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Master's Thesis

ACCESS TO AFFORDABLE IRRIGATION TECHNOLOGY FOR SMALL FARMERS IN NORTHERN GHANA - AN EXAMPLE OF MARKETING TO THE BASE OF THE PYRAMID (BOP, VERSION 2)

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I. Abstract

Bottom of the Pyramid (BoP) business strategies or so-called market-based approaches have been praised to tackle the problem of poverty by marketing to the BoP while generating new income opportunities for the private sector. Nevertheless, BoP business strategies and their successful implementation have been rather limited to date. Therefore, this thesis examines factors critical to the implementation of a market-based approach at the BoP and investigates how a successful supply chain of irrigation technologies can be built up. To that end, the different theoretical inputs consolidated under the concept of BoP 2.0 are considered. Then, the theoretical concept is reduced to three critical factors: partnerships, micro-finance and product-mix. The framework of the 4As – affordability, awareness, availability and acceptability – guides this analysis. Subsequently, the theoretical key components are critically contrasted with the example of International Development Enterprises (IDE) Ghana and complemented with empirical findings of this case study. Based on the theory and IDE Ghana's experience, a future roadmap for IDE Ghana is developed, especially with regard to the affordability factor. In other words, new models are presented on the basis of the introduction of a future solar treadle pump in order to address the critical factors investigated in the thesis. In particular, these new models illustrate how to combine innovative financing models with new product and service developments to the end of making irrigation technologies affordable to smallholder farmers in northern Ghana while generating income opportunities for the private sector.

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III. List of abbreviations

BoP	Bottom of the Pyramid
CIGAR	Consultative Group on International Agricultural Research
CMF	Community-marketing facilitators
ECLOF	Ecumenical Church Loan Fund
GDP	Gross domestic product
GHS	Ghanaian cedis
IDE	International Development Enterprises
IFC	International Finance Corporation
ITT	International Telephone & Telegraph Corporation
IWMI	International Water Management Institute
LEDs	Light-emitting diodes
MNCs	Multinational corporations
MoFA	Ministry of Food and Agriculture of Ghana
NGO	Non-governmental organisation
PFAG	Peasant Farmers Association of Ghana
R & D	Research and development
SDC	Swiss Agency for Development and Cooperation
SHSs	Solar Home Systems
SMIDO	Suame Magazine Industrial Development Organisation
USAID	United States Agency for International Development
USD	United States dollars
ZAR	South African rands

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1 Introduction

In many parts of the developing world, smallholder farmers rely on traditional low-productive agricultural practices and on rainfall to cultivate their few acres of land. Generally, their yields are of low quality and are barely sufficient for their own consumption. As a result of poverty, crop production experiences immense seasonal fluctuations, because smallholder farmers do not dispose of the means to acquire irrigation technologies (Codjoe, 2007). Hence, they have to rely on erratic rainfall due to the lack of financial means and of knowledge, which exposes farmers to a "high risk of crop failure" (Codjoe, 2007, p. 164). Against this background, better access to affordable and effective irrigation technology are key to increase agricultural productivity, which allows farmers to yield more profits and thus, to step out of poverty (De Chaisemartin, Normann, & Pestiaux, 2010; Codjoe, 2007; Sanghvi, Simons, & Uchoa, 2011).

The effect of irrigation on poverty reduction has been examined in diverse studies. Generally, it has been found that irrigation and treadle pumps in particular reduce poverty[1], because "it reduces time and labour requirements for irrigation" (Adeoti, Barry, Namara, Kamara, & Titiati, 2007, p. 22). In other words, farmers could intensify their land and labour productivity by expanding their cultivated land (Adeoti et al., 2007; Hiller, 2007). Seeing the positive impact of irrigation technologies on poverty alleviation, the question arises of how to make irrigation technologies effective, affordable and accessible to smallholder farmers.

There are different options to provide irrigation technologies to the poor. Charity, such as giving pumps for free, or foreign aid are well known measures for targeting poverty alleviation in the developing world. However, criticism concerning their impact, effectiveness and sustainability has been growing. The economist Dambisa Moyo concludes (2009) that "more than USD 2 trillion of foreign aid has been transferred from rich countries to poor over the past fifty years – Africa the biggest recipient, by far. Yet […] aid has failed to deliver the promise of sustainable economic growth and poverty reduction" (p. 28)[2]. Furthermore, there have been several government attempts in Ghana to reduce poverty by ameliorating irrigation, such as governmental building of dams. Nevertheless, only between 1% and 2% of Ghana's

[1] Adeoti et al. (2007) estimated a net income increase of $393 per hectare; Hiller (2007) calculated an income increase between $208 and $250 for treadle pump users.

[2] From 1960 to 2009, Ghana alone received more than USD 21 billion (current USD) in net official development assistance and official aid (World Bank, 2011).

irrigation potential has been exploited so far (Codjoe, 2007; MoFA, 2007; Nyamadi, 2011). In other words, governmental efforts to make irrigation technologies effective, affordable and accessible to smallholder farmers have been marginal to date, which is also reflected in the late enactment of a detailed water policy in 2010.

Against this background, market-based approaches and the Bottom of the Pyramid (BoP) in particular have gained momentum since the change of the millennium. However, not the promise of reducing poverty caught the primary attention of the private sector to expand to the BoP, but rather the potential of doing business with billions of individuals – while alleviating poverty – in a so far untapped market. Since its formulation by C. K. Prahalad, the BoP concept has attracted a lot of attention. While academics have advanced and refined the concept, companies have started to experiment with its implementation. Even though some industries, such as the telecommunication sector, have rapidly succeeded in their endeavour, others struggle with the successful implementation of business concepts targeting at the BoP, a market inherently different to markets of the developed world.

In the light of these difficulties by many companies to successfully do marketing at the BoP, it is worth questioning what a BoP business strategy should look like and what the critical factors are in theory and in practice. In order to answer these questions, International Development Enterprises (IDE) Ghana serves as case study for this thesis in order to thoroughly examine the different steps necessary to a successful implementation. IDE Ghana focuses on an integrated market-based approach to build up a private market supply chain of irrigation technologies in order to make markets work, both for business and for poverty alleviation.

In the first part, the BoP theory evolution is evaluated. Thereby, the thesis highlights three theoretical key elements to succeed at the BoP, that is to say, financing, partnerships and an effective product-mix. Furthermore, business implications of the BoP theory in terms of the 4As – affordability, availability, acceptability and awareness – are elucidated. In the second part, the theoretical key components are critically confronted with IDE Ghana's experience and complemented with empirical findings of the case study. The last part gives a future roadmap for IDE Ghana with special regard to the critical factors considered in the thesis. First and foremost, innovative financing models and new product and service developments are presented, namely on the basis of a future solar treadle pump.

2 Research method

2.1 Objective

The final goal of this thesis is to show ways of how smallholder farmers can get access to affordable irrigation technologies with a market based approach. Special emphasis is laid on finding new models of affordability that are consistent with BoP 2.0 theory, the 4As and IDE Ghana.

2.2 Hypothesis

I argue that smallholder farmers in Northern Ghana can get access to affordable irrigation technology with the help of a market-oriented approach.

2.3 Research Questions

The following research questions guide the research process in order to evaluate the hypothesis:

BoP theory: What is a market-oriented approach? How has the BoP theory evolved (from BoP 1.0 to BoP 2.0)? What are the key factors highlighted by the theory? What are the implications of a change of perspective for corporations? What does availability, access, awareness and affordability mean with regard to the BoP theory?

Empirical evaluation of the theory at the example of IDE Ghana: What does the theory look like in the field? What does availability, access, awareness and affordability mean in the context of irrigation technologies? What is critical in the practice and do these critical factors confirm the theoretical key factors?

IDE Ghana on the way towards BoP 2.0: What is critical for IDE Ghana in the future towards BoP 2.0? What are possible new models to address the question of affordability?

2.4 Methodology and structure

In order to evaluate the research hypothesis of how farmers can get access to affordable and effective irrigation technology with the help of a market based approach, I decided for a case study, namely IDE Ghana. Against the background of the research question, which basically asks to analyse a process, it is rather more sensible to embark on qualitative research. It allows analysing the different steps in the process, which would not have been possible with a quantitative dataset (Bryman & Bell, 2007). IDE Ghana's project is rather recent, so that extensive quantitative data is not available yet.

Furthermore, the research concentrates on a holistic picture of BoP theory and analyses the interaction and the interface of diverse key factors that can be examined well in a case study.

The thesis is composed of three main parts: In the first part, the evolution of the BoP theory will be assessed and critical factors carved out. The second part is the practical examination of the theory on the basis of the example of IDE Ghana. A future roadmap for IDE Ghana towards BoP 2.0 will be elaborated in the final section.

Information for the theoretical part was gathered from extensive literature research. Thereby, different academic research papers, books and websites served as primary and secondary sources (for more details see chapter VII).

Further information was collected on a field visit in Ghana from February 1 to May 15, 2011 and in formal (structured and semi- structured) and informal interviews with IDE Ghana staff, partner organisations, consultants and researchers. From March 9 to March 18, 2011, farmers, manufacturers, dealers and installers were questioned in the Upper East Region of Ghana and in Kumasi. In total, 28 interviews were conducted (for more details see appendix VI.a and VI.b). In the case of farmer interviews and to a certain extent also concerning producer interviews, I had to rely on translators. Therefore, the interviews were backed up with additional primary and secondary sources, that is to say, IDE reports, interviews and various academic research papers (for more details see chapter VII).

The time horizon embraces the period between IDE Ghana's foundation in September 2009 and the end of the first dry season in April/ May 2011. In geographical terms, the case study focuses on IDE Ghana's project in the Kassena-Nankana District, in the Upper East Region of Ghana, and Kumasi, where the treadle pump production is located (for more details see chapter 4.2.2 and appendix VI.f).

2.5 Limitations

This thesis is limited to a single case study of IDE Ghana. In other words, the research focuses on a specific case of irrigation technologies in the context of one specific country. Therefore, I do not pretend to generalize findings of this research to other countries or business areas even though findings of my research may be relevant.

Furthermore, the project in Ghana is not yet mature and my research stay was limited to five months. Therefore, I cannot make any long-term assertions yet. Final conclusive statements may only be possible after years and vigorous project

evaluations. Therefore, my research conclusions may be seen as intermediate assessment, which will be subject to further evaluation in the future.

Moreover, I do not make any attempts to draw any conclusions concerning the impact on the environment or poverty alleviation per se, because I do not dispose of a sufficient database to assert these consequences. My focus is limited to an entrepreneurial perspective of how to implement the BoP theory in terms of creating a market for irrigation technologies, building up a respective supply chain and finding new models concerning financing and product/service developments.

Lastly, IDE Ghana adopts a comprehensive strategy that goes beyond building up a supply chain of irrigation technologies. For instance, it also tries to link farmers to better output markets. However, the main focus of this thesis is on the supply chain. In other words, this thesis addresses some activities of IDE Ghana only in a marginal way.

