth in per capita income for the middle class, while the poorest billion's income is stagnating or declining (Collier, 2007).
- Urbanization is caused by pull-factors like economic opportunities in the city, but also by push-factors like food instability in rural areas.

Challenges:

- The widening gap between the world's poorest and the new global middle class, effectively creating "two different worlds" (Collier, 2007) (Euromonitor Research, 2013).
- Growth of urban poverty: urban slums, fierce competition and reduced access to drinking water.
- Food shortages and rise of food prices, due to demand outpacing supply by far (causing dependence on aid and imports) (Euromonitor Research, 2013).
- Building capacity for least developed regions through self-sustaining market-based systems (Prahalad, 2010); areas where despite growing income, child malnutrition often remains high at 50% (OPHDI, 2006).

Impact:

Overall, human growth offers potential, while at the same time placing an ever greater strain upon available resources. Per capita income growth generates opportunities for local economic development (UNDP, 2008), but a widening gap between supply and demand is a major concern, leading to more food insecurity (Euromonitor Research, 2013) (Goedde et al., 2015). Solutions must be implemented from above and below - as in the case of urban farming initiatives (Worldwatch Institute, 2013) (Calkins, 2013) (Moyoyo, 2015).

RECENTLY DISPLACED POPULATIONS

Rising Levels of Migration Lead to Hunger.

The reasons for migration may vary and are often interconnected. They relate to suffering brought about by changing climate, an increase in natural disasters, droughts, continuing poverty, and human conflicts. From 1990 to 2013, migration on the global stage rose by 77 million (UNDESA, 2013). Internal and external conflicts in both the Middle East and Latin America play a rising role in driving hunger and migration. Migration streams caused by conflicts tend to be larger and more sudden. Migrants driven by conflict are also arguably less prepared for daily lives at their destinations (Williams & Pradhan, 2009). Yet, we also see an increase of 70% in the number of highly educated, tertiary immigrants in the last decade (OECD & UNDESA, 2013). The shift in the demographics of new immigrants can be seen in the Syria crisis. A highly educated population with access to technology may arrive within a region with a differential degree of mobility and capacity to integrate them than previously.

Facts:

- Persecution, conflict, and poverty have forced an unprecedented one million people to flee to Europe in 2015 (Redmon & Greece, 2015) (IOM, WFP & LSE, 2015).
- Globally, one in every 122 humans is now either a refugee, internally displaced, or seeking asylum. (Redmon & Greece, 2015).
- In 2013, 232 million international migrants traveled to seek new opportunities (UNDESA 2013).
- For 137 of 145 countries of origin, the emigration rate of highly-skilled labor exceeds the total (average) emigration rate (OECD & UNDESA 2013).
- Food insecurity of immigrating populations is more than seven times that of the general population (Quandt et al., 2004).

Key Drivers:

- Internal and external armed conflicts (as in the Middle East and Syria) which lead to unstable and weak infrastructure, unable to support the basic needs of the community including safety.
- Less support towards the communities during natural disasters from local governments and NGOs.
- Food security agendas with less focus on the growing challenge of feeding rapidly growing cities with large migrant populations (Crush, 2013).
- Informal economies a major driver of urbanization and internal migration (Yuki, 2007).

Challenges:

- Legal restrictions on employment for migrant communities, upon arrival.
- Ensuring migrants' access to their human rights and their legitimate entitlements.
- Ensuring migrants not being discriminated and not finding themselves in socially excluded situations due to language barriers and other cultural differences.
- Perception of refugees and migrants as a threat to the national economy.

Impact:

Rapid migration growth due to conflicts introduces challenges, both to host communities as well as to the migrants themselves. Particularly within underdeveloped regions, migration can impose challenges on already limited resources and infrastructure. This has the potential to create more conflicts and cause further cyclic migration (UNDP Armenia, 2009). With more effort towards integration, migrant and refugee communities have the potential to make definite contributions to host countries, as well as their communities of origin (Redmon & Greece, 2015). Recent Sub-Saharan and Asian migrants in Europe, for instance, have made significant gains in income and employment. Economic stability and connectivity brought about by migration, may also have a positive impact on the country of origin to reduce poverty and hunger (OECD, 2014).

EDUCATION & WOMEN'S EMPOWERMENT

The Rising Status of Women and Childhood Education: Keys to Food Security.

Wherever people starve, learning is impaired. Conversely, where people are more educated, they are less hungry (Muro & Burchi, 2007). Education also plays a huge role in promoting gender equality and women's empowerment, which has a positive impact on fighting hunger (Asian Development Bank & FAO, 2013). The Gender Gap remains higher in developing countries than in developed countries (World Economic Forum, 2015). Women have a weaker bargaining position within the family, while being expected to care for children, the elderly, and the household. This reduces the time available for educational, and economic activities (Asian Development Bank & FAO, 2013). Reducing this gap, promoting education, and fighting hunger are all included under the UN Sustainable Development Goals (UN, 2015). School Feeding Programs (SFP) in particular fight hunger by feeding children with on-site meals and take-home rations, while additionally reducing poverty by promoting local food production and teaching important skills to future generations (Espejo, Burbano, & Galliano, 2009). In SFP, girls have the same access to education as boys and are treated as equal.

Moreover, digital literacy plays a major role in the fight against hunger, and towards women's empowerment. Internet provide a platform for literate women to voice their concerns and access important information. Yet, providing the technology is not enough: people often lack the skills to properly use digital devices to access relevant knowledge. This is why education efforts must also place a focus on digital literacy.

Facts:

- More than 800 million people suffer from food insecurity and lack of education (Muro & Burchi, 2007).
- 60% of the people in undernourished populations are women or girls (World Food Programme, 2009).
- Women represent 43% of the agricultural labor force (FAO, 2013) and 59% of child laborers work in agriculture (ILO, 2013).
- In Sub-Saharan Africa (SSA), 37% of the adult population still lacks basic literacy skills (GSMA, 2014).
- Women face wage discrimination in rural labor markets and are more likely to work part-time or to take seasonal jobs while being paid less (FAO, 2013).

Key Drivers:

- Involvement of women in political and public leadership, which will lead to policy initiatives in favor of women's rights and education (VITAL VOICES, 2016).
- Economic empowerment, i.e. equal access to land, employment and markets (contract farming, group farming, fishing, and aquaculture) (Asian Development Bank & FAO, 2013).
- Equal access to digital technologies and the Internet with greater smartphone penetration and digital literacy.
- Regulations in favor of contraceptive use and abortion carried out by women organizations (ICRW, 2015).
- Incentives, subsidized by the government and organized by NGOs, to send children to school like School Feeding Programs (SFP).
- Products (e.g. pot-in-pot refrigerator or hippo roller) which make food provision more efficient, so time can be used to go to school.

Challenges:

- Social customs and norms may be at odds with legal reforms (Asian Development Bank & FAO, 2013).
- Distribution of unpaid work like childcare, care of the elderly and the household (Asian Development Bank & FAO, 2013).
- In 60% of the developing countries, the lack of labor force is not a problem, but a lack of jobs (ILO, 2013b).
- Women have lower language and digital literacy rates than men - and less access to smartphones (UNESCO, 2014).
- Adequate teacher training, in particular to spread relevant knowledge, and digital literacy.
- High operational costs for implementing Home Grown School Feeding (HGSF) and local food production.

Impact:

Empowerment of women has a major potential to contribute to an overall reduction of hunger in the developing world (Asian Development Bank & FAO, 2013). In places where women are enabled to run their own farms, and can seek rural employment, total crop and agricultural output rises. Likewise, poverty rates decrease thanks to higher rates of productivity, a broader labor supply, and increased entrepreneurial ventures (ICRW, 2015). Furthermore, education positively alters the survival rate of children under five, as a result of better nutrition and health care knowledge (FAO, 2015) (UNDP, 2015). The education of children in schools creates a synergy effect, as less of women's time and labor is required for care work. Education has the power to address overall societal awareness of health issues, and to move towards bridging the digital divide.

THINK LOCAL, ACT GLOBAL

Culturally Adaptive Solutions Allow for Economic Growth.

The globalization paradox states that the more globalized the world, the more important becomes recognition of local cultures and societies. Nowadays, development aid focuses increasingly on demand within developing countries, and tends to be conducted by regional organizations (Kent, Armstrong & Obrecht, 2013).

The cultures of developing countries are very diverse, however, their collectivist structure continues to separate them from post-industrial and developed countries (Hofstede, 2001). Collectivism has been shown to be a complicating factor in traditional economic growth (Gorodnichenko & Roland, 2010) wherein, inversely, economic growth encourages cultures to become individualistic (Hofstede, 1997). Technology may allow developing countries to "leapfrog" or advance more quickly through the steps of economic development, whereas culture may be slower to adapt. Economist Ernst Schumacher has put forward the term "appropriate technology" for technological solutions that are (1) people-centered, (2) affordable, (3) easy to maintain, (4) small-scale, and (5) based around local and renewable resources (Akubue, 2000). Some examples of appropriate technology include solar-powered light bulbs, water collection devices, and pot-in-pot refrigerators (listverse, 2010). ICT has a similar potential for culturally appropriate implementations, if executed with adequate forethought, and local research. One such path forward has emerged from the Enabling Innovation Database project (Pearce et al. 2012), which connects local communities with engineering and technology students worldwide, in an effort to produce precisely these kinds of necessary, local solutions.

Facts:

- In Africa, approximately 75% of development projects fail, in a substantial part due to the lack of consideration for local cultures, customs, and beliefs (Reeser, 2015).
- Expected impact of development aid is impaired by 50% due to unaccounted for cultural differences (Minasyan, 2015).
- 42% of people in developing countries perceive access to ICT as having a negative influence on morality (PEW Research Center, 2015).

Key Drivers:

- A new generation of aid, which aims at strengthening local leadership (e.g. Bill & Melinda Gates Foundation's "Partnership for Child and Family Health") (Walker, 2015).
- NGOs, including the World Food Programme, have increased attempts to cooperate with local NGOs and to implement solutions using bottom-up approaches (Karamchandani, Kubzansky, & Frandano, 2009).
- International firms perceive base of the pyramid populations as potential customers, rather than passive beneficiaries, leading to greater efforts to comprehend their desires and needs (Karamchandani et al., 2009).
- Rise of sovereignty and autonomy in developing countries, enabling agency over intervention and aid (Kent et al., 2013)

Challenges:

- Intense competition between local and global NGOs targeting the same donors and fundraising markets (Aldashev & Verdier, 2008).
- Lack of proper communication channels for effective feedback, in part as a result of language barriers.
- Differing expert opinions on preferred types of aid across diverse locations, and cultures.
- NGOs reaching beneficiaries via ICT (NetHope, 2016), when in many areas populations are resistant or distrustful towards these technologies.

Impact:

The chance of solutions in the fight against hunger, becoming sustainable in the long term is greatly increased by attention to regional, cultural, and social norms (Minasyan, 2015) (Oino, 2015). Giving local people a voice in the implementation, and collective decision-making will make solutions more likely to be adopted successfully. Regional knowledge is crucial to finding solutions to hunger (Pearce et al., 2012), as well as preserving traditions and local culture for future generations. Empowerment of local leadership additionally decreases dependence upon foreign aid, and enables local actors to tackle hunger themselves (Kent et al., 2013).

POLITICAL & LEGAL TRENDS

International Engagement: Africa and Middle East

Financial Rethinking

Towards Agricultural Trade Openness

Agricultural Policy Supports Industrial Farming

Biofuels Take New Direction

Increasing Fight Against Corruption

Social Safety Net Programs

POLITICAL & LEGAL TRENDS

Political and legal actions play an important role in the fight against hunger. Policymakers try to tackle the problem of hunger on both national and international levels.

Policy is the result of and the enabler for many social, environmental and economic trends relating to hunger. Policy can have both positive and negative impacts on hunger, as will be examined throughout this trend report. The trends follow a structure, flowing from macro to micro perspective, taking into account international and national policies From a geopolitical perspective, internal instability and international interventions contribute to a continuous destabilization of countries in the Middle East and Africa. In particular, armed conflicts disrupt political, social, and economic systems, which are vital for a functioning state. Resulting bottlenecks in the food supply, migration and the breakdown of infrastructure negatively affect food security. Furthermore, regulations of banking systems are a precondition for reaching the full potential of a country's economy. The banking sector in developing countries is still underdeveloped, however, the adoption of ICT and mobile phones drives the implementation of digital payment solutions and thus, the financial inclusion of the poor into the economic system. With a more stable management of finances, and the ability to invest the future, food security is increased and local economies are strengthened.

Increasing openness in agricultural trade also has an impact on hunger. For major food exporters, trade openness can be a driver for growth and therefore alleviate hunger. However, the liberalization of trade can also lead to dependency of importing nations on large exporters of agricultural products, making them vulnerable to fluctuations.

Nationally and internationally integrated agriculture policies are trending towards large scale, industrial monoculture cultivation. The consolidation of farmlands with high industrial inputs, pushes small farmers out of business and impoverishes them. Furthermore, the increase of monocultures reduces diversification in croplands and makes the food supply more vulnerable to disruptions.

Another agricultural trend is the political endorsement of biofuel. The biofuel policies are mainly driven by the desire to protect against volatile oil prices and to bolster national clean energy policies. Policies that support biofuel ultimately reduce the amount of food in the available food supply and raise the price of food, thus increasing hunger.

On a ground-level perspective, anti-corruption initiatives play an important role in the fight against hunger. Corruption inhibits the economic development of countries by making the systems inefficient and by diverting the allocation of resources away from those in need. Since corruption often arises from political deficiencies, it needs to be addressed on a political level. Emerging ICT technologies open up new possibilities to combat corruption, which enable more aid to reach the intended recipients.

Finally, on a household level of hunger policy, social safety net programs are increasingly implemented in developing countries to support the poor and raise food security. In particular, governments in Sub-Saharan Africa are striving to improve the reach and efficiency of such programs. The rising spending power of low income households increases the affordability of food and overall food security.

INTERNATIONAL ENGAGEMENT: AFRICA AND MIDDLE EAST

Global Players Pursue Anti-Terror and Resource-Securing Interests, Causing Instability and Hunger.

Many countries in the Middle East and North Africa (MENA) as well as in Sub-Saharan Africa (SSA) are rich in natural resources like oil, copper, iron, and rare earths (Coles, 2015). These resources play a key role in today's industries and economies. Thus, the great economic powers seek to secure their access to these resources to remain globally competitive (Ilunga, 2015).

Despite this strategic advantage, many MENA and SSA states are politically unstable (Messner et al., 2015) and economically underdeveloped. As a result, these regions are susceptible to terrorism (Campos & Gassebner, 2009). This can be seen from the recent emergence of ISIS and Boko Haram. Their terrorism activities often trigger international military interventions, which further destabilize these regions, their respective food supplies, and food security. This completes the downward spiral of destabilization, terror, and international intervention. But also terrorism in their own countries drives the vicious cycle of instability and power vacuums, clash between cultures, and terrorism.

Both political and economic, as well as military interventions, can critically disrupt the balance and stability in the targeted countries. Whereas military engagement mostly increases hunger (WFP, 2016; Messer, Cohen, & D'Costa,1998), peaceful exertion of influence can also promote economic growth, stability and thus reduce hunger.

Facts:

- Armed conflicts cause hunger (WFP, 2016; Messer et al., 1998).
- Non-state conflicts in the Middle East have almost tripled since 2012 (Sundberg, Eck, & Kreutz, 2012).
- The international involvement in intra-state conflicts is on the rise (Pettersson & Wallensteen, 2015).
- The external military support increases the duration and number of fatalities in conflicts (Pettersson & Wallensteen, 2015).

Key Drivers:

- The USA fight terrorism in its originating countries (Taylor, 2005), which are mainly located in MENA.
- Russia has been seen to increase its military involvement in conflicts within former USSR territory (Oliker, Chivvis, Crane, Tkacheva, & Boston, 2015).
- Existing poverty, failed political institutions, and economic dependence on natural resources in Africa facilitate civil wars (Elbadaw & Sambanis, 2000).
- Economic superpowers influence Africa politically and economically to secure precious resources (Ilunga, 2015).

Challenges:

- The biggest challenge is to find interventionist means that are matched with the targeted country's political, social, and economic circumstances (Bueno de Mesquita & Downs, 2010; Easterly, Nunn, Satyanath, & Berger, 2009).
- Sociopolitical conflicts are inherently complex and it is difficult to pinpoint specific drivers for each output.

Impact:

The magnitude of political and economic tools used to influence MENA and SSA states usually outweigh the intrinsic energy of reforms in the targeted countries. This imbalance often induces aggressive measures and economic inducements. External manipulation can result in unintended disruption.

Military interventions generate political instability in the long-term (Bueno de Mesquita & Downs, 2010) and do not improve the targeted country's situation (Easterly et al., 2009). This results in a decrease of agricultural output (Kimenyi et al., 2014) and consequently causes hunger (Messer et al., 1998). For example, the conflict in Syria has caused almost 400,000 people to starve (Strickland, 2016).

FINANCIAL RETHINKING

Political Initiatives Unleash Africa's Banking Systems and Form Economic & Monetary Policy

Africa's economies have failed to generate considerable growth over the last decades. This is partially due to the underdeveloped financial system (World Bank, 2014a). With these underdeveloped systems, it is hard to achieve economic stability and harness Africa's huge economic potential (European Investment Bank, 2013). Since stable and sufficiently large markets positively affect food supply and trade, improvement also reduces hunger (Soubbotina, 2004).

Consequently, governments are actively supporting the development of a strong, inclusive, and penetrating banking system. For instance, they promote the formation of panafrican banking groups (Verster, Gounden, & Nkhumeleni, 2012; European Investment Bank, 2013), monetary unions (Monga & Yifu Lin, 2015; Economist, 2013) and reduce entry and exit barriers for new players (European Investment Bank, 2013).

Facts:

- In the majority of African countries, establishing a business is subject to the same rules for international banks and local banks (Verster et al., 2012).
- African governments reduce barriers for banks to enter the retail banking sector (Verster et al., 2012).
- African banks spread throughout the continent and establish local subsidiaries (European Investment Bank, 2013; Verster et al., 2012).

Key Drivers:

- Economies are seeking inward investments (Verster et al., 2012).
- Policymakers are committed to creating platforms for growth (Verster et al., 2012) and are convinced that monetary unions are a way to achieve that (Economist, 2013).
- Several interest unions aim to build up cross-border payment systems (KPMG, 2012).

Challenges:

- The priorities promoting financial sector development, innovation, and inclusion have to be balanced. (European Investment Bank, 2013 p.24-25)
- Risks, which would disrupt the financial sector's stability have to be limited.
- It is necessary to protect potentially poorly informed customers.
- It is important to remain open for financial innovation and to allow experimentation.
- Expand cooperation and information exchanges (European Investment Bank, 2013, p. 23) to successfully supervise multinational banks.
- Financial reforms have to be complemented through "bold institutional and economic coordination decisions" (Monga & Yifu Lin, 2015, p. 131).

Impact:

This topic has an impact on hunger mainly through the channel of the economy. Policies allowing the banking systems to open up will support an economy that can live up to its full potential and ultimately provide stability (European Investment Bank, 2013). Stability and economic growth provide the necessary conditions for alleviating hunger by reducing uncertainty and risk in planning and in systems (Soubbotina, 2004).

TOWARDS AGRICULTURAL TRADE OPENNESS

Governments Strive to Reduce International Trade Barriers.

Agricultural trade is a major factor in satisfying global food demand and increasing food access. For regulatory purposes, a country may adopt multiple trade measures such as import or export bans, tariffs, and signing bilateral or multilateral trade treaties.

In the short-term, trade policies affect domestic availability and the prices of goods, which result in implications on food access (FAO, IFAD, & WFP, 2015). In the long-term, they have effects on market structure, productivity, sustainability of resource usage, nutrition, and various population groups in different ways, which ultimately affect food security (FAO et al., 2015).

In the context of wider economic reforms, policies have generally taken place to increase openness to international trade (Demeke et al., 2014; FAO, 2013). This trend is expected to continue in the next 5 to 10 years (FAO et al., 2015; Demeke et al., 2014; FAO, 2013).

As the FAO phrased it in its report on food security, "Trade, in itself, is neither a threat nor a universal cure when it comes to food security, but it can pose challenges and even risks that need to be considered in policy decision-making" (FAO et al., 2015, p. 35).

Facts:

- Agricultural-related subsidies and export tariffs from both the industrialized and developing countries have been cut back (Maggio et al., 2015).
- Export bans on staple food were widely utilized during the 2007/08 global food crises. Over the subsequent periods, the proportion of countries applying such measures declined sharply (Demeke et al., 2014).
- Interest in public food reserves was renewed in Africa and Asia as a price stabilization tool (Demeke et al., 2014).

Key Drivers:

- Countries use policy measures to stabilize domestic food prices (FAO et al., 2015; Demeke et al., 2014; FAO, 2013).
- Nations attempt to enhance national food security (FAO et al., 2015; Demeke et al., 2014; FAO, 2013).
- Raised awareness regarding product differentiation and concerns for safety issues in western society call for more standardization (FAO, 2013).

Challenges:

- Huge subsidies persist in richer countries. Farmers in countries with lower or no subsidies struggle to compete with subsidised production (WTO, 2015).
- During international trade negotiations, regulations are often used to bypass agreements on opening markets (WTO, 2015).
- During rule-making processes in the WTO, sometimes it is hard to balance trade liberalization with other goals concerning food security, rural development and environmental protection (WTO, 2015).
- Net food importers, relying primarily on global markets, are vulnerable to price shocks and changes in trade policies (FAO et al., 2015).

Impact:

Policies to increase openness in international trade show mixed results for food security and hunger. For major agricultural exporters, the development of high-value food export sectors is an important strategy to foster growth and alleviate poverty (WTO, 2014).

According to a study done by the FAO (FAO et al., 2015), case studies on China, Peru, Chile, and Nigeria show positive outcomes on food security with economic reform and elimination of policy distortion. In contrast, trade openness could also increase countries' reliance on imported food and curtail domestic production, thus, affecting food security. Case studies (FAO et al., 2015) in Guatemala, Kenya, Senegal and Tanzania show mixed or mostly negative results.

AGRICULTURAL POLICY SUPPORTS INDUSTRIAL FARMING

The Rise of Genetically Modified (GM) Crops and Monocultures.

The national agricultural policy of the world's largest staple food producing countries has a significant effect on the world market in terms of availability, distribution, and variety of food as well as on the prevalent methods of farming. This subsequently affects policies, markets, and ultimately hunger.

In developing countries, governments often promote large scale industrial farming to quickly increase food supply (James, 2014). On a broad scale there is a trend towards large, industrial, mechanized, monoculture agriculture especially with the rise of the global-scale food market (Altieri, 2016). A related force in the growth of industrial agriculture is policies favoring the cultivation of GM crops. Significant to note is that the share of acreage of GM crops in developing countries has overtaken that of industrialized countries (James, 2014).

Facts:

- In 2014, there were 18 million farmers who planted new GM crops, spanning 28 countries, 94% of those farmers were small-scale, poor farmers from developing countries (James, 2014).
- Agriculture policies pushed by the World Bank starting in the 60s and 70s have led to the overtaking of industrial, high input agriculture in developing countries (Kwa, 2001).
- New policy changes in large producing countries, such as India, have shifted to pro-genetically modified crop cultivation, after a period of previous low acceptance (Das & Bhardwaj, 2015).

Key Drivers:

- Policies supporting integration of farming into the global economy, reward economies of scale over diversity of crops and cultivation methods (Altieri, 2016).
- Almost 50% of the agricultural industry is controlled by just three companies: Monsanto, Syngenta, and Dupont, which warrants economies of scale through industrial farming (Howard, 2009).
- The oligopoly power of these companies has not been hindered by regulations, thus, allowing them to raise seed prices, control inputs, and further push large-scale, GM farming (Howard, 2009).

Challenges:

- The agricultural output needs to be increased on a long-term scale and in a sustainable manner (Altieri, 2016).
- Global seed companies with significant market power will need to be properly regulated (Howard, 2009).
- Scientific and social consensus as well as acceptance need to exist for policies to be passed (Saeed, Abubakar, & Kanwa, 2015).
- Indigenous knowledge and local agricultural resource management practices are often disregarded (Abraham, 2014).

Impact:

Policies supporting GM crops and monoculture farming impact hunger through the effects of yield, access, and stability. In some cases, GM crops have been shown to reduce crop yields in the long term and thus reduce the overall food supply (IAASTD, 2009). Monocultures are by definition not diversified, making them more vulnerable to price fluctuations, diseases, and environmental conditions. Thus, the rise of policies supporting monoculture and industrial farming endangers stability. Additionally, the dependency and indebtedness of small farmers to large seed companies brings down their bargaining power and increases their rate of poverty, and thus hunger (University of Cambridge, n.d.).

BIOFUELS TAKE NEW DIRECTION

Greater Policy Rethinking.

Biofuels, in particular bioethanol, are often produced using crops such as corn and sugarcane and are blended with gasoline to create a reduced-emission fuel. Growing crops intended for fuel production rather than food consumption, however, decreases the overall food supply and makes the crops more expensive for those who would like to use them as food (Josling, Blandford, & Earley, 2010).

Biofuels can be split into two major categories: biodiesel, which is closely related to fuels, and bio-ethanol, which is more closely related to the foods branch (Kristoufek, Janda, & Zilberman, 2012). Biofuel policies often mandate minimum blending percentages for fuel and include supports for farmers who farm biofuel crops (Josling et al., 2010). Biofuel policies in the EU and USA are in the midst of restructuring. However, they are not expected to result in significantly higher biofuel production (OECD & FAO, 2015). In Brazil, a major producer and consumer of biofuel, bioethanol policy has increased the mandatory mix of ethanol in gasoline and has terminated subsidies for petrol in order to make ethanol competitive again (Gallas, 2015). Thus, biofuel policy is going through worldwide restructuring in large producing countries, which, in sum will lead to a moderate increase in production.

Facts:

- In the USA, EU, and Brazil, biofuel policy is part of clean energy policy. It is often supported by subsidies for farmers to produce crops for biofuel production (Josling et al., 2010).
- When oil prices are low, first-generation biofuels are not profitable without mandates or subsidies (OECD & FAO, 2015).
- In Brazil it is mandated to have 20-25% ethanol content in gasoline (Josling et al., 2010).

Key Drivers:

- Pro-biofuel policies arise, as a response to variable oil prices (OECD & FAO, 2015, Josling et al., 2010).
- Biofuel policies are seen as a response to climate change (Josling et al., 2010).
- Biofuel policies are considered as a part of renewable energy policy in many large, energy consuming areas, such as the USA and the EU (Josling et al., 2010).

Challenges:

- Biofuels burn cleaner but reduce the available food supply, thus weighing the positives and detriments of such policies is complex.
- Biofuel produced from crops, such as corn and soybeans, need more fossil fuel during production than the fuel itself saves (Pimentel & Patzek, 2005).
- First and second generation biofuels have different effects on the food supply and make policy creation more complex (Kristoufek et al., 2012).

Impact:

Growing crops for biofuels instead of food consumption reduces the volume of potential food supply (Josling et al., 2010). Furthermore, biofuel production and prices, particularly that of ethanol fuels, positively correlate with the price of food on the global market (Kristoufek et al., 2012). Increasing biofuel production and prices, increase food prices, thus, making food unaffordable for the poor and leading to increased hunger worldwide.

INCREASING FIGHT AGAINST CORRUPTION

Increasing Engagement to Fight Corruption Internationally and Nationally Through Transparency.

Corruption can be defined as "the abuse of public or private office for personal gain" (OECD, 2014, p. 1). It negatively affects the goal of sustainable economic, political, and social development (OECD, 2014) and is considered as one of the key drivers for world hunger (Bain, et al., 2013). Therefore, the international interest in reducing corruption is increasing (Olken & Pande, 2011). The fight against corruption takes place both on an international and a national level. On an international level, organizations, for instance the International Association of Anti-Corruption Authorities (IAACA), try to enhance the international cooperation against corruption (IAACA, 2011). On a national level, different measures are taken, such as the introduction of mobile payments in Afghanistan, which lead to higher transparency in payments (Rice & Filippelli, 2010). The implementation of a data tracking mechanism to monitor corruption in Uganda (Inspectorate of Government, 2014), or a mobile application for whistleblowing in Senegal are also viable examples (World Bank, 2014b). The next step in the fight against corruption is applying these successful strategies on a broad scale.

Facts:

- Corruption costs more than 5% of global GDP ($2.6 trillion) (World Economic Forum, n.d.).
- Each year more than $1 trillion are paid in bribes (World Economic Forum, n.d.).
- Every year approximately 25% of the GDP ($148 billion) of African states is lost due to corruption (OECD, 2014, citing an estimate from the African Union, 2002).

Key Drivers:

- Technological innovations help to build administrative mechanisms that are harder to manipulate and circumvent, thus, helping to reduce corruption (Olken & Pande, 2011).
- Providing citizens with information enables them to monitor the government's decisions and enforces greater accountability (Olken & Pande, 2011).

Challenges:

- The assessment of corruption to a full extent is problematic, since corruption is "shadowy and secretive by nature" (Transparency International, 2013, p. 2).
- The full potential of mobile phones and new technologies has yet to be realized (Chêne, 2011).
- Access, anonymity, and cost of anti-corruption interventions have to be taken into account (Chêne, 2011).
- Officials could adapt to anti-corruption policies by developing new ways of corruption or by learning to manipulate the new mechanisms (Olken & Pande, 2011).

Impact:

Corruption aggravates hunger in different ways. It can cause problems in the food supply (Economist, 2015) and has a negative impact on long term agriculture policies (Uchendu & Abolarin, 2015). It also impedes international and regional development institutions in their attempt to fight hunger and famines. On top of that, it withholds the benefits that are meant for and entitled to ordinary citizens (Aziz, 2001). Also, a study found that there is a positive correlation between corruption and food insecurity (Uchendu & Abolarin, 2015). Therefore, reducing corruption can be considered as one of the key factors in the fight against hunger (Bain et al., 2013).

SOCIAL SAFETY NET PROGRAMS

Social Safety Net Programs and Direct Cash Transfers Gain Popularity.