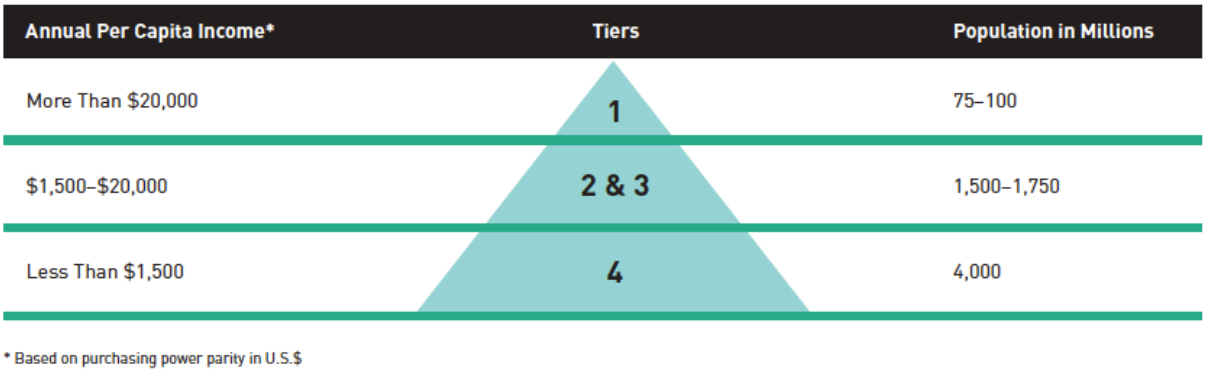
3 BoP Theory

The BoP theory is a market-based approach meaning that the concept relies on market forces to achieve its goal in a sustainable way. In the case of BoP theory, the goal is to reduce poverty of the unfortunate in the world while generating profits for all actors involved. A market-based approach argues that all people participate in one way or another in commerce. Thus, all – the poor and businesses – can profit from making "markets more efficient, competitive, and inclusive" (World Resources Institute, n.d.). This market-based approach to reduce poverty stands in sharp contrast to traditional development theories, which focus on more aid-driven models. In general, the BoP theory sees and seeks to capture the opportunities of markets to do both, alleviate poverty and generate income opportunities for business (World Resources Institute, n.d.).

3.1 BoP 1.0: "The fortune <u>at</u> the bottom of the pyramid" (Prahalad & Hart, 2002, p. 1)

Since the turn of the millennium, the BoP theory has been in the limelight of business strategies. The BoP is a concept going back to C.K. Prahalad, Stuart Hart and Ted London. It basically claims that there is a fortune to make at BoP markets. The BoP refers to the world economic pyramid of consumers, which can be divided into 4 tiers (see **Figure 1**).

Figure 1: World economic pyramid *(Source: Prahalad & Hart, 2002, p. 4)*



Tier 1 includes middle- and upper-income customers of the developed world and some rich people from the developing world. Tier 2 and 3 embraces the bulk of customers in developed countries and the growing middle class in developing countries. At the base of the pyramid, there is Tier 4, which consists of an estimated 4 billion people, who earn less than USD 2 a day[3] (Prahalad & Hart, 2002).

The basic idea behind the BoP theory is that corporations have neglected these 4 billion people so far, who together constitute an immense consumer market. Accordingly, there is an untapped multitrillion-dollar market at the BoP. In the words of Prahalad and Hart (2002), the BoP concept means "selling to the poor and helping them improve their lives by producing and distributing products and services in culturally sensitive, environmentally sustainable, and economically profitable ways" (p. 2). Therefore, the BoP paradigm suggests doing both by targeting consumers at the BoP, creating income opportunities for corporations and tackling poverty at the same time (Karnani, 2007). The authors name six dominant assumptions that have diverted businesses from the BoP market to date (for more detail see appendix VI.c). Generally, corporations have believed that they can neither cater for the needs of the poor at the BoP efficiently nor do the poor have the means and the use of products and services from developed markets. However, the first generation of BoP (BoP 1.0) argues that BoP constitutes a viable market for corporations if they overcome those wrong assumptions. Therefore, a shift of perception is an indispensable prerequisite to harness the full potential of BoP markets. However, not only does this shift require a change of mind towards BoP customers, it also implies that corporations have to adapt and innovate their "technology, business models, and management processes" (Prahalad &

[3] Different concepts refer to this consumer group. Even though using diverse terms and slightly different definitions, the essence is basically the same. Therefore, this paper will not differentiate between the different expressions used.

Hart, 2002, p. 6) to this new circle of customers. In other words, radical innovations are required in order to meet the challenges of BoP markets, that is "low cost, good quality, sustainability and profitability" (Prahalad & Hart, 2002, p. 5). A more comprehensive picture of the dimension that requires innovations and the principles guiding this process are given in appendix VI.d.

The authors see large multinational corporations (MNCs) in collaboration with local communities, non-governmental organisations (NGOs) and governments best apt to tap into the BoP market, because MNCs possess necessary resources to build "a complex commercial infrastructure for the bottom of the pyramid" (Prahalad & Hart, 2002, p. 11).

In sum, the first generation of BoP theorists have drawn business attention to BoP markets and to the interests of the poor. Hence, they understand the poor as potential consumers. Furthermore, they highlight the possibility to combine profit driven business strategies with social targets, such as poverty alleviation. In the words of Prahalad and Hart (2002), the double goal of profit making while helping the BoP step out of poverty is possible by "linking the poor and the rich across the world in a seamless market organized around the concept of sustainable growth and development" (p. 14).

3.2 "The misfortune at the BoP" (Karnani, 2007, p. 99)

The honourable assumption of tackling poverty by selling to the BoP has soon met with a lot of criticism, most pronounced by Aneel Karnani. Critics speak of an illusion of the BoP. In other words, the BoP theory shows many fallacies: First, the size of the BoP market is alleged to be inaccurate. Karnani points out that the 4 billion people market is largely overestimated and varies according to the definition of poverty. Additionally, the BoP does not constitute a homogeneous market. Consumers are rather heterogeneous and dispersed. Furthermore, he argues that medium-sized local corporations and not large MNCs can and do best serve the BoP, because it is hard to exploit scale economies in BoP markets. According to Karnani, selling more to the poor does not imply an improvement of their situation unless spending serves higher-priority needs. Another argument brought forward is that profits in BoP markets are rather limited, because drastic cost reductions are either possible only in some industries or are at the expense of quality (Karnani, 2007; Pitta, 2008). Further criticism is brought forward concerning "higher unit price or the environmental sustainability of single-serve packaging used by corporations within the BoP" (Landrum, 2007, p. 3).

Karnani's key message is that consumption alone does not improve poor people's life in a sustainable way unless their real income increases. Therefore, he argues from another perspective, that "the poor need to be viewed primarily as producers, not as consumers" (Karnani, 2007, p. 107) in order to alleviate poverty with the help of the private sector. Raising their real income is key to this end. Karnani does not contest BoP theory completely, but he emphasises that one needs to be more cautious about the extent and the role of the private sector and how it can contribute to poverty alleviation. Even though models such as microcredit can have a positive impact on poverty alleviation, its real impact remains rather modest. Karnani argues that the poor lack the necessary skills and competences to be entrepreneurs that use microcredit in an efficient way. Thus, "this romanticization of the poor as entrepreneurs has led to an overemphasis on microcredit as a way to reduce poverty" (Karnani, 2007a, p. 13). Furthermore, he emphasises the essential role of governments to provide for a sound economic and political framework where the formal market can thrive and prosper. According to Karnani, only real job creation and increased productivity have a significant and sustainable impact on increasing the buying power of the BoP. In other words, only if the poor are able to capture a part of their added value, they are apt to increase their real income. Hence, "the private sector can help alleviate poverty [but only] by focusing on the poor as producers" (Karnani, 2007, p. 109).

3.3 BoP 2.0: "A fortune with the BoP" (London & Hart, 2011, p. 2)

The harsh criticism by Karnani and his colleagues[4] and practical absence of real large-scale ventures of BoP strategies have provoked a shift in the BoP paradigm, namely from finding a fortune at the BoP to creating a "fortune with the BoP" (London & Hart, 2011, p. 2). This so-called second generation of BoP approach (BoP 2.0) rethinks the BoP theory and its approach towards "business opportunities, poverty alleviation benefits, and environmental impacts associated with such activity" (London & Hart, 2011, p. 4). The BoP 2.0 generation tries to reframe the BoP theory in a broader and more human-centered way and to detach it from a debate solely focussed on numbers and definitions. In other words, creating a fortune with the BoP raises notions such as co-creation with the BoP, mutual value creation and creation of markets as such. It defines the BoP segment and business more heterogeneous by taking into account the BoP market "as buyers, sellers and entrepreneurs" (London & Hart, 2011, p. 9). It also

[4] Other critics are Bendell, Crabtree, Hopkins, Jenkins, Jose, Rost, Ydren, Walsh, Kress and Beyerchen (for more detail see Landrum, 2007).

includes a wider spectrum of actors beyond MNCs that work in "partnerships across different sectors" (London & Hart, 2011, p. 10) and emphasises the importance of a more long-term profit perspective facilitated by patient capital (see chapter 3.3.1.3).

Generally, the BoP 2.0 approach beliefs in a BoP market and its opportunities if "business, non-profit, and development leaders […] collaborate by embracing this new perspective on venture development and cross-sector partnership" (London & Hart, 2011, p. 218). Under the concept of the BoP- Protocol, some authors of this second generation of BoP business strategies (BoP 2.0) propose a concrete model for MNCs of how to co-create successful ventures with the local community[5].

3.3.1 Change of perspective to do business with the BoP

Doing business at BoP requires a complete rethinking of business strategies. BoP markets are dynamic and are primordially an unknown area for many industries and corporations. Nevertheless, some industries, such as the telecommunication or microfinance sector, or corporations such as Microsoft, Vodafone or Monsato, have already succeeded in developing adequate business models for the BoP and can report positive feedbacks (Prahalad, 2010).

Confronted with criticism and reflecting on business experiences, BoP 2.0 theorists have rethought business strategies and adapted their theory. Therefore, a change of perspective concerning the following factors is key to doing business with the BoP:

3.3.1.1 Acknowledging the heterogeneity at the BoP

The debate on the definition of BoP markets has pointed out that BoP markets and their actors are not a homogeneous unity. Markets and customers at the BoP are heterogeneous not only in terms of culture, religion, and geography but also when concerning income, preferences and needs. Criticism has induced the need for better consumer understanding and provoked studies on the BoP markets[6]. Accordingly, the BoP does not constitute a unity. It can rather be decomposed into different market segments. Hence, corporations seeking to harness the BoP market opportunity have to analyse these segments and have to define their segment focus, because no single business strategy can address all BoP customer needs at once. Accordingly, business models need to respond to the demands of the specific BoP segments (Prahalad, 2010).

[5] For more information on the BoP- Protocol see http://www.bop-protocol.org/.

[6] The World Resource Institute and the International Finance Corporation, for example, have studied the consumer behaviour and BoP markets in detail. For more information see http://rru.worldbank.org/thenext4billion.

3.3.1.2 Market creation instead of market entry

BoP 2.0 intellectuals further emphasises the necessity for market creation before the possibility of serving the needs in a BoP market. Erik Simanis (2011) argues in *Needs, Needs Everywhere, But Not a BoP Market to Tap* that the existence of a "basket of compelling needs is not yet a market in the traditional sense of that term" (p. 103). In other words, the simple existence of needs at the base of the BoP does not imply a market for those needs. A market first has to be developed or needs to be organised before a corporation can tap into it. Therefore, consumer market creation is critical. Simanis makes the clear distinction between market entry and market creation, which both require a different set of tools and strategies. According to Simanis, consumer markets at the BoP are not developed to the same extent as in developed markets. Therefore, traditional market entry strategies are not suitable to the BoP that requires market creation strategies (Simanis, 2011).

Market creation strategies require a set of tools distinct from market entry strategies. Unless a product or service is embedded or integrated in a lifestyle of BoP customers, we cannot speak of a market. A product or a service has to make sense for customers in their life. Therefore, customers have to connote their own value to a product and corporations should be open-ended with the value-proposition of a product or service. By letting customers define the value of a product themselves, customers tend to develop a kind of ownership and sense of commitment to a product or service. In other words, the product becomes embedded into a community and the market has emerged (Prahalad, 2010; Simanis, 2011).

Traditionally, this process of sense-making or embedded innovation takes time (Gardetti & D'Andrea, 2010) and profit can only be expected after five years at the earliest (Simanis, 2011). In other words, market creation is a long-term investment, which presupposes diligent consumer investigations, adequate research and development (R & D) and entirely new business strategies. Hence, BoP business ventures and stakeholders have to take this time component into account in order to be able to yield profits (Simanis, 2011).

3.3.1.3 Rethinking the premises on return of investment

The BoP environment is risky considering the prevailing poor infrastructure, corruption or low purchasing power. Therefore, traditional capital providers have been largely reluctant with investments at the BoP. BoP 2.0 theorists argue that a new approach concerning capital funding is required. Robert Kennedy and Jacqueline

Novogratz see a promising approach to tackle poverty at the BoP while generating business opportunities in patient capital combined with social entrepreneurship (Kennedy & Novogratz, 2011).

The notion patient capital goes back to "so-called philanthrocapitalists[7]"(Kennedy & Novogratz, 2011, p. 46), which mainly consist of organisations seeking for social return. These organisations adopt private business tools and strategies to invest capital in businesses that have a positive social impact, that is to say, on poverty alleviation. In the words of Kennedy and Novogratz (2011), "patient capital is helping to create and support an economic ecosystem that allows BoP ventures to thrive" (p. 51). In contrast to conventional approaches, patient capital is more tolerant towards time and risks than traditional capital providers, in exchange for higher social and environmental returns (Kennedy & Novogratz, 2011; Kaberuka, 2010).

In addition to patient capital, social entrepreneurs are needed to create innovative ventures catering for BoP needs. Social enterprises are market driven with a social objective, active "in areas deemed unprofitable by the private sector and neglected by the state" (Di Domenico, Haugh, & Tracey, 2010, p. 681). They differ from traditional NGOs in the sense that they are financially self-sustained, however, pursue social goals primordially in a less fortunate context (Di Domenico et al., 2010).

Together, they form a new approach, a mix of a market approach and aid, where social entrepreneurs cater for innovative businesses and patient capital supports its implementation. More generally, "business and donor-community leaders must […] embrace an orientation based on collaborative interdependence" (London & Hart, 2011, p. 42) in order to achieve the double goal of making profit and alleviating poverty (Kaberuka, 2010).

3.3.1.4 Do not be a lone fighter at the BoP

BoP markets are new for most companies. Hence, they need to acquire a lot of knowledge and build up trust in the local community to create a consumer market. Corporations must be socially embedded, " that is, the capability to gain a deep sense of the social context and a detailed knowledge of the intrinsic economic rationale of the local economy" (London, 2011, p. 34). Prahalad emphasises that the capacity to cooperate and build up a local ecosystem is much more important than the investment capacity (Prahalad, 2010), because corporations alone do not possess the necessary

[7] Kennedy and Novogratz (2011) mention the "Gates Foundations, Omidyar Network, Google.org and Virgin Unite" (p. 46) to give some examples of such philanthrocapitalists.

resources to create a BoP market. It is much easier to set up a sound ecosystem around the target business, which helps the corporation to expand (London, 2011). That is to say, cooperation between institutions such as the government, local communities and NGOs can provide essential information, decrease transaction costs and facilitate business at the BoP. BoP 2.0 business strategies stress the importance of such partnerships and the creation of a fortune with the BoP.

Last but not least, achieving large scale is important to have a significant impact on both, profit making and poverty alleviation. Moreover, missing large numbers is one of the major arguments brought forward by criticism, which has also been supported by practical evidence. In other words, to reach scale and to skim profit from the BoP market not only requires a shift of perspective towards value creation with the BoP and market creation in the first place, but it also calls for a different approach with regard to venture creation. Hammond argues for two models in order to scale up; for ventures that are "both together, bottom-up and top-down" (Hammond, 2011, p. 198) and for business ecosystems in the form of hybrid organisations. In the former, enterprises with a local and global component benefit from the opportunities of both approaches. This means that local business structures can provide for local knowledge whereas the global component contributes with funding and/or technology. This type of venture can take the form of alliances and personal partnerships between local and global entrepreneurs. In the latter, hybrid organisations connect the business and non-business structures. Hybrid organisations are partnerships between business and non-business structures. The later is also known under the notion of citizen sector (Drayton & Budinich, 2010). Hybrid organisations build on the complementary strength of both entities, that is to say, non-business structures support corporations with funding and information, for instance in order to achieve a social goal, whereas corporations can provide for technical and operational expertise (Drayton & Budinich, 2010). Both models, hybrid organisations and bottom-up /top-down ventures, can be complementary to reach scale. In the words of Hammond (2011), corporations can seek both "local and global partnerships within an ecosystem to support local and global aspects of the venture" (p. 197).

3.3.1.5 Innovation incubator of environmental sustainability at the BoP

BoP 2.0 theories also deal with environmental issues. Consumption patterns in BoP are far below those in developed markets. To give an example, Hart (2011) assesses in *Taking the Green Leap to the Base of the Pyramid* that the "average

American consumes […] hundreds of times more than the average Ethiopian" (p. 80). Projecting growing population rates and increasing consuming rates in growing and transforming economies, environmental issues gain in importance. Single-serve sachet packaging, for instance, may help corporations to generate profits, however, often at the expenses of the environment. The BoP 2.0 generation of BoP business strategies argues that generating profits for corporation while alleviating poverty can also be in accordance with environmentally sustainable development. The concept of creative commercialization or the *Green Leap Strategy* states that green technologies used in the top of the pyramid can be developed and commercialized at the BoP. In other words, corporations can co-create with the BoP environmentally friendly products, which stand a chance in upmarket migration also known as reverse innovation (Drayton & Budinich, 2010), "that is, the ability to incubate low-cost innovations in the developing world and then migrate them up-market to the developed world" (Hart, 2011, p. 90). Basically, green technologies can be tested and experimented with at a small-scale at the BoP. However, if proven successful, they can evolve globally, as the telecommunication sector has proven. Generally, BoP business strategies can be environmentally friendly. Even more, the BoP can serve as an innovation incubator for sustainable development (Hart, 2011; Prahalad, 2010).

3.3.1.6 Special product and service features for BoP requirements

People at the BoP face different challenges to people at the top of the pyramid that shape their daily life and decision. Business has to be aware of the special needs and circumstances of potential BoP customers. Viswanathan (2011) argues that corporations should adopt a bottom-up vision in order to design products and services for the BoP. The key words are participation and co-creation. Products and services have to be co-developed with the BoP community in order to meet their needs. The BoP 2.0 generation sees the participatory process as key to embed a product or service socially (Arora & Romijn, 2009). People at the BoP are poor, which also has consequences on corporations. For example, the poor are usually low literate, which implies that corporations have to adopt visual marketing strategies. In contrast, people dispose of entrepreneurial skills that are also known under the notion "marketplace literacy" (Viswanathan, 2011, p. 146). Further characteristics of the base of BoP are low income, which implies short-term vision of BoP consumers and entrepreneurs. However, religion, family, social networks and relationships are very important and rather medium- to long-termed. Studies have further shown that "consumers are

sometimes willing to pay a little more for better products, particularly for central consumption […] due to the chronic inability to consume" (Viswanathan, 2011, p. 139). The BoP consumer also adopts sustainable behaviour by reusing or recycling even though it is for more imminent reason of survival than the ecological consciousness per se. Lastly, markets are "highly fragmented and geographically dispersed" (Viswanathan, 2011, p. 144).

3.3.2 Business implications of change of perspective: The 4 As

In view of BoP business strategy generations, what does this evolution imply for product and service development? Whereas the principles for business innovation as proposed by Prahalad (for more detail see chapter 3.1 and appendix VI.d) remain valid as general guidelines, this section gives a more detailed look into the 4As approach. The 4As stand for affordability, availability, acceptability and awareness (see appendix VI.e). It is a framework going back to Jamie Anderson, Costas Markides and Niels Billou to "articulate best practices as companies deal with the challenges of serving low-income customers in developing markets […]" (Anderson & Billou, 2007, p. 3).

Rather than focusing on identifying potential consumers, the framework aims at answering the question of how and with what products or services BoP consumer needs can be addressed (Anderson & Markides, 2007). In other words, the framework provides the theoretical background of how to make a product affordable and accessible to the BoP:

3.3.2.1 Affordability beyond cheap products or services

In general, affordability means cheap in terms of price, which implies that quantities have to make up for the small profit margin. Therefore, pricing of products or services designed for the BoP market is a delicate balance between a price setting, which is too high and affects sales, and one, which is too low and presses corporate profits down. Solutions can be simple product designs and local materials, which usually help to keep prices down (Anderson & Billou, 2007; Heierli & Katz, 2007; Pitta, 2008).

However, affordability not only in terms of inexpensive prices, but also in form of size, usage and maintenance simplicity, and a short period of amortisation are crucial elements for the accessibility of the product (Heierli & Katz, 2007; Pitta, 2008). BoP consumers do not have the means to make large up-front or long-term investments (Heierli & Katz, 2007; Heierli, 2008). In other words, large up-front investments or long payback periods affect farmers' immediate cash flow, which cannot be covered

otherwise due the large absence of savings (Anderson & Billou, 2007). Innovative strategies such as linking customers to credit institutions can further help to lower the entry barrier for customers and thus, make the product or service affordable (Pitta, 2008).

In sum, affordability means more than cheap product or services. Corporations have to go beyond the mere cost structure and design appropriate products and services for the needs of BoP.

3.3.2.2 Availability through private sector supply chains and modern technology

In chapter 3.3.1.2, we have seen that markets at the BoP are often inexistent or too fragmented to be considered as functioning markets. Not only must a product be affordable and effective, but it must also be accessible in terms of location and after-sales services. The word location not only embraces the immediate product seller but also "the supply chain that brings the product to the customer" (Heierli & Katz, 2007, p. 36). Unless the product or service is effectively available per se, it cannot become socially embedded either. This latter point is especially true for consumers at BoP, which are hardly reachable due to poor infrastructures. To overcome the problem of accessible product channels (or distribution) and to create vibrant markets, corporations have to adopt innovative solutions. Modern technologies, for instance, are the key to tackle the distribution problem (Anderson & Billou, 2007). However, modern technologies cannot always surmount the distribution problem. Therefore, the setting up of private supply chains can be a valuable alternative to reach and cater for the BoP needs in remote areas (Heierli & Katz, 2007). Together, private sector supply chains complemented with modern technologies can create efficient markets for products and services. In other words, corporations have to think about appropriate selling "places […and] sellers, […eventual] intermediaries, […] after-sales services […and] support, […and] local manufacturing or importing" (Heierli & Katz, 2007, p. 38) in order to make a product accessible.