An increasing number of governments are investing into social safety nets. These programs are non-contributory social policies, designed to provide poor and vulnerable people with regular and predictable support. Social safety nets are often part of more comprehensive social protection systems. Although already over 1.9 billion people in 136 countries benefit from social safety net programs, coverage in those areas, where the poorest 20 percent live, is only around 10% (World Bank, 2015). As a result of the success of existing programs, about one third of Sub-Saharan African countries are currently pursuing safety net programs.

While the number of countries with traditional safety net programs, such as school feeding, is stagnating, systems based on direct cash transfers are being increasingly implemented (World Bank, 2014c). About 36% of all social safety net programs are based on direct cash transfers. This has positive effects on the fight against hunger and inequality by providing the poorest people with a reliable, stable source of income and further strengthening local economies. Despite the remarkable progress made within the last years, a total coverage including the poorest has yet to be achieved (World Bank, 2015).

Facts:

- The number of countries with cash transfer programs rose from 27 in 2008 to 64 in 2015 (World Bank, 2015).
- On average, there are 20 safety net programs per developing country (World Bank, 2015).
- Social safety nets reduce the poverty gap globally by 15% (World Bank, 2015).
- Direct cash transfer programs have a nominal income multiplier of up to $2.52 for the local economy for each $1.00 invested. (World Bank, 2015)

Key Drivers:

- The success of pilot cash transfer programs encourages further implementation (Haushofer & Shapiro, 2013; Van Domelen & Coll-Black, 2012).
- Social safety nets have been observed to be effective and affordable in the fight against poverty and hunger (World Bank, 2015).
- International organizations, such as the African Union, promote the implementation of social policy frameworks to national governments (Garcia & Moore, 2012).

Challenges:

- The coverage of safety nets in low-income countries is still sparse and most cash transfer programs do not yet-provide sufficient income support (World Bank, 2015).
- The programs of Least-Income-Countries depend on donor funds (World Bank, 2015).
- Safety net programs need long term commitment and continuous evaluation of their efficiency (Van Domelen & Coll-Black, 2012).
- The adoption of Information and Communications Technology (ICT) and digital technologies (e.g. biometric identification) is a precondition to provide scalability in the future (Garcia & Moore, 2012).

Impact:

An evaluation of the World Bank shows that social safety net programs improve food security directly by increasing the spending power of low-income households. Especially unconditional safety net programs which support the beneficiaries with no additional requirements, have a high impact on school enrolments and attendance. This results in better nourishment in early stages of child development (World Bank, 2015).

In addition, cash based programs increase the households' buying power through predictable money transfers. This helps to reduce the income gap, provide stability, strengthen the local economy and give beneficiaries the dignity to choose which food to eat (World Bank, 2015).

ECONOMIC TRENDS

Widening Trade Deficit

Food Price Volatility

Ongoing Consolidation in Food Industry

Rise in Agricultural Productivity

Innovation in the Financial Sector

Growth of Entrepreneurial Ecosystems

Christian Feuerbacher, Christian Gebhardt, Josephine Kühl, Marius Wiggert, Ferran Pla Cardona

ECONOMIC TRENDS

Economic developments play a big role in reducing poverty and reaching the goal "Zero Hunger". This section deals with six major trends in the global economy and within the local markets of developing countries and mainly focuses on those trends that directly influence the agricultural industry. Thus, they are important factors in securing the food supply in the upcoming years.

First, a sizable number of developing countries is becoming more dependent on importing food and other agricultural products to meet their increasing demand. At the same time the export of agricultural products is concentrated in a small number of countries, which can make use of their competitive advantages. Due to a projected rise in the agricultural trade deficit, the food sovereignty of developing countries is expected to further deteriorate.

Second, the trend of high food prices and price volatility is likely to continue destabilizing the global food market. The fluctuations in the food supply and the increasing demand during the last decade led to constantly high variations in food prices around the globe. The effects of global prices have a significant impact on local agricultural markets.

Third, the consolidation of the global agricultural market structure develops in favor of leading multinational companies. During the last years, these corporations have been able to drastically expand their position in the global market, leaving farmers with little bargaining power, especially in developing countries. While this powerful position enables global players to exploit local farmers, it also gives them a decisive role in contributing positively to achieve the "Zero Hunger" goal.

Thereafter, the increase in agricultural productivity is discussed as another means to meet the aforementioned growing food demand. The increasing usage of specialized seeds and fertilizers, the progressing mechanization and the reductions in post-harvest losses drive an overall growth in agricultural output in developing countries. Nonetheless, significant regional differences remain and countries do not yet exploit their full potentia.

Furthermore, innovations in financial and insurance systems affect the economies in developing countries, largely fueled by an upsurge in the presence of the private sector in this area. In particular, the introduction of tailored financial and insurance products, such as microcredits, microsaving or microinsurances, drive the economic inclusion of the Bottom of the Pyramid (BOP).

Finally, the growth of the entrepreneurial ecosystems in developing countries promotes a shift in the formation of business from necessity to opportunity. In the emerging markets around the world, businesses that are innovative, sustainable, and scalable will benefit from this trend. This creation of supportive business environments constitutes a "fertile soil" for the hereinafter discussed emerging business models.

WIDENING TRADE DEFICIT

Developing Countries Shift from Net Exporters to Net importers of Agricultural Commodities.

While the overall exports of agricultural products nearly tripled in value between 2000 and 2012 (World Trade Organization , 2014a), developing countries in particular have become increasingly dependent on importing goods to serve their demand. Since the mid-1980s, a large number of developing countries has been shifting from being net exporters to net importers for agricultural commodities. These so called Net Food-Importing Developing Countries (NFIDC) increased in number over the last decades (Food and Agriculture Organization of the United Nations, 2003, 2011b; Valdés & Foster, 2012). While a large number of countries relies on imports, agricultural commodity exports become more concentrated in few countries because of their competitive advantage in natural resources, climate conditions, and domestic policies (OECD & Food and Agriculture Organization, 2015). The resulting agricultural trade deficit for the importing countries is further increasing and forecasted to quadruple by 2030 (Food and Agriculture Organization of the United Nations, 2003; Valdés & Foster, 2012). Thus, the trade dependence between developed and developing countries is expected to persist for the next decade (OECD & Food and Agriculture Organization, 2015).

Facts:

- Developing countries' demand for agricultural products increases faster than their production (Africa Progress Panel, 2014; OECD & Food and Agriculture Organization, 2015; United States Department of Agriculture, 2013).
- Developing and developed countries will account for more than four times as much grain production as the Least Developed Countries (LDCs) by 2024 (OECD & Food and Agriculture Organization, 2015).
- LDCs face a decline in their share of global agricultural exports (World Trade Organization, 2014a).
- The African regions with exception of Eastern Africa increased their net food importing bill from 2009 to 2013 (United Nations Conference on Trade and Development, 2015b).
- The EU, USA, Brazil, and Canada are the leading exporters of agricultural products (World Trade Organization, 2014b).

Key Drivers:

- Low levels of agricultural productivity hinder the growth of the agricultural production in developing countries (Africa Progress Panel, 2014).
- Internal political disruptions and civil wars affect exports negatively and lead to increases in import demand (Valdés & Foster, 2012).
- Food safety and agricultural health standards are export barriers for developing countries, as they face higher risks regarding their infrastructure, the spread of diseases, and climate conditions (Aksoy & Beghin, 2005).
- The lack of infrastructure and substantial transportation costs complicate the food transportation processes in developing countries, resulting in lower investment incentives (Aksoy & Beghin, 2005; Food and Agriculture Organization of the United Nations, 2003; United Nations Development Program, 2012b).
- Increasing openness in international agricultural trade rules intensifies the global competition, leaving LDCs further behind.

Challenges:

- Supply chain disruptions, for instance by natural disasters, are a particular threat for countries, which rely on food imports (OECD & Food and Agriculture Organization, 2015).
- Developed countries are less attractive for investments, which are directed towards countries with better physical infrastructure (Food and Agriculture Organization of the United Nations, 2003).
- Importing countries are exposed to currency fluctuations of the exporting countries (Gosh, 2010; Trostle, 2008).
- NFIDC become more vulnerable, because price setting mechanisms of food and agricultural commodities shift from local to global risks (Valdés & Foster, 2012).

Impact:

The impact of food imports depends on a country's capability to pay for food import bills. However, the consequences of increasing food imports relative to exports show different degrees of risk for the affected countries. First, for countries which are rich in oil and minerals, and for relatively industrialized countries, importing agricultural commodities is more beneficial than to establish domestic production (Food and Agriculture Organization of the United Nations, 2011b). Second, for countries that do not have enough foreign currency reserves, a food trade deficit is harmful, because the money which is needed to be invested in development initiatives is directed towards paying the food import bills. Therefore, the problem to secure the domestic food supply persists (Food and Agriculture Organization of the United Nations, 2011b). Lastly, countries that rely mostly on exports of agricultural goods face even higher risks, because revenues from traditional exports (cocoa, coffee, spices) are less persistent and depend upon the international market prices (Food and Agriculture Organization of the United Nations, 2011b).

FOOD PRICE VOLATILITY

High Food Prices and Price Fluctuations Destabilize the Food Markets.

Over the last decade, there has been an increasing concern about variations in agricultural prices. These variations are described with the term "volatility" (Food and Agriculture Organization of the United Nations, 2011a). Price levels and price volatility are both determined by supply and demand, high prices and volatility tend to be correlated. Concerns about volatility involve apprehensions about price levels, particularly the impact of high prices on the food security of the most susceptible households and the impact of low prices on vulnerable producers. The prices of agricultural products and food have been very volatile around the globe. The main reasons for this are the increasing demand over the past years and the high variations in supply caused, for example, by adverse weather conditions, which reduce the wheat production and trade with other countries. Prices and volatility are likely to stay on a high level within the next years (Food and Agriculture Organization of the United Nations, 2011a, 2012).

Facts:

- After a low and stable 25-year trend, prices of agricultural commodities experienced an upsurge between the beginning of 2007 and mid-2008, for instance triplicating for rice (International Fund for Agricultural Development, 2009).
- By the end of 2008, the price of corn went down by 64% while wheat and rice prices fell by 55% (International Fund for Agricultural Development, 2009).
- In 2010, the return of high food prices raised fears of a repeat of the 2007 and 2008 food crisis, increasing food insecurity and food price inflation (Food and Agriculture Organization of the United Nations, 2012).
- International food prices decreased by 14% between August 2014 and May 2015, falling to a five-year low (The World Bank, 2015).

Key Drivers:

- The impact of natural factors (e.g. droughts) on harvests cause supply-side variability (International Fund for Agricultural Development, 2009).
- Higher prices for fertilizer and machinery lead to rising production costs (Food and Agriculture Oganization of the United Nations, 2011a)
- Variations in transport costs are fueled by high and constant fluctuations in the oil prices over the last decade (Food and Agriculture Organization of the United Nations, 2011a).
- Slower growth of cereal yields result in production slowdown (Food and Agriculture Organization of the United Nations, 2011a).
- Increased demand on commodity futures markets is a result of speculation. Agricultural future price movements are linked to index trading (Spratt, 2013).
- Trade policies (see political and legal trends) encourage producers to withhold supplies and consumers to take part in panic buying (Food and Agriculture Oanizatin of the United Nations,2011a).

Challenges:

- Excessive food price volatility needs to be limited to avoid food insecurity and supply uncertainty for the most vulnerable (Food and Agriculture Organization of the United Nations, 2011a).
- It is necessary to increase the transparency in agricultural markets to avoid speculation, one of the major causes of food price volatility (Hallam, 2013).
- Governments have to pass regulations and policies to stabilize food prices in the global market (The World Bank, 2012).

Impact:

The short-term price changes caused by the aforementioned reasons might have long-term impacts on the personal development of the population in developing countries. If prices of agricultural commodities are high, families cannot afford basic staples. This will lead to a lack of children's consumption of the most important nutrients. Especially during the first two years of life this has negative long-term implications, as it reduces their physical and cognitive development. In the future, this will affect their earning capacities (Food and Agriculture Organization of the United Nations, 2011a).

The unstable food prices also have an impact on the development of the local agricultural sector in developing countries, since smallholder farmers fear to invest in ways to raise their productivity due to unpredictable food price changes (Food and Agriculture Organization of the United Nations, 2011a). In summary, high and volatile food prices aggravate food insecurity, resulting in malnutrition and undernourishment (Food and Agriculture Organization of the United Nations, 2011a; International Fund for Agricultural Development, 2009).

ONGOING CONSOLIDATION IN FOOD INDUSTRY

Multinationals' Empowerment Gives Them a Decisive Role in Alleviating Hunger.

The global agricultural market is dominated by a relatively small group of large multinational corporations that have increased their market power with global expansion strategies over the past decades (Sexton, 2010; United Nations Development Program, 2012a). This increasing market power brings both threats and opportunities for developing countries.

In particular, the farmers in developing countries have to bargain with global corporations both from the supply and customer side. With regard to agricultural inputs, farmers rely on multinational corporations to get access to improved seed varieties and plant breeding technologies (Srinivasan, 2003). This input stage of the industry is characterized by intense, concentrated global competition (Markets and Markets, 2015a, 2015b). Furthermore, supermarkets, which purchase agricultural commodities from the farmers, are able to source products where they are cheapest due to the globalized supply chains (Sexton, 2010; Starmer & Anderson, 2008). As a consequence, the private sector is an ever more important "key stakeholder in the fight against food insecurity, malnutrition, and rural poverty" (Food and Agriculture Organization of the United Nations, 2013, p. 3). For instance, corporations support developing countries' economies by creating jobs, conducting foreign investments, and paying local taxes. Additionally, they contribute directly to fighting poverty and supporting international organizations (Vienna University of Economics and Business, 2016) such as the World Food Programme.

Facts:

- With horizontal and vertical integration, companies have gained control over critical agricultural inputs (Markets and Markets, 2015b; Starmer & Anderson, 2008).
- The six major producers of agrochemicals account for approximately 70% of the global agrochemicals market (Markets and Markets, 2015a).
- The ten biggest retailers tripled their sales from 2000 to 2011 (Corstjens & Lal, 2012).
- The top 30 companies account for approximately one third of global grocery sales (Sexton, 2010).
- A large number of companies of the private sector participate in fighting hunger (Gerholdt, 2014; World Food Programme, 2016) by supporting the projects of the World Food Programme in 80% of countries (World Food Programme, 2016).
- 85% of Africa's farms occupy less than two hectares, leaving the farmers with small bargaining power (McKinsey, 2010).

Key Drivers:

- Due to marginal growth levels in mature markets of the food industry, companies compete for market shares, growth, and economies of scale (Research and Markets, 2016).
- Retailing is a low-margin business driving rapid expansion strategies to remain attractive to investors (Corstjens & Lal, 2012).
- Liberalization (currency devaluation, reduced farm supports, and corporatization of markets) strengthens corporations and weakens the farmers' influence on the agricultural market (McMichael, 2009).

Challenges:

- A closer collaboration between international organizations, the public sector, and the private sector is required (Food and Agriculture Organization of the United Nations, 2013).
- Public education campaigns worldwide need to raise awareness about direct marketing options for farmers and consumers and to establish transparency of market abuse (Starmer & Anderson, 2008).
- It would be the most effective strategy for farmers to strengthen in numbers to increase their bargaining power (Starmer & Anderson, 2008).
- The market of the BoP is small and unlikely to be profitable in particular for multinational corporations because of high distribution and marketing cost as well as customer heterogeneity (Karnani, 2006).
- The real income of the BoP needs to be increased to strengthen consumer power (Karnani, 2006).

Impact:

Market power induces artificial cheapening of traded food, destabilizes farmers' incomes, produces a labor reserve, and makes farming unprofitable (McMichael, 2009). This leads to severe consequences for the world's poor living in rural areas, because 70% of them rely on agriculture as main source of income and employment (The World Bank, 2016d). Corporations contribute significant monetary support to improve food security (Food and Agriculture Organization of the United Nations, 2013). The private sector and large multinational corporations can in particular contribute to the goal of "Zero Hunger", by creating job opportunities and investing in education and productivity, instead of regarding the BoP solely as a target market (Karnani, 2006).

RISE IN AGRICULTURAL PRODUCTIVITY

Producers in Developing Countries Improve Their Harvest Yield.

The agricultural industry in developing countries has achieved a significant increase in the total agricultural output mainly due to high growth rates in productivity per hectare of arable land. This process is driven by intensified use of agro-inputs, mechanization, and reduction in post-harvest losses. While the general tendency of this progress can be observed in all developing countries, the actual growth rates show tremendous differences between regions. The agricultural productivity of countries in Asia and South America grew six to eight times faster than in Sub-Saharan Africa (SSA) (Agricultural & Applied Economics Association, 2012). Accordingly, the reduction of undernourishment was more successful in Asia and South America compared to other regions affected by hunger (Food and Agriculture Organization of the United Nations, International Fund for Agricultural Development, & World Food Programme, 2015). Despite the past improvements, there is still a high potential for productivity gains in all developing countries, especially in Africa (Jayne, Rashid, Minot, & Kasule, 2009).

Facts:

- The annual growth rates of the agricultural total factor productivity were especially high in Brazil (4%) and China (3%), but significantly lower in SSA (0.5%) during the period from 2001 to 2009 (Agricultural & Applied Economics Association, 2012).
- The fertilizer consumption per hectare of arable land in Latin America and Caribbean rose from 101 to 148 kg/ha whereas in SSA it rose from 13 to 18 kg/ha between 2009 and 2013. (The World Bank, 2016c).
- The least developed countries increased their total food production by 19% between 2008 and 2013 (The World Bank, 2016a).
- In Asia, 41% of the cultivated land is irrigated whereas in Africa only 5% is (Africa Progress Panel, 2014; Food and Agriculture Organization of the United Nations, 2008).
- SSA countries, such as Malawi, Ethiopia, Nigeria, and Uganda, have a huge potential to increase their maize yields by 200-500% per hectare (Jayne et al., 2009).

Key Drivers:

- Governments invest in research and development to adapt agricultural technologies to local farming conditions (Agricultural & Applied Economics Association, 2012).
- Mechanized land use (tractors and irrigation systems) and improved agro-inputs (seeds and fertilizer) increase productivity (Agricultural & Applied Economics Association, 2012; Alliance for a Green Revolution in Africa, 2013).
- Implementation of warehouses, storage infrastructure, and cooling techniques reduce post-harvest losses (Alliance for a Green Revolution in Africa, 2013).
- Famers improve their access to markets and to current price information (via mobile phones) (Alliance for a Green Revolution in Africa, 2013).
- Information and communication technology provides agricultural knowledge and environmental data (e.g. weather forecasts) (United Nations Development Program, 2012a).

Challenges:

- Poor road infrastructure and high cost due to a lack of economies of scale cause poor access to inputs (United Nations Development Program, 2012a).
- Total post-harvest food losses remain constantly high (e.g. up to 40% for fruits in SSA) because of a lack of warehouses and cold chain facilities (African postharvest losses information system, 2016; United Nations Development Program, 2012b).
- Gender inequalities hinder productivity growth (United Nations Conference on Trade and Development, 2015a).
- Farmers have low levels of education (United Nations Economic Commission for Africa, 2012).
- Most farmers still lack knowledge about accurate market prices (United Nations Economic Commission for Africa, 2012).
- Limited integration of the agricultural sector in the total economy hampers the agricultural and economic growth (United Nations Economic Commission for Africa, 2012).

Impact:

In developing countries agriculture employs up to 65% of the labor force and accounts for a significant part of the GDP (The World Bank, 2016b). Agricultural productivity growth is of key importance for fighting hunger as it does not only increase food production but also frees up labor forces to further spur economic growth. This effect is especially visible in Asia and Latin-America where it contributed to reducing the prevalence of hunger from 24% (1990) to 12% (2014). Africa's slow productivity growth only led to a small reduction in hunger, while the total number of undernourished people even grew (Food and Agriculture Organization of the United Nations et al., 2015). Forecasts predict, that if growth rates of agricultural productivity in SSA stay low and the population continues its rapid increase, SSA could only meet 14% of its own food demand by 2030 (Global Harvest Initiative, 2015).

INNOVATION IN THE FINANCIAL SECTOR

New Financial and Insurance Products Emerge in Developing Countries.

For a long time, most people in developing countries did not have access to basic financial services, such as bank accounts. This has changed recently due to the technical and political progress. Especially the wide adaption of cell phones provides many people in developing countries with Mobile Money (m-money) accounts and allows them to transfer money electronically. There are also large opportunities for those who already have a bank account to benefit even more from financial inclusion (World Bank Group, 2015). Many western banks and insurance institutes are discovering this market. Additionally, the number of local Micro Financial Institutions (MFIs) has risen continuously in recent years (International Finance Corporation, 2015).

These developments grant local farmers and entrepreneurs access to seed capital in form of microcredits for necessary investments. So far, this sector still reaches less than 20% of its potential market (International Finance Corporation, 2015). Further emerging financial products focus on saving and risk reduction: microsaving allows people to save very small amounts of money and, therefore, to equip themselves with a minimum of financial security (Alliance for Financial Inclusion, 2010). Life or health microinsurances can protect poor people against a financial crisis in case of sudden death or diseases within their family (Munich Re, 2015). Furthermore, new „index based agricultural insurances" are a cheap way for farmers to prevent harvest losses caused by environmental disasters like floods, heavy rainfalls, or droughts (Lloyds, 2015).

Facts:

- In 13 countries of SSA, penetration of m-money accounts is ranging from 10% in Namibia to 58% in Kenya (World Bank Group, 2015).
- The International Finance Corporations (IFC) committed 519 million in 43 projects with MFIs in 2014. The IFC's cumulative investment portfolio in finance exceeded $3.5 billion in the same year (International Fund for Agricultural Development & World Food Programme, 2011).
- Microinsurances in Africa cover over 60 million people. This market grew by 30% between 2011 and 2014 (Munich Re, 2015).
- The number of insured lives by Allianz in developing countries increased from 34.1 million to 57.4 million between 2014 and 2015 (Allianz, 2015).
- The global market for agricultural insurance grows continuously. But it still remains underdeveloped in some emerging markets (Lloyds, 2015).

Key Drivers:

- The amount of cell phone owners is rising to penetration levels similar to developed countries of about 80% within the last years (Poushter & Oates, 2015).
- Information system technologies decrease financial (transaction) costs for MFIs (Mohan, Potnis, & Alter, 2013).
- Technologies, such as satellite measurements and weather stations, allow cheap regional loss assessments for „index based insurances" (Society of Actuaries, 2015).
- The World Bank and national governments foster Public Private Partnership projects (PPP-projects) and private projects in the financial sector (Ion, Beyard, & Sedaca, 2014).

Challenges:

- Financial inclusion requires investments in payment infra structure (World Bank Group, 2015).
- Many unregulated credit organizations, which charge high interest rates, harm the growth and success of microfinance products (Sharma & Tewari, 2014).
- Financial literacy about the basic interactions involved in a digital payment system is required among new account owners (World Bank Group, 2015).
- In rural areas, the (transaction) fees are still high and there is low access to financial services (Sharma & Tewari, 2014).
- Climate change requires new types of insurances and risk management (International Fund for Agricultural Development & World Food Programme, 2011; World Economic Forum, 2016).

Impact:

The access to several financial services opens up opportunities for faster economic development and financial security. Therefore, it has an indirect but important impact on food security. Using electronic payments for the sale of agricultural products can increase the security of money transfers and grant farmers a first entry point into the formal financial system (World Bank Group, 2015). Microcredits and micro saving products enable people of the BoP to escape the poverty trap and combat permanent hunger. Insurances, in general, can assist in case of unexpected emergencies to avoid starvation. In particular, agricultural insurances give farmers a risk hedging service in the event of food crises due to weather catastrophes and, therefore, provide farmers with basic financial security.

GROWTH OF ENTREPRENEURIAL ECOSYSTEMS

Entrepreneurial Ecosystems Are Striving and Offer New Opportunities for the BoP.

As economies all over the world become progressively dependent on entrepreneurial activity, the need of supportive entrepreneurial ecosystems is increasing. Especially in developing countries, strong ecosystems will help entrepreneurs to move from necessity to opportunity. Entrepreneurs, who build innovative, sustainable and scalable businesses, which take advantage of local needs, will benefit of strong networks. The ideal entrepreneurial environment is based on five pillars: (1) funding access, (2) culture that encourages entrepreneurs, (3) supportive tax and regulatory regimes, (4) entrepreneurship education, and (5) a coordinated approach between the public and the private sector (EY, 2015). Although developed countries are a lead the field in the funding options, educational systems as well as tax and regulatory environments, developing countries made efforts to catch up on these aspects during the past years. Entrepreneurial ecosystems are expected to continue growing around the world (EY, 2014; World Economic Forum, 2014).

Facts:

- Rapidly growing economies of the developing countries show much higher total early stage entrepreneurial activity (TEA) index rates than mature economies (EY, 2014).
- The TEA index rate that is necessity-driven is at 30% for SSA compared to 14% for North America and 22% for the EU (Kelly, Singer, & Herrington, 2016).
- In 2014, there were more than 90 technology hubs offering incubators and accelerator programs across Africa (EY, 2014).
- Since 2010, 152 companies have formed out of iHub, Nairobi's innovation center (Bright, 2013).
- In India, venture capital investment rose from $600 million to $1.4 billion between 2006 and 2012 (EY, 2014).

Key Drivers:

- Early successful entrepreneurs with already functioning business models have a decisive role in the takeoff of a strong local entrepreneurial ecosystem, as they become a source of inspiration (Mason & Brown, 2013).
- Developing countries offer great opportunities for frugal innovation. Entrepreneurs can design lower-cost products and services to fulfil local market needs (EY, 2015).
- Digital technologies facilitate the scaling up of new businesses at a lower cost (European Commission, 2015).
- Some developing countries (e.g. India) make efforts to create financing and regulatory environments to support early stage businesses (EY, 2015).

Challenges:

- The access to funding is one of the biggest difficulties for entrepreneurs around the world (EY, 2015).
- Entrepreneurs perceive governmental and regulatory policies which imply excess of bureaucracy, lack of transparency, and length of approval processes as growth inhibitors (World Economic Forum, 2014).
- Developing startup communities by identifying leading entrepreneurs and helping them to connect is a main challenge of local govnments (World Economic Forum, 2014).

Impact:

Supportive entrepreneurial ecosystems will increase the ability of entrepreneurs to generate new wealth and to boost consumer power in developing countries (EY, 2015). The emergence of entrepreneurial activities offers people new self-empowering opportunities to improve their economic situation and create new jobs (Mason & Brown, 2013), instead of relying on large global corporations, governmental support, or other aid programmes (World Economic Forum, 2014). Entrepreneurs creating new ventures will have a positive impact on poor communities, offering new ways for the BoP to escape the poverty trap and helping to fight hunger.

BUSINESS MODEL TRENDS

Sharing Economy

Value Chain Inclusion

Cooperatives

Financial Inclusion

ICT for Micro-Entrepreneurs

BUSINESS MODEL TRENDS

"Entrepreneurs are the lifeblood of economic growth – they provide a source of income and employment for themselves, create employment for others, produce new and innovative products or services, and drive greater upstream and downstream value chain activities." (Ernst&Young, 2015)

In order to be able to succeed as an (micro-)entrepreneur, a financially sustainable business model is crucial. Micro-entrepreneurs "make a living and care for their families with income earned from operating small businesses" (Global Partnership, 2013). Their underlying business models are highly affected by various trends in different aspects. In order to assess and categorize which parts of their business model are influenced by the trends, the business model canvas is used as the underlying frmework. First, the sharing economy movement is described, which will enable numerous opportunities for micro-entrepreneurs in the upcoming years since resources, costs, and other core dimensions of a business can be shared.

Second, economic growth is also dependent on collaboration between private corporations and the BoP (Base of the Pyramid) micro-entrepreneurs. The latter are increasingly integrated into the existing value chains of those bigger players either as suppliers or as distributors/retailers. While corporations use these partnerships, for example to reach out to rural areas, micro-entrepreneurs profit from the collaboration in the form of increasing incomes.

Third, micro-entrepreneurs themselves increasingly form associations to be able to have an empowered joint negotiating position when they are confronted with business partners who usually would just bypass the necessities of smallholder entrepreneurs.

Fourth, emerging financial resources for entrepreneurs in developing countries are illustrated. Access to funding is a main driver, but at the same time still one of the biggest challenges entrepreneurs have to face. Hence, initial and also improved access significantly drives entrepreneurship. Finally, the chapter closes with an assessment of how information and communication can connect the BoP. As these are crucial in tomorrow's competitive world, especially in the developing countries, a few best practice examples are outlined to provide an outlook.

SHARING ECONOMY

Enhanced Utilization Through Collaborative Access to Resources.

According to PwC (2015b, p. 14), the sharing economy can be described as an "emergent ecosystem that is upending mature business models across the globe". To be more specific, sharing economy means peer-to-peer sharing of resources and services based on the principles of trust, maximizing efficiency and utilization. Besides more collaborative ways of consumption, the movement is all about access over ownership, which means that more choice is realized for individuals, while the costs associated with ownership are mitigated. This is a significant enabler for micro-entrepreneurs, as it affects several parts of their business model. First of all, new distribution channels are created: for instance, Uber and other sharing services can now be used to deliver goods. In addition, business models can also be based on resources, which are not owned by the company itself but shared (e.g., Hello Tractor: borrow a tractor for one day by sending a message). Another example is that knowledge can be shared with other players. For instance, WeFarm.org enables knowledge sharing on how to grow food or P2PU shares knowledge in local learning circles.

Facts:

- The sharing economy is estimated to have $15 billion global revenue (2014) and can grow up to $335 billion in 2025 (PwC, 2014).
- The announced partnership from March 2015 between Uber and UN Women to empower the position of women in the economy by creating one million jobs for women by 2020 was cancelled due to the lack of worker's protection such as minimum wage or health care (Alter, 2015).
- People, who are most excited about using sharing economy models, are between 18 and 24 years old (PwC, 2015b).