3.3.2.3 Acceptability by all actors along the value chain

BoP customers are not homogenous (see chapter 3.3.1.1) but heterogeneous and each customer segment has its special demands (see chapter 3.3.1.6). Furthermore, a product or service only becomes embedded in the lifestyle of BoP consumers if it makes sense for them (see chapter 3.3.1.2). In the words of Anderson and Billou (2007), "it is the acceptability of a product or service by low-income customers that is the key issue" (p. 8). Not only do customers need to integrate the product in their lifestyle, but

distributors or producers also have to deal with the product or service. Hence, to make a product successful, all actors along the whole value chain must be willing to accept the product or service by letting customers define the value of a product or service themselves (Anderson & Billou, 2007; Pitta, 2008).

3.3.2.4 Awareness

Not only are BoP customers often hardly reachable in terms of distribution, but also in terms of marketing (Anderson & Billou, 2007). Becoming aware of a product or service by conventional promotion used in developed markets is not necessarily suitable to BoP[8]. Multiple strategies are required, because BoP customers act according to different behaviour patterns and cannot be treated as a unique set of customers. For example, a traditional farmer may be more reluctant towards new technologies than some individual characterised as more innovative. Moreover, BoP customers are often scattered over an area, which makes it difficult to reach them individually. Illiteracy and the abundance of different languages and dialects further limit common promotion techniques and call for more intense social interaction and follows-up. BoP customers are constrained by financial means and investment decisions are very critical and risky for them. In order to minimize risks and increase the chance of high returns on investment, farmers "want to touch it, feel it and try it out" (Heierli & Katz, 2007, p. 39). Thereby, they also rely and build on the experience of other BoP customers or other charismatic persons in the community (Anderson & Billou, 2007; Heierli & Katz, 2007).

Promotion also needs to be financed. In the light of market creation and building up of a previously inexistent supply chain it is rather difficult to recover costs for extensive promotion in the selling price. Nevertheless, promotion has to be included in the product price on the long run (Heierli & Katz, 2007).

3.3.3 Summary: three critical factors to succeed at the BoP

Having discussed the theoretical foundations and implications for corporations of the BoP theory, this section summarizes the three most critical factors for successful BoP ventures mentioned by the literature (Pitta, 2008). The three factors also stem from the various principles mentioned in sections 3.3.1 and 3.3.2 and summarize their substance (see **Figure 2**).

[8] For example, the AIDA- Model can help to frame a promotion strategy. For more details see appendix VI.g and/ or Heierli & Katz, 2007, p. 38.

Figure 2: Critical factors for BoP ventures *(Source: Own figure)*

3.3.3.1 Product-mix

The first key factor is an efficient product-mix adapted to the needs of BoP customers. The 4As mentioned in chapter 3.3.2 are especially critical to an efficient product-mix, also known as the Ps[9]: First, the product must be easy to use and maintain. The product design must serve adequately some specific need without highly sophisticated attributions. Secondly, its price must be affordable, it is to say, the product must not only be cheap, but impediments on the immediate cash flow must also be avoided, for instance in the presence of lengthy payback periods. The third element in the product-mix concerns the place. In other words, the product must be available and accessible in terms of location and after-sales services, which implies the setting up of an intact supply chain. Lastly, promotion needs to be adapted to the specific BoP environment. Generally, the AIDA-model can guide the promotion strategy (for more detail see appendix VI.g) (Anderson & Billou, 2007; Anderson & Markides, 2007; Heierli & Katz, 2007; Pitta, 2008; Viswanathan, 2011).

3.3.3.2 Partnerships

As discussed in chapter 3.3.1.4, most companies seeking to harness BoP markets miss adequate knowledge of the BoP environment. The literature stresses that cooperation and the formation of local ecosystems are crucial to the company's success. Partnerships and alliances provide necessary knowledge, reduce costs, help to reach scale and facilitate business in BoP markets in general. Therefore, partnerships across sectors and with all stakeholders involved are the second key factor to create a fortune with the BoP (Hammond, 2011; London, 2011; Pitta, 2008; Prahalad, 2010).

[9] The product-mix embraces the concept of the four Ps, which stand for product, price, place and promotion (Heierli & Katz, 2007).

3.3.3.3 (Micro-) Finance

The third key factor to the success of BoP ventures is finance. The aspect of finance has two sides. First, corporations need a complete new approach to funding, which takes the risk of BoP ventures into account. This aspect has been discussed in chapter 3.3.1.3. Secondly, finance and microfinance in particular can also contribute to enhance the buying power of the BoP. Corporations can and should adapt their business strategy according the 4As model. However, limited financial means of BoP consumers is often cited as the most significant barrier to access products and services (Pitta, 2008). Therefore, corporations can simultaneously try to enhance the purchasing power of their consumers by providing them with or linking them to microfinance institutions while designing an affordable product-mix.

4 Empirical evaluation of the theory: The case of IDE Ghana

This section evaluates the theory against the background of a case study, namely IDE Ghana. A special emphasis is laid on the steps undertaken by IDE Ghana to build up a supply chain for treadle pumps in Ghana in order to draw conclusions regarding the convergence of BoP 2.0 theory and practice. Finally, practical key factors to success shall be elaborated on. These factors will later guide the future roadmap for IDE Ghana in section 5.

4.1 The case of IDE Ghana

4.1.1 IDE Ghana

IDE Ghana is the national organisation of IDE in Ghana. Founded in 2009, IDE Ghana is a non-profit organisation with the mission to "create income opportunities for poor rural farm households" (IDE Ghana, 2011). It tries to improve smallholder farm productivity and increase income by using a market-based approach. In order to reduce poverty significantly amongst smallholder farmers, IDE Ghana focuses on the whole value chain. In other words, its intervention design concentrates on three aspects and seeks to implement all these three factors simultaneously: input, on farm production and output market strategy.

First, IDE Ghana "specializes in establishing private sector manufacturing and distribution of irrigation technologies that are affordable for smallholder farmers" (IDE Ghana, 2011). It chooses "water as the entry point" (IDE, 2011) to alleviate poverty of rural smallholder farmers, because water is key to agricultural productivity and thus, crucial to generate additional income for the rural poor. Not only does more efficient

water management and control contribute to more prosperity of smallholder farmers, but it also ensures better food security in general. With better access to affordable and effective irrigation technology smallholder farmers are enabled to plant their garden all-year round and to increase agricultural productivity in a significant way. In its input strategy, IDE Ghana does not limit its focus on irrigation technologies. It also recognises that quality improvements by investing in higher value crops such as vegetables further contribute to poverty alleviation (Heierli & Katz, 2007; Sanghvi et al., 2011). In other words, IDE Ghana follows a comprehensive approach to improve smallholders' income.

Besides available and affordable technology in the market, farmers must also be able to make use of the accessible technology in a productive and efficient way (Heierli & Katz, 2007). For that reason, IDE Ghana adopts an on farm production strategy, in which IDE Ghana basically engages in farmers training such as in better farming techniques and in integrated pest management.

With the third element in its whole value chain strategy, IDE Ghana focuses on linking farmers to "high-value market opportunities in order to sell its additional produce and increase their income" (IDE Ghana, 2011).

IDE Ghana uses an integrated market-based approach to help farmers to lift themselves out of poverty. A market-based approach in the context means that IDE Ghana acts as a facilitator to create a market for irrigation technologies and to pave "the way for the private sector to act profitably for the benefit of the poor" (Heierli & Katz, 2007, p. 29). IDE Ghana creates its market-based strategies around these three simultaneously implemented pillars; affordable irrigation systems with the help of private sector supply chains, increasing farming capacity and better access to markets.

4.1.2 Case justification

IDE Ghana is a non-governmental organisation (NGO) and therefore not a corporation in the proper sense and in the context of BoP business strategies. Nevertheless, it follows business principles and illustrates an example of the above mentioned hybrid ventures, where business, non-profit, and development leaders work together. Following a market-based approach and employing patient capital, IDE Ghana facilitates the emergence of private market businesses in the irrigation sector with the goal of alleviating poverty of smallholder farmers. In other words, it co-creates business ventures with the BoP in order to seek economic, social and environmental returns (IDE, 2011a). It embarks on a market creation journey for treadle pumps by partnering

locally and globally and building up a sound supporting ecosystem. It invents its products locally while being integrated into a global framework of IDE. It further collaborates with diverse local and global partners in order to scale up. In sum, IDE Ghana facilitates the emergence of a private irrigation technology business, which would not have emerged on its own under traditional short-term business perspectives.

Even though IDE Ghana as a case study argues from a NGO perspective, it serves as an example for corporations of how to frame and implement BoP 2.0 business strategies and of how to create a fortune with the BoP. Last but not least, BoP 2.0 theory asks for an intense collaboration with multiple stakeholders, so that strict boundaries increasingly start to blur, which is to say, the emergence of hybrid organisations. In other words, the case of IDE Ghana illustrates the above-mentioned necessary collaboration between corporations, non-profit and development leaders from the viewpoint of a market-oriented NGO, which is equally relevant to private corporations.

4.2 Background information on Ghana and the rationale for the treadle pump

As outlined in chapter 3.3.1.6, people at the BoP face different challenges and business has to be aware of their special needs and circumstances in order to co-create socially embedded solutions for the BoP. In order to establish an adequate intervention design for affordable and effective irrigation technologies in Ghana, rigorous field assessments are required to identify the specific context of smallholder farmers at the BoP. The following section summarizes the key findings of these diverse precedent studies conducted by IDE Ghana. However, findings concerning IDE Ghana's on the farm production and output market strategy will not be given in detail.

4.2.1 Water resources

In Ghana, there have been several attempts to ameliorate irrigation, such as by governmental buildings of dams or efforts by NGOs to sell or give pumps for free. Nevertheless, it is estimated that only 2% of "a potential area of 500 000 ha for irrigation […] has been developed so far" (Codjoe, 2007, p. 164). The Ministry of Food and Agriculture (MoFA) of Ghana even speaks of less than 1% and acknowledges the poor management of existing irrigation structures (MoFA, 2007). Other authors estimate Ghana's irrigation potential of 1,9 million hectares with a possible additional million hectares in inland valleys (Nyamadi, 2011). Whatever number may be correct the irrigation potential on poverty alleviation has not been exhausted yet.

Economic water scarcity prevails in many parts of Africa and Ghana in particular, which means "water resources are abundant relative to water use. [However], human,

institutional, and financial capital limit access to water even though water in nature is available locally to meet human demands" (FAO, 2007). In other words, physical water scarcity, where "water resources development is approaching or has exceeded sustainable limits" (FAO, 2007) is not the pivotal problem for smallholder farmers in Ghana (see **Figure 14** in appendix VI.i for the rainfall patterns in Ghana). It is rather the access to affordable irrigation technologies, their availability per se and the limited financial means to acquire them that hinder smallholder farmers from stepping out of poverty.

4.2.2 Socio-economic situation in Ghana

In 2009, agriculture accounted for 31% of Ghana's gross domestic product (GDP) (World Bank, 2011a). It further employs 56% of the active work population (Nyamadi, 2011). Thereby, smallholder farmers account for "about 80% of Ghana's total agricultural output" (MoFA, 2007, p. 4). In other words, smallholder farmers form the backbone of Ghana's agriculture.

There is no single definition of smallholders. It varies according to country, agro-ecological zones or even livestock size and it is important to "analyse the farm household as a unit within the context of the local economy, community and agro-climatic environment" (Dixon, Tanyeri-Abur, & Wattenbach, n.d.). In Ghana, by smallholder farmers IDE Ghana understands farmers with "less than 1.5ha of land" (IDE Ghana, 2011a). In terms of poverty distribution, the densest pockets of poverty are in the northern parts of Ghana (for a more detailed picture see appendix VI.h).

Against the background of the prevalence of smallholder farmers in agriculture and role of irrigation in terms of development and poverty alleviation, the Ghanaian government has enacted a detailed policy and complete strategies for the water and irrigation sector under the broader umbrella of the agricultural policy in order to modernize agriculture while improving and transforming the situation of the rural poor (Nyamadi, 2011). Productivity improvements and irrigation and water management further belong to the priority list of investments in the medium term (MoFA, 2010). Generally, the government of Ghana attributes a high priority to agriculture, irrigation and smallholder farmers (Adongo, 2011). In other words, the political situation concerning irrigation and agriculture provides a favourable environment for IDE Ghana.

In Ghana, irrigation is provided by both the formal and the informal sector. All kinds of development organizations, governmental and non-governmental, are

summarized under the formal sector[10]. Irrigation systems built by farmers with or without the assistance from development organizations are commonly referred to as informal irrigation[11] (Adhikari, 2010).

Concerning current irrigation practices, the bulk of smallholder farmers do not employ any irrigation technology to get water or to apply the water to the field (for more information see appendix VI.j). In terms of wells, three different types can be found in Ghana (see also appendix VI.k). First, there are the dug outs without lining, which are cheap and simple. However, they have the disadvantage that they collapse during the rainy season. Secondly, hand dug wells with concrete lining are common in Ghana. They have the advantage of not breaking down during the rainy season. Nevertheless, this well construction is expensive and usually remains unaffordable for most farmers. For that reason, most of those lined wells have been built by development organizations, which has some implications on the IDE project (more details see chapter 4.3.2.4). Tube well constructions are the third type of wells found in Ghana, which require manual or mechanized drilling. A NGO called Pump is Life has mainly been active by providing this service (Adhikari, 2010; Kamassah, 2011).

Between 2002 and 2003, Enterprise Works, a NGO working in West Africa, introduced a treadle pump in Ghana known under the name SOKA pump. In total, nine out of 21 trained manufacturers together sold 630 SOKA pumps. After Enterprise Works' exit in 2004, the SOKA pump sales collapsed due to the "premature state of the market, quality issues and undeveloped after sale service and product design" (Adhikari, 2010, p. 7). However, since their introduction, treadle pumps have developed and retained a bad reputation due to their association with the SOKA pump (Adhikari, 2010).

Some farmers have acquired motorized pumps for irrigating their fields instead of using buckets. Motorized pumps include both petrol/diesel pumps and electric pumps. Others farmers have hired pumps "at [some] fixed cost per day ranging from GHS 8.00 to GHS 10.00 in Ashanti or at a cost of GHS 50 per season" (Namara, n.d., p. 25). The price of motorized pumps varies according to the model, the size and the place of purchase. Roughly, prices for motorized pumps start from around GHS 200 (Namara, n.d.) and rise quickly to from several hundreds up to a thousand GHS (Dogbe, 2011). Even though some very cheap models of motorized pumps for about GHS 110 could be

[10] Namara, Horowitz, Nyamadi and Barry (2011) refer to conventional systems in the same context.

[11] Namara et al. (2011) use the term emerging systems under which they also include irrigation systems initiated by private entrepreneurs.

found in some areas, additional costs for accessories and operation costs such as fuel put the price into perspective. Furthermore, those models usually date from the 1990s (Namara, n.d.). In general, electric pumps are slightly cheaper than petrol or diesel pumps. However, operational cost of electricity relativizes prices again (Namara, 2011a). Moreover, motorized pumps do not meet smallholder farmers' needs; motorized pumps have an overcapacity in relation to the irrigated land, operational costs are too expensive for smallholder farmers, and the capacity of the pump exhausts the water recharge capacity of the well very quickly (Nanes, 2011).

The SOKA pump was a cheap treadle pump alternative with a price between USD 83.3 and USD 88.9 (Adeoti et al., 2007). Its operational costs were low. It further met smallholder farmers' needs in terms of water lifting capacity and operation in general (Adeoti et al., 2007; Nanes, 2011). Nevertheless, since Enterprise Works' exit in 2004, the production of the SOKA pump has collapsed and does not constitute any valuable alternative any longer.

A look at the investment costs for irrigation suggests that irrigation expenses are high. Nevertheless, it is generally recognized that high value crop production, such as vegetable production, is profitable, because it "can be harvested many times (up to 10-15) when water supply is regular and market in urban centres is assured" (Namara et al., 2011, p. 29). The cost structure is composed of digging or drilling costs for wells, pumps, accessories and on-farm water distribution technologies (Namara et al., 2011). Smallholder farmers using buckets only face digging costs for wells, which can also be very high against the background that seasonal wells have to be rebuilt every year. Additionally, at the end of the season the well has to be refilled to avoid a collapse. Labour and in the case of lined wells the cement account for the biggest share of the well construction costs. On average, the cost per well of a seasonal shallow in-field well is estimated at GHS 15.2 whereas costs for a lined permanent shallow well vary between GHS 67 and GHS 639 (Namara et al., 2011; Farmers, 2011). Smallholder farmers often dig wells themselves or ask neighbours for assistance, which decreases costs for well digging. Nevertheless, digging of wells can take a long time due to the lack of any modern equipment (Kamassah, 2011; Farmers, 2011). Furthermore, manual irrigation with buckets is labour intensive. "Migration of young people [… and] the overlapping of agricultural operations, such as the coincidence of peak irrigation season with peak harvesting and threshing operations of rain-fed crops" (Namara et al., 2011, p. 34) often cause a shortage in labour availability. Labour costs are estimated between

GHS 2.5 and GHS 3 per man-day. "Labour constitutes 31 percent to 64.2 percent of the variable cost of production depending on the type of the crop" (Namara et al., 2011, p. 30). The second big bulk in variable production costs is attributed to fertilizers.

Regarding any possible production sites for irrigation technology in Ghana, IDE Ghana has also conducted a supply chain assessment with the focus on the availability and cost of input materials. It has been found that pipes, metals and woods are generally available in Ghana. However, plastics are less established or mainly missing. Furthermore, there is a cluster of small metal workers concentrated in an area called Suame Magazine in Kumasi, which constitutes a high potential with regard to a future production site. Last but not least, IDE Ghana has identified agro-input suppliers as the main agro suppliers and contact persons with smallholder farmers (Adhikari, 2010; Input, 2010).

Culturally, Ghana is multifaceted with a long history of coexistence between migrant groups and indigenous people. Their diverse background is reflected in cultural and ritual practices, which are often similar but which also have the potential to create conflicts between groups. Generally, a patrilineal descent ideology organises social life whereas chieftaincy and to a lesser extent the office of tendaana[12] also influence and organise people's life (Ali, 2011; Awedoba, 2006; Kamassah, 2011). In terms of ethnicity, ethnic groups can be roughly differentiated by language. Even though most languages belong to a similar language family, the ethnic groups do not form a cultural homogeneous group and communication in the sense of understanding is not granted between the different groups (Awedoba, 2006). Some farm practices are relevant to highlight such as compound farming. In other words, a compound exists of mud huts positioned in circular structure, within which animals are kept in the night. Besides keeping livestock, farmers cultivate crops and legumes throughout the year (Awedoba, 2006). During the dry season, animals are kept lose during the day, which causes many problems in terms of field destruction by livestock. Adequate fences are not available or simply not affordable (Farmers, 2011).

In sum, the explorations have revealed that smallholder farmers in Ghana lack irrigation technologies, rely heavily on buckets or cannot afford available irrigation technologies. Against this background, there is a need for low cost irrigation technologies in order to enhance agricultural productivity and thus, income of

[12] The office of tendaana means a type of earth priests, who function as priests. Nowadays, chiefs often replace them (Awedoba, 2006).

smallholder farmers in Ghana. Based on a clear set of criteria[13], IDE Ghana has defined its targeted market segment according to the following reasoning:

IDE Ghana starts its intervention with smallholder farmers in the Kassena-Nankana District in the Upper East Region of Ghana (see **Figure 11** in appendix VI.f), because the poverty rate in the Upper East Region is the highest compared to other regions (for more detail see political map of Ghana in appendix VI.f). Furthermore, the population density in the Upper East Region also surmounts other regions and makes an intervention more efficient in that area. Both surface and sub-surface water in the Upper East Region is available all year round and the soils are generally good. Moreover, traditional bucket irrigation and low crop diversity is a main issue in the Upper East Region. In other words, affordable and effective small-plot irrigation technologies combined with trainings have the highest impact potential in the Upper East Region. The introduction of treadle pumps is further facilitated by the absence of any previous treadle pump history in the region. For all these reasons, IDE Ghana has decided to start its project in the Upper East Region as its first entry point before expanding to other regions (Nanes, Weight, Torgbor, Keller, & Hughes, 2009).

Furthermore, IDE Ghana has decided to set up a manufacturing site in Kumasi to harness the opportunities stemming from the large informal network of metal workers in Suame Magazine (Nanes et al., 2009).

4.3 IDE Ghana and BoP 2.0 business strategies

In chapter 3.3.1, it was shown that BoP 2.0 business strategies require a change of perspective to do business with the BoP. This section examines to what extent IDE Ghana has implemented the theory.

4.3.1 IDE Ghana's perspective towards BoP

4.3.1.1 Acknowledging the heterogeneity at the BoP

By focusing on smallholder farmers in the Upper East Region of Ghana, IDE Ghana has recognized the diversity of the BoP. In more detail, it does not only concentrate on one specific segment at the BoP, namely farmers, but it also differentiates between farmers in size, type and region. So, IDE Ghana focuses on smallholder farmers active in vegetable production in the Upper East Region of Ghana. Deeper analysis of that segment has highlighted further differences within that segment:

[13] The following criteria were examined during the field assessments: Surface and sub-surface water availability, population density, poverty rates, proximity and accessibility of output and input markets, formal and informal irrigation, communal and individual irrigation (Nanes, 2011).

In the western part of the Upper East Region, three major ethnicities with their particular linguistic attributes exist: the Kassena, the Builsa and the Nankansi. The Frafra ethnicity lives in the centre of the Upper East Region. In the eastern part of the Upper East Region, the Kusasi and the Mamprusi people cohabit, although in a more hostile way (Awedoba, 2006; Nanes, 2011). In order to better understand and address these customers' needs, IDE Ghana has taken this difference into account and employed local staff able to communicate within the respective communities.