Key Drivers:

- Increasing trust, convenience, and a sense of community pushes the adoption of the sharing economy (PwC, 2015b).
- Within developing countries, the percentage of people with the willingness to share assets from others (81% to 71%) is significantly higher than in the developed world (54% to 52%) (Welsum, 2015a; Richter, 2014).
- Information Technology and the rise of smartphones coordinate sharing activities and give access to sharing providers.
- The rise of entrepreneurship and the spread of inclusive service providers from other states enable service offers.

Challenges:

- It is difficult to raise awareness for using available information technology to get access to resources.
- There are geographical restrictions of shared services in certain regions and a need for a critical mass of users per region in order to work efficiently.
- Efficient logistic distribution systems are required since services are very depended on location and time.
- There are potential future legal restrictions and terms which prevent the models of sharing economy providers from being profitable.
- Unclear insurance situations and a dependency on strangers might become a problem with regard to reliability and product quality (PwC, 2015b, p. 11).

Impact:

Thanks to the availability of shared resources, farmers do not have to invest in big machines like tractors anymore. The startup Hello Tractor demonstrates this effect by lending means of production to farmers, turning fixed costs into variable costs. Such changed cost structures enable micro-entrepreneurs to take on business. Furthermore, the sharing economy optimizes utilization significantly, making the food production more efficient (HelloTractor, 2015). Micro-entrepreneurs can also offer their services by using sharing economy platforms: Uber, for example, has created 2,000 new workplaces in South Africa within two years and expects the number to grow up to 15,000 (Elkin, 2015).

VALUE CHAIN INCLUSION

Increasing integration of the BoP into supply and distribution chains of private corporations.

Including the poor into the value chain as supplier, distributor or retailer - also known as Inclusive Business Model (IBM) - positively influences the progress and evolution of companies, the local population, and the environment. This is particularly applicable to the food and agricultural sector (Endeva, 2010). The approach has gained significant popularity over the past decade and is expected to rise even further in the coming years (FAO, 2015).

In an integrative supply chain, micro-entrepreneurs usually sell their products in fixed quantities and with an agreed quality level directly to corporations. Those, in turn, provide necessary inputs as well as training for farmers and buy the products. Besides that, the "Aggregator Model" is very successful in the agricultural sector: farmers engage in intermediaries between processor and producers, so called Aggregation Centers, which assist smallholders to supply better quality and consistent volumes of raw materials while reducing post-harvest loss (UNDP, 2012).

In an inclusive distribution chain, corporations distribute their products into rural areas via micro-franchising (Hürlimann, 2011). The Distribution Chain Integration helps to overcome the challenge of last mile distribution, which means the difficulty to reach out to the areas that are geographically isolated or hardly accessible due to bad infrastructure (Dutt, 2012). Micro-franchisees work under the brand of the corporation. This provides them with the security of a proven business model and low initial investments (Hürlimann, 2011).

Facts:

- Multinational corporatation such as Nestle and Coca-Cola as well as national companies like BIDCO and East Africa Breweries engage in inclusive sourcing (UNDP, 2012).
- Franchising in the food sector represents the biggest investment area in developing countries (Awoseila, 2011).
- A five-year agreement was made February 2014 between Unilever and the International Fund for Agricultural Development (IFAD) on working with small-scale farmers and rural enterprises (livelihoods for smallholder farmers, n.d.).
- The number of mobile vendors working for Unilever increases. The status quo in 2014 is 25,000 mobile vendors; the target for 2020 is 50,000 mobile vendors (Inclusive Business, n.d.; Livelihoods for smallholder retailers, n.d.).
- In 2013, the Multilateral Investment Fund (MIF) invested $5 million into SCALA, an initiative to scale micro distribution networks based on micro-franchising models (SCALA, 2013).

Key Drivers:

- The extended use of technology enables an inclusive market access (UNDP, 2012).
- The need for tailored business models drives the demand for an integration of local expertise (GIZ, 2013a).
- Local networks are crucial for a successful establishment in developing counties (GIZ, 2011).
- Growing public expectations to pursue corporate social responsibility enhances the engagement with the BoP (Corporate Citizenship, 2012).
- A limited infrastructure in rural areas stimulates the corporations' need for other ways to reach out (UNDP, 2008).
- The increasing gap between food demand and supply fosters need for productivity (Global Harvest Initiative, 2015).
- The private sector targets the market potential of the BoP in developing countries due to a saturation of the developed market (GIZ, 2013a).

Challenges:

- There is a two-sided pressure for farmers worldwide due to globalized supply chains resulting in low returns and high-priced farm inputs.

- The access to financing is limited due to a lack of documented success stories and the long-term horizon of inclusive business models (GIZ, 2013a).
- Governmental regulations hinder the engagement of low-income peoples' informal businesses in a formal economy (GIZ, 2013a).
- The lack of a market infrastructure leads to a lacking transparency of prices and an increase in transaction cost for micro-entrepreneurs (GIZ, 2013a).
- The quality assurance and knowledge transfer from corporations to micro-entrepreneurs is a challenge (Dutt, 2012).
- Micro-franchising poses the reputational risk that the distribution partner might harm the brand image (Dutt, 2012).

Impact:

By including the BoP in the distribution channel, the food supply will expand, i.e. goods are brought to rural areas, which would otherwise be mostly inaccessible (Hürlimann, 2011). The value chain integration leads to an increase in the agricultural productivity (UNDP, 2012) and additionally, more farmers become suppliers. All in all, the value chain integration leads to higher incomes, shortened supply chains, and decreased environmental footprints (GIZ, 2013a).

COOPERATIVES

Small-Scale Businesses Forming Associations to Empower a Joint Negotiating Position.

Co-operative businesses are autonomous associations fully owned and democratically controlled by their voluntary members in order to meet their common economic, social, and cultural needs. This ranges from small-scale farmer co-operatives to public transportation service co-operatives (International Labour Organization, 2015). During the global financial crisis in 2008 and 2009, co-operative businesses have proven that they are remarkable alternatives to conventional companies (Berr, 2013).

Due to a massive cancellation of regulations in many African states in the 1990s, the co-operative movement nearly collapsed. It is recovering and even growing with upcoming mobile communication networks.

The International Co-operative Association lists seven principles and six values, which should be fulfilled by associations to be called a co-operative (International Co-operative Alliance, 2016a).

One important specialization of co-operatives are credit unions, in which people jointly save up money at a bank and share it. Additionally, those financial co-operatives can obtain better credit conditions, and provide a general loan security respectively.

Facts:

- Total turnover of the 300 largest co-operatives has reached $2.2 trillion in 2012 with a growth of 11.6% (International Co-operative Alliance, 2016b).
- Around 30% of the 300 largest co-operatives operate in the agricultural and food sector (Food and Agriculture Organization of the United Nations, 2016).
- In 2012, 75% of Fairtrade certified products came from co-operatives (The Co-operative College, 2011).
- 2012 was the International Year of Cooperatives (IYC), an initiative of the United Nations, to promote the worldwide growth of co-operatives (World Food Programme, FAO, International Fund for Agricultural Development, 2012).
- In 2013, the World Council of Credit Union counted 22,385 credit unions in Africa (raised by 7.46% in comparison to 2012) with a total asset of $7bn (World Council of Credit Unions, 2013).

Key Drivers:

- The emerging revolution of ICT enables and enhances co-operatives since co-operatives strongly rely on the democratic principle, which implies an enormous need for communication (de Carvalho, 2011).
- An enhanced communication network could form new co-operatives by providing a platform for exchange between small-scale businesses (de Carvalho, 2011).
- The rising number of supermarkets is a clear driver for farmer co-operatives that provide an effective, low-cost way to meet the market demands of supermarket chains (OCDC & USAID, 2009).

Challenges:

- Local farmers are still rarely used as food suppliers because some supermarket chains find it more profitable to import from high-income countries with large farms (OCDC & USAID, 2009).
- An insufficient structure of co-operative governance organs can rapidly lead to chaos and therefore to the failure of the co-operative (Cooperative Grocer Network, 2005).
- Sharing of initially defined values by all members in order to comply with the co-operative principle is crucial but challenging over time (Cooperative Grocer Network, 2005).
- Co-operative managers need to learn to align their decision making to the co-operative values. Therefore, profit-oriented managers could affect the trust of the co-operative's members (Cooperative Grocer Network, 2005).

Impact:

First, farmers receive more competitive prices due to their improved negotiating position by being a member of a co-operative since such larger organizations reduce the risk of losses for business partners. This also results in a higher income for farmers and reduces their personal risk of hunger. Second, a co-operative is able to build up distribution channels for food a lot easier than a single farmer which has a positive impact on the business sustainability. This also improves the general availability of food and thus, the food security.

FINANCIAL INCLUSION

Broader Access to Financial Resources Enabling Micro-Entrepreneurship.

Access to funding remains one of the biggest challenges to drive entrepreneurship in developing countries – a range of options is essential for (micro-)entrepreneurs (Ernst&Young, 2015).

According to the Grameen Bank, founded by Nobel Peace Prize laureate Muhammad Yunus, microfinance is a source of financial services for small businesses and entrepreneurs, who do not have access to traditional banking (Grameen Bank, 2016). Microloans can either be applied by individuals or by a group of individuals.

The second option is crowdfunding, an innovative finance model in which the seed money for startups consists of monetary contributions by a larger number of people that either lend, donate or provide their money equity-based. In the latter case, the contributors acquire a share of the founded business (World Bank, 2013).

Third, Peer-to-Peer (P2P) lending platforms (websites) are services that unlike traditional banks do not lend their own funds but match borrowers, for instance micro-entrepreneurs, that are looking for a loan, with investors, who are typically also private persons (PwC, 2015).

Each of these three options gives micro-entrepreneurs (credit users) the chance to set up their own small business. This enables them to create jobs, foster their own financial situation and therefore their food security.

Facts:

- 200 million micro- to medium-enterprises (< 250 employees) lack access to affordable financial services and credit (World Resource Institute, 2014).
- 35% of these small firms report that this lacking access to financial resources is one of the major obstacles to their operations (World Resource Institute, 2014).
- In the micro-finance market, the expected annual growth is 19 %, from $5.7 billion in 2014 to nearly $14 billion in 2019 (Ernst&Young, 2015; responsAbility, 2014).
- The size of the crowdfunding market in developing countries amounted to $5 billion in 2013 which could rise to $96 billion by 2025 (Ernst&Young, 2015; World Bank, 2013).
- The P2P lending market's size was $5.5 billion in 2014, while the worldwide potential market size will be 150 billion or higher by 2025 (PwC, 2015a).

Key Drivers:

- The number of micro-finance, crowdfunding, and P2P platforms and institutions is increasing.
- The access to these platforms increases with the "connected BoP" (mobile movement etc.).
- More and more innovative platforms are partnering with traditional financial institutions to create opportunities that are mutually beneficial. Even in rural areas, this will result in broader access to financial resources for micro-entrepreneurs (PwC, 2015a).
- The increasing access to education will leverage the awareness of chances and risks of using the named financial services.

Challenges:

- Many individuals still do not have access to a mobile phone.
- Excessive interest rates (up to 100 %) are potentially making entrepreneurs plunge into debt (average interest rate 20-30% worldwide (CGAP, 2013)).
- Micro-finance may rather help larger businesses than the small ones (Banerjee et al., 2015).
- The lack of education opens up possibilities for fraud and exploitation.

- For crowdfunding and P2P lending, there is a fulfilment risk. It is vital to avoid fraud projects (e.g. made up projects in a developing country) because these might destroy the trust of the community (World Bank, 2013).
- As traditional lenders enter the market, the competition among P2P providers increases, which is helpful for entrepreneurs (lower interest rates) but constrains the providers' expansion (market pressure) (PwC, 2015a).
- Regulations for providers might reduce the attractivity of the P2P model (PwC, 2015a).

Impact:

There is a significant positive correlation between financial access and poverty rates (ADB, 2015). A broader financial access enables productive activities and "smoothens [the individual's] consumption in the face of short term adverse shocks" (ADB, 2015, p. 17). Examples like the The Hunger Project report that "over two million individuals will take microloans [...] this year. They will use [them to] improve farming techniques for increased crops. The profits they make, will in turn serve to feed and send the next generation to school (THP, 2016)." According to the World Bank (2007), the most effective financial inclusion models combine the provision of capital with mentoring and business education. This means that, if a loan is required, nutrition education could be mandatory, even on innovative platforms, to effectively fight hunger.

ICT FOR MICRO-ENTRE-PRENEURS

Higher Productivity and Efficiency Through Information and Communication.

In today's and even more in tomorrow's competitive world, information is not only a basic necessity of everyday life, but it is required for everything (Bachhav, 2012). It can be retrieved from different sources and tailored to the requirements of the ones in need. Micro-entrepreneurs are more than ever in need of information. Especially, since all of the other players in the market usually have access to it and know how to use it. More and more farmers are using information to better cope with droughts and floods. Information is also education and therefore improves the negotiating position for micro-entrepreneurs, when dealing with suppliers and customers. As everyone is informed about market prices, exploitation becomes more difficult. On top, the access to weather forecasts and information about soil conditions increases the farmers' productivity (de Carvalho, 2011).

Communication is another need of micro-entrepreneurs: communication services connect businesses with other businesses and consumers. For instance, digital marketplaces cut out middlemen and thus facilitate a better price for both, the buyer and the seller (de Carvalho, 2011). Another example is Jana, a service that facilitates low-cost consumer surveys via mobile phones (GIZ, 2013b).

Facts:

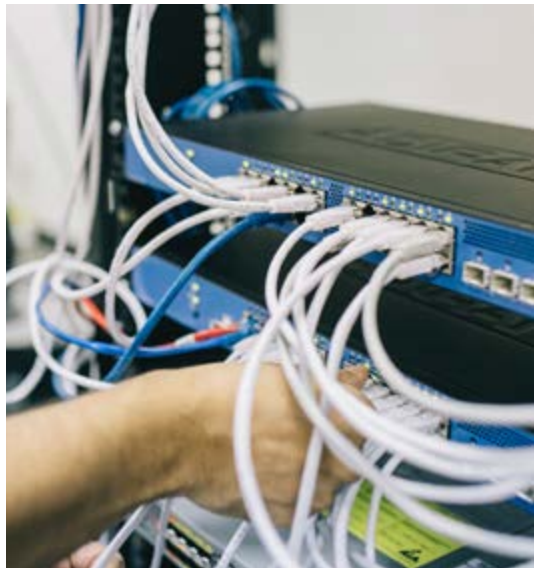
- In 2014, 84% of the population in emerging and developing nations owned a cellphone (Poushter, Bell, & Oates, 2015).
- Android smartphones are now available for around $20 (Amazon.com, n. d.) and there are initiatives to lower the price even more (The Indian Express, 2016).
- Specialised SaaS solutions are becoming affordable for micro-entrepreneurs to increase their productivity and efficiency (GIZ, 2013b).
- A survey in nine developing countries revealed family and friends as the preferred source of information (27%), followed by mobile news services (17%) (intelecon, 2013).
- There is a huge potential for efficiency optimization: in 2014, 18% of cereals in Africa were lost after harvesting (African Postharvest Losses Information System, n. d.).

Key Drivers:

- Relevant information becomes affordable as more and more datasets are easily available thanks to sensors in technical devices and governments publishing open data (GIZ, 2013b).
- Big data insights support farmers in timing their decisions better (Price, 2014).
- Location-based services are more valuable for the individual entrepreneur since they are tailored to their circumstances (GIZ, 2013b).
- The increased usage of mobile phones in developing countries enables entrepreneurs to receive targeted information (International Telecommunication Union, 2014).
- Through mobile money, unbanked entrepreneurs can now remotely access fee-based content which is relevant for their business.

Challenges:

- Despite the increasing mobile penetration among the BoP, most individuals do not own a smartphone (Salazar Ortegón, n. d.; World Bank, 2014).
- Low literacy rates prevent many people in the BoP from accessing information (Khan, 2011).
- BoP farmers are not familiar with and do not trust ICT (de Carvalho, 2011).
- Some of the available information is not for free which poses a financial barrier to the entrepreneurs.



- Due to the variety of languages in some countries 122 in India (Census of India, 2011) and 510 in Nigeria (Ethnologue, n.d.)) some services are not available in the micro-entrepreneur's language.

Impact:

Education enables smallholder farmers to apply more advanced farming techniques. Information about the environment supports them to adapt to difficult soil conditions and to prepare for natural disasters. Using information on both education and environment, they can increase their productivity and thus the agricultural output. Fewer products are lost on the way from the farmer to the consumer, as communication services facilitate a demand-oriented production and improve the timing of sale and storage. Finally, farming becomes more attractive due to lower costs and higher sale prices which is likely to increase the number of farmers and thus, again the agricultural output (de Carvalho, 2011).

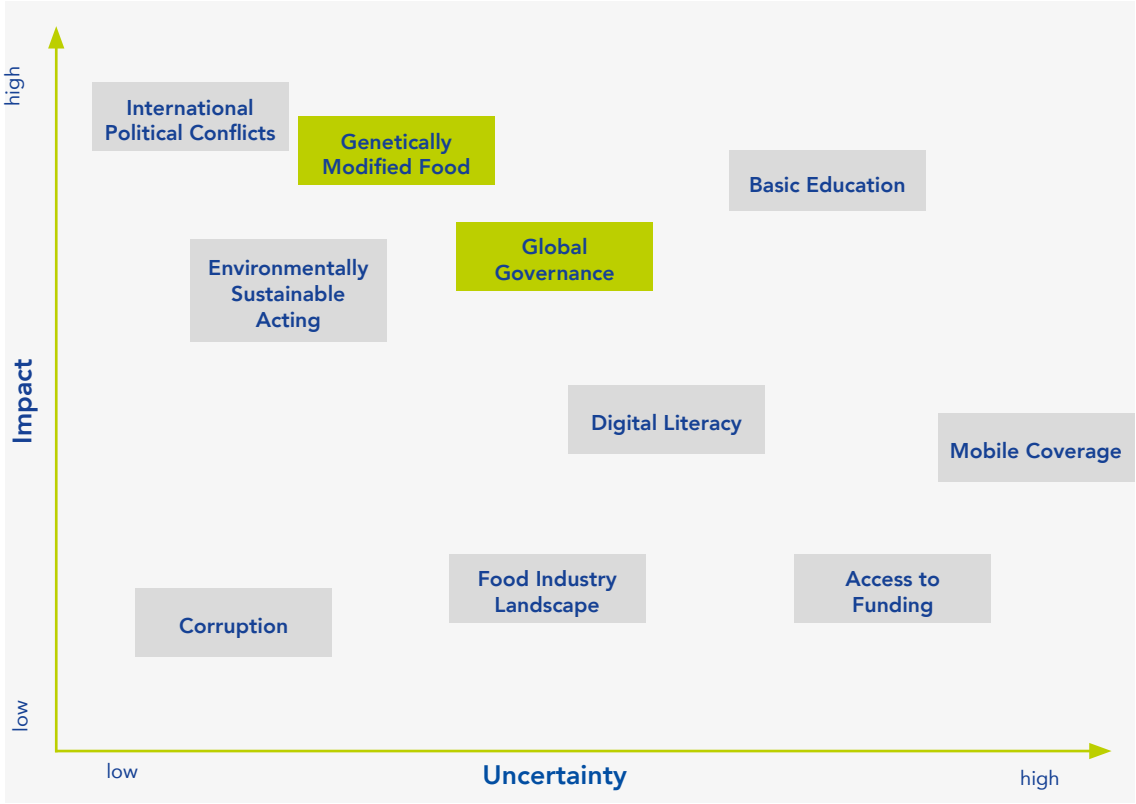
SCENARIOS

The following chapter describes four scenarios of different futures. They represent possible extreme outcomes of two key development drivers that are characterized by a high impact on hunger and a high degree of uncertainty for their predicted outcomes. Furthermore, we define signposts as events that are likely to happen between now and the year 2035 to illustrate a development towards one of the four scenarios. Stories of personas experiencing a day in 2035 help envision each scenario in its final state.

DRIVER MATRIX

The Scenario Building Phase follows a structured approach. Based on the research conducted in the Basic Phase of the Trend Seminar, drivers for the future development of hunger worldwide are identified. Drivers are distinct forces that have a major influence on hunger and are usually exogenous to individual organizations. All identified drivers are modelled with bipolar, extreme outcomes.

To select a suitable pair of drivers that helps us describe future scenarios, we rank them according to their degree of uncertainty and magnitude of potential impact. The graphic to the right depicts the result of this assessment. The two selected key drivers are highlighted with a green background: the degree of Global Governance and the penetration of Genetically Modified Food. These two key drivers are described in detail on the following two pages. Also, all other high impact and high uncertainty drivers are described briefly. Finally, the Scenario Matrix on page 56 illustrates which scenarios describe the four possible outcomes of these two key drivers.



KEY DRIVERS

Full Collaboration

Full Global Collaboration evolved as an association of all standing sovereignties from the former United Nations model. Severe humanitarian crises and other incidents concerning environmental degradation call for global unification and collaboration. This global authority demands collective actions and enforced political decisions to effectively respond to various crises, which often have significant impacts on food security and hunger. The nature of such a global association not only ensures global food security in critical ages, but also blurs national boundaries, increases global mobility, and narrows the inequity between developed and developing regions. However, it also raises crucial matters such as total surveillance, diminished individuality and reduced personal freedom.

← Global Governance →

Global governance refers to the act of collaboration between and across nations worldwide. A close international collaboration provides the political backbone to ensure food security and reduce hunger. It has direct impacts on food, such as trade facilitation, food standardization, and regulation. The indirect impacts foster global initiatives on environmental protections, counter global warming, and others. The current standing of the United Nations as well as other major international authorities are the starting points of this driver. The UN itself had to cope with several voices of criticism in the past, namely "inaction, inefficiency and indolence" (Arias, 1999), which are mainly caused by the lack of collaboration and enforcement power among member states.

No Collaboration

The UN is shattered. Governments become isolationists. Protectionism thrives. Terrorism, financial crises, and refugee movements strike one after the other. Multilateral and international negotiations halt. Eventually, global collaboration and pre-existing international organizations collapse. The complete suspension of international collaboration results in stringent border controls and decreased transnational mobility. It fuels corruption on multiple levels, especially regarding food. Trade persists, however limited, and is only retained by a few resource-hungry major players. The lack of international law and jurisdiction on issues concerning taxes, intellectual property, pollution and resource consumption indulges these corporations to exploit the environment as they wish - all of this under the pretense of "profit maximization".

No Food Genetically Modified

Genetic modification is not used in any step of food production in 2036. Sufficient nutrition is still unavailable for many people at the bottom of the pyramid as food prices increase. One reason is the spoilage of non-GMO plants which are more susceptible to diseases. Additionally, soil degradation due to climate change and former use of GMOs makes farming more difficult. Meat turns into a luxury good with prices exploding because a high number of crops is needed for animal feeding. To cope with food shortage, people around the world are taking measures like industrial farming, fertilization and landrace breeding.

← Genetically Modified Food →

According to the Encyclopædia Britannica, a genetically modified organism (GMO) is an "organism whose genome has been engineered in the laboratory" (Fridovich-Keil, 2015). Such organisms may contain physiological traits which make the food production more efficient and reliable. Additionally, GMOs can be used to produce biological products like biofuel (Sjøgren 2014), insulin (Walsh, 2015) and painkillers (Hoffman, 2015). In the following scenarios, we solely consider genetical modifications within food production. The first edible GMOs were tomatoes, created by scientists in 1994 (Bruening & Lyons, 2000). In 2010, 10% of the worldwide cropland was cultivated with genetically modified crops (James, 2011). Such plants can resist diseases and insects while having better nutritional value (Lobardo, 2015). On the other side, they are suspected to degrade soil and cause allergies.

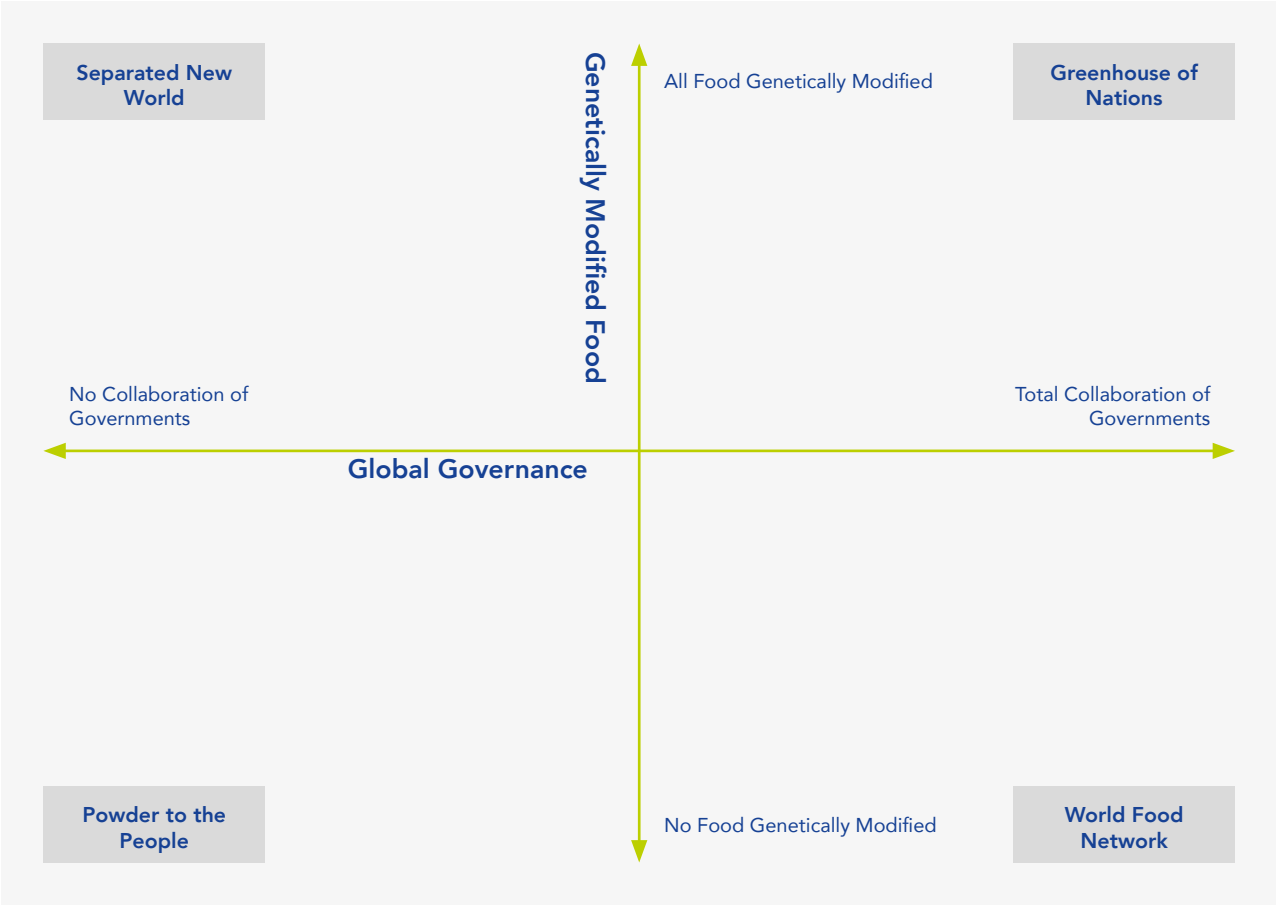
All Food Genetically Modified

The fight against hunger has been mainly successful due to genetically modified food. In 2036, every food product is genetically modified at some point in the production process. Therefore, many crops are more resistant to diseases and spoilage is reduced. Animals can be genetically modified to produce more and better quality milk, eggs and meat. Due to genetic modification, crops and livestock can survive under difficult environmental conditions. Thus, the price of crops and meat has dropped, while the quality has improved. The available food has helped to nearly eradicate hunger in many regions. While optimized crops are fitted to the needs of malnourished people, many traditional plants have become extinct.

OTHER DRIVERS WITH HIGH IMPACT AND A HIGH DEGREE OF UNCERTAINTY

Global Monopoly One powerful holding covers worldwide food supply	← **Food Industry Landscape** →	**High Willigness To Pay** Small companies competing in local markets
Environmentally Unsustainable Acting Mankind degrades environment in every way possible	← **Environmentally Sustainabe Acting** →	**Environmentally Sustainable Acting** Everyone considers the outcome of their actions
Conflicts Among All Countries Big military powers exploit weaker, minor nations	← **International Political Conflicts** →	**No Conflicts Among Countries** Countries fully agree on international decisions
No Education Nobody receives basic education in public institutions	← **Basic Education** →	**All-Embracing Basic Education** Everybody gets the same basic level of education
No Mobile Coverage Nobody can communicate with mobile devices	← **Mobile Coverage** →	**Total Mobile Coverage** Everyone can communicate with mobile devices
No Access to Funding Nobody has access to funding	← **Access to Funding** →	**Complete Access to Funding** Everybody has access to unlimited funding
Total Corruption Every decision is influenced by corruption	← **Corruption** →	**No Corruption** Corruption does not exist anymore
Low Taxes Intellectual property protection is enforced world-wide	← **Intellectual Property Regulation** →	**Open Source** All intellectual property is freely accessible and usable
No Social Safety Nets Nobody is covered by any social safety net at all	← **Social Safety Nets** →	**Compete Social Safety Net Coverage** Everybody's basic needs are covered by social safety nets

SCENARIO MATRIX



Philip Braun, Christian Gebhardt, Josephine Kühl, Christian Hülsemeyer, Lakmal Padmakumara, Hagen Schmidtchen, Chiara Secules

GREENHOUSE OF NATIONS

A day in 2035

Zainab is a mid-level farm manager in Banjul, Gambia in the year 2036. Unlike the generations before her, she has had the ability to wake up in the mornings unafraid of war, and supported by the social system in times of trouble. Ever since the Global Association of International Alliances (GAIA) came into power to regulate world politics through diplomacy and economic incentives, Gambia and the surrounding areas have been in a state of diplomatic conflict. Gambia's agriculture sector also benefits greatly from liberal trade opportunities, particularly in Genetically Modified Organisms (GMs).