4.3.1.2 Market creation

In chapter 4.2, the lack of irrigation technologies has been revealed as critical for smallholder farmers in improving agricultural productivity and thus, their income. Therefore, smallholder farmers in Ghana are clearly in need of effective irrigation technologies. Again, the simple existence of a need does not imply a market for that need. Even though diverse pumps have been sold in Ghana, a well-established market for treadle pumps with sound production and distribution channels is basically absent in the Upper East Region of Ghana.

Between 2002 and 2004, Enterprise Works, a NGO working in West Africa, embarked on a market creation activity for a treadle pump known under the name SOKA pump (for more information see chapter 4.2.2). However, after the premature exit of Enterprise works in 2004, sales collapsed. What remained was a rather bad reputation of treadle pumps associated with the SOKA pump. Not least for that reason, IDE Ghana started its programme in the Upper East Region, where Enterprise Works was not active and where the treadle pump was not socially rejected by its bad reputation.

In sum, a consumer market for irrigation technologies is not completely absent in Ghana. However, it has started in a wrong direction. In other words, IDE Ghana not only has to create a consumer market for irrigation technologies in some parts of Ghana, but it also has to deal with the consequences of unsuccessful groundwork done by others in some areas.

4.3.1.3 Return on investment

IDE Ghana is a NGO and is funded by so-called patient capital. Patient capital providers are, for instance, the Bill and Melinda Gates Foundation and the Swiss Agency for Development and Cooperation (SDC) (Nanes, 2011). These organisations invest capital in order to have a positive social impact, that is to say, on poverty alleviation.

By following a market-based approach, IDE Ghana facilitates the emergence of private market business in the irrigation sector with the goal of assisting smallholder farmers to step out of poverty. Thereby, IDE Ghana goes beyond economic return on investment and also seeks social and environmental returns (IDE, 2011a).

4.3.1.4 Partner scoping

In order to build a favourable ecosystem, to harness the opportunity from any collaboration with partners and to reach scale, IDE Ghana has identified and continues to look out for potential partners in the operation region. The following section gives an overview of IDE Ghana's partnerships and their purpose to date.

4.3.1.4.1 Microfinance institution: Ecumenical Church Loan Fund (ECLOF) Ghana

IDE's experience from other countries suggests that farmers make a net annual additional income of about US$ 200 – 500 (Egan, n.d.) if they have access to irrigation equipment and high-value crops. However, farmers usually lack founding for such an initial investment. For that purpose, IDE Ghana seeks to collaborate with microfinance institutions, which provide loans for smallholder farmers.

In order to meet this goal, IDE Ghana approached ECLOF Ghana in July 2010. ECLOF Ghana is affiliated with the finance institution ECLOF international based in Geneva, Switzerland. Its mission is to "mobilize resources and offer sustainable, customer-centred financial services for the total development of [its] clients and for the benefit of all stakeholders" (ECLOF Ghana, 2010). Its main objectives is overlapping with those from IDE Ghana, that is to say, enabling smallholder farmers to lift themselves out of poverty by providing better access to irrigation technologies and inputs. Hence, IDE Ghana and ECLOF Ghana signed a Memorandum of Understanding for a microfinance loan pilot program on August 24, 2010 (IDE Ghana & ECLOF Ghana, 2010; ECLOF Ghana, 2010).

4.3.1.4.2 International Water Management Institute (IWMI)

IWMI is an international research centre embedded in the larger Consultative Group on International Agricultural Research (CGIAR). Its sub-branch in West Africa "focuses on efforts to reduce poverty and to provide improved food security through sustainable and efficient agricultural water use" (IWMI, n.d.). To date, IDE Ghana has mainly consulted IWMI's expertise for ground water resource assessments and related topics such as soil compositions (Kizitio, 2011; Namara, 2011).

4.3.1.4.3 Ministry of Food and Agriculture of Ghana (MoFA)

MoFA is the responsible agency for Ghana's agricultural sector. Against the background of comparable visions in terms of irrigation and water management, IDE Ghana aims to collaborate with MoFA and its extension workers in the sense of providing trainings to farmers. So far, the collaboration has been limited to the attendance of MoFA representatives at IDE Ghana's trainings in pest and disease control management and vegetable production. However, IDE Ghana continues to involve MoFA in the project (Kamassah, 2011).

Against the background of a market-based approach, this collaboration with MoFA to provide agronomic trainings is put into perspective. Therefore, market-centered solutions with regard to such trainings are presented in chapter 5.1.1.2. Nevertheless, some cooperation with MoFA can make sense, because MoFA disposes of necessary local knowledge and political support that can reduce transaction costs.

4.3.1.4.4 United States Agency for International Development (USAID)

USAID is an independent federal government agency of the United States and assists countries "recovering from disaster, trying to escape poverty, and engaging in democratic reforms" (USAID, 2010). Currently, IDE Ghana and USAID are working on a joint project in direction of female crops, such as the sheer tree. More specific details are not available yet due to the infancy of the project idea (Nanes, 2011).

4.3.1.4.5 International Telephone & Telegraph (ITT) Corporation

ITT Corporation is a private American corporation leading in fluid technology, defence and information solutions and in the motion and flow control sector (ITT, 2011). ITT Corporation's flow control division is amongst the global leaders in pump production. In more detail, the flow control division engages in a kind of think-tank, the ITT Innovation Laboratory in Gloucester, Massachusetts, in order to realise innovative ideas and product designs "for low-cost water solutions for people in developing countries […] that could increase water access for rural farmers and families in emerging markets" (ITT, 2011a). Besides, ITT Corporation is also supported by the Gates Foundation to experiment with renewable energy (Woon, 2011).

ITT Corporation has approached IDE Ghana in order to test low-cost solar pumps for the BoP market (Light, 2011; Woon, 2011). In other words, the theory of creating a fortune with the BoP seems to come full circle with the collaboration between ITT Corporation and IDE Ghana, the use of patient capital and the starting of the test period of ITT's solar pumps by IDE Ghana in April 2011.

4.3.1.5 Environmental friendly irrigation technologies at the BoP

Stemming from the previous chapter and going beyond the environment-friendly manual treadle pump, IDE Ghana collaborates with ITT in order to test solar pumps for smallholder farmers (Light, 2011; Woon, 2011)[14]. In other words, IDE Ghana together with ITT co-create with the BoP environmental friendly products in the form of small-scale solar pumps. Hence, the BoP serves as a laboratory to experiment with high-tech solar pump technology from the top of the pyramid in order to adapt it to the needs of the BoP. Furthermore, if developed and commercialized successfully at the BoP, this innovation stands a chance to upmarket migration to the developed world. In sum, IDE Ghana has adopted a shift in perspective with regard to seeing BoP customers as able and willing to use state-of-the-art technology.

4.3.1.6 Special product features and special services supporting the product accessibility

BoP 2.0 theorists stress the participatory process in order to design products, which meet the needs of the BoP. This implies developing the product in a way that meets the specific characteristics of smallholder farmers in the Upper East Region of Ghana.

In the Upper East Region of Ghana, there is a cultural and especially linguistic diversity amongst smallholder farmers. However, they have some factors in common: smallholder farmers are poor and have minimal or no infrastructure. They are illiterate, follow similar social and agricultural practices and face all the risks of high crop failure due to the lack of adequate irrigation technologies. Farmers need products which function without electricity and are able to cater for water to irrigate their few acres of land. Furthermore, smallholder farmers are geographically dispersed, though organised in communities. Moreover, payment systems need to be adequate to overcome smallholder farmers' up-front investment problems.

Against this background, IDE Ghana has decided to start with classical treadle pumps, which seem to be most suitable to smallholder farmers' needs. Not only does the treadle pump design fit the particular context of smallholder farmers (for more detail

[14] IDE Ghana also collaborates with other institutions on the same issue, such as with the Solar lab of the University of Applied Science in Biel, Switzerland (Heierli, 2010). However, as this project had not been initiated at the time of my field research, I will not enter into detail here but rather come back to it in the next part of the thesis, namely when it comes to elaborate a future roadmap for IDE Ghana. Nevertheless, the project and collaboration is comparable to the one with ITT.

see chapter 4.3.2.1), but IDE Ghana has also established a whole package around the product to make the product better accessible for smallholder farmers:

4.3.1.6.1 Credit-links

IDE Ghana bases its intervention on the assumption that smallholders can step out of poverty due to higher agricultural productivity with better access to irrigation technologies. However, irrigation technologies constitute a high up-front investment for smallholder farmers, which is often insurmountable, especially if we take the plant cycle into account. There is a time gap between agricultural investments and revenues due to the natural plant cycle between planting and harvesting. For that reason, smallholder farmers do not dispose of financial means to acquire and pay for irrigation technologies before the end of the first harvest time (Nanes, 2011). Therefore, IDE Ghana not only focuses on irrigation technologies, but also adapts, develops and collaborates with partners on services to overcome hurdles not directly linked to the product per se. For instance, IDE Ghana has partnered with ECLOF Ghana on a pilot project of providing loans for rural smallholder farmers with the focus on linking smallholder farmers to credit institutions, which integrate the plant cycle into the microfinance system.

The relationship between ECLOF Ghana and IDE Ghana was written down in the form of a Memorandum of Understanding for a microfinance loan pilot program in order to clarify each one's role and responsibilities (IDE Ghana & ECLOF Ghana, 2010). In more detail, the collaboration takes the following terms (IDE Ghana & ECLOF Ghana, 2010; Ujoranyi, 2011):

ECLOF Ghana assesses the borrower's loan eligibility based on clearly defined criteria[15]. The credit system also takes account of the particularity of the agricultural sector in the sense that returns are not immediate. There is a natural time gap between the investment and its returns in form of yield. The credit system incorporates this particularity of the plant cycle in a grace period. In other words, the loan term is scheduled for six months with an interest rate of 3.2% per month and a grace period of four months. In case of repayment default, a penalty will be imposed (IDE Ghana & ECLOF Ghana, 2010).

[15] First, the farmer has to conduct dry season gardening. Secondly, he has to cultivate specific types of crops, for example pepper or leafy vegetables. In contrast, tomatoes bear high risks and do not fall into this specific range of crops. Thirdly, the farmers need to dispose of a well. Fourthly, he has to belong to a farmers' group recommended by IDE Ghana (Ujoranyi, 2011).

The total of the loan amounts to GHS 160. GHS 90 are allocated in form of a voucher for the treadle pump. The rest is given in cash in order to buy critical farm inputs. Upon signing of the loan, the client will receive a voucher for the irrigation equipment, which he will present to the dealer. The dealer will present the voucher to ECLOF Ghana and receive immediate cash for the voucher. The loan part for farm inputs will be disbursed directly to the farmer in cash. The individual loan scheme is further assured by group guarantee and collaterals in form of livestock (IDE Ghana & ECLOF Ghana, 2010; Ujoranyi, 2011).

A particular component of saving is also included in the repayment schedule, because farmers often face saving problems. In order to circumvent mismanagement of savings, the loan incorporates a saving component of GHS 2 per week in the repayment amount, which will be repaid by ECLOF Ghana with interests at the end of the loan period (IDE Ghana & ECLOF Ghana, 2010; Ujoranyi, 2011).

4.3.1.6.2 Package offers: Trainings and agro-inputs

The best irrigation technologies will not make an impact unless smallholder farmers know how to make use of it in an efficient way and thus, embed the product successfully in a smallholder's life. In other words, smallholder farmers must be able to avail themselves best of the irrigation technology, which goes beyond the mere purchase of the irrigation technology. Other impediments to productivity, such as pest and disease, must be reduced to tap the full potential of the product. In other words, farmers need more initial training and assistance. For that purpose, IDE Ghana has developed an on farm production strategy: Not only effective irrigation technologies are offered, but also whole packages in terms of high-quality seeds and trainings in better agronomic practices. IDE Ghana offers a complete package that complements the purchase of the treadle pump. Not only does the package make the product more attractive but dealers also benefit from such additional services and products. Nevertheless, the question arises for farmers how to finance such services and additional products.

Stemming from the previous chapter, IDE Ghana and ECLOF Ghana have incorporated in the loan structure of GHS 160 a cash component of GHS 70 designated to buy critical farm inputs. Concerning the provision of product services such as trainings, there are two ways: public extension organisations or private initiative. The first is contingent upon political will. The emergence of a private initiative depends largely on the fact whether the service is sustainable in terms of profit on the long term.

Both may be inaccessible for smallholder farmers, be it due to financial reasons or the simple unavailability of such services in many countries (Heierli & Katz, 2007; Nanes, 2011).

Against this background, IDE Ghana has adopted a three-sided small farm production strategy, which is a mix between private and public service providing. First, IDE Ghana trains private input-dealers with the purpose that they advise farmers with the purchase of agro- inputs. Furthermore, IDE Ghana teaches its field staff in order to assist farmers directly with sustainable and efficient farming practices. The idea is that they can instruct lead-farmers and representatives of farmer groups, who subsequently pass the knowledge down to the single farmer. Lastly, IDE Ghana has invited agricultural extension officers, representatives of MoFA, to the trainings in order to engage the public sector in farmer capacity building. In the light of the projects infancy, the training is provided at the expense of IDE Ghana. On the longer term, IDE Ghana plans to embed trainings in the supply chain, eventually in collaboration with MoFA. In terms of training content, IDE Ghana has focused on two areas, on vegetable production and on integrated pest and disease management (Ampofo, 2011; Nanes, 2011).

A more detailed discussion of how to better incorporate such advisory services in a market-based approach according to a BoP 2.0 theory will follow in chapter 5.1.1.2.

4.3.1.6.3 Output market strategy

IDE Ghana also focuses on a third aspect in their approach, namely on output markets. In other words, best technologies and practices do not help to alleviate poverty unless farmers are able to sell the produce profitably at stable markets. This aspect clearly goes beyond the BoP 2.0 theory for business. For that reason, the analysis is limited to a short description of the output strategy in order to give a comprehensive image of IDE Ghana's work.

In general, smallholder farmers in the Upper East Region of Ghana have links to markets through so-called market queens. Market queens are women who buy smallholder farmers' produce on the farm or at local markets. Some farmers also sell their products directly at local markets. Normally, market access is not the main issue in the Upper East Region of Ghana, which is the reason why IDE Ghana has not concentrated heavily on an output market strategy for smallholder farmers so far (Nanes, 2011).

4.3.2 IDE Ghana's approach to the three critical theoretical factors and the 4 As

The BoP 2.0 theory highlights three critical factors for successful BoP ventures: product-mix, partnerships and (micro-) finance (for more detail see chapter 3.3.3). This section examines their practical importance and their implication in the implementation process. Furthermore, it is evaluated whether other factors stemming from practical experience are important.

4.3.2.1 Product-mix

A product designed for the BoP has to fulfil the conditions of the 4 As (for more details see chapter 3.3.2). Against the background of the theory and after having studied and examined Ghanaian smallholder farmers, their needs and potential production sides, IDE Ghana has decided to market treadle pumps to smallholder farmers in the Upper East Region of Ghana. As water assessment has shown, the Upper East Region of Ghana mostly disposes of good shallow water throughout the year. With a capacity to lift water up effectively from a depth of seven meters (IDE, 2011b), the treadle pump constitutes an effective irrigation technology suitable to the region.

4.3.2.1.1 Product

The treadle pump shall meet the criteria of the 4 As. In the context of product design, the factor of affordability is particularly relevant. Concerning the different aspects of affordability, the fixed only treadle pump is a simple pump easy to use. In terms of divisibility, its output capacity of a minimum of 34 litres a minute is suitable to irrigate small plots of 200 square meters in roughly an hour (IDE, 2011b). The average size of a farm in the Upper East Region is approximately 500 square meters. In other words, the treadle pump technology provides the farmer with the quantity of water he realistically needs (Nanes, 2011). Concerning maintenance, the fixed only treadle pump is a simple pump without highly sophisticated features, which makes it easy to maintain and to repair in the case of damage. Emotionally, the fixed only treadle pump may be associated with a more modern picture compared to traditional water lifting with buckets – a sign of social status.

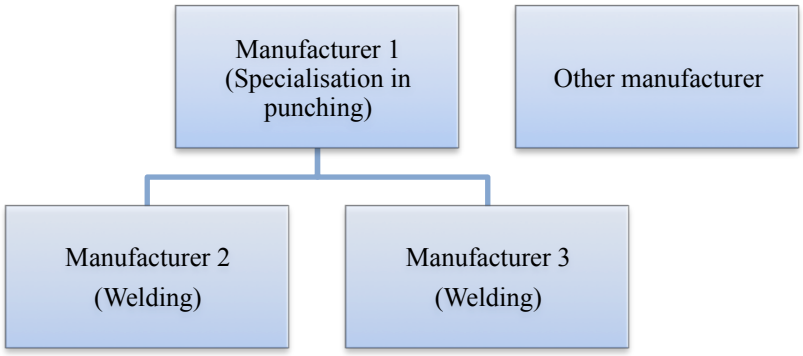
PRODUCTION

Seeing a vibrant cluster of small-scale metal workers and the actual availability of most raw materials in Kumasi, IDE Ghana has decided to produce the treadle pump locally, namely in Kumasi. Only the plastic bucket for the cup seal can be imported more cheaply from Asia due to a shortage in adequate local plastic supply. With the

help of Suame Magazine Industrial Development Organisation (SMIDO)[16], an organisation, which brings "all stakeholders of Suame Magazine Industrial Estate together for the pursuit of a common development agenda" (SMIDO, 2009), IDE Ghana has identified and approached different potential treadle pump manufacturers. Three metal workers, mainly welders, have shown interest in producing treadle pumps and have agreed to manufacture treadle pumps with the help of IDE Ghana. In other words, treadle pumps are produced locally. In the context, local production refers to the establishment of local business and should not be confounded with employing local materials (Asante, 2011; Life, 2011; Musah, 2011; Opoku, 2011).

A particular relationship between the manufacturers has emerged (see **Figure 3**). The three manufacturers[17] are doing both; competing and collaborating in the production of treadle pumps.

Figure 3: Relationship between manufacturers *(Source: own figure)*



All three manufacturers produce treadle pumps, that is to say, they buy raw material, have it cut and weld it. Nevertheless, a kind of specialisation has emerged for technical reasons, because previous attempts to punch parts manually have not been satisfying in terms of quality. Therefore, a kind of a subtracting liaison between the manufacturers has emerged. Manufacturer 1 disposes of a machine required for mechanical punching. Hence, he punches all parts of the treadle pump. As manufacturer 2 and 3 do not own such a machine, they subcontract the punching of the required parts to manufacturer 1.

A similar subcontracting relationship exists for the rolling of the treadle pump cylinder, which equally requires mechanical precision for quality reasons. Here again,

[16] For more information on SMIDO consult http://www.smidoghana.org/.

[17] The three manufacturers are Musah Abdul Rashid (referred to as manufacturer 1), Emanuel Asante (referred to as manufacturer 2) and Master Life (referred to as manufacturer 3).

manufacturer 1 disposes of the required machine. However, manufacturer 2 and 3 have reported that they occasionally subcontract the rolling of the cylinder to another metalworker in Suame Magazine (see **Figure 3**), who also owns such a machine (Asante, 2011; Life, 2011; Musah, 2011; Opoku, 2011).

In sum, IDE Ghana has identified and trained three treadle pump manufacturers in Kumasi and has been assisting them actively with the production. As the project is still in its infancy and for technical and quality reasons, IDE Ghana continues actively to assist those three manufacturers. Nevertheless, the intensifying of the work relationships between the manufacturers and the widening scope of the production actors put IDE Ghana's active role into perspective. It further exemplifies its function as facilitator for the emergence of a private market production of treadle pumps. IDE Ghana's active role as facilitator and the question of a possible transformation from a facilitator to an active social enterprise will be discussed in chapter 5.2.

THE FIXED ONLY TREADLE PUMP

Concerning the product design itself, IDE Ghana has decided to produce the fixed only treadle pump (see **Figure 17** in appendix VI.l) on the basis of IDE's well-established treadle pump commonly used in Asia. Raw materials are almost all available in Kumasi except one plastic component, which can be imported from Asia. Besides plastic and metal components, the treadle pump requires wood for its pedals (Life, 2011; Opoku, 2011).

The production costs of the fixed only treadle pumps amount to GHS 34. It is sold to the dealer for GHS 42, which includes a manufacturer's profit margin of 20% and GHS 2 for transport by public buses (Opoku, 2011).

In February 2011, the production of fixed only treadle pumps was ceased. First, not all of the produced fixed only treadle pumps had been sold so far. In other words, the fixed treadle pumps in stock have been sufficient to cater for the last weeks of the dry season. Furthermore, product adaptations are intended due to product problems regarding the unsteady wood supply, its fluctuating prices and the frequent complaints about the breaking of the wood treadles and the valve. Last but not least, farmers often have more than one well, which calls for a more mobile pump (Opoku, 2011).

THE MOBILE TREADLE PUMP

In order to better cater for the needs of smallholder farmers in the Upper East Region of Ghana and to integrate their feedback in the product – or to co-create a

product with the BoP – first prototypes of the mobile treadle pump have been produced. Currently, they are being tested in the field for a possible introduction in the next dry season. The advantage of a mobile treadle pump is that farmers can use it on more wells and easily take it home. Furthermore, the treadles of the mobile treadle pump are made of metal to correct the weakness of the wood treadles in the fixed only treadle pump (Opoku, 2011).

In terms of production, the mobile treadle pump is similar to the fixed only treadle pump and requires only a few amendments. It is further planned to transform the remaining fixed only treadle pumps in stock into mobile ones (Opoku, 2011).

Due to some additional components and the metal pedals, the production cost of a mobile treadle pump is higher and amounts to GHS 75. Including the manufacturer profit margin of 20%, the pump will be sold to the dealer at roughly GHS 90 excluding transportation costs (Opoku, 2011).

4.3.2.1.2 Price

In the context of price, affordability is also the most important factor of the 4As. Affordability in terms of price has two sides: inexpensive in terms of price and payment schedules that do not affect the immediate cash availability. **Table 1** gives the calculated cost structure of the composed fixed only treadle pump as of July 2010.