Zainab left her simple hut made of recycled bottles in the morning at around 5am. The sun was just barely starting to rise and she could see the morning dew sparkling on the power lines along the gravel road to the farm. She made it to the bus stop with a few minutes to spare and pulled out her morning e-paper. Ever since the fixed bus routes and new city transport network were established, she has never once seen them run on time.

From down the road, Zainab could hear the soft humming of the electric bus coming around the bend. She shuffled in line behind the few other early risers and boarded the bus. Once inside, she pulled out her e-paper again for the 20 minute ride from the city suburb to the croplands just on the outskirts of the city. In bold, block text on the front page the words "Shocking GM deaths reported in France" jumped out. Unsettled, Zainab read further: "11 French scientists found dead in GM lab south of Paris. This lab houses an open innovation center for foreign scientists, funded by the GAIA public-private research foundation for food and agriculture innovation. The scientists were working on a new type of GM crop that produces its own herbicide and can store up to 10 times the amount of standard nutrients. However, in the process it seems that something went horribly wrong with one of the experiments and it poisoned the scientists working in the lab. Corruption and cutting corners may have lead to this negligence."

Zainab was both shocked and concerned. Before taking this job as field manager at the local Banjul cooperative Moko she had studied in one of the GAIA international crop research institutes as a funded scholarship student from the African development union. She got to know about many of the new crop innovations and how they could help the people of her country to have greater food security and productivity, despite the ever more variable climate conditions due to climate change. However, Zainab considered some of the research done at the institutes too extreme for her taste and she was worrying that it would one day come to a point where it would be dangerous. Her assumptions, sadly, were confirmed that day.

Despite the possible risks of new GM varieties, Zainab was still optimistic about the operations she was helping to run at the cooperative as it provided the people of her city with a more stable food supply than before. The only concerns she had were that the crops were not that diversified. Furthermore, despite the crops having more nutrients, this still could lead to instability due to threat of disease and possible unintended malnutrition.

The bus came to a gradual halt at the entrance building to the cooperative farm. Zainab descended the steps into the hazy morning sunshine and entered into her two story office building to the refreshing breeze of buzzing fans. She proceeded to the control room to start her day.

On the wall was a projected screen showing the data from the crop sensors over the last week and a map showing where the automated machines were already checking, assessing or tending to the plants. Even though most of

the work on the cooperative farms had been given over to automated processes, there were still people who monitor the control systems and sometimes inspect the crops by hand. The technology that their cooperative could afford, even with access to funding, wasn't as good as in Europe or the USA, but it was still fairly efficient. They were able to produce more food per harvest than with traditional crops, which also due to GM cultivation and weather changes were no longer able to grow anyway.

After she had a look at the overnight data, Zainab went into a meeting with a few of the farm inspectors who were just out on the field for the morning maintenance round. One of the inspectors, an older gentleman with a sun-etched face, had a rather solemn expression. His name was Jacob and for the majority of his life he had worked as a small farmer. Now he had sold his land to the cooperative, for which he also works. He was one of the few of the older generation who was skilled enough and determined to find work in this new digital age of agriculture. This was however, more due to his expert knowledge of plant diseases than his aptitude for technology. Despite the majority of the plants being monitored by sensors and tended by machines, the cooperative still used experts like Jacob to be the first line of defense against new or unknown crop ailments.

Once the last of the inspectors entered the room and closed the door, Zainab immediately asked Jacob to share what was troubling him. He shared that he had been inspecting the crops in sector D4 of the GM strawberry cropland and that he had found strange blue spots growing on one of the plants. This immediately startled Zainab, as she had heard of some other strawberry fields falling ill to the same problem, which resulted in massive harvest losses and replanting. Jacob had also brought a sample with him, which quickly confirmed that the plant was indeed diseased and has to be removed immediately before the disease could spread. Zainab commended Jacob for his sharp eye and immediately alerted the extermination team via her wristband to quarantine and burn the diseased crop and its neighbors to be safe. With so much to do, Zainab quickly adjourned the meeting and went back to the control center. She started monitoring the progress and doing some follow up research on what kinds of new seeds she could order that might be resistant to the blue disease.

After pushing the analysis button, the data analysis of climate and risk scenarios ran on her display, ending with an output of three seed varieties of different price ranges. She would have loved to purchase the new resistance-V series strawberry from Canada, but it was a bit out of the cooperative's price range. She settled for the cheaper version and sent the digital payment order over the global currency system. She was very pleased with this system. In the last 10 years many technologies had 'leapfrogged' their way into the agriculture sector with rising infrastructure and optimizing of imported technologies, making development and food production much more efficient.

Satisfied with the outcome, Zainab went out into the sunny haze to take a late lunch break. She was exhausted, and went to the cafeteria to order her favorite dish: the corn salad with vegetarian beef and a strawberry fruit salad, fresh from their farm. She really liked the cultured vegetarian beef. It was no longer such a luxury to eat meat in Gambia, because as it could now be grown, it costs a lot less. However, she did miss some of the foods she used to eat as a child, like her mother's white bean soup. The white beans were not yet available as GM varieties in Gambia and the natural varieties had died out from the climate change years ago. She secretly hoped to acquire some seeds in the cooperative during the next few years so that they could grow the beans again.

After her lunch break, Zainab went back into the control room to check on the progress of the extermination team and the instruments. To her delight, everything seemed to be going smoothly and it was reported over the screen that the crop disease had not spread to the neighboring crops. This was a relief. Even though the GM crops were quite resistant, they still had trouble keeping up with nature. Scientists were usually able to quickly modify seeds to be resistant to new diseases, but these diseases had to be identified first.

Looking at the clock, it was 5pm. Zainab, pleased with her day at work, saw no reason to stay late again and decided to pack up and go back to her family home. She was looking forward to enjoying a fruit and cultured steak dinner cooked by her dear brother, Ajuma, who was also coming home early from his job in the city. Despite the mishap, it was a good day in Banjul.

Signposts:

- 750 million people are covered by Global Alliance Social Safety Network in Africa
- Robots take over GM farms: harvest productivity quadrupled in Sub-Saharan Africa and quintupled in Asia
- New hybrid species grow meat for commercial production
- North Korea signs treaty to be the last country to join the global trading zone GTIP
- Genux, the open source platform of the three biggest global GM companies, breeds ecologically sustainable GM plant
- "Kyoto 2.0": UN nations decide upon globally binding environmental actions: USA, Russia and China might make global alliance possible
- Nations of the world unite in global governance: foundation of Global Association of International Alliances (GAIA) is a ground-breaking milestone for global peace and prosperity
- Global food industry structure enables friendly coexistence of global supra brand and specialized global niche market players to enable global food coverage
- 98 out of 100 people have access to basic digital financial services: inclusion of BoP accelerates
- GAIA celebrates achieving the majority of millennium goals this year

Patrick Kastner, David Hahn, Janis Marquardt,
Yingxi Chen, Ferran Pla Cardona

WORLD FOOD NETWORK

A day in 2035

"Don't forget the meat after work, we haven't had some for almost a month and mum wants to cook some tonight", Bob's father shouts as he leaves the house for work. It is 7:00 AM in Manghan City, a large city in Sub-Saharan Africa. Bob is happy that the week is almost over. "Only one more day and I won't have to see those stupid plants anymore", he murmurs. In the beginning, he was happy that his brother got him a job at the Vertical Farming Corporation, even though he was just 17 years old when he started. Working and studying at the same time turned out to be more intense than he had imagined. Bob is a freshman studying Food Economics and participating in online courses almost every day. The university he is enrolled in is also located in Manghan, but it would take him over two hours to reach it by bus. This is why he decided to enroll in the online program. Bob is a young, enthusiastic and ambitious boy who has always looked up to his older brother Balabi. Through increased government subsidies and funding options, Balabi was able to set up his own social business, which he handed over to his co-founder a year ago and now works for a GAIA Agency in Europe. GAIA stands for Global Association of International Alliances, the new World Government that evolved from the UN due to the global food crisis that irreversibly damaged the majority of farmable land in 2025. Since then, more and more people began to work in international organizations in order to foster collaboration.

Every morning when Bob arrives at work, just a few blocks from home, he talks to the guard Tayo. Bob receives his suit and politely listens to Tayo complaining about the latest tax increase on meat. After putting his personal belongings in his locker and stepping into the smelly suit he hated, Bob starts his shift.

"Bob? … Booooob!", his boss yells. "It is already 12:30 PM! Your shift is over! Get out of here or I'll have problems with the work council again. They know everything nowadays!" Bob, a little confused, leaves the greenhouse, takes off his working suit and can't wait to get out of the building. "Damn!", he thinks, "The meat dealer only sells until 1pm on Fridays". Fortunately, his friend sent him a voucher for one of the new E-Bikes that are now available in every street in Manghan City.

He grabs a bike, unlocks it and rides to Meat Alley, a black market place for meat and other costly goods like dairy products. During the course of the crisis, food prices skyrocketed as a result of new restrictive regulations and taxes. Fortunately, Bob always receives discounts on most products since his dad still knows many of the dealers, as he used to work with them in the small farms in the old days. "Lucky you! It is almost 1:00 PM! Well, beef, I assume?! It's the last Friday of this month, isn't it, Bob?!", Mbundu, the vender, greets the boy. Bob happily confirms and after a hesitant look over his shoulder, he swipes his iPhone 16S over the sensor and receives his receipt that is almost one third of his monthly income.

When Bob comes home, his mum gives him a kiss and thanks him for picking up the meat. His mum always makes him feel like everything was ok, and he often wonders how his brother could cope with being so far away from his family. After lunch, Bob grabs his laptop and steps outside into the yard to study a bit. A few years earlier, his family had been able to plant seeds in the garden and grow some decent food, but the use of genetically modified seeds from the west, irreversibly drained their soil, as in other parts of the country. On Monday, Bob is going to write his food exam, which examines the knowledge of freshmen about healthy and sustainable nutrition. As an incentive, successful test takers are allowed to increase their individually assigned food by 10%. The program was established a year ago by the World Food Network, an initiative by GAIA. As the afternoon passes by, Bob becomes tired of studying. Fortunately, his dad asks Bob to follow him into the house and say hello to his brother. Bob's eyes widen and he rushes inside.

Bob is happy to finally see his brother again, although he is just a hologram, projected into the air of the living room. "Balabi!", Bob welcomes him, "How are you?". Balabi has not been able to speak to his family for a long time. His workload has risen due to protests against the decrease of nutrition quotas in Europe. Bob still remembers the day, when GAIA declared total collaboration amongst all countries of the world. This action was taken to cope with the food crisis in which roughly 50% of all farmable land had been destroyed by the extreme use of Genetically Modified Crops. Consequently, GMs were banned entirely by GAIA.

Balabi makes an exhausted impression. "Tough times, tough times...", he sighs. "I am sure you heard about the undernourishment protests. The US and Europe are going nuts! Of course, since every person in the world is assigned a precise amount of food per day, they feel unfairly treated from their point of view. They have to pay tons of money if they want more!" A few years earlier, it was still easy to circumvent the Food Index regulations. But since the introduction of total surveillance using artificial intelligence and the Body Manager (BM) in the World Food Network, committing fraud is becoming more and more difficult. The BM measures the nutrition in one's body through sensors in your blood vessels in order to identify the degree of total undernourishment of specific regions and countries. This gives GAIA the chance to allocate resources more accurately and according to the food index between well-fed and undernourished countries, while at the same time, allowing governments to match your personal nutrition with your expenditures.

"Those over-consuming, insatiable gluttons!", Bob's father jumps in." For hundreds of years, they have been taking advantage of us and now that they are dependent, they complain!" Bob's father always gets quite worked-up in conversations like this. Balabi tries to calm down his father and gets support from his mother, who is preparing the meat in the Kitchen. "Pakka!", she yells from the door, "if it was not for GAIA, their global governance and the efforts of equal food distribution, we would still live as we did when we were young. Beans every day and sometimes not even that. Would you prefer that? A life without any security? Now, we even have the GAIA Health Insurance." Although Pakka seems to understand her point, he still mumbles some words under his breath.

Balabi takes advantage of the situation and directs the conversation to a new topic: the actual reason of his call. His voice turns quieter and more serious. "Listen", he starts. "You know I try my best and work hard. I mean… this is the reason why I am in Europe." Even though the gap between developing and developed regions narrows in terms of living conditions, wages still differ a lot. This is why Bob's brother chose to benefit from the new mobility opportunities - leaving his home country and supporting his family from abroad. "I'll only be able to transfer half the money next month", he continues. "The price for food here is an absolute nightmare and to make sure that I don't starve, I'll have to spend almost all of my money on nutrition. I am so sorry." He stares on the floor while he waits for a reaction from the family. "Balabi…", his father begins. "You know that we are proud of you. Don't feel bad about this. We will make it. Bob is helping a lot in the Vertical Farming Corporation and I still know my fellows at the market, if you know what I mean." Balabi starts smiling. He looks up and even though the hologram connection got pixelated, he saw his father wink at him. Balabi seems relieved and the conversation continues to take its course. At the end, Balabi tells Bob to look for his old food test study materials in the cloud storage. Finally, as the hologram fades, Bob's mum arranges the food on the table.

It smells delicious, Bob thinks, he still recalls the first time he had meat. It was his 10th birthday. His parents told him that he would not have a younger sibling anymore, due to the one child policy, implemented to cope with the dramatic population growth. To cheer him up, his family prepared a barbecue, as he had always wished for a younger brother. After dinner, the family puts on their virtual reality glasses and starts streaming a history documentary about postcards, as Balabi had recommended. Before going to bed, Bob once again reviews for his upcoming food exam and then falls asleep after a long, but rewarding day.

Signposts:

- Population reaches 9 billion people
- Food security increases slowly
- GMs are found to cause irreversible damage to soil
- 50% of the world's farmable soil is destroyed
- Food supply worldwide reaches critical level
- Severe humanitarian crises such as famine, hunger, undernourishment, and food refugees in both developing and developed countries become more frequent
- International collaboration is established to counteract the food crisis and other crises
- Global governance intervenes with full collaboration of its member states primarily on food security issues
- World Food Network (WFN) is implemented, a mobile safety net that provides a calorie quota to each individual with a minimum and a maximum of free food supply
- Calorie consumption, especially in terms of meat, is strictly regulated worldwide

Sophia Wessling, Kim Borrmann,
Marius Wiggert, Peter Juras,
Johannes Stanggassinger, Michael Fröhlich,
Jakob Gebauer

POWDER TO THE PEOPLE

A day in 2035

The vibration of her wristband wakes up Nia. It is still dark outside and her first thought is whether the charge of her solar powered battery will be sufficient to cook breakfast. She starts the day by heating up a pot with water on the electrical cooking plate. She carefully weighs out the rationed nutrition powder for one adult and two children. After a moment's hesitation, she adds a handful of dried fruits to the porridge of dissolved powder. While waking up her children Kibwe and Mara, she thinks about her husband Hamisi and how hard the times have been since he died in the civil war. If only her two elder sons would still be with them, life would be a lot easier.

"I want more, Mommy," claims Mara clinging her spoon against the empty bowl. "Then you won't have any at the end of the season - don't be too sad, tonight will be the harvest celebration. Plus, you should never forget that we were far worse off some years ago," answers Nia. Five years ago, one of the most serious droughts led to a millennium famine that killed millions in Kenya. Many things had changed since Nia was a child herself. After the western countries stopped their involvement, a civil war and an increasing number of droughts changed the Sub-Saharan landscape dramatically.

"Do we still have to study an hour on the tablet before the harvest celebration?" Kibwe carefully asks his mother. "Of course! I want you to study, so you'll be able to receive higher education. Remember how much daddy loved his job as an engineer?" Nia replies. "We're not in the city anymore, what would I need higher math or history for?" Kibwe mumbles into his food. Disappointed he texts his girlfriend that he won't have time in the afternoon. Nia sighs, "Enough already! Finish your breakfast. We have to leave for work in 5 minutes."

On the way to work passing, by the opening shops, Nia cannot help herself thinking about the future of her children. Wasn't there some truth in her son's complaint that additional studying seems pointless? Over time, the incapability of the corrupt government to handle the frequent food-shortages led people out of the cities and back to the rural areas to work in agriculture based communities. By these means, they are at least able to live self-sustainably today. However, instead of formal education her children now learn about how to maintain the community businesses with the other children in the Thikama-community. Nevertheless, she still keeps her hopes up that the community would be able to save enough money to send at least a few children to university - and maybe these lucky ones will be hers?

Nia drops her children off at the community's building which

states in capital letters "Shule na Kazi". Literally translating to "School and Work", this is a place where children are taught tribal knowledge and learn everything about farming and the relevant technologies while helping out with the harvest. Nia turns and runs her eyes over the large fields. The vast size of the land prevents her from making out the end at the horizon. Before entering the farmhouse, she walks past the buildings providing breeding space for insect cultures. Nia wonders when they will exceed their spatial capacity but luckily that is none of her concern. She mostly works on her computer to perform the analyses, as she is one of the few with a university degree. The rich harvest of this year is an indicator of her good work and she is proud of it. Enough daydreaming - she needs to focus now. Her first task is to access the most recent data on NAP, the National Agriculture Platform. It contains not only weather forecasts but also data on soil conditions and crop growth of all farms across the country. The platform is open source and free to use for all the small farming communities. The data which is collected by sensors that are placed in the soil to evaluate its humidity, nutrient content and density, is also shared with other communities. By adding demographic data of each community, Nia is able to forecast the demand for the coming months. Based on this, she calculates how much food is effectively needed for fresh supply and how much can be set aside to be conserved as nutrition powder. The harvested crops, as well as the insects, are processed to a powder so that it contains the most necessary nutritions in a condensed form. On the one hand, this is part of the daily basic diet and on the other hand, the preservability of the powder makes it a perfect provision for the next inevitable crisis. An accurate distribution plan of the current food supply is particularly crucial since the data is signaling a drought for the coming year. After having set this week's harvest goals, Nia switches to the aerial pictures of the farmland which were collected by a drone yesterday. A software automatically detects areas where crops grow slower than the average. The workplan is then readapted to ensure that those crops get more attention.

Nia's wristband vibrates, it's time for lunch. The wristband measures how active a person has been during the day and calculates the number of calories he or she receives. In Nia's case it is 385. She goes down to the kitchen where the portions for the employees in her building are prepared. There she meets her older colleague Baha who is responsible for the seed selection. They are talking about the latest hybrid

of two barley seeds, which may be drought-resistant, when the topic leads to seeds they used years ago.

Baha explains, "The soil was severely exploited by the genetically modified corn, it took us quite a while to find out which seeds will be able to grow on these fields." Nia asks, "I know that we also had some GMs, but weren't they illegal the whole time?" "That's true," replies Baha, "We still got some through aid packages though. Luckily, these packages became scarce, so we never relied completely on GMs.

In some other countries however, it was a huge deal. When scientists proved that GMs were the reason for severe soil depletion and allergic reactions, one country after each other banned GMs." Nia adds," I know that some Asian countries still have not recovered." "Times were tough here as well. Anyhow, I have good hopes that we are on a good way now," finishes Baha. Nodding in agreement, Nia still finds herself to be amazed by the efficacy of the current approach. Who would have thought that going away from systematic national breeding programs and focusing on local landraces was the key to evolving resistant crops that were sustainable in the long run? Beside the local crop hybrids, insect farming has become very important in food production. Containing proteins, amino acids and fat, milled insects constitute up to 20% of the highly nutritious powder.

After work, Nia buys the latest update for Kibwe's study-app via mobile money. She wanted to do that for days but had to wait for her monthly salary. Kibwe and Mara finish their daily study program and when they finally reach the community house, it is already packed. It is the annual harvest celebration that was introduced after the millennium famine when the agricultural yields were picking up again. Everyone is there - of course no one wants to miss the feast. While everyone is anticipating the food, the tribal elder gets up to hold the traditional speech. Thanks to a successful harvest, the elder is especially enthusiastic to announce that this year's surplus is so high that they will be able to afford the new self-driving AfriTractor. After the speech, Nia overhears a discussion between her neighbour and some other men on the table, "You know, I am so excited that the AfriTractor is completely build by recycled, local resources and therefore, we'll be able to maintain it. Imagine we would have easy access to financing, then we could have bought it a lot earlier!" "Compared to other communities we are quite well off…" Nia replies and it reminds her of her sister who still lives in the city. As the direct access to food is limited in urban areas during crises, most citizens depend on knowing someone in regional food production - especially because there is no global agriculture industry. Nia takes a digital note to consider her sister in her nutrition powder savings.

For the first time in two months they had a decent meal. Meat is a rare commodity, especially since GMs have been banned. Animal feed just got too expensive for large scale animal farming. All in all, the plates are not overloaded but still fuller than at a usual dinner. She looks around and is satisfied with what she sees: everyone is included in and cared for by the community - even those who lost their families because of the famines.

It is already dark when Nia and her children go home, silently enjoying the feeling of a full stomach. Today has been a good day.

Signposts:

- An increasing amount of countries with nationalist governments enforce protectionist policies
- Scientific consensus on adverse health effects of GMs
- Growing international disputes due to complex crises (e.g. refugee, financial, terrorism)
- Stronger border enforcements and less mobility
- Strict national regulations for food production
- Opposing national interests make consensus-based UN resolutions unachievable
- Unprotected international IP and new regulations make GMs unprofitable due to high research and development costs
- Humanitarian aid and financial credits for developing countries are cut
- Ban of GMs in more and more countries

Tobias Dümmling, Christian Feuerbacher, Adrian Hesse, Mary Clare O'Donnell, Martin Patz, Lukas Rambold

SEPARATED NEW WORLD

A day in 2035

Rose rises at dawn from racing thoughts to gaze over the sleeping city of Lagos. Obi, her husband, breathes quietly. She has lived in the capital city for more than a decade, but on mornings like these, her mind still travels back to her village in northeastern Nigeria. Like many other young Nigerians, she moved to the capital to find a safer place to work, and a stable source of income.

From her kitchen window, anyone could see how Lagos had changed in recent years: a higher skyline, more developed infrastructure, and an ever-growing population. These were not the only shifts. The changing climate had made the midday heat in the city unbearable. Generally, Rose preferred not to think about these problems, instead turning her thoughts to the breakfast. As with most mornings, there were processed breakfast cereals, and heaps of genetically modified fruit - the only fruit available.

Many of the citizens of Lagos, including Rose, had experienced digestion problems with the 1st generation of GreenCorps™ food products. Now she barely registered the fruits' sweetness or size. When the 3rd generation of modified foods came out, her digestive tract had stabilized. She nevertheless had a certain, uneasy feeling about the situation, but there was no alternative.

On a global scale agricultural production had long since transitioned to a complete reliance on genetically modified organisms (GMs). They were the only means to guarantee that crops would survive the rising temperatures and the increasingly volatile climate. That fact alone spurred further rapid food industry consolidation. The clear winner of this race was GreenCorps™, the pioneering GM crop technology company. GreenCorps™ had then become a monopolist in most countries across the world, with Africa in particular.

Obi comes into the kitchen to kiss Rose goodbye before leaving to his job as a border patrol. From the doorway he says, "sorry, no football-shaped objects for me this morning...", tossing and catching an oversized orange midair. He chuckles, entertained by his own joke. The military self-driving transport that bears him and the other troops to Nigeria's western border is waiting. "Looks like it will be… NutriSquares! Delicious converted dog biscuits... the best part of modern nutrition! This lovely advanced era we live in!"

Laughing more, this time with a mouth full of dense crumbs, he drapes his military jacket over his shoulders. As he flies out the door, Rose shouts after him: "You won't be needing more food then!" Somehow NutriSquare bars were mysteriously filling. She herself could not eat an entire square. Obi seemed to have no such issue. The man could consume a box in one sitting.

Along with the many things she prefers not to think about, Rose hates imagining the border. It gives her nightmares. She asked herself, if the use of nutrient-added food supplements was worth it that Obi spent his life removing undetonated explosives. He and the other soldiers devoted blood, sweat, and tears to holding together the fragile security of the state. And for what?

As time-notifications buzzed on her screen, she tried to focus on preparing her daily lesson. Rose made her living as a teacher, but like Obi, she was perpetually running late. Old habits die hard. The same with her undying love for walking and cycling. Most Nigerians now preferred private transport drones. However, she had no choice today but to order one of the drones from overhead, where they cluttered the already polluted airspace.

Rose's school was located at the heart of the mega-city's last remaining slum, built on stilts extending out into the lagoon.

No aspect of the school's nondescript concrete revealed this history. In a single classroom, one hundred children sat before gleaming smartphones. The only imaginable advantage of teaching a class this size was that all children now had access to basic education, and a daily meal. There was no shortage of digital, automated solutions to handle a class of this size - an application tracked the students' progress. This left Rose with what at times felt like a merely supervisory function.

"Good morning, students," Rose chimed from the front. Healthy, well-nourished adolescents gazed back at her. She

had not lost the memory of how it had been before, with students distracted and listless from hunger. This reminds her of the need for their generation's compromises. Because of this, there could be a food-at-school program; one of the many public-private partnerships between GreenCorps™ and the Nigerian military regime.

In exchange for pledging support to social projects, GreenCorps™ held free reign over a monopoly within the national market. Rose witnessed the positive impact of the corporate sponsorship, but corruption played a large part in it and made her feel uneasy. What worried Rose particularly was that the financial system, entirely regulated by the government, was also tailored to the monopolist's needs. Funding for new ventures hardly existed.

"Please look up from your devices, students, as we will now begin our sustainability workshop. What does sustainability mean to you?" One child's hand shot up: "Benin, not throwing their trash into our seas!" Many pupils in the class nodded. "The Government's anti-smog program, of course," another pupil in the front row adds eagerly. Ominous traces of nationalism invaded every aspect of life in her country, and it was not absent from her classroom. Rose could understand that her students, from one of the poorest neighborhoods in Lagos, had reasons to support the regime. Their families benefited from the programs instituted after the government coup, with the financial and logistical assistance of GreenCorps™.

It was a fact: nobody in Nigeria went hungry any longer. Instead, the poorest ate overripe, outdated foods from the last generation of food modifications. GreenCorps™ did not permit this to be discussed as a different, continued form of inequality. Tired and deep in thought, Rose rides the dilapidated public transport system back to her neighborhood. Lagos' old city transport system remained, though only barely, for those who could not afford other means of travel.

Once back in the small apartment, Rose scans the hallway for her husband's boots - a reflex rooted in permanent fear that one day he would not come back. "Thank God, you are here!" she sighs, entering the kitchen. She cannot understand how Obi, deployed at the border day in and day out, can maintain such positivity.

It was less than a decade ago since the regime introduced the military draft to secure the country from external invasions and inner upheaval. Obi's mandatory service had ended, but he had opted to continue an army career out of pragmatism. Obi had dreamed at one point of being an entrepreneur, developing sustainable solutions to Nigeria's pollution. Insufficient funding made it virtually impossible, in a system where competition was prohibited by corrupt government contracts with GreenCorps™. Hence his idea would remain a dream forever. Obi made do with the job he had - it was, after all, a well-paid job that allowed them a good standard of living, and to afford high-end food modifications. For him it was also a matter of pride in these insecure times.

"Hello, sweetheart!" Obi greeted her from the sofa. "How was it all day at the border?" she asked reflexively, then hesitated, nervous to trigger any memories. "Much the same as always," he shrugs, avoiding her eyes. To distract her he leaps up, his tall, gangly frame bounding towards the kitchen, to prepare their predictable supper. As they cut, chop and boil together, Obi returns his eyes to hers, and opens up further about his day. For the first time in months, there were no major incidents. Neither Obi nor Rose believe the situation will improve anytime soon.

In their neighboring country, Benin, ongoing draughts had turned a once fertile land into desert. To protect local farmers, the Benin government refused to open the national market to GreenCorps™. As there were internationally enforceable intellectual property regulations, GreenCorps™ kept obsessive secrecy over their patents. Benin instead tolerated bad imitations of drought resistant seed lines, leaving their population malnourished, and at worst suffering from serious health problems. The desperately poor suffered the worst, and made daily attempts to cross the border. Sectarian groups forced out of the country in the military junta of 2026 continued to plot attacks on checkpoints, including the one where Obi was posted. The Nigerian Government, meanwhile, refused to allow in the refugees from Benin. This disturbed Obi and Rose, but they reminded one another there was nothing to be done. It was a conversation that had continued for years, as with the discussion of Obi's job at the border. At heart it was the same issue: complete lack of opportunity outside the grasp of government, military, or GreenCorps™.

The life Rose and Obi led together was more comfortable than any they had previously thought to imagine. There was no longer cause for fear over where their next meal would come from. If the day left them too tired, as with today, they had enough to eat. At least this was something. As they lay down their heads, and prepared for a new day, Rose's mind ran once more back over the day. But this time, hand in hand with Obi, she can fall asleep.

Signposts:

- Authoritarian regimes increasingly take over destabilized systems throughout the world
- Refugee crisis leads to irreconcilable disunity among most countries
- Establishment of protectionist trade policies lead to a steep decline of overall global trade
- As an outcome of consolidation in most industries, global monopolies arise
- GMs reach a higher productivity level than regular crops and thereby gradually replace traditional agricultural products
- World population reaches 10 billion people. The food demand exceeds supply
- International environmental efforts and agreements come to an end
- Pollution of seas, climate change, and the widespread use of monocultures reduce biodiversity

IDEATION

The following chapter gives an overview on the ideation on process, which for the first time included an open innovation challenge, followed by internal ideation on workshops. Out of 200 ideas, five were chosen to be developed further into detailed concepts. These five concepts and corresponding business models are described based on the Osterwalder Business Model Canvas, Blockchain Model Canvas and Social Business Model Canvas.

Philip Braun, Josephine Kühl, Martin Patz,
Ferran Pla Cardona, Marius Wiggert

BLISS

Commodity Monitoring Solution for WFP's Downstream Chain Using Blockchain Technology

The Blockchain Logistics Integrated Support System (Bliss) is a monitoring system for the downstream supply chain, which covers the route from the WFP over Co-operating Partners (CPs) to beneficiaries. The current paper-based monitoring process is very resource-intensive as it requires secondary checks and a third party involvement. Additionally, the error-proneness of manual checks sometimes results in the loss of commodities, double serving, and fraud. Bliss offers a solution to counteract these challenges with a digital and automated supply chain monitoring solution, enabling transparency, reducing redundant work, and obviating the need for secondary monitoring checks. By solving the problem of the opaque last mile, Bliss has a great potential to support the WFP to fight hunger in the digital era.

The digitalization and automation of the monitoring with Bliss requires both hardware and software. First, a database stores a reliable record of the transactions, including the delivery routes, delivery times, transfer points, and identities of the involved stakeholders. The disruptive innovation behind Bliss is blockchain technology, creating a decentralized and distributed database. It prohibits unverified transactions and changes of the ownership history without a majority consensus. The shared and tamper-resistant records prevent fraud, hinder double serving of beneficiaries, and enable the detection of commodity losses. Second, Bliss provides the WFP with the necessary technology devices to facilitate the tracking. In the WFP storages, automated labeling terminals tag the smallest commodity units (SCUs) with QR codes and assign IDs to them. Bliss sells smartphones, which are equipped with fingerprint scanners for the beneficiary identification, to the WFP, that gives them to the CPs.

The self-sustaining revenue model of Bliss consists of licensing fees, payments for reports, as well as selling and renting out hardware. The WFP pays an annual licensing fee and monthly payments for single user access to the software. Based on the scope of the tracked project, reports are offered in different versions and charged with a tiered payment accordingly. The third source are revenues from renting out QR code labelling terminals and selling smartphones with fingerprint scanners.

Blockchain Business Model

System Touch Points

Physical Touch Points
- Fingerprint registration
- Commodity registration
- Distribution of commodities from WFP to the CPs

Digital Touch Points
- Integration with LESS (Logistics Execution Support System)

Technological Distinction

- Ensuring consistency in a distributed shared-write database
- Independently verfied tracking

Key Dependencies

Physical Devices
- Smartphones, computers, printing terminals, backend servers

Other Dependencies
- Development team
- Blockchain platform

Value Proposition

- Lean automated supply chain monitoring process
- End-to-end transparency of the downstream supply chain
- Immutable ownership history
- Fraud prevention

User Relationships

- Beneficiaries will be in contact with a digital delivery confirmation tool
- Less WFP monitoring teams in local NGOs

Leadership & Marketing

- Supply chain leader: SAP
- Blockchain leader: Ethereum
- Direct sales and key account management
- Customized solution for the WFP

Customer Segments

- End-customers in rural areas
- End-customers in urban areas
- Businesses with internal networks
- Mesh application developers

Time

- Software conceptualization (mobile app + data analysis tool)
- Integration with the existing WFP environment

Revenue Streams

- Licensing
- Price differentiation for reports
- Selling and renting out hardware

Value Proposition

Bliss' core mission is to offer a supply chain monitoring solution that enables transparency and security for the WFP downstream supply chain and in particular the opaque and decisive last mile to the beneficiaries. The monitoring process is currently paper-based and involves secondary checks and audits of different CPs, resulting in delayed and unverified reporting. As an integrated monitoring solution, Bliss will digitalize and automate the last mile monitoring process. However, Bliss goes beyond mere monetary cost savings and transparency increases - it can be an important enabler for securing food for people in need.

Lean Automated Supply Chain Monitoring Process

Bliss obviates any need for secondary verification, reducing work redundancies and third party monitoring to a minimum. The lean and automated monitoring process simplifies the tracking of the commodity handover from the WFP to the CPs to the beneficiaries.

End-to-End Transparency of the Downstream Supply Chain

Bliss enables end-to-end transparency of the downstream supply chain for all the stakeholders such as the donors, the WFP, the CPs, and the beneficiaries. The monitoring process gives transparent information about transactions, including the delivery routes, delivery times, transfer points, and identification of the involved stakeholders. On the one hand, it simplifies existing structures. On the other hand, it builds up monitoring capacities for still uncovered parts of the opaque supply chain.

Immutable Ownership History

Bliss offers a trustworthy database of shared and tamper-resistant records. As it relies on a blockchain database, performing invalid transactions or changing information without majority consensus is not possible.

Fraud Prevention

The secure and trustworthy database allows the verification of the beneficiaries' eligibility thanks to digital IDs and fingerprint scanners. This reduces double servings of beneficiaries and sets high barriers to commit fraud with commodities. Since the WFP relies on a large number of CPs around the globe on a daily basis, the omittance of a leap of faith is a huge advantage to reliably serve the beneficiaries with food.

User Demographics

Bliss' User Demographics revolve around two central questions: for whom do we create value? And, does the user need to be aware of how the underlying technology works?

Value Creation for all Stakeholders

Bliss creates value for the WFP as it enables the lean, decentralized, and fraud protected tracking of the last mile delivery. CPs benefit from a trustful relationship with the WFP as the last mile transparency removes possible suspicion. The value for beneficiaries lies in the tracking of "who receives what". Bliss ensures that every beneficiary receives his fair share of the available food. In a future fully integrated system, the blockchain technology could create end-to-end transparency even up to the donor, providing him with rewarding details of how his money was used.

Low Necessity of Blockchain Technology Awareness

Bliss will be an out-of-the-box solution with an easy to use interface that does not necessarily require its users to understand the blockchain-based backbone architecture. However, for Bliss to achieve its full potential, some users should be aware of the implications of a blockchain database architecture. For CPs, it is useful to be aware of the fraud prevention mechanisms that a blockchain architecture imposes. In particular, the immutable ownership history as well as the prevention of double serving. In a potential fully integrated system, the donors involved should be aware about specific blockchain concepts to fully trust the provided insights. Especially the concepts of a decentralized database with smart contracts and an immutable ownership history are useful to understand the value of the blockchain architecture.

User Relationships

There are four major groups of users who are in contact with our services: the beneficiaries, the CPs, WFP employees working along the supply chain, and people working with the data stored in the blockchain. These groups interact with the services provided by Bliss as follows.
The beneficiaries will be in contact with a digital delivery confirmation tool for the first time. Thus, their interaction when receiving food commodities will increase. This could reinforce trust in their own community because receiving multiple aid packages is impossible.

Contrary to the beneficiaries, the CPs have been partly in contact with a commodity tracking tool (COMET) in the past. This interaction however was paper-based and is now replaced by a fully digital solution. Complying with this new system increases the CPs' reputation for the WFP. Moreover, the CPs will be provided with more training and help, insofar as the WFP staff will spend less time with human monitoring. Eventually, compliance of the CPs will be a mandatory requirement in the lucrative support contracts of the WFP.

One step up in the value chain are the WFP employees that hand out the commodities to the CPs. They are located at the intersection between the upstream tracking system Logistics Execution Support System (LESS) and a paper-based downstream tracking system. Especially in the non-automated case, registering and tagging each SCU requires a higher interaction. With the introduction of Bliss, the WFP needs less monitoring teams in the field since committing fraud is harder. These human resources could compensate the higher work demand in the WFP warehouses and ensure a proper use of Bliss.

Groups that are physically interacting with the supply chain require a setup and instruction service. They can also rely on on-site or telephone support provided by WFP call centers.

The last stakeholders involved with Bliss are those who work with or analyze the data stored in the blockchain. As Bliss is the last piece missing in the supply chain tracking sequence, it provides a whole new range of opportunities. Donors can confirm that their donations reach the intended beneficiaries. The WFP can optimize its supply chain and identify defrauding parties.

System Touch Points

Our proposed implementation is focused on the last mile of the downstream supply chain. It starts with the last WFP warehouse being in contact with the commodities and ends with the targeted beneficiaries. The touch points with Bliss can be grouped into two sections. On the one hand, there are the physical internal touch points of the supply chain that create data, which is stored in Bliss' database. On the other hand, there are the digital touch points to connect Bliss to the existing supply chain monitoring systems.

Physical Touch Points
Bliss offers four physical touchpoints: the beneficiary registration, the commodity registration, the commodity distribution, and the handover of food to the beneficiaries

Fingerprint Registration
Bliss requires a fingerprint-based registration of each inividual beneficiary and CP. This fingerprint is linked to a digital identity, with which the person can be identified and interact with the blockchain database. The challenge is to register each beneficiary and CP manually.

Commodity Registration
The registration of all commodities takes place at computer terminals that are located in the WFP warehouses, which distribute the commodities to the CPs. They assign a unique identifier to each SCU and print a corresponding QR code. Bliss also connects the newly created unique identifiers with the big parcel they were taken from. Bliss aims here to be as lean as possible by relying on an already existing identification infrastructure.

Distribution of commodities
The distribution of the commodities to CPs takes place at the WFP warehouses. The aforementioned terminal for the commodity registration tracks the unique commodity and where, when, and to whom it is handed over.

CPs Commodities Handover to Beneficiaries
The smartphone provided by Bliss is used to determine the GPS location and what type and quantity of the unique commodity is handed over to which beneficiary. The registered beneficiary verifies himself and confirms the transaction by means of his fingerprint. Depending on network coverage, this transaction is instantly verified and recorded in the blockchain or temporarily stored and transmitted when internet connectivity is available again.

Digital Touch Points
WFP recently implemented the supply chain tracking system LESS that provides them with real-time tracking from the donors to distribution at the WFP warehouses. The proposed Bliss implementation tracks what is not covered by LESS: the last mile delivery to the individual beneficiary. It is a successor of the staff-intensive, paper-based monitoring system Country Office Monitoring and Evaluation Tool (COMET) which is not connected with LESS. In order to cover the whole supply chain and provide end-to-end transparency, Bliss integrates with LESS.

Technological Distinction
Bliss is based on blockchain technology which is a decentralized and distributed data storage architecture. Blockchain yields many competitive advantages which will be presented in the following.

Consistency in a Distributed Shared-write Database
The blockchain architecture enforces consistency of all data records through an immutable and cryptographically signed ownership history. All transactions are stored decentralized and visible to all the data nodes in the network that also have to verify each transaction. This procedure requires a permanent internet connection of the network nodes.

Independently Verified Tracking through Ledgers
Existing databases are focused on storing the current state and location of commodities and additional transaction data. In contrast, the blockchain architecture only stores an immutable transaction record that enables all users to independently verify the current state of the commodity distribution. Ultimately, the waypoints of all commodities can be identified and authenticated.

Immutable Ownership History
The blockchain stores which entity was owned by whom across time. In contrast to centralized databases, where the data owner could change data as he wishes, the distributed chain characteristic of the blockchain architecture makes this history immutable – even for the owner of a data node. This enables spotting the place and time of commodity losses. Additionally, it is impossible for a fraudulent distributor to pretend handing over the same physical entity several times.

Key Dependencies
The core concept of Bliss is to represent the physical movement of commodities in a digital data structure. Consequently, the key dependencies are physical devices to record these transactions and report them in addition to a software that can process, store, and show this information. The physical devices in use are smartphones, computer terminals, and backend servers or office PCs. The back-end servers or office PCs are used to store the decentralized

blockchain and are considered as existing resources of the WFP.

The CPs use smartphones to identify the beneficiaries when delivering the commodities and to verify the transactions. Each transaction is defined by the amount and the type of commodity as well as the time and the location of the transfer. Equipped with a camera, the smartphones identify the delivered commodity with its unique QR code. A fingerprint scanner verifies the beneficiary's identity. A GPS module records the location of the transaction.

If network coverage is available, each transaction is then in-

stantly recorded on the blockchain using a 3G/LTE or WIFI module. If not, the transactions are temporarily stored and transmitted when internet connectivity is available again
.
As a part of the blockchain network, the computer terminals are located in the WFP warehouses, which store the commodities prior to the distribution to the CPs. The terminals need to be equipped with fingerprint sensors, QR code readers and QR code printers. The goal is to rely on the existing infrastructure as much as possible.

Bliss relies on both a developer team and another team in the field. First, the developer team is responsible for the software of all digital devices which are required for the monitoring solution. This team will develop the user interface, the mobile application for the smartphones, the hardware interface for the fingerprint reader, and a standard database interface to store the personal information of the CPs and the beneficiaries. Bliss will rely on blockchain experts and on one of the existing blockchain platforms - either Multichain (private blockchain) or Ethereum (public blockchain). Second, the other team deploys the hardware in the field and provides adequate training to the WFP warehouse workers and CPs.

Time

The main complexity of building Bliss arises from two aspects: the software conceptualization and the integration into the existing WFP environment and its existing tracking solution LESS. These two challenges are also expected to be the most time consuming tasks to realize.

First, experts have to implement a customized blockchain. It is still unclear if Bliss will run on a private permissioned blockchain (Multichain) or a public permissioned less blockchain (Ethereum). Second, another standard database has to be set up which stores all sensitive information that should not be accessible by external users. Additionally, a data analysis software has to be provided to the WFP employees, in order to give them relevant and usable information on the transactions stored in the blockchain.

To put the insights which are gained about the last mile delivery in a broader context, the services have to be connected with all other relevant data nodes of the WFP. This implies that Bliss needs to be linked to the database of the upstream tracking system LESS and the personal data records of the beneficiaries. SCOPE, a pilot project in Somalia, already uses fingerprint scanners and e-cards and could be linked with Bliss as well.

On the software side, there are already existing, free developer platforms, and frameworks for all aspects of the services. Even though, developing all back- and frontend software still requires the largest proportion of the invested time.

On the hardware side, there are also readily available commercial products. Some of them are already used by either the WFP (computer terminals) or the CPs (smartphones).

Leadership & Marketing

Market Leadership

Over the past years, SAP was the market leader for supply chain management solutions, followed by Oracle and JDA Software. The WFP currently relies on a customized SAP solution. Bliss only focuses on the last mile tracking which is not covered by the customized SAP solution. Therefore, Bliss does not replace WFP's current monitoring system but rather supplements it.

Technology Leadership
Ethereum is the leading platform running on blockchain technology which enables decentralized applications (DApp) and smart contracts, allowing no possibility of downtime, censorship, fraud, or third party interference. Some blockchain supply chain solutions exist, such as the London-based start-up Provenance which runs on Ethereum.

Communication Channel
The relationship between Bliss and the WFP will be established via direct sales and key account management. Key account management is the main communication and reporting channel between the Bliss sales team and the WFP. There is no need for a direct communication channel or marketing between the Bliss sales team and the CPs since a paid service relationship exists between the WFP and its CPs, obviating the setup of an incentive scheme for the CPs to incorporate Bliss into the monitoring processes.

Distribution Channel
Initially, the establishment of Bliss starts with a collaborative creation of the solution to offer a customized service for WFP's requirements. The key account managers of each project consult the WFP about the number of hardware devices (printing terminals, smartphones, laptops) required for the corresponding project. These are delivered to the WFP distribution hubs for further transport to the relevant storages.

Relevance for Other Institutions in the Sector
A blockchain-based supply chain monitoring solution could provide benefits to other institutions. It is particularly promising in the public aid sector because the humanitarian aid sector faces opaque supply chain conditions.

Revenue Streams
The bundle of service and hardware provided by Bliss is based on three main revenue streams that allow the establishment of a self-sustaining business: First, the payments for licensing of the software are charged both on an annual and monthly basis. Second, three different types of reports made available to the WFP allow capturing revenues from price differentiation. Third, the selling and renting of hardware generates additional revenue.

Licensing
First, for the general access to the Bliss service, an annual licensing fee is charged. This fee is based on the value proposition of saving time and reducing costs by reaching full transparency of the downstream supply chain. For instance, commodities that were not distributed can be retrieved for distribution in other locations. In addition, a single user access license has to be purchased for every employee to access the interface on a monthly basis.

Price Differentiation for Reports
Second, three different types of reports are available. The raw data is included in the annual fee charged for the license. Based on the scope and individual requirements of the tracked projects, the basic and premium reports are priced accordingly. The price discrimination allows to incorporate the flexibility to incorporate variations within projects, for example in terms of projects lengths or the requirement of fast or comprehensive monitoring results.

Selling and Renting out Hardware
Finally, a revenue stream is based on providing hardware to the WFP. For the tagging of the SCUs, labelling terminals are rented out to the WFP for the required time of the tracked project. Furthermore, the WFP has to pay for the Android smartphones with the included fingerprint scanners.

Scenario Fit:

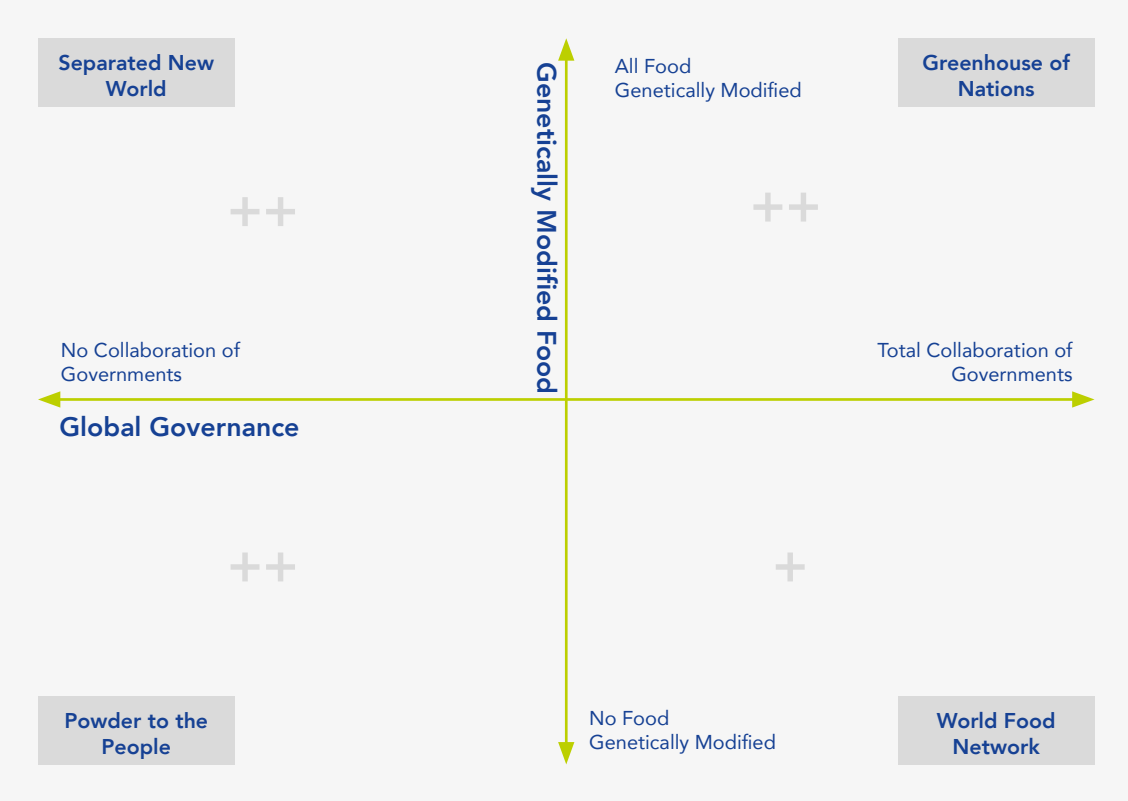
Greenhouse of Nations
Bliss would have a prosperous future in the Greenhouse of Nations scenario. The total collaboration between governments and a consensus on GAIA would enable Bliss to reach its final goal: the full integration of blockchain technology into the GAIA supply chain. Indeed, Bliss would be used by GAIA to provide end-to-end transparency, from the donor to the beneficiary - making sure that the food commodities are sent at the right time, to the right place, and to the right people. Furthermore, automated processes have replaced manual labor and human monitoring in the Greenhouse of Nations scenario. Smartphones with sufficient processing power, fingerprint readers, and good internet connection will be commonplace in every country. With these technical advances, the Bliss blockchain will run smoothly and ensure a fair redistribution of commodities for countries in need.

World Food Network
In the World Food Network scenario, where full collaboration will become a reality, Bliss would be implemented throughout the whole humanitarian supply chain. The transparency, which the blockchain provides, would be crucial for the World Food Network as it would help in the process of redistributing food commodities globally. The advanced technology in this scenario will meet the data storage needs of a global blockchain, enabling Bliss to track the whole process: from the donor to the beneficiary. Providing trustful and transparent information about the operations of the World Food Network is one of the principal objectives of GAIA. Therefore, Bliss would be a feasible solution for tracking and monitoring the humanitarian supply chain.

Separated New World & Powder to the People
Because the adoption degree of GMO crops has a negligibly small influence on the supply chain of humanitarian aid, a simultaneous assessment of the scenario fit for Separated New World and Powder to the People is possible. Both scenarios have in common that the global collaboration of governments has stopped. Consequently, the UN, in case it still existed, would not provide money for global projects such as the WFP anymore. By relying on international funding, the WFP could not run the humanitarian supply chain anymore, reducing the usability of Bliss to a comprehensive extent. However, if the humanitarian aid within countries will emerge, Bliss could have a very suitable scenario fit. Especially because parcel sizes are small, the single unit tracking capabilities of Bliss yields a great advantage. Bliss could also be used by private food corporations to track their commodities along the whole supply chain - it would, however, take another direction than the initially intended purpose of Bliss. In the Separated New World Scenario with a consolidated GMO food industry, Bliss would ensure transparency throughout the distribution channels. Whereas in the Powder to the People Scenario with fragmented subsistence communities, this would not be feasible.

Challenges:

- Training the CPs on how to use the mobile application and the fingerprint readers.
- Training the WFP staff on how to use the data analysis software.
- Implementation in crisis situations when registering the commodities and the beneficiaries is not a priority.



Outlook:

Bliss' vision is to provide a comprehensive and transparent end-to-end tracking solution for the WFP and other NGOs, fully running on blockchain technology. In the long run, Bliss aims to scale up as a standard monitoring tool for the up- and downstream supply. By integrating the entire process from the donors to the beneficiaries, it will replace all existing tracking solutions. The donors will be granted a full overview of how their money is spent, where the purchased commodities are supplied to, and what concrete impact has been achieved. A public accessible user interface will provide everyone with unforgeable information about the whole supply chain without privacy infringement or threatening the security of the WFP's operations. This will have a positive impact on donations, as the trust between donors and the WFP will be reinforced. Thus, Bliss will act as powerful enabler in fighting hunger with digital means.

Jakob Gebauer, Laurenz Altenmüller, Lukas Rambold, Mary Claire O'Donnell, Tobias Dümmling

TRUESTORIES

Give people a smartphone. They will tell their stories.

When we share our stories, we share our humanity. TrueStories has the chance to provide people who have never owned or seen a smartphone with the possibility of capturing and sharing their stories. TrueStories is a platform for sharing stories between the developing and developed world. Within the TrueStories vision, beneficiaries of humanitarian aid around the world become creators and producers of digital content, with the creative power to solicit funds for their own communities.

TrueStories will cooperate with local project partners to distribute new or used smartphones to beneficiary creators, along with increased internet access. Recorded videos are brief and dynamic with virtually no constraints. Creator content can document any aspect of everyday life: conversations, community pick-up soccer, community events or family cooking. This is real life, these are real voices. That is True Stories.

Humanitarian aid organizations operating on the other side of the globe often face significant difficulties in maintaining transparency. The problem of connecting places where people have a lot to places where people have a little is larger than many may think in an interconnected era. Understanding the lives of people on the other side of the globe is a crucial step to bridge this gap. TrueStories believes this connection can be made through video storytelling.

The further challenge faced by humanitarian aid organizations and non-profits is to find means to access the true opinions and voices of the people they serve for their own organizational knowledge. Due to language barriers and lack of literacy, this can be more easily said than done. TrueStories can also help address this issue.

TrueStories steps into this space to answer this need by amplifying the voices of recipients of aid. Beneficiaries of humanitarian aid will, through TrueStories, receive their first smartphones from donors and gain a digital space to express stories about their daily lives. Non-profit organizations will in turn be able to utilize truly valuable stories and creative content, to share the projects being implemented in developing countries and to connect to potential donors.

TrueStories establishes a connection to key members of communities, for them to act as makers of original creative content. This creator content, made by these TrueStories' creators, adds value to current humanitarian aid models by giving direct insight into the impact of projects on the ground. These creators thus have the chance to take direct action to gain donations for their communities.

On the other side of TrueStories' mobile app are the donors in the developed world who want to make a difference and find a cause. By combining instant mobile donations with genuine content from real-time projects, TrueStories creates significant potential for new donation and funding streams for the non-profit sector. The ultimate aim of the TrueStories platform is for humanitarian aid projects to be self-sustaining in the future through the means of crowdfunding and without exclusive dependence on grants and international institutions.

After TrueStories creators have captured geniune content from their lives - whether their family, friends or communities, cooking, celebrating, and living together - creators upload their videos to the TrueStories project platform. The TrueStories editing platform is the final stage before content is uploaded for donor viewing around the globe. Creators who upload content have the right to also rate the content of other creators in other parts of the world, and to determine top-rated content to be visible for donations.

Project partners and non-profit projects have a choice in what content donors get to view, from top-rated content on TrueStories. For TrueStories' potential donors, who have yet to make a donation, highlights from creator content and ongoing projects are made publicly accessible in the TrueStories app. Once a donation is made to a TrueStories project, the donor receives further, full access to real-time video updates from creators on their project, and a direct, fresh view into the daily lives of creators and humanitarian projects.

TrueStories' projects are implemented in close alignment with project partners made up of non-profits, humanitarian aid organizations, and local NGOs. Project costs associated with providing and educating about technology are covered by a small fee for the basic provision of the TrueStories application and platform. Add-on premium services are available, including in-app challenges for creators or consistent donors. Certain donors will make the choice to further support TrueStories as an initiative after having first made their one-time donation to a listed project. Partnerships with smartphone manufacturers (OEMs) and Internet Service Providers (ISPs) assist with reducing upfront costs, in exchange for insights into developing markets.

Social Business Model

Key Resources

- Video contents
- Partner networks
- Individual donations

Key Activities

- Providing and managing the platform
- Supporting the project partners in acquiring smartphones
- Connecting beneficiaries with donors

Type of Interventions

- Allowing beneficiaries a measure of control over their image
- Creating a direct connection

Segments

Beneficiary

- Geography
- Demographics

Customer

- Beneficiary communities
- Project partners (e.g. NGOs)

Customer Segments

- End-customers in rural areas
- End-customers in urban areas
- Businesses with internal networks
- Mesh application developers

Partners & Key Stakeholders

- Local and global NGOs
- Creators
- Donors
- Private corporations

Channels

- Project partners
- Donation app

Cost Structure

- Software development
- Maintenance of platform
- Acquisition of Partners
- Pilot projects
- Overhead cost
- Smartphones and internet access

Surplus

- Invest in creators to become filmmakers
- Improve infrastructure and reach

Revenue Streams

- Basic use fee
- Premium services
- Direct donations
- Sponsored content

Type of Interventions

TrueStories seeks to make an intervention in the field of non-profit and NGO fundraising in two major respects: first, to allow beneficiaries a measure of control over their image and circumstances, in order to secure funding for the projects that benefit them; second, to create a direct connection between donors and non-profit projects on the ground. As a business model, True Stories wishes to provide the non-profit world access to fundraising through a software as a service model. As for-profits social networks have changed how information is conveyed and how transactions are made, it is time that humanitarian aid is able to access similar platforms and to close the gap between donors in the developed world and actors in the developing world.

Value Proposition

Social Value Proposition

TrueStories' added social value consists of establishing a closer connection between donor and beneficiary communities who previously lived in isolated worlds. Connecting these two worlds will create more potential donors by increasing awareness and access to the problem at hand, thus closing the understanding gap between separate parts of the globe. Awareness is the first step towards change. Once potential donors see firsthand the stories of those experiencing global issues like hunger and displacement, they are more likely to take a hand in solving those problems. Beneficiaries of humanitarian aid projects gain real power in their lives through the opportunity to tell their story and by offering their authentic insights into the projects that affect their lives. The social value chain begins with the smartphone devices necessary for capturing content, leading to a secondary Value Proposition. By supporting our partners in the distribution of smartphones and internet connection, TrueStories spreads awareness of the importance of smartphone usage with smartphone ambassadors. The widespread reach of smartphones offers potential for many basic improvements to quality of life, nutrition and health, as well as a platform for communication, networking and self-expression (including via TrueStories).

Impact Measure

A major aspect of TrueStories' value is making the impact of non-profit and humanitarian projects visible. Thus, a crucial element of our services will be the ability to measure contact with potential donors. There are numerous means available to assess our reach in this regard, including constantly updated numbers on newly acquired donations, the number of videos watched per week, and the influx of projects expressing interest in being listed on TrueStories. Projects will initially place between 3 and 10 TrueStories creators in a community to begin capturing stories. Given the possibility of constant contact with Creator users in the developing world through the TrueStories platform, it should be easily feasible to receive feedback on TrueStories and a sense of TrueStories' impact from our constituent producers of content. This is a further value added to non-profit partners, which may consider using TrueStories as a means of direct impact assessment and listening to beneficiaries' voices.

Customer Value Proposition

The value generated for TrueStories' customers is examined from several different perspectives, i.e. aforementioned creators, donors, not-for-profit partners, and corporate partners. In the first place, individual donors receive the benefit of transparency on their donations in terms of how they contribute and where their contribution is directed. TrueStories is uniquely positioned to offer original, authentic insight into humanitarian projects and the lives of donation recipients. NGOs also strongly benefit from this aspect of TrueStories' insight for their marketing and donor reach. Content commissioned through the TrueStories platform is multi-use and repurposable for future campaigns. At a basic level, this content expands the number of potential donors who will witness the NGO's impact, overall increase awareness of projects, and enlarge on private donations.

Key Activities

The core activities of TrueStories centers on developing and managing an internet platform consisting of two distinct smartphone application functions. Key approaches must be in providing a system that will function both on older smartphones with low bandwidth in developing countries while remaining user-friendly and exciting as a platform for potential donors. To achieve this, we plan on collaborating with network providers and project partners to use their WLAN access points for fast video uploads. Free internet access creates hereby an direct incentive to use and keep using our app. TrueStories furthermore collaborates with local project partners/non-profits on editing and selecting those videos already uploaded by creators and beneficiaries. On the donation side, advertising campaigns have the potential to spread awareness of TrueStories and their project partners. The easing of donations will be a primary innovation and value added upon current models, allowing for the platform to operate financially independently and sustain its own activities. Corporate sponsors and non-profits, while acting partners in the provision of TrueStories services, will leave primary management of the platform and certain aspects of smartphone and Internet distribution to TrueStories.

Key Resources

For TrueStories, development of the video-donation platform and applications will be the most crucial step in long-term establishment in the field of non-profit fundraising. Hence, finding and hiring an experienced and talented developer team will be an immediate need and key resource. Other key resources include the seed funds and donations of mobile smart technology to begin saturating particular project areas. At a later point in business development and financing, greater importance will be placed upon utilizing project partner's networks for grants and funds. Grants from foundations and corporate sponsorships in emerging developing world markets will be of use not only in acquiring smartphones but also in spreading the reach of the TrueStories platform so that a critical mass of projects can be reached.

Once the platform is established, up-and-running, the content made, uploaded, and shared on the app by the creators will become TrueStories' key resource. TrueStories offers a novel space in which stories can be told across borders. Stories can be told as beneficiaries and creators want to tell them - potential donors also receive a stronger sense of the impact of international aid and of the true value of their donation. Individual donations collected by this means are undoubtedly necessary to keep the platform going.

Partners & Key Stakeholders

TrueStories' holistic funding model covers the entire donation cycle, from the perspective of several different stake-

holders. The central partners most crucial to identifying and ensuring the impact of TrueStories are (1) local and global NGOs, (2) on-the-ground beneficiaries/creators of NGO projects and (3) potential donors in the developed world. First and foremost, TrueStories depends on local and global NGOs as a customer base and as project partners. The humanitarian aid and not-for-profit sector has a significant interest in accessing real lives and voices of beneficiaries - and thus creating transparency for donors and foundations that offer them financial support. They have also the role of distributing the smartphones to their beneficiaries who are then guided through the next steps by the app. For TrueStories' success, it will be important to find NGOs highly passionate about building new streams of donations, and building a connection with their beneficiaries. By creating an access point to the stories of beneficiaries, non-profits and NGOs will be placed in a strong position to make innovative interventions in the field.

Naturally within projects, it is creators who ultimately capture, edit, and upload video content - they are equally partners and leaders in this process. Creator and beneficiary-made content is at the core of TrueStories, so it is TrueStories' aim to support creators in the developing world as much as possible. To be able to do this, Corporate Sponsorships and CSR projects for mobile technology providers and smartphone manufacturers are an option to secure further funding. For these stakeholders, TrueStories creators would be a real investment in the interest of improving PR and gaining insights into emerging markets.

Channels

To access the market in mobile non-profit donations and philanthropy, TrueStories must utilize various channels. Not only must TrueStories connect to potential donors through our own mobile app but the platform must also create increased exposure for NGO partnerships. The initial organizations to adopt our mobile donation service (i.e. early adopters) will increase our exposure and saturation. As TrueStories may be technically considered as a crowdfunding donation platform, there is also significant potential for increased exposure via network effects, and the spread of word within relevant circles through partners. These channels are by their nature multi-directional as project partners utilize TrueStories' networks to gain media content and exposure, and TrueStories gains traction and credibility within the tech and fundraising field through project partners.

Segments

Beneficiary Segments

TrueStories' beneficiaries are actually seen rather as creators. They are equal participants and agents in the TrueStories model, as much as non-profit partners and potential donors. Beneficiaries are the ones with the potential to create true value. The TrueStories model is scalable to any non-profit project, anywhere in the world where it is valuable for donors to be able to see the direct impact of their support. In the early stages of the TrueStories' development, certain projects' geographic and demographic contexts may initially bear less barriers than others. As the TrueStories model centers on the use of smartphones, digital literacy may be one such mitigating factor. Educational initiatives may be more necessary in certain regions than others.

Projects in Southeast Asia, for instance, may gain easier, immediate traction given higher levels of mobile technology saturation. Whichever barriers exist in more remote areas including minimal smartphone access can be overcome - as one of the primary objectives of TrueStories is to provide smartphone technology where it does not already exist. In certain highly conservative countries operating under Islamic law, these barriers may be harder to address in the short-term given antipathy towards western culture and technology.

In areas with fewer access barriers it may be a possibility to tap existing networks of smartphone owners to include beneficiaries without access to smartphones. In demographic terms, urban and densely populated areas will be better to target in initial stages as cellular-network coverage is larger and there is simply a larger audience. Rural areas will be equally valid spaces for projects, where smartphones can be provided in areas where their use is currently limited. Furthermore, young beneficiaries might be more inclined to frequently use the smartphones but in general a good mix of ages should be achieved.

The primary beneficiary segment are users in the developing world, who act as creators, working on the creator-side of the TrueStories platform. These creators will be recruited across the population in local communities, where aid projects are taking place. The goal is to reach every part of the population, though young people with an interest in and passion for learning about digital technology may be likely candidates. By producing content, creators increase the efficacy and funding available for non-profit projects, and humanitarian aid. On the other side, potential donors will get first hand insights into the lives of beneficiaries.

Customer Segments

TrueStories' user segments mainly consist of customer constituencies that pay for the content that is produced by the creators. On TrueStories' donor-facing platform, customers are app users viewing content, seeking a direct connection to a humanitarian aid project, and supporting creators in telling their stories.

The other side of the customer base, apart from donors, are

non-profits and humanitarian aid organizations, i.e. project partners who wish to gain exposure and expand their donation base beyond funding streams from governmental institutions. The non-profit and humanitarian aid sector finds it increasingly pressing to find these alternative sources of funding and necessary to find new means of making the impact of their projects visible.

Cost Structure

The cost structure of TrueStories can be broken down into initial one-off costs, fixed costs and variable costs.

Initial costs

To get the TrueStories platform ready to launch, the bulk of the investments will go into the development of the applications and the underlying software infrastructure. This means that spendings will especially be needed for (freelance) software developers and initial licenses as well as Software Development Kits (SDK) that are required. The first few test projects will also naturally require special attention and diligence, thus increasing the initial cost by increased early-on marketing expenses and spendings for smartphones that can be distributed to the first project partners.

Fixed costs

The fixed costs mainly consist of the maintenance of the software and hardware as well as the ongoing hardware costs of servers and smartphones, including electricity. In terms of server, probably a third-party service will be chosen leading to a monthly fee. A small number of employees will also be needed for overhead functions such as marketing, support, finance and others. Office space for the TrueStories team will require a certain amount of monthly rent and additional running costs such as electricity and internet. In addition, a certain amount of monthly communication fees for e.g. telephony will also need to be paid.

Variable costs

Acquiring and maintaining project partner will be a big part of TrueStories' variable cost. This especially includes travel expenses that will incur in order for the TrueStories team to visit the projects around the globe. In addition, TrueStories will support the project partners in obtaining smartphones, internet data plans as well as hotspots. To be able to do so, partnerships and cooperations with smartphone manufacturers, ISPs and other large companies are planned.

Revenue Streams

TrueStories has several revenue streams that are independent from each other. First of all, we will ask the donors that contribute to the projects on our platform for a small contribution to our initiative. Furthermore, there is the option to pre install content to the smartphones that we distribute among the population. In exchange for this service we will charge the provider of the application. Additional premium services (e.g professional editing, in app challenges, customization, etc.) that are provided to our project partners are another source of TrueStories' earnings. Moreover, ISPs that want to keep the customers we bring to them through our app can be charged for every customer they keep after our project is done. In a later stage, additional partnerships with corporations that are very conscious about their corporate social responsibility could be initiated.

Surplus

The financial goal of TrueStories is first and foremost, to be self-sustaining as a social enterprise, with revenues covering all costs. If at a later stage, TrueStories achieves a profit margin, this profit will flow directly towards future projects and furthering impacts on the ground. One future pipe dream may be to empower especially active creators to become amateur filmmakers by supplying them with more advanced equipment. In addition, surpluses could also be spent on further marketing campaigns to increase the reach of the platform, connecting even more donors with creators.

Scenario Fit:

Separated New World

Separated New World describes a possible future in which international collaboration fails entirely and GMs reach 100% saturation of the global agricultural sector. Under those circumstances it is very hard for TrueStories to unfold its full potential due to the lack of international governance in the scenario, i.e. an oversight body such as the United Nations would not have any power, and thus would not be able to offer spaces for intervention in humanitarian crises. As border conflicts leave many countries divided from neighboring regions, and the wider world, any project on the ground would have to begin on a national basis. With a move back towards monopolistic behavior, colonial dynamics and domination, it would be difficult for TrueStories to remain neutral. The dominance of GMO crops would have little impact on the TrueStories business model.

World Food Network

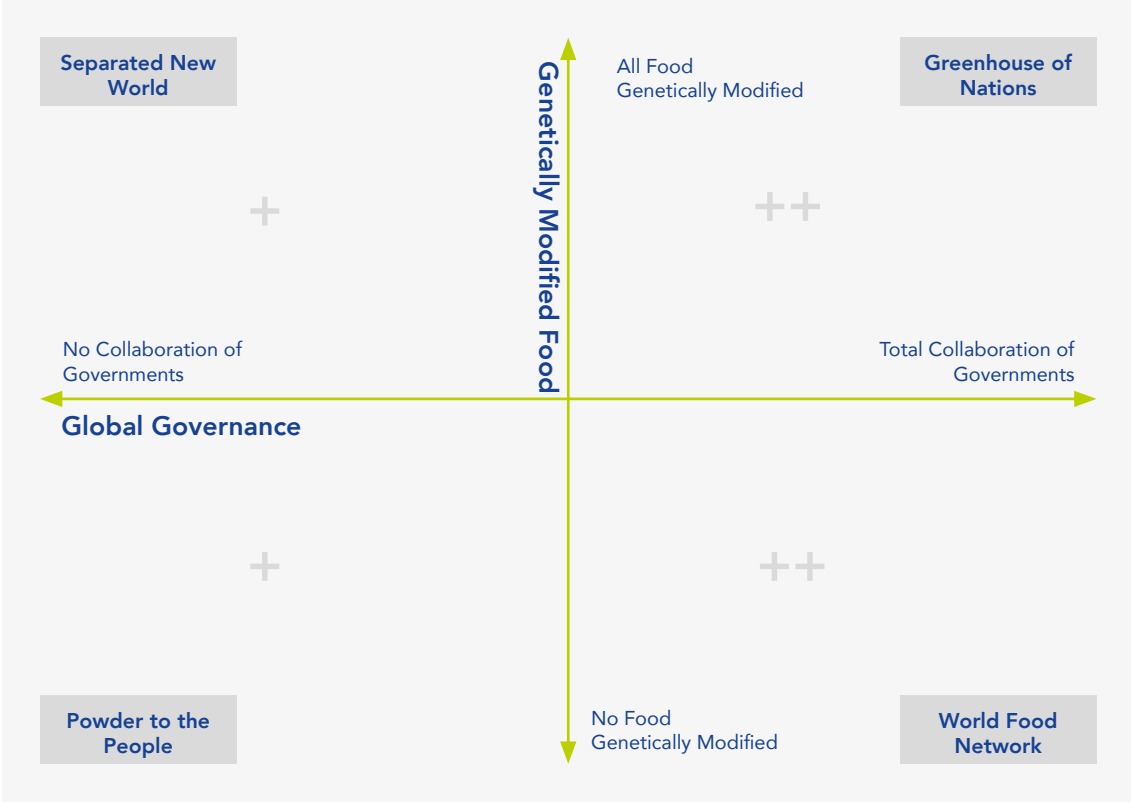
Here, arable land is scarce and GMOs are outlawed for use in boosting food production. Complete global governance and full international collaboration enables implementation of a World Food Network, which offers a way to trade calories and available food. TrueStories' impact and fund-generation would remain of dire importance in alleviating hunger at the BoP. TrueStories' effectiveness would in fact have the potential to be increased by a direct connection to developing country populations. TrueStories would then operate directly with international oversight organizations such as the UN and WFP, without managing relationships to local NGOs.

Powder to the People

In the "Powder to the People" scenario, international co-operation is non-existent, and most countries, especially in the developing world, struggle to feed their population. GMOs have not been implemented and agricultural yields are not meeting demand. Wherein communities have organized themselves to be self-sustaining, TrueStories could be a very useful platform. Most international humanitarian organizations will have major problems in finding funding since they cannot rely on government aid. TrueStories could thus be an ideal platform to find individual donors, in order to continue humanitarian projects. Many people globally are still fairly well off and would want to help those less fortunate in their communities. Through TrueStories, they can locate a direct channel to see the impact of their donations – an important feature as consolidated media coverage will be sparse, at best.

Greenhouse of Nations

This scenario envisions full internatonal collaboraton across the globe and GMOs as the only remaining method for cultivating crops. In this scenario, full collaboration and the complete reduction of global hunger will reduce the impact TrueStories can have on the beneficiaries' lives - however, other social problems, such as poverty, and the remaining lack of education in some parts of the country provide new use cases. Nevertheless, the platform would need some adjustments to fit the new needs of its users, especially in the field of education. The rising amount of GMO crops



also opens new fields of application, particularly in the private corporate sector.

Challenges:

- Developing a user-friendly app to suit the needs of both beneficiaries and donors
- Video-editing software usable by beneficiaries with limited digital literacy
- Securing smartphone contracts and sponsorships
- Distribution of smartphones to non-profit project hubs
- Scalability and maintaining creator content & video quality on rating platform
- Achieving requisite internet connectivity in developing areas
- Incentivize creators/beneficiaries to produce content; motivate power users
- Reaching a substantial base of app users and donors in the developing world

Outlook:

Growing access to the internet has brought the world closer than ever before, though primarily in the developed world. However, TrueStories believes this connectivity and the opportunities that accompany it should be extended to include the developing world. This is encouraged by the TrueStories platform, especially the provision of Internet access at points of humanitarian activity. This aspect of TrueStories' services could be scaled and expanded in the coming years through partnerships with mobile technology providers with an interest in emerging markets. With increased saturation of smartphone technology and the TrueStories platform, there is opportunity to expand beyond non-profit partnerships towards direct funding of individual projects and start-up ideas from beneficiaries and creators. In the long run, TrueStories is about much more than just stories.

Yingxi Chen, Michael Fröhlich,
Christian Gebhardt, Adrian Hesse,
Christian Hülsemeyer

TOOBER

Accelerate growth through sharing.

Lack of agricultural investment stands as one of the central causes of global hunger. On a structural level, many developing countries lack key agricultural infrastructure, such as roads, warehouses, and irrigation. The result is high transport costs, storage facility shortages, and unreliable water supplies (WFP, 2016). At an operational level, many smallholder farmers lack access to farming tools and machineries, either due to insufficient funding or because of a limited knowledge of how to operate these tools. The results are low productivity and high post-harvest losses due to inadequate storage. Each of these factors conspire to limit agricultural yields and access to food.

Though infrastructure growth is typically dependent upon local and regional development, Toober aims to offer smallholder immediate access to tools and services at every step of the farming process.

In the short run, tools and machines rented and shared using the Toober platform could increase farmer incomes, increase crop yield, and reduce postharvest losses. In the long run, farmers could accumulate sufficient income and farming knowledge to be able to purchase their own tools. Ultimately, the goal of Toober is to enable farmers to be self-sustainable, through exchanging their tools and services for compensation on Toober's platform.

One of the crucial features of Toober is affordability. In developing countries, large agricultural machines (such as tractors,) are common amongst commercial farmers, but remain completely unaffordable to the majority of agricultural laborers. Smallholder farmers cannot afford to own, or even to pay the rental fees upfront for this kind of machinery, despite the presence in their countries of vast uncultivated land. Thus, Toober is implementing a payment strategy of "service first, payment post-harvest" in order to secure the affordability of the tools, and ensure increased incomes for smallholder farmers.

In the future Toober wants to scale existing business models from community to community, equipping farmers with adequate farming tools and knowledge and enabling self-sustainability. Toober's long term outlook involves expanding these existing, local business models in order to tackle infrastructure problems throughout the farming process (e.g. lower transportation cost, or additional storage.)

Type of Interventions

Toober's disruptive intervention is meant to address groups of neighboring farming communities. As a prerequisite, several members of these communities will need have internet access and a cell phone. The interventon also requires that a critical mass of the farmers is interested and invested in taking part in the project, and sharing their resources. Toober provides a two-step service to improve farmer productivity. The first step is to rent out tools to selected farmers who have basic education, and an interest in participating. In order to teach the farmers how to use the tools in question, Toober provides locally sourced instructors capable of demonstrating correct usage.

The second step of the process involves farmers with access to equipment using the Toober platform to offer services and tools to other farmers who still lack technologies. This enables the whole community to jointly increase productivity. The Toober platform is an online service, but communicates with farmers via SMS and thus can be accessed with a simple cell phone. The farmers send their location, the requested service, the dates for delivering this service, and their contact information. The platform then provides two matched parties with the contact information of one another. Both parties can then individually negotiate the terms of the transaction and the service, thus making the platform more scalable to the farmers' individual needs and circumstances. The process of spreading tools in a village and promoting the platform is repeated community by community.

Social Business Model

Key Resources

- Initial funding (credits or investors)
- ICT infrastructure
- Suitable road infrastructure
- Local NGO & WFP connection

Key Activities

- Platform development & maintenance (platform building)
- Marketing & customer acquisition by cooperating with local NGOs
- Hiring farming professionals
- Managing payouts (collateral, fees, harvest, etc.)
- Customer support

Type of Interventions

- Providing tools and training to farmers in th einitial phase
- Providing a renting platform as a service

Segments

Beneficiary

- Smallholder farmers
- Skilled farming professionals

Customer

- Smallholder farmer with no tools
- Smallholder farmer with no advanced knowledge to use tools
- Smallholder farmer with land but no sufficient labor

Customer Segments

- End-customers in rural areas
- End-customers in urban areas
- Businesses with internal networks
- Mesh application developers

Partners & Key Stakeholders

- Farmers
- Telecommunications service provider
- Investors (WFP)
- Local NGOs
- Tool manufacturers

Channels

- SMS service
- WFP
- Local NGO
- Village chiefs

Cost Structure

- Technological infrastructure
- Salaries to permanent employees
- Administrative costs
- Training
- Others

Surplus

- Scaling and investing in new tools
- Tackling storage and transportation problem

Revenue Streams

- Rental time fee collecting a fraction of the farmers' additional income
- Service fee

Segments

Customers

The main target group intended for Toober consists of smallholder farmers who require tools to improve existing agricultural practices, such as storage, productivity, or crop quality. Toober provides an all-in-one farming solution package delivering tools, services and education at the same transaction point for this target group.

The secondary customer group of Toober is advanced farmers or skilled farming professionals, who own tools, and are seeking additional income. Toober also benefits these customers by connecting them with farmers in need.

Beneficiaries

First, Toober serves both as a provider and a connector of agricultural services, thus boosting overall productivity in the benefited areas. The beneficiaries may be the whole local farming community, by proxy of the recipient of the service – smallholder farmers, and the farming professionals who provide tools.

At the same time, the beneficiaries of Toober are not only limited to local communities, but the concept can also include larger urban in cities nearby. Generally, an unstable food supply causes huge price volatility in the urban markets nearby. Malnutrition and hunger strikes when food prices are high, as the urban population can no longer afford food. As Toober expands its services to more communities, the scaling effect of increased yield eventually will expand availability of food in the local market, leading to lowered price volatility, and increased food security. This, will ultimately benefit all populations in the radiation area who are affected by hunger.

Channels

Distribution Channels

Due to the low but growing penetration of smartphones in developing countries, Toober provides a SMS service accessible via cell phone. Customers can send a SMS to the Toober service mobile number and receive a message back indicating where currently available services are listed. This list is tailored accordingly to the farmer's location, since his mobile phone number is associated with his location during the registration process. After reviewing the general service listing, the customers can communicate regarding further steps, such as contact info, the desired date of transaction, or payment information.

In the future, when the penetration of smartphones is sufficiently prevalent, Toober can also be offered in the form of a smartphone app.

Communication Channels

Toober's most important communication channels are local NGOs. These NGOs will be initially primarily reached through the WFP's partners. World Food Programme's contacts in rural farming communities, will be instrumental in connecting with village leaders and the local community. The existing substantial, reputable network of WFP and local NGOs can help Toober to promote and distribute its services. For instance, local NGOs can promote Toober to the farmers. Since local farmers are living in a close-knit community, Toober's concept also assumes that communication between farmers is vital for spreading adoption of the platform. Particularly local farmers who notice the benefits of Toober might spread the information through "word-of-mouth" to other villagers.

Value Proposition

Toober's main impact is the empowerment of smallholder farmers. By providing them with affordable access to tools, the company has the potential to become a significant enabler of agricultural productivity. On top of this, Toober's sharing platform fosters an efficient allocation of tools. Through offering tools for different important parts of the farming process, the farmers can solve their individual challenges in farming.

Another important part of Toober's business concept is sustainability in agricultural growth. Along with renting out tools, the company will provide selected farmers with the knowledge of how to use and implement them. Thus, the farmers gain independence in their use of these tools, and can spread this knowledge within their community as well as to other communities. After using Toober's services, farmers' additionaly earned income may even offer enough purchasing power to buy the tools on their own. The platform also provides the farmers with an easy way to coordinate access to their services.

The crowdsourcing approach can have further positive spillover effects on cohesion within farming communities. Particularly because the platform is accessible by cell phone, this does not exclude farmers who cannot afford smartphone technologies. Since the farmer's early model mobile phone is necessary only to order services, tools, or to contact Toober with questions, even communities that share mobile phone access are not excluded.

Seen in a broader context, Toober has the potential to make a vital contribution to the fight against hunger. Access to crucial tools and services allows farmers to provide local populations with more food. Increased food supply in these regions leads to lower food prices on the market overall, making food also more affordable for the poorest of the society. Finally, by providing tools for improved food storage, Toober also enables a more stable food supply, reducing volatility and the danger of famine.

Key Activities

Toober's key activities can be divided into three main services. Sharing farm tools and services through an online and SMS-based platform is essentially Toober's core service. Therefore, software development and maintenance for the platform stand to be of great importance. A beta-version of the platform could be programmed within a few weeks. This beta-version should be sufficient to start the tool sharing concept in a small region with a limited amount of farmers. Later on, the platform could be refined, with the development of more robust software, capable of handling a huge amount of service offers, requests, data and money transfers in real-time.

Toober's sharing platform depends on two distinct customer segments: the service provider and the service user. Thus, the platform must include not only sharing capabilities, but also a focus on marketing activities and customer acquisition, to engage farmers from both customer segments on the platform. The previously mentioned NGO-network has the potential to act as a vector to promote Toober extensively in rural areas. Aside from connecting farmers and providing basic information, Toober will also manage the payouts on the platform as an additional service.

Two more functions are particularly vital for the launch of Toober. In order to generate enough machines and tools on

the provider side of the platform, one major activity in the first stage will be purchasing tools, and leasing them for a small fee to local farmers. As the farmers increase their income and purchasing power in later stages, sales of initially rented tools could gain importance.

Another initial key activity must is assisting farmers about how to use the platform and the tools. During this process, skilled farmers will show new machine owners and renters how to use and maintain tools. In the first place, these contacts will initially transport the tools to the farmers and afterwards offer a hands-on crash course to get started.

This initial contact with farmers will also be instrumental in informing about the platform, explaining how it works, and showing them the value of participation. Beyond conveying the most important information to farmers, a customer support team will continue to answer farmers' questions about the platform and the tool. Customer support is especially important as it provides a venue for feedback to improve Toober's services, according to farmers' real needs.

Partners & Key Stakeholders

A main partner and key stakeholder for Toober is the UN World Food Programme. On the one side, WFP may allocate necessary seed capital to cover initial expenses (see cost structure). Furthermore, WFP has access to a huge network and collaborates directly with many local NGOs (see communication channels). These networks and collaborations will remain vital for getting directly in touch with locals. While financing could also be provided by other institutions, WFP presents a unique opportunity for influence and scalability to establish the platform across a large area.

On a fundamental level, local NGOs will contribute crucial information about local circumstances, so that Toober is aware of challenges and can reduce risks. NGOs may also assist by promoting Toober and informing farmers about the potential of the sharing platform. The reputation of NGOs among locals could also help convince farmers, promoting trust and a sense of reliability.

By providing mobile connection, another key partner for Toober will be telecommunication companies. Since the main channel of communications and later on also payment (or transaction fees) will be deliverable by SMS-communication, cooperation with these stakeholders is essential. Additional partnerships with payment processors may be required for the platform payment service. Finally, Toober has potential to partner with internet infrastructure companies in providing the server infrastructure and hosting the web platform.

On top of these considerations, cooperation with tool manufacturers or retailers could offer a further channel for renting tools to the farmers. By providing agricultural manufacturers with knowledge and data concerning the specific needs of farmers in developing countries, Toober could benefit from discounts on prices for tools.

Key Resources

Key resources for the Toober project vary across different stages from market entry to implementing operations. The existing connection between local NGOs and the UN WFP may serve as a key channel to promote Toober during the market entry phase. This will be crucial for extensive and reputable local presence in the areas where Toober seeks to operate and in the interest of developing relationships with local village elders.

In the initial phase, several key resources are needed. Firstly, Toober needs to have sufficient funding to purchase tools. These resources may be financed through a bank loan or alongside potential investors and partners. On a secondary note, human resources will be a vital aspect for Toober. As Toober functions not only as a lender of farming tools, but also as a service provider, experienced farming professionals are essential partners in the organization. Farming professionals will be in charge of practical implementation and training for farming machinery operations.

As a final note, infrastructure development remains paramount to the whole lifespan of the project, ranging from physical infrastructures, such as roads, to ICTs. Because Toober provides its service via SMS communication, farmers need access to basic cell phones and must be able to receive messages. Appropriate road infrastructure is equally necessary for transporting machinery to the farms.

Cost Structure

Costs for Toober correlate with key activities of the enterprise. The initial phase will naturally require a larger seed investment to foster the use of Toober, while in the later stages Toober can address management costs for the core business through the provision of the platform.

The largest cost driver for the core business of Toober is the development and maintenance of the platform. A skilled software engineer team is needed in the first stage. Later on, a smaller team would maintain the platform, and implement adjustments as well as further features not included with the initial version.

Costs for ICT infrastructure are the second part of the costs for the platform itself. Expenses for telecommunication, server, and payment services are the key factors in this segment.

In addition to platform costs, salaries must be generated for administration and support. Especially in the first instance, direct contact to the customer creates higher costs. Although NGO networks can be utilized to promote the platform, there will be some expenses for marketing initiatives.

The second major expense for the initial phase involves gathering the tools necessary to launch the provide-and-rent procedure. There are major expenditures involved in acquiring these tools and renting them to the farmers. Although some costs may limit initial expansion, they are necessary to launch the platform and gather important information about the real needs of farmers. In this manner, a significant number of skilled farmers can gain employment, and be paid salaries, by training new tool owners on a large scale.

Revenue Streams

In each community, revenues have the possibility to be generated based on two different phases within project development. In the initial phase, as tools are purchased by Toober, Toober will collect the rental fee directly to offset the high fixed cost of machinery and tools. In the later phase, as Toober only serves as a platform provider and no longer a tool/machinery provider, only a service fee is charged for users who post onto the sharing platform.

Rental Fee

Rental fees will serve as the primary revenue stream in the initial stages of Toober. In monetary terms, in most cases, the fee is not collected immediately after each usage, but post-harvest, making the service affordable for smallholder farmers who have no money upfront. For each tool, Toober estimates a percentage rate of increase in harvests, due to the productivity surge from using more advanced tools. When farmers have sold their seasonal crop, Toober collects a fraction of farmers' income from harvest sales based on prior estimations.

Due to lack of reliable transportation and other conditions, smallholder farmers in certain areas may have trouble selling their full crop, or may sell them at inadequate prices. Toober therefore proposes a floor price for individual crops. If the current market price for crops is too low, Toober advises farmers to delay sale, while storing the crops for extended shelf time through a rentable, Toober crop-drying tool. The calculation of floor prices can be based upon cost, plus reparation for specific tools, divided by the estimated average user life of the specific machinery. A certain percentage based on maximum product lifetime usage and any pertinent discount rates would then be added.

Service Fee

In the second stage of implementation, farmers will move towards the use of Toober as a platform for information exchange. Instead of a rental fee, Toober would then charge a service fee to farmers on the platform. Every time contact information is exchanged, both potential contract parties are charged a fee. This service fee is collected from the telecommunication partners via airtime payment. Telecommunications business partners also share a portion of the payment for ICT services, with remaining collected service fees transferred to Toober.

Surplus

The central aim for Toober is surplus redistribution, parsed into two related goals: 1. Scale and replicate the existing product to other regions 2. Extend the existing business model in successful regions which will further increase the ability to scale.

Scale and replicate

The majority of villages, communities, and regions would be entered by Toober through two primary stages. In the initial stage, Toober would serve as both service and platform provider; in the second stage, only as a platform. In providing services directly at the first stage, farmers are forced into financial and logistical dependency on Toober, while this business model would require further heavy fixed costs and investment. That scenario is hardly scalable. Toober's business model can only reach self-sustainability in the second stage, as a pure sharing platform. Surplus profit will therefore be primarily spent on tools and machinery, and then be invested to expand into new villages and regions.

Extend the business model

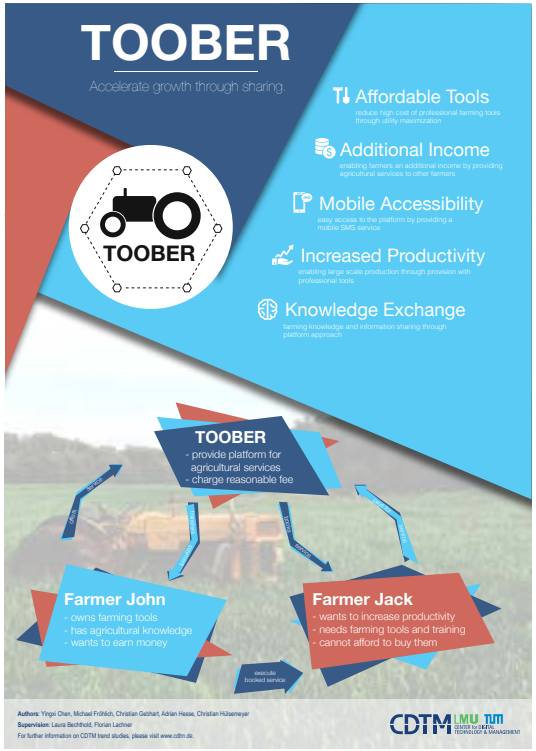
Storage and transportation remain the biggest hurdles to achieving true large-scale industrial farming in most underdeveloped regions. Mature market channels as well as effective storage and transportation systems are vital for the modern agricultural supply chain. Immense harvest gains made through large-scale industrial farming cannot realize their actual monetary value, without these factors. Thus, tackling storage and transportation problems become inevitable for regions to achieve true self-sustainability and prosperity. A portion of the surplus will therefore be dedicated to extending existing business model further and contributing to storage and transportation solutions. For instance, through the Toober platform, a possible next step could be to connect the vehicles passing through villages, to farmers who require vacant space for the transportation of crops.

Scenario Fit:

Separated New Worlds

In the first scenario, where global collaboration has ceased and GMOs are widely used, Toober faces severe challenges. International conflicts between states are more common than today and border areas are filled with refugees. Access to international market is limited in most cases and countries are trying to satisfy their food demand self-sufficiently with varying degrees of success.

In order to meet the demand for food, the agricultural industry is largely consolidated in most countries, leaving no place for smallholder farmers in the market. As a consequence, the remaining large scale farming corporations own all of their agricultural tools themselves, thus pushing sharing platforms like Toober out of the market. Ultimately,

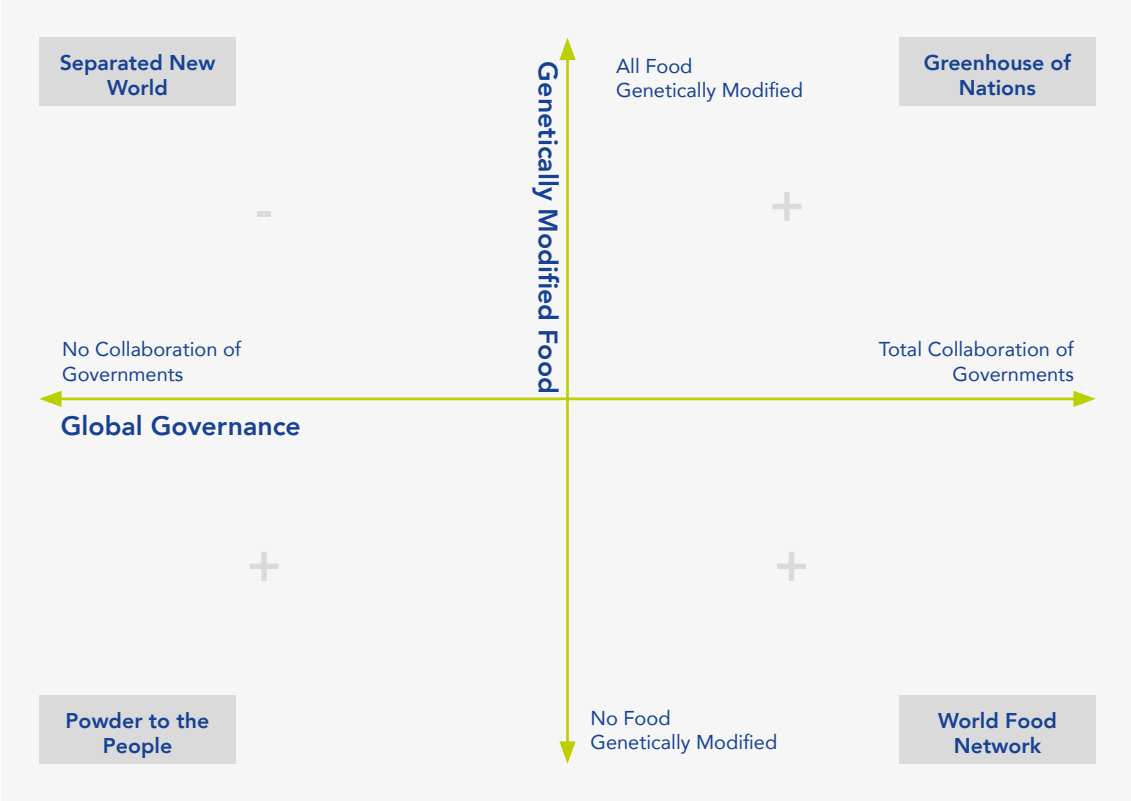


agricultural sharing platforms like Toober are only profitable in countries where food security has traditionally been high, and smallholder farmers are still in business.

Powder to the People

A scenario where international collaboration stops completely and GMOs are not used at all would not be favorable for the business concept of Toober. The disappearance of GMOs results in fewer services which can be offered on the platform. Furthermore, the acquisition of specialized tools is more difficult than today, due to high tariffs. On the other hand, this will lead to higher demand in services including such tools.

Moreover, the overall business model would have to adapt



to collaboration existing only on a smaller, more national, and regional level. By shifting the focus to regional characteristics and local communities, Toober could become a vital partner for community based sharing of agricultural devices and services.

However, in this case, the final product would be quite different to the original idea of enabling farmers across communities to share their tools and services.

Greenhouse of Nations

The world in this scenario has been shaped by strong global governance and the rise of GMO crops. Big agricultural corporations have gained significant market power and increased their influence across national borders. This leads to a comprehensive consolidation of the food industry, leaving no place for smallholder farmers. For those large-scale farming corporations left, it is more profitable to buy most traditional agricultural tools on their own.

Additionally, international trade has risen in importance, and places which were inaccessible for industrial farming companies earlier are now also consolidated.

Consequently, the business model of Toober to empower smallholder farmers would be outdated in its current form. However, by focusing on highly specialized, high cost agricultural tools, which are not affordable even for large farmers, Toober could still operate profitably under these conditions. This approach would be supported by the increased infrastructure for services to be offered across far larger areas.

World Food Network

In a world where total global governance regulates the worldwide food distribution, Toober would face some major challenges. The strong consolidation of the food industry pushes traditional smallholder farmers out of business, and large scale industrial farming becomes the new standard. As a consequence, the demand for sharing agricultural services among smallholder farmer ceases, since large-scale food producers acquire farming devices on their own.

On the other hand, the disappearance of GMOs drives a rise in urban farming and a need for agriculture in cities. The newly developed technologies and the higher public awareness of urban farming could give rise to new business opportunities for Toober. In particular, areas of high population density with short distribution routes present complimentary conditions for operating a sharing platform. Since food supplies will be distributed by a global food index, citizens have high motivation to extend access by growing food themselves. This could open families or individuals as additional target groups for small farming services within cities.

Challenges:

- Road infrastructure necessary to access larger regions and farmers
- Productivity increases have positive impact when food transport and market access available
- Wages for service providers highly dependent on crop market prices
- Tools rented through Toober platform must be insured in case of damage
- Rented tools have to be maintained, therefore access to spare parts and knowledge of how to repair tools necessary

- Minimum number of tools per area needed to establish Toober on the ground
- Toober only available for literate farmers with access to ICT
- Rudimentary mobile platform interface, such as registration and authentication
- Motivating farmers to participate and reaching the remote communities
- Shortage of farming professionals with knowledge to train other farmers in using new tools, in certain regions
- Language diversity in Africa poses difficulty for scalability

Outlook:

In the future, Toober stands to take on an important role in development, the efficient use of limited resources through sharing, empowerment, and increased productivity of smallholder farmers. The aim is therefore to establish a sharing platform across diverse areas, especially where hunger is still present, and a serious, pressing humanitarian issue. To achieve this end, Toober seeks to operate independently, after the first less scalable stage of pre-financing tools and machines.

Toober will achieve independence and grow more quickly by adapting its services to specific needs of farmers, and including additional services. Transportation opportunities and market access are particularly essential to address. Growing penetration of cheap mobile technologies, and internet accessibility, are key factors in enabling such service extensions. Today, the majority of farmers in rural areas are still engaged in subsistence farming. Yet, with entrepreneurial spirit and innovation on the rise, smallholder farmers' former dependency on external factors can be lifted towards autonomy to create a new generation of agricultural entrepreneurs.

Christian Feuerbacher, David Hahn,
Janis Marquardt, Johannes Stangassinger,
Peter Juras, Hagen Schmidtchen

FAIRCAST

future. predicted. together.

Aid organizations like the World Food Programme face a dilemma: even conservatively calculated, "the net costs of late [emergency] response is five to seven times higher than multi-year resilience building" (WFP, 2015). Yet with aid budgets limited, multi-year resilience building is simply not possible everywhere. As a consequence, early emergency response is fundamentally necessary. The later the response, the higher the costs incurred, and the more severe the humanitarian consequences. To mitigate these risks, the WFP and other aid organizations are highly dependent on predictions and reports to allocate their resources as quick and efficient as possible. Nonetheless, traditional methods of forecasting leave significant room for improvement, tending to lack the accuracy necessary for dire scenarios.

faircast presents a social online betting platform with the capacity to deliver far more accurate predictions. Users and NGOs are thus offered the possibility to bet on scenarios, with the purpose of forecasting future events. faircast employs an underlying model of prediction markets and hence benefits from the wisdom of the crowd by collecting predictions from independent betting actors.

The most pressing problems of our time, such as the international refugee crisis, can be addressed directly by faircast. Predicting sources of food supply, accommodation, and work opportunities in regions affected by flows of migration has emerged as a major challenge. Consequently, the circumstances presented by refugee migration also serve to showcase the potential of faircast, and how a prediction platform would operate in an aid situation. An urgent question facing aid organizations such as UN WFP, for instance, concerns the number of refugees arriving in Turkish refugee camps within a specific time frame.

faircast would primarily target both those refugees already en route and individuals with knowledge of topics related to migration, to contribute insights and predictions. The faircast system utilizes bets involving actual sums of money, as well as test portfolios with virtual play money, to include participants without financial means to place actual bets. faircast positions itself as a social business that generates revenue from two streams: organizations in need of forecasts (clients) and directly from those interested in casting bets/predictions (users). Surplus generated through either revenue streams will be donated to migration-related agencies that articulate credible demand for monetary support. Thus, customers and users contribute to their causes both winning even when losing a bet. These forecasts will then be verified by credible market research institutions and partner agencies, such as the UN World Food Programme.

Through faircast's predictions, the WFP can use the information provided to (1) be prepared for emergency situations, (2) allocate their resources more adequately, and (3) communicate forecasts to their partner agencies.

Type of Interventions

faircast is a betting platform that allows aid organizations such as the World Food Programme to ask dire questions, such as "How many refugees will be registered in Turkish camps in May 2016?" Users of faircast then bet on answers to this question to determine the likelihood of outcomes. A mathematical algorithm takes all bets into account and calculates the expected number of refugees, thus assisting WFP to plan their actions and distribute resources more cost-efficiently. The idea of using crowd-based betting platforms to predict futures is known as prediction markets." The concept has already been used successfully to predict outcomes in U.S. elections more accurately than traditional polls as well as by companies like HP to predict revenues (Wolfers, & Zitzewitz, 2004, 2006).

faircast utilizes prediction market mechanisms to provide three separate services, targeting different groups of stakeholders. Firstly, clients, such as the UN WFP are addressed through accurate predictions for questions related to aid and resources. Secondly, users can also experience faircast as a betting platform, while knowing they are supporting a good cause. The bet itself delivers helpful information, and users contribute to faircast's revenue, which is ultimately donated. Lastly, humanitarian organizations receive donations from the platform, enabling them to provide direct help to refugees in need.

Value Proposition

Customer value proposition

When there is an emergency, such as a natural disaster or a conflict that affects food access or causes population displacements, the WFP quickly delivers resources (WFP,

Social Business Model

Key Resources

Physical
- Office space
- Server infrastructure

Intellectual
- Technology on betting / verification

Financial
- Initial funding required

Human
- Specialized Staff

Partners & Key Stakeholders

I/N/GO marketing agencies
- Initiating dialogue with users

I/N/GOs, government, and private research institutions
- Sources for outcome verification

IT providers

Financial partners for money transactions

Key Activities

Operating IT platform
- Software development and site setup

Operating betting and prediction system
- Create accurate and reliable system

Customer acquisition
- Marketing: on the ground via key channels

Verification of prediction results
- Use case: number of registered refugees in Turkish camps

Surplus distribution
- Use case: donation to Turkish refugee camps and humanitarian organizations involved

Type of Interventions

- Prediction market service to forecast events utilizing wisdom of the crowd

faircast's three services:
- Low price prediction for clients
- Betting platform for users
- Surplus donations to beneficiaries
- Use case: WFP accesses information when and how much emergency response

Channels

To users
- Mobile phones
- Social media
- NGOs (flyers for vouchers)
- App-stores

To clients
- Direct contact
- Key partners

To beneficiaries
- Clients and their partners
- Application process

Segments

Clients (IGOs, GOs, privates, NGOs)
- Use case: WFP Quest: How many refugees are going to arrive in Turkish camps in May 2016?

Customer
- Use case: Individuals interested either in short-term monetarization, general event outcome predictions and/or "donating" (could be an insider/expert)

Customer Segments

- End-customers in rural areas
- End-customers in urban areas
- Businesses with internal networks
- Mesh application developers

Cost Structure

Fixed costs
- Once: Large upfront investment for initial platform development
- Ongoing: platform related: HR, server infrastructure, maintenance

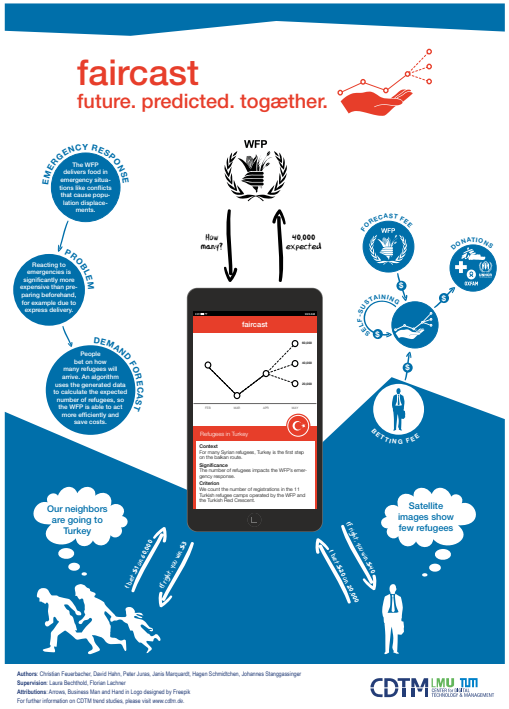
Variable costs
- Betting payouts
- Verification
- Customer acquisition

Surplus

- Allocation to humanitarian aid organizations
- Reinvest: improving faircast's and therefore client's prediction accuracy
- Use case: Support aid organizations with migration involvement

Revenue Streams

- Users
- Fee on stakes via reduced odds
- Clients:
- One-time fee per question to use the faircast predictions
- Additional bonus payment in case of accurate prediction



2016). Yet reacting to emergencies without warning is significantly more expensive than preparing aid beforehand. faircast is an additional early warning indicator to know when and where emergency response is needed — in advance. Such knowledge is extremely valuable from an economic point of view but also crucial for beneficiaries who will suffer less from hunger and other severe consequences of emergency situations.

Humanitarian agencies need accurate predictions to allocate resources in the most efficient way possible, to be prepared for sudden change. The mechanism of prediction markets has already been proven successful in this respect (Wolfers & Zitzewitz, 2004, 2006) in generating precise, low-cost forecasts for clients requiring up-to-date information. In comparison to conventional means of prediction, such as extrapolation, faircast further incorporates the voice of the affected people and thus includes insider knowledge. On the user side, faircast gives betting users the possibility to multiply their stakes with correct predictions. Additional extrinsic incentives include correct predictions leading to higher social status and credibility within the user community, as well as fun through the element of competition. Simultaneously, faircast appeals to intrinsic motivational factors, since users contribute to a good cause – even if they lose a bet, they are still left with a positive feeling.

Social value proposition

faircast creates social value in two ways. Firstly, if the forecast question relates to a social issue (as in the use case) faircast provides useful information that directly impacts those affected by this concern. Secondly, faircast uses surplus generated through clients to further support beneficiaries, such as refugee camps or migration related projects.

Impact measures

faircast will demonstrate its social impact by establishing a history of correct predictions used to benefit humanitarian organizations. In the primary case of refugees and displaced populations, this can be done by comparing the efficiency of resources allocated based on faircast's predictions, to the results achieved with traditional estimates or no prediction whatsoever. As an additional note, faircast will publish how much surplus goes to beneficiaries, and what percentage is used via a real-time indicator on the platform.

Key Activities

Operating an IT platform

Bettors can access faircast via different channels, which must be implemented and made accessible using corresponding technologies. All this involves a major one-time effort of implementation to begin with, and minor but constant maintenance efforts thereafter.

Operating the betting and prediction system

The core of the faircast prediction and betting service is a mathematical model which determines odds, registers bids, and predicts outcomes. This model is highly complex, and must be validated, since it involves money transfers and requires extreme accuracy and reliability.

Customer acquisition

Prediction accuracy, revenue generation, and achieving a surplus each relies on a large user-base. Especially in the first stages, it is crucial that faircast acquires a significant amount of bettors to enable reasonable prediction. Hence, marketing strategies may prove useful, especially social and conventional media campaigns, tracking app-store rankings and in certain cases, as with displaced refugee populations, flyers/sign-up vouchers. These activities will remain important once faircast is established, in order to continually improve prediction accuracy, and increase donations. Client acquisition is again vital in order to achieve a critical mass of bets running on the platform.

Verification of prediction results

Payouts for bets can only be completed once there is proven data about the outcome of the predicted question. Hence, for instance, faircast has to find and provide validated data about the real-time numbers of refugees arriving in Turkish camps.

Surplus distribution

Once prediction rounds are over, and expenses are covered, surplus will be donated to migration-related aid organizations. The task of faircast is to find appropriate beneficiaries to whom funds ought to be distributed.

Segments

Customers

In the first place, faircast is intended to be useful to a wide range of clients from the private sector, to governments, international aid organizations, and NGOs. The initial focus here will be use cases related to humanitarian organizations i.e. the UN WFP offering assistance to refugees and predicting the number of refugee arrivals in Turkish camps.

This is where the second customer segment, namely, users who want to place bets, enters into the equation. On the one hand, refugees themselves have potential insider-knowledge of the number of other refugees who will arrive – either in a test or real money market. On the other hand, private betting individuals, who are interested in the issue, are able to assist the WFP by contributing to their predictions. Some users will likely also be interested based primarily on monetary gains. One example of the customer segment might be a migration expert from a developed

country, who could register at faircast and take part in making a prediction.

Beneficiaries

The initial target group of beneficiaries addressed by faircast, as a social business, will be Turkish refugee camps, the agencies involved there, and generally aid organizations active in the field of migration. faircast supports these organizations by granting a part of its generated surplus in funding, and by allowing future increases in efficiency of resource allocation, through better predictions.

Key Resources

A successful market entry for faircast must be based on four key resources.

Firstly, a qualified team with a diverse skillset is crucial to build the platform. Product development requires experienced software engineers and experts both in prediction markets and betting platforms, in order to set up faircast. Especially in the first stage, marketing specialists are critical for customer acquisition, and thus the overall odds of success for faircast.

Technology is the second key resource. Value for the customer is created through specific prediction market algorithms that generate odds and probabilities, depending on the bets of users. In the long run, machine learning and pattern recognition technologies play a role as well, to draw further, more valuable conclusions from collected prediction data.

The product development process and the salaries of faircast's staff must of course be financed. Therefore, especially at the offset, sufficient funding is essential. Preferably, an international aid organization, such as the WFP, would grant a first round of monetary support, until other funders and sources of financial sustainability can be established.

On a final note, physical resources, such as office space and server infrastructure, would quickly become necessary. Here, faircast will make use of cloud service solutions to set up the first stages of the platform.

Partners & Key Stakeholders

In the best case, the WFP would become a first key partner of faircast, providing initial funding to the company, assisting by engaging refugees, and providing valuable insights on the current state of the field.

Other important initial partners are other organizations well-positioned for reaching faircast's customer segments. This could include non-governmental organizations (NGOs) and inter-governmental organizations (IGOs) distributing vouchers to involve refugees and people on the move. On the other hand, marketing agencies could also help reach other customer groups in the developed world, which must be identified for entrance into the market.

As betting on future outcomes is the core function of faircast, crucial information needs to be verified and documented at the end of each bet. The WFP and other UN agencies involved in migration issues, as well as NGOs in the field, will confirm the results of stated bets.

faircast will also collaborate with payment providers such as PayPal, Visa, MasterCard, or M-Pesa (for mobile money) to ensure adequate usability. faircast will further enter into dialogue with the private sector to negotiate rewards for bettors who utilize the test portfolio, rather than a real money portfolio. Corporates would be incentivized with the possibility of posting their relevant questions for prediction on faircast for free or with significant discounts.

To complete the circle, faircast's IT partners must be capable of scaling up quickly. Thus, there is a space for faircast to partner with IT infrastructure providers, such as Amazon or Microsoft that charge only for used resources.

Cost Structure

Variable costs

As faircast is a betting platform that crowdsources predictions of future events, the major part of variable costs is directly linked to payout outputs. Similar to usual betting systems, bettors who succeed with predictions can receive the funds initially placed on a certain odd, plus the respective win. With a higher number of bettors, the costs for faircast decline, with payouts (co-)financed by the bets of other participants. In case of only a few participants placing higher amounts of money, there is a risk of very significant payout costs. One potential means to mitigate this would be an upper bet limit, dependent on the current liquidity situation of faircast.

Secondly, acquiring new customers or users is a resource-consuming process and therefore a major challenge to the success of faircast. Flyer campaigns via partner NGOs are costly. But providing users with the possibility of placing predictions within the free test portfolio might not be enough in the long run. This means that cost intensive vouchers could be handed out to new users, e.g. $5 real bet money for a new registration, depending on faircast's financial assets.

Furthermore, verifying the prediction results with exact numbers must constitute a considerable portion of variable costs, either internally from our own faircast experts, or externally, through hiring research institutes.

Fixed costs

There is a large one-time upfront investment required to be able to develop, and set up the faircast platform. This includes hiring experts in several fields, such as betting software, prediction markets and statistics. Other costs involve maintenance, server infrastructure, and service. Lastly, in order to be able to operate a betting platform, several licenses are required.

Revenue Streams

"[A] Social business is a cause-driven business" (Yunus, 2007). faircast is cause-driven for two reasons. First, it aims at supporting decision-making for organizations that provide humanitarian aid and resources to displaced people/refugees. Further, potential surplus is intended to be allocated to these organizations as well. As for every business, revenue is the oxygen to create long-lasting impact. In faircast's case, revenue is generated from two different sources.

Users

Every time a participant places a stake/bet on a "wrong" event, this prediction is "lost" and transferred to users that chose a more precise prediction. For each monetary transaction, faircast charges a transparent percentage fee through reduced odds. The player is then able to see how much of the funds they have invested in faircast already have been donated to a good cause. Accordingly, faircast charges higher percentages, or in other words, provides lower odds, than usual betting platforms. These result in

higher revenues partly used to finance faircast's operations, as well as to cross-finance organizations active in the field of migration-related aid.

Clients

The dependence of aid organizations on accurate prediction and the difficulty in achieving those predictions, are the pains faircast tackles with the predictive markets solution. This is the basis for a one-time fee, per prediction question, for clients such as the WFP. The amount charged depends on the question asked, as different expenses will be required to verify the event afterwards. Secondly, if the faircast community accurately predicted an event, a bonus is charged as an additional payment.

Surplus

So what is fair about faircast? Gambling or betting usually means: "in the end, the bank always wins". This does not sound fair at all. At faircast, not only users, but also organizations are assured: if they use faircast's service, the surplus is reinvested in humanitarian aid. Hence, this "bank" is "fair" and splits its revenues for a good cause. Especially in the beginning, the strategy is to use faircast predominantly for migration related questions, as it is stated in the use case, which is also why faircast will allocate its surplus either directly to beneficiaries via its own platform or to NGOs that are active in that field.

Through reinvesting in the company, a part of the surplus could also be allocated to improve the prediction accuracy of faircast in order to generate an even better impact for humanitarian aid organizations. This could be incentivized by transferring prize money for outstanding bet performances especially to beneficiary users.

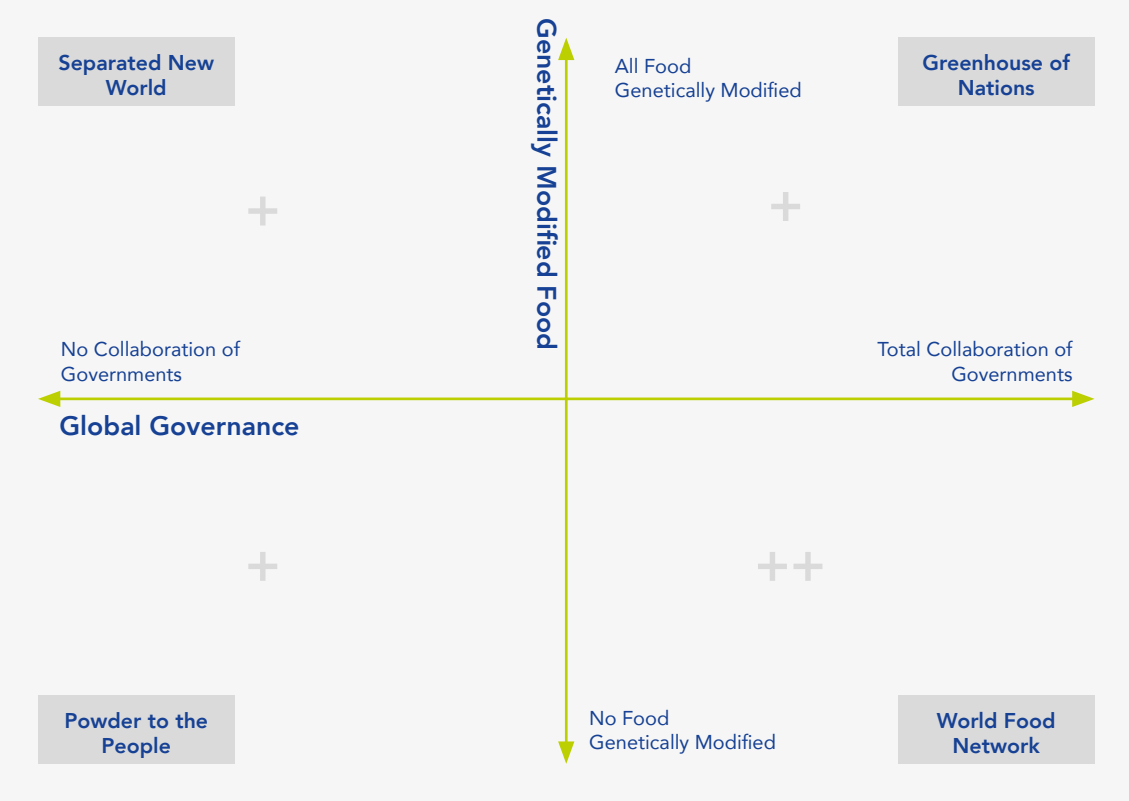
Channels

faircast will reach out to three different target groups over different channels. On the one hand, these are customers divided into forecast question creating clients like the WFP and betting users. On the other hand, there are beneficiaries which are represented by Turkish refugee camps.

Since clients are contributing the forecast questions for the predictions, they are essential for the whole process. However, already a few clients or even the WFP alone are able to provide enough questions to generate a constant activity on the faircast platform. So it might be enough to initially focus on the WFP and maybe a few other clients. The goal is to establish close partnerships with high customer satisfaction. Therefore, those clients are directly approached by responsible staff members, building up strong relationships.

Because faircast's surplus donations are targeted to migration related projects, clients might give recommendations where help is needed the most and might even be the direct supplier of aid. Once faircast is known, beneficiaries can directly apply for donations and those will be targeted to selected beneficiaries.

The biggest effort will be user acquisition, since paying bettors create revenue, and thus surplus for donations through their contribution. Targeted advertising involving social and conventional media campaigns is crucial to get a sufficiently large initial customer base. Turkish partner NGOs of the WFP will distribute sign-up flyers in Turkish refugee camps. The faircast platform can be accessed through var-



ious channels like a website, a smartphone app, or an SMS based system to reduce access barriers. Here, a partnership with M-Pesa could be an option to use the SMS to ask questions and directly transfer money via the M-Pesa mobile bank accounts. Additionally, a positive user experience might create network effects and make existing customers acquire new ones. This can be further incentivized with a recommendation based reward system.

Scenario Fit:

Greenhouse of Nations

Due to "total collaboration of governments", the radius of operation and the financial power of internationally active humanitarian organizations increases significantly. This is achieved by removing international barriers, promoting aid activities and creating public awareness via official channels. As a result, humanitarian organizations will be able to operate more aid projects and might therefore also have a higher budget for event predictions. These contain general developments and emergency response forecast, including migration questions answered by faircast.

While faircast highly benefits from this development, it is counteracted by the elimination of armed conflicts through global governmental enforcements, taking away a main reason for migration and thus decreasing the applicability of faircast.

Therefore, in this scenario the target of faircast should be extended to other questions connected to humanitarian problems. Since Greenhouse of Nations suffers especially from GMO crop failures, faircast could address the prediction of those events and deploy its full potential.

Separated New World

Caused by the discontinuance of international collaboration, internationally funded humanitarian agencies will no longer exist. Additionally, closed borders make it difficult for privately funded NGOs to provide emergency response in other countries. The same fact also makes refugee migration into other countries nearly impossible. Hence, faircast's initial purpose becomes obsolete. Further, relative food security in countries in which GreenCorps' GMO dominance is prevalent, makes food demand predictions rather unneeded.

At the same time, national governments and GreenCorps might use faircast to predict GMO crop failures linked to temperature increases or to foresee other climate related catastrophes.

Also national governments, as well as NGOs, could find faircast's predictions helpful to prepare for upheavals at the borders as well as within countries.

In this scenario, the donations from faircast's surplus could prove to be important, especially to ensure the independence of NGOs from multinational monopolies like GreenCorps.

So even though faircast will most likely not serve its initial purpose anymore, there still exist various other opportunities to make use of faircast in the Separated New World.

World Food Network

World Food Network is characterized by intensive collaboration of governments and humanitarian organizations. As a result, human mobility climaxes.

The two main reasons for this are food related migration e.g.

high urbanization, as well as movements due to labor demand. Here, faircast profits from high migration and can fully utilize its capabilities in accurately forecasting those movements. Governments, IGOs, NGOs as well as private companies can therefore highly benefit from faircast's service and are able to plan actions and capacity far better.

Moreover, corruption and the establishment of black markets increase because of high taxes on meat and disproportionately high overall lack of food. For this reason, the precise prediction of food prices will be a second opportunity to foster faircast's business.

At the same time, surpluses generated by faircast will be thoughtfully distributed where help is needed most – in this case regarding food scarcity related causes.

World Food Network thus is the ideal environment to fully deploy faircast's potential in both the initial field of migration and various others.

Powder to the People

As governments collaborate less and nationalism is on the rise, people care less about other countries and are not interested in international bets anymore. Therefore, prediction markets will be more local.
Developing countries see a decrease in urbanization in which tribes become important administration units. Communities have to cope with unstable harvests due to natural disasters like droughts and famines. Since genetically modified crops are banned, farmers cannot use them to cope with these disasters. Communities depend on other mechanisms to deal with unstable harvests. This is where faircast unfolds its potential: communities can use the predictions to be prepared for bad harvests by conserving more food in the form of powder.

While the questions faircast answers will be on a smaller scale, it will play an important role in securing the food supply for the base of the pyramid.

Challenges:

- In order to make meaningful predictions, faircast relies on a large active user base, making successful and vast customer acquisition critical at the beginning. Even though this might be tackled by using existing channels, such as WFP food donations, there still remains the problem of how to incentivize users to use faircast. Handing out vouchers with a starting credit could be an option albeit a rather expensive one.
- Criminals could heavily influence refugee streams and cause harm and unintended side-effects (e.g. by creating conflicts or blocking passages) in order to win bets with high odds which were unexpected by the rest of the user base. By restricting the height of stakes, faircast could overcome this threat.
- As with every betting system, addiction prevention is necessary – especially to protect refugees. A possible solution is based on activity restrictions (e.g. number of bets).

Outlook:

Migration is just the beginning. faircast aims to position itself as a combination of an accurate, reliable prediction service provider and a betting platform with a positive social impact. Through the expansion to other geographical regions and humanitarian fields, such as food price predictions, faircast will enhance its public awareness and consequently its sphere of influence. Once faircast generates enough revenue, there might be room for voucher-based customer acquisition campaigns with real money, especially for refugees. After a critical mass of users is gained, faircast could be used by humanitarian organizations as a hedging mechanism to compensate for unexpectedly high emergency response demand. This can be achieved by betting on events that are correlated to an extremely high emergency response demand.

To find out what is really needed, a true dialogue among peers and between beneficiaries/humanitarian agencies is desired. One way could be to incentivize refugees to share their knowledge and insights on current faircast questions. A voting/endorsement based comment system is planned to reward useful inputs.

There is a trend for corporates using prediction markets, for example to forecast their revenue. In the future, companies might prefer paying faircast for predictions instead of a full-profit competitor, as faircast's surplus is partly donated. The companies will then be able to declare faircast's service as corporate social responsibility (CSR) expenses. In addition, a subscription based model for regular clients could be introduced.

Chiara Secules, Patrick Kastner,
Kim Borrmann, Lakmal Padmakumara,
Sophia Wessling

CROPSPOT

Mobile solution automating crop disease identification through image recognition & machine learning.

Harvest resilience, and the protection of crops against diseases play a significant role in meeting the growing demand for food quality and quantity. Losses due to plant diseases and pests range from 20% to 40% regarding global agricultural productivity (Savary et al., 2012). The largest losses are reported for rice and wheat: key food crops in developing countries. These numbers indicate that for developing countries, losses due to plant diseases are costly in terms of food security, necessary food imports, and income losses for farmers and others whose livelihoods depend on agriculture related activities.

Chemical pesticides have reduced crop losses in many situations. However, inappropriate or excessive pesticide use can lead to increased and unnecessary pest outbreaks and additional pest losses due to the inadvertent decimation of natural pest enemies. This is where farmers would benefit from a platform to reach local and international expert knowledge, and advice in real-time. CropSpot tries to bridge this gap between farmers and knowledgeable experts using a few trending technology concepts.

The usage of smartphones and access to Internet is still low in developing regions compared to developed countries. Yet the use of ICT and the Internet are increasing rapidly. This is why CropSpot presents a mobile solution with the purpose of giving access to this centralized knowledge repository, independent of the farmer's location.

CropSpot can be introduced as a crowdsourced platform where a farmer can simply upload a picture of an infected crop via his smartphone and receive advice and recommendations from a global expert network. Going a step further, CropSpot combines the power of image recognition and machine learning (ML) technologies to provide an automated response platform for the users. It is trained using the image data and relevant expert opinions collected over a period of time. While the quick and accurate response reduces the probability of farmers losing their harvest, CropSpot could also assist plant researchers and agricultural experts in collaborating to speed up plant disease research.

Type of Interventions

CropSpot will provide crop analysis and expert knowledge as a service for smallholder farmers, with regards to the condition and appropriate treatment of their crops. The service is provided via a mobile application, hence, can be used independently of the user's location. Farmers take pictures of their diseased crops and upload them into the

Social Business Model

Key Resources

- Expert knowledge
- Opensource database of pictures from crops and its diseases
- Crowdsourced pictures
- Image recognition algorithm
- Machine learning algorithm
- Application developers

Key Activities

- Build up image database of diseased crops
- Implement image recognition
- Train machine learning algorithm
- Acquire expert knowledge
- Integrate and automae expert recommendations
- Build application
- Analyze application data and write industry reports

Type of Interventions

- Crop analysis and expert knowledge as a service
- Mobile application

Segments

Beneficiary

- Smallholder farmers in developing countries
- Industrial farmers in developing countries

Customer

- WFP
- Research institutes
- Pesticide, herbicide and seed companies
- Government (agricultural and environmental departments)
- Cooperatives

Customer Segments

- End-customers in rural areas
- End-customers in urban areas
- Businesses with internal networks
- Mesh application developers

Partners & Key Stakeholders

- WFP
- Local NGOs
- Experts
- Universities
- Corporate institutes
- Facebook

Channels

Beneficiaries

- App store and smartphones
- Network of local NGOs
- Cooperatives
- Social media

Customers

- Academic and industrial conferences
- Network of WFP and UN functions
- Direct sales approach

Cost Structure

Upfront Cost

- Application development
- Acquisition of commercial image datasets
- Acquisition of expert knowledge

Running Cost

- Renting cluster infrastructure
- Continuous app development and algorithm optimization

Surplus

- Continuous improvement of app
- Algorithm training and optimization
- Research grants to acquire experts
- Expanding the reach
- On-site experts

Revenue Streams

- In-App advertisements (banners / posters)
- Product placement
- Affiliate model
- Selling data and analysis as reports

CropSpot application. Image processing extracts the image features and a machine learning algorithm detects the disease. CropSpot then gives the farmer an automated, real-time response on how to treat his crops, and in consequence save his harvest.

Value Proposition

Social Value Proposition

The main value proposition is a real-time, automated disease recognition combined with expert recommendations for remedies, including direct links to suppliers of the solution. Image recognition combined with machine learning will allows an identification of the type of plant and type of disease. Expert recommendations will suggest the farmer how best to deal with the situation.

The quick advice and readily available expert information will help to increase yield in the long run by reducing crop losses due to spreading diseases. By saving parts of the current harvest and/or facilitating future cultivation of crops, the farmers' income is secured and also ideally increased. Hence, CropSpot also allows for harvest resilience and prevention of losses.

Impact Measure

The reach can be captured through the number of application downloads and active users. The usage can be measured by the number of pictures that are uploaded and analyzed. By determining the ratio of solved requests to total requests, the success rate of the algorithm can be analyzed. This can be further refined by collecting feedback from the farmers, whether the advice was effective or not. This can be done through a very simple like and dislike button to ensure a high response rate. A more detailed survey among the application users could reveal how much their yield has increased by using CropSpot for disease identification and by following the recommendations.

Customer Value Proposition

Customers will receive detailed data on crop diseases: types of crops and diseases, their frequency, and their location. Gathering numerous real time data points from farmers all over the world, and across time, will allow for regional pattern recognition. Tracking the spread of crop diseases can be used by governments and industry organizations to predict how diseases might spread. Statistics about the crop types and their respective diseases will furthermore enable supply predictions.

Key Activities

Build up an image database for diseased crops

Use open source and commercial photo databases. The photo database serves as the training input for the machine learning algorithm.

Implement image recognition

Image recognition could be achieved both manually via crowd based platforms such as Amazon Mechanical Turk, and automatically via openly available image processing libraries.

Train machine learning algorithm

Once enough initial picture data and relevant expert reviews on these pictures are available, the training of the machine learning model starts. The trained model can give automated responses for new picture submissions without the user having to wait for input from experts.

Acquire expert knowledge

Expert knowledge, particularly in the early development stages, is essential as it sets the diagnosis accuracy standard for the algorithm. Expert knowledge will be acquired by offering payments in the beginning. Later on experts can be incentivized with free access to the data and analysis reports.

Integrate & automate expert recommendations

Automated matching of expert recommendations with plant diseases and particular cases. This increases scalability by reducing the need for human responses.

Develop application

This comprises initial coding and development of the application, particularly the user interface of the app, the backend, which integrates the algorithms, as well as storage, and management of the generated data. The initial setup will be followed by continuous maintenance and improvements.

Analyze application data & write industry reports

Real-time data collected through the application, or crowdsourced photos, will be analyzed by experts and algorithms to produce valuable industry reports with trend and outlook information.

User acquisition

Convincing the World Food Programme (WFP) as well as farming cooperatives, and other partners that help to distribute the application. Hire local sales people and train experts onsite to further boost the application distribution.

Segments

Beneficiary

The main beneficiary target group is smallholder farmers in developing countries. About 80% of the food consumed in developing countries is provided by smallholder farmers (IFAD & UNEP, 2013). Farmers use their harvest to nourish their families and sell the surplus to generate income. As up to 40% of the yield can be lost due to crop diseases, improving the yield is highly demanded (Savary et al., 2012). Since farmers often cannot identify the disease immediately and do not have full knowledge about an appropriate treatment, CropSpot will help to save their harvest and thus, increase onsite yields. This will help fighting hunger in the short and long term.

Industrial farmers in developing countries are the second group of beneficiaries. Also they can benefit from the free service to fight crop diseases and increase yields.

Customer

The data generated through CropSpot regarding crops, locations, spread of known and unknown diseases, and need for pesticides, fungicides, and fertilizers can be marketed and sold to various customers. This data would be of high value to the WFP for understanding the individual farmer's situation, for measuring the improvement of the food supply, and for overseeing the development and spread of certain diseases. The same interest, but on a national level, is also prevalent for agricultural and environmental departments of governments. Furthermore, research institutions can benefit from CropSpot, as they can use the generated data for research on new, and existing diseases.

Other parties interested in the data are cooperatives, which have a big interest in increasing the productivity of their farmers. They can use the data to find out about the most recent developments of a disease as well as new potential threats, which they might need to prepare for. The data helps to foresee harvest losses and enables cooperatives to better forecast the yield of their farmers.

Pesticide, herbicide and seed companies can benefit from the data as well to develop new products tailored to new diseases. Apart from acquiring the data generated through CropSpot, they can use CropSpot as a data-driven platform to better develop as well as market their products to targeted customers. The latter can be established in the form of advertisements and product placements directly in the application.

Partners & Key Stakeholders

In order to make CropSpot a reality, partners, and key stakeholders need to be integrated into the process. For the initial development and ongoing maintenance, acquiring knowledge would be necessary to train the model as explained further in Key Activities of CropSpot. The knowledge will be taken from experts working at universities or corporate institutions. Either the expert is incentivized on an individual level, or through the employee's institution as a whole. Throughout the development of the application, and after its implementation, the data collected through CropSpot will be useful to the respective institutions. These universities and research institutes could not only profit from the data, but also aid in optimizing the image recognition, and also dealing with new diseases. This would create a mutually beneficial partnership.

Especially with regards to the international marketing of CropSpot, the WFP would be a valuable partner, providing networks in the targeted countries, be it with regards to facilitating connections with the local industry, or with the respective governments.

In addition, local NGOs will be able to act as on-the-ground partners and assist in the product adoption by smallholder farmers and community-based organizations. Local NGOs are trusted by the locals and therefore are a perfect partner for addressing the last mile distribution challenges.

Finally, Facebook will be used as a partner in that the user can login to the application with its Facebook account. Going along with that, the application can integrate a button to share the user's activity on Facebook.

Channels

Beneficiaries

CropSpot will be a smartphone application that can be downloaded from currently popular app stores. To overcome the last mile in marketing CropSpot to the beneficiaries, CropSpot will rely on the networks of local NGOs, as they have many local contacts and are trusted advisors. They can promote the application among the people they care for during their main projects. Additionally, cooperatives are, by definition, well interconnected among farmers. They are in regular contact with their members and have a valid interest in enabling their farmers to have the best possible harvest. Instead of performing physical training, they can rely on CropSpot as a mobile solution for helping the farmers to achieve higher yields. Thus, they are incentivized to market CropSpot amongst their members.

Finally, CropSpot will be promoted on social media. Sharing one's experiences and CropSpot's recommendations on Facebook will virally spread the word about the service and also integrate CropSpot into a community network.

Customers

As local NGOs are used as intermediaries to overcome the last mile to the beneficiaries, the network of the WFP and other United Nations organizations consists of very close connections and collaborations with potential customers of CropSpot. Hence, relying on these existing networks can be used as a multiplying factor for connections to governments, universities, and the industry. Moreover, topic-relevant academic & industrial conferences can be used to further publicize the platform to the private sector and academia. Using these channels, CropSpot earns credibility, acquires potential customers, and attracts grant support and sponsorships. To promote CropSpot as an advertising platform, a direct sales approach will be used to contact local firms as well as bigger pesticide, and herbicide companies.

Key Resources

The CropSpot application will be able to provide valuable, data-driven solutions for farmers around the world. Since the application will be designed to recognize crop diseases from photographs, one first needs to train the machine learning algorithm with already confirmed and existing photos of crop diseases in different contexts. For this, CropSpot will rely on existing photo databases of crops and their respective diseases, as the accuracy of the disease recognition depends on the quality, and quantity of initial training data for the algorithm. These existing picture data sets will be the initial input for the application in order to train the model. As the model becomes more precise, the application can begin to use crowdsourced pictures from the users to augment the dataset and increase the precision of the algorithm.

Image recognition algorithms for feature extraction are a key technical resource. They perform the color transformation, image segmentation, and feature extraction. To

compliment the image recognition algorithm, a machine learning algorithm is needed to identify the matching crop and disease type. Once feature sets of past images are extracted and expert comments and recommendations are mapped to those extracted features, these learning algorithms can recognize diseases, and give recommendations for new images even without the involvement of an expert.

To make the image recognition algorithms and the machine learning algorithms together with the application interface a reality, application developers are needed to integrate the solutions and build up the application. The developers should have the following skills: programming of image recognition, machine learning, Android/iOS development and the capability to use cloud based tools and infrastructure, such as Amazon Web Services.

Revenue Streams

Especially during the initial stages, in-app advertisements for pesticide, herbicide or seed companies, and possibly also specific to the local geographic area, are an important source of revenue. Furthermore, relevant local stores or online stores can pay to place poster or banner ads in the application. These posters and banners will be shown between uploading the picture and showing the result to bridge the processing time. This way beneficiaries inevitably notice the advertisement without the advertisements being too intrusive.

CropSpot will offer product placements in the form of recommendations for plant disease remedies. The platform provides a direct connection to potential customers that are in need of pesticides, herbicides or seeds. The customer acquisition costs are reduced and the marketing reach is extended to all app users. Hence, CropSpot will also establish an affiliate model: the respective companies will pay CropSpot not only for mentioning their products within the app, but also for redirecting them to their websites through embedded links. Several models, such as pay-per-click, pay-per-lead or pay-per-sale, are possible and can be negotiated with the respective company individually.

Once the application gets more popular and the real-time, user generated database grows, revenue will be generated by selling analyzes on crop types, their diseases, and their respective spread. These reports are sold on an annual or biannual basis to industry groups, companies, governments, universities, and research institutes. The collected data can be offered, both in exchange for expertise, and for money.

Cost Structure

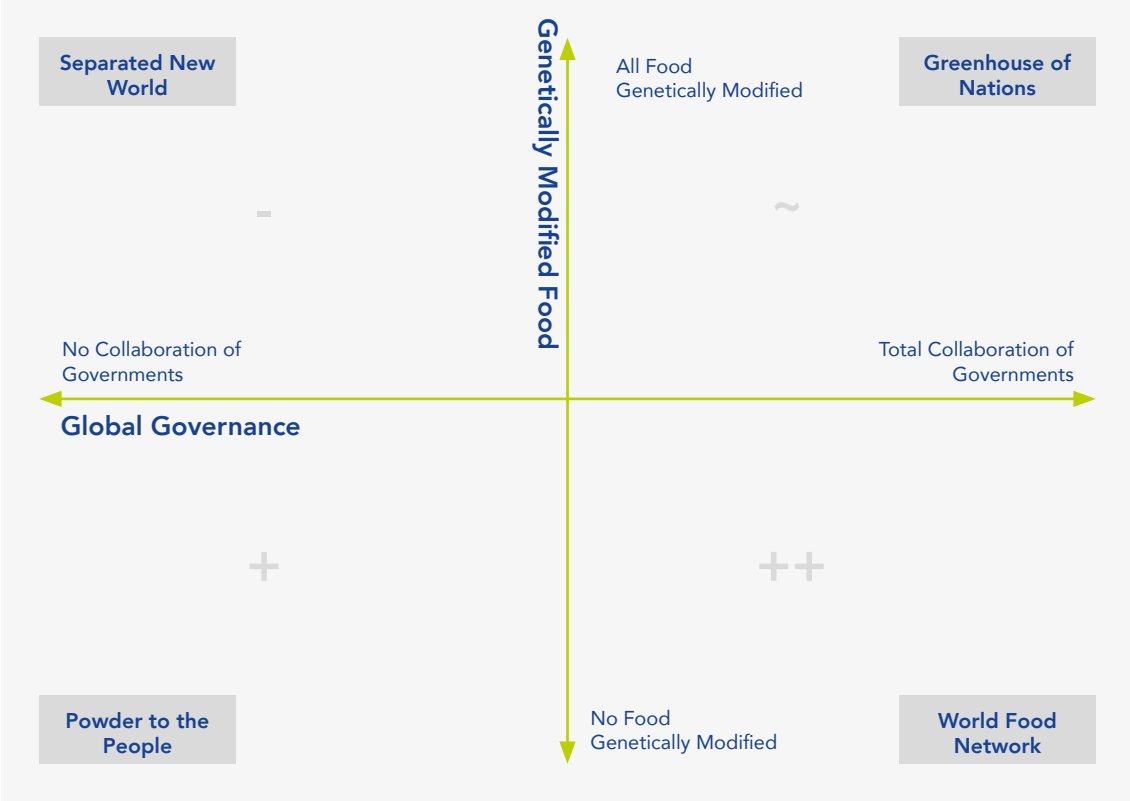
Upfront Costs

Most of the costs for the development of the CropSpot application will be due upfront: The application development requires funding before any revenue can be generated. Additionally, the application requires a large amount of data input and training in order to produce the desired result. Therefore, both the training and the acquisition of expert knowledge can be named as significant cost drivers.

Although CropSpot will extensively rely on open-license datasets for crop disease pictures, commercial image datasets will also be used. These commercial databases require an upfront investment to buy the images' rights. Once the application is launched, the image database can be augmented using the images uploaded by application users to optimize the disease recognition capabilities of the algorithm. To prepare the images as an input for the machine learning algorithm, they need to be paired with expert knowledge. The acquisition of expert knowledge utilizes platforms such as Amazon Mechanical Turk to have people extract features from initial datasets. Additionally, initial incentive processes for acknowledged experts to share their time and knowledge will also be included in the upfront costs. After having created enough content for the initial algorithms' training, the need for expert knowledge significantly drops. Furthermore, once the application is running, experts will be incentivized with the data collected by CropSpot instead of money.

Running Costs

The analysis of large image datasets in real-time is expensive and requires an extensive amount of computing power. This cannot be done on ordinary computers and must be done with cluster infrastructure. The required infrastructure can be rented from cloud service providers such as Amazon Web Services (AmazonS3 for storage and AmazonEMR for processing) on an hourly basis. This gives CropSpot great flexibility in extending or reducing its infrastructure according to the development progress and the size of the cus-



tomer base.

Additionally, CropSpot will invest into expanding its reach through local marketing campaigns, increased incentivizing of farming cooperatives to distribute the application, and the hiring of more local salespeople to bring the application through the last mile to the farmers who need it most.

In the later stages of the development, it would be beneficial to invest in training onsite experts who can act as product salesmen and educators for the smallholder farmers, especially since the last mile to reach smallholder farmers is crucial in many countries. Also continuous development of the application by the development team, and algorithm optimizations are ongoing costs.

Surplus

The surplus generated by CropSpot will be reinvested in further development of the product in terms of technology as well as content. In the beginning, this means to invest in a continuous application development and further algorithm training and optimization. This development refers specifically to training the algorithm to identify new diseases as well as a large variety of diseases, and to improve recommendations based on context. With regards to the content, the surplus is used to fund research stipends to investigate the new diseases identified by the application.

While the work of hired experts is based on their existing knowledge, and improving the algorithm for existing diseases, the funded researchers shall focus on developing the algorithm with respect to new diseases, and new species with a particular focus on image recognition, and machine learning. This way, CropSpot can selectively award research stipends, ranging up to thousands of dollars, to the best experts in their fields on a personal, project or time-period basis. Thus, the recommendations from CropSpot will always refer to the most recent developments and discoveries in research. There will always be room for CropSpot to delve deeper into new fields of plant research and to get more researchers, and academics on board to support with their skills and knowledge.

Scenario Fit:

Separated New World

In a world where GMOs completely take over the food production, CropSpot would need to adapt its technical learning process to cater for new GMO-related diseases. Identification, treatment, and prevention of these GMO-related infections would require expert knowledge from researchers who are familiar with GMO technologies and their side effects. With no government collaboration and limited industry collaboration, it would be more difficult to share this expert knowledge between different regions of the world. The datacenter of CropSpot would include all natural and GMO related crop diseases, which are commonly seen in both developed and developing regions. However, it would be very difficult for CropSpot to identify and recommend precautions for diseases that are unique to developing regions, where no extensive local expert knowledge is present.

Powder to the People

A scenario in which GMOs completely disappear from the agricultural production is favorable for CropSpot. As crops cannot be genetically modified to be insensitive to diseases, people still have to deal with the issue of harvest losses. To identify the diseases and take actions to improve their harvest they can use CropSpot, which gives them tangible

recommendations.

As countries do not collaborate, the recruitment of international experts would be challenging. CropSpot would then rely more on crowd-based input. The incentivizing process in turn, would be facilitated by a community approach, which is prevalent within a country. Despite various governments isolating each other, CropSpot could provide an easy solution to foster knowledge sharing: a remote communication tool to cross borders.

World Food Network

The World Food Network (WFN) is the ideal scenario for CropSpot to thrive. The World Food Network is totally focused on natural (non-GMO) food production processes. Due to total collaboration, knowledge is shared between all regions on both a country level, and an individual level. The agricultural researchers and institutes from different regions can use CropSpot as a common platform to collaborate and share their expertise about new methodologies and tools for preventing crop diseases. The automated response system of CropSpot would be well trained to provide results with high accuracy due to the large amount of data collected over all regions of the world from local farmers and experts.

Greenhouse of Nations

The Greenhouse of Nations Scenario would be a passable scenario for CropSpot to succeed. Due to the full collaboration, large photo databases of crop diseases for the image recognition and machine learning algorithm would be much more readily available. This allows the algorithm to be optimized at a lower cost. However, the application would need to be adjusted for GMO specific diseases, and also to specific GMO-plants. The GMO harvests would be subject to rapid fluctuations due to diseases and the limited diversification of monocultures. CropSpot would be very helpful in preventing this, but also have to adapt quickly. Additionally, the algorithm would have to be adjusted to recognize not only natural, but also human-made diseases.

Challenges:

- Smartphone and internet coverage as a pre-requisite
- Initial database for training the machine learning algorithm
- Language barriers for illiterates and with regards to numerous dialects
- Initial incentivizing of experts
- Limited utility of international experts for local conditions

Outlook:

Looking into the future of CropSpot, the application has a lot of potential for development. Once the algorithm has been well trained with common diseases, it can be adjusted and augmented to adapt to new diseases. If a disease cannot be determined, it will forward the results to research centers. Speeding up these long processes of knowledge transfer and communication gives researchers a chance to solve the upcoming issues in time.

Furthermore, in connection with the crowdsourced, location based data from the application, an early warning system for surrounding areas can be developed that can give location based, real time warnings to hinder diseases from spreading.

In addition, to allow the application and information to be available to everyone, a voice and language recognition solution will be put in place. This enables illiterates to use the service of CropSpot. As an additional extension of the customer base, the application will be available to farmers in developed countries. The crops and diseases in the database will have to be extended, but the customer base will be increased by more well-funded farmers. This will lead to an increased revenue. Also they could serve to enable price-based subsidies for the farmers in more poor countries.

LIST OF CONTRIBUTORS

Laurenz Altenmüller
Electrical Engineering & Information Technology

Kim Borrmann
Psychology

Philip Braun
Business Administration, Management

Yingxi Chen
Life Science Economics and Policy

Tobias Dümmling
Computer Science

Christian Feuerbacher
Psychology

Michael Fröhlich
Computer Science

Jakob Gebauer
Management & Technology

Christian Gebhardt
Physics

David Hahn
Management & Technology

Adrian Hesse
Business Administration

Christian Hülsemeyer
Electrical Engineering & Information Technology

Peter Juras
Human-Computer-Interaction

Patrick Kastner
Environmental and Sustainability Engineering

Josephine Kühl
Business Administration

Janis Marquardt
Anthropology, Business Administration

Mary Clare O'Donnell
American History, Culture and Society

Lakmal Padmakumara
Computer Science

Martin Patz
Electrical Engineering & Information Technology

Ferran Pla Cardona
Electrical Engineering & Information Technology

Lukas Rambold
Media Informatics

Hagen Schmidtchen
Robotics, Cognition, Intelligence

Chiara Secules
Consumer Affairs

Johannes Stanggassinger
Software Engineering

Sophia Wessling
Management & Technology

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Chair for Data Processing
Technische Universität München

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Ludwigs-Maximilians-Universität

Prof. Dr. Tobias Kretschmer
Chair for Strategy, Technology and Organization
Ludwigs-Maximilians-Universität

Prof. Dr. Wolfgang Kellerer
Chair for Communication Networks
Technische Universität München

CDTM MANAGEMENT TEAM

Florian Korte
M.Sc. Economics

Florian Lachner
M.Sc. Mechanical Engineering & Management

Gesa Biermann
M.Sc. Sustainable Resource Management

Laura Bechthold
M.Sc. Sustainability Science and Policy

Michael Chromik
M.Sc. Informatics

Patrick Bilic
M.Sc. Informatics

Philipp Nägelein
M.Sc. Business Administration

Stefan Nothelfer
M.Sc. Engineering & Management

Stefanie Weniger
M.Sc. Business Administration

Veronika Gamper
M.Sc. Computer Science

Patrick Christ
M.Sc. Physics

Maximilian Engelken
Dipl. Wi-Ing.

Kilian Moser
Dipl.-Kfm.

OTHER PUBLICATIONS

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FIGHTING HUNGER IN THE DIGITAL ERA

The supermarket - the modern land of milk and honey! Located just around the corner, it provides us with a magnificent selection of food and beverages: fresh fruits and vegetables from all over the world, meat and fish in abundance, coffee from Brazil, rice from Thailand, beef from Argentina – every product available 24/7. For most inhabitants of the industrialized world, purchasing and consuming food is easy and convenient. No dirty hands, only a few dirty dishes. Food consumption has become so easy and cheap that it is done on an excessive level: since 1980, the number of obesity cases has doubled globally and reached more than 1.4 billion adults in 2008 according to the World Health Organization Fact sheet No. 311 (2012).

But whereas one part of the world needs to fight the demons of ever tempting delicacies, there are also parts where hunger is part of everyday life: In the period between 2010 and 2012, about 12,5% (approx. 870 million) of the global population have been chronically undernourished, with an ever-rising trend in the least develop countries in Sub-Saharan Africa and Western Asia according to the World Health Organization. This paradox between overconsumption in one part of the world and food shortage in the other one is a major issue of our time. In times of rapid technological development, however, there are many opportunities to fight hunger around the world.

This report consists of three parts: First, the authors analyse trends in the field of fighting hunger. From these findings, four scenarios are derived that vividly depict possible futures. In the final part, five business ideas are elaborated and validated in each of the four scenarios.

The concepts ideated range from a blockchain logistics system, a photo-sharing based donation platform, a mobile platform for tool-based agricultural services among farmers, a social online betting platform to forecast refugee flows, and a mobile solution to automate crop disease identification: empowered by image recognition and machine learning technology.

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Building on the strengths of two of the most prestigious universities in Germany, CDTM provides highly qualified and ambitious students with an excellent academic education in the field of emerging digital technologies. As a research institution, CDTM closely cooperates with the industry, concentrating on Telecommunication, Information Technology, Media, Entertainment, Health and Energy sectors.

E-mail info@cdtm.de
Internet www.cdtm.de

Laura Bechthold, Florian Lachner

9 783981 851113