Table 1: Cost structure of fixed only treadle pump in July 2010 *(Source: Own table based on Opoku, 2011)*

Component	**Price**
Production cost	40 GHS
Cost of transportation from production hub to dealer	6 GHS
Cost of wooden treadles and PVC pipes	30 GHS
Dealer margin (20%), 2 GHS to be passed to installer	8 GHS
Installation cost	4 GHS
Cost of transportation from dealer to village	2 GHS
Total cost	**90 GHS**

The price of 90 GHS looks affordable for three reasons: First, the entry price for the pump is amongst the lowest in Ghana. Secondly, IDE Ghana further lowers the entry barrier through the collaboration with ECLOF Ghana, which has committed to give loans to farmers. In other words, farmers can afford the pump either by their own means or by an easy accessible loan. Thirdly, calculations have revealed that farmers

normally make around 300 GHS pro "500 square meter plot for vegetable farming in the dry season" (Malhotra, 2010, p. 3). Hence, farmers should be able to repay the loan or to amortize the acquired fixed only treadle pump within one dry season of vegetable production[18].

Since the starting of the treadle pump commercialization, prices for raw material have risen enormously. As IDE Ghana's program manager in Bolgatanga says, "Ghana believes in price changes" (Kamassah, 2011). In other words, changes in price and especially petrol prices are reflected immediately in general consumer prices. In our case, the costs of wood and PVC pipes have risen significantly. For instance, the costs of wooden treadles and PVC pipes for a fixed only treadle pump were initially budgeted at GHS 30. Early March 2011, the wooden treadles and the PVC pipes accounted for GHS 39.60, which is an increase of 32% within eight months. The effective cost structure of the fixed only treadle pump inclusive installation fee jumped from GHS 90 in July 2010 up to GHS 109 in March 2011 (Kamassah, 2011).

The arrangement between ECLOF Ghana and IDE Ghana has been implemented as described in chapter 4.3.1.6.1. That is to say, the farmer gets a loan of GHS 160. GHS 90 are allocated in form of a voucher for the treadle pump and GHS 70 in cash. The fixed selling price of the fixed treadle pump at 90 GHS and the growing input prices suggest that somebody has to bear the price discrepancies. In real market situations, price differences are normally passed on to customers. In this case, the farmers have received a voucher with a fixed pre-printed price issued by ECLOF Ghana. Hence, the dealers could not pass price changes on to customers. However, continuing pressure on dealers' profit margins affects the profitability and attractiveness of the treadle pump business in the long term. In order to avoid this problem, IDE Ghana has covered the cost of price changes in the first dry season (Nanes, 2011). However, in the future the voucher will have to take a more flexible form in order to integrate price changes in the product price.

Against the background of the increasing instability of raw material prices, the more expensive price of the mobile treadle pump is put into perspective. In other words, the volatile price fluctuations of wood will cease to apply. Here again, the loan arrangement with ECLOF Ghana has to be renegotiated and adapted to the mobile treadle pump.

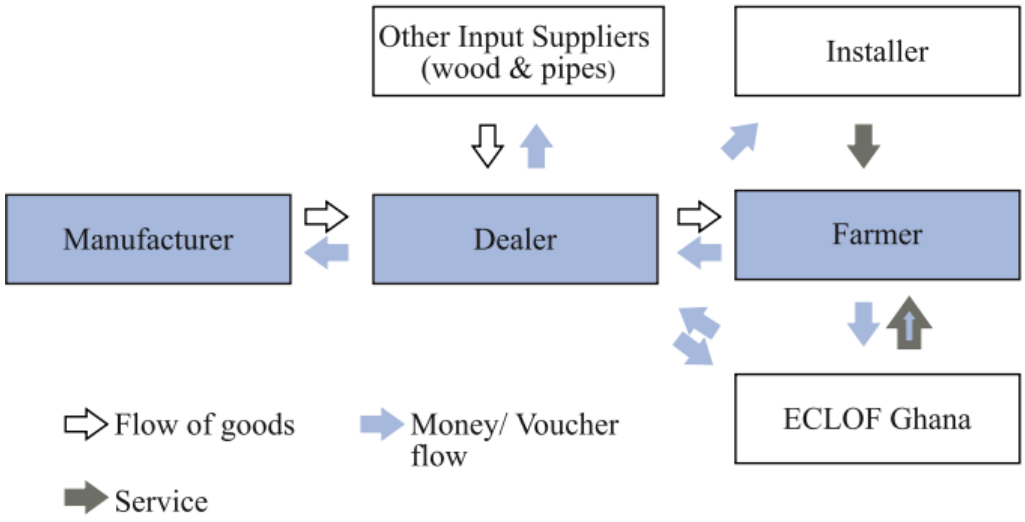
[18] The duration of the dry season varies according to annual rainfall variations.

4.3.2.1.3 Place

Not only must a product be affordable and effective, but it must also be available in terms of location and after-sales services. The word location not only embraces the immediate product seller but also "the supply chain that brings the product to the customer" (Heierli & Katz, 2007, p. 36). Generally, a successful supply chain generates profits for all the stakeholders involved and, therefore assures a stable supply of the product. In other words, the product becomes available.

Farmers in the Upper East Region have irrigated their fields with buckets to date. Hence, with the introduction of the treadle pump and the building up of an effective supply chain, an easy irrigation technology becomes available to smallholder farmers in the Upper East Region of Ghana. IDE Ghana has constructed its supply chain around a dealer, as illustrated in **Figure 4**.

Figure 4: Supply chain of treadle pumps *(Source: Own figure)*



The dealer is in the centre of the supply chain, who acts as intermediary between the manufacturer and the farmer. He places pump orders with the manufacturer, organises other required inputs such as wood and pipes, and sells the product directly to the farmer. An independent installer contacted by the farmer procures the installation (Nanes, 2011; Opoku, 2011).

Organizing the supply chain around dealers makes sense for different reasons. First, farmers are rather scattered throughout the Upper East Region and their mobility is limited. In other words, it makes sense to place sales location as close as possible. Two cities in the Upper East Region, namely Paga and Navrongo, have been identified as suitable due to their centrality and proximity to most farmers and their popular

setting for local markets. Moreover, both cities are in close proximity of potential input dealers of wood and pipes.

Selling treadle pumps complements the traditional business models of agro-input dealers. Trading in treadle pumps alone may not be a sufficient incentive to set up an entire new business at the beginning of the project. However, it constitutes an attractive additional income potential for the dealers in the agro-input sector. Furthermore, this situation is convenient, because dealers and farmers have already existing connections. By working with agro-input dealers, IDE Ghana can also advise and train dealers in pest and disease management so that they can advise and sell products to farmers in a more sustainable way (see also chapter 4.3.1.6.2). Furthermore, the appointment of two local dealers, one in Navrongo and one in Paga, has been considered as adequate to foster both, sufficient business scale to remain interested in the sale of treadle pumps and healthy competition between the two dealers (Nanes, 2011; Malhotra, 2010).

For the time being, there has been no need for any additional intermediaries. The local dealers have enough capacity to store pumps and additional required inputs such as wood. Other required inputs, such as pipes, are often directly delivered to the community. Moreover, the interaction between manufacturer, dealer and famer is straightforward. In other words, the organisation of the treadle pump supply by dealers is satisfying and does not require any other intermediaries.

Independent local installers will care for after-sales services. Dealers also provide spare or damaged parts. More generally, introducing punch plate certification for quality control and warranty provision to consumers to consolidate after-sales services and assure quality control are further suggestions to enhance after-sales services (Malhotra, 2010).

A look at the flow of goods shows the following picture: The manufacturer produces the pump in Kumasi. By public transportation the treadle pump is sent to the dealer in the Upper East Region, namely either to Paga or Navrongo. The dealer stocks the pump and orders other spare parts necessary for the pump; the wood is supplied by different carpentries either in Paga or Navrongo (Kuvuga, 2011; Jagula, 2011). The pipes are bought at Navid Ltd., a company located in Nayagia, the Upper East Region of Ghana (Navid Ltd., 2011). The transport from the dealer to the farmer is supposed to be organised by the farmer. Furthermore, the dealer provides the farmer with the contact detail of potential installers. Subsequently, the farmer contacts the installer, who renders

the service of installing the treadle pump on the farm. Besides, installers also take care of any reparations related to the treadle pump.

In terms of money flow, the dealer pays the manufacturer 50 % on delivery of the treadle pump. The other 50 % are paid once the dealer sells the treadle pump to the farmer. In contrast, the manufacturer, respectively the dealer, has to pay raw materials directly in cash. The installation costs of 6 GHS are included in the selling price and paid by the dealer. However, the farmer bears the installation cost in the end, because the installation costs are incorporated in the price. The farmer himself receives a loan from ECLOF Ghana in form of a voucher of GHS 90. By buying the pump, he gives the voucher to the dealer, who hands it over to ECLOF Ghana and subsequently gets reimbursed in cash. After a grace period of four months, the farmer starts to repay the loan to ECLOF Ghana at an interest rate of 3.2%.

IDE Ghana has been assisting all the actors along the supply chain in order to set up a smooth establishment of the treadle pump supply chain. In other words, IDE Ghana's involvement is rather active at this stage of the project. Especially at the beginning its assistance is important to link those actors and to help building a trust relationship between all stakeholders. Therefore, IDE Ghana has an engineer permanently based in Kumasi. Furthermore, there are 5 field staffs of IDE Ghana in the Upper East Region of which three are permanently in the field; two market development officers[19] responsible for the farm communities and one field technician in charge of more technical issues (Akanamba, 2011; Mimpori, 2011; Ali, 2011).

IDE Ghana has further trained 12 local installers, who are supposed to act independently in the long term. Some installers have reported having made pump installation as their main and sole business, which testifies of a promising market based approach (Fellah, 2011; Musah A. , 2011; Kamassah, 2011).

Nevertheless, some challenges mainly linked to the financial part have emerged during the first season of the treadle pump sales. In other words, financing is very sensitive and people are reluctant to invest their money. This is also true for both manufacturers and dealers (Jagula, 2011; Kuvuga, 2011). For instance, manufacturers have to pay for the raw material in cash, but receive the money for the treadle pump sale only after the instalment of the pump. The dealer also faces this risk. Yet, both actors in the supply chain seem to be coping with this kind of business. Nevertheless, it is

[19] Market development officers are also referred to as community-marketing facilitators (CMF).

reported that manufacturers tend to prioritize the work that brings immediate cash over the treadle pump production (Opoku, 2011).

After having gotten some feedback on repayment rates, ECLOF Ghana's risk management has decided to be more reluctant to give out additional loans (Ujoranyi, 2011). In other words, the facts that loan access has become more difficult for farmers and the approaching of the end of the dry season were reflected in the stagnating treadle pump demand.

Another issue regarding financing is that the loan pilot project start got delayed due to farmer's screening and related administration issues. In other words, first loans were given out only in the middle of November, when the dry season had already started. This implies that farmers were able to buy pumps rather late. Furthermore, they did not outline their garden in accordance with the treadle pump. This means that many farmers could not take advantage of previously constructed channel systems to water the field. They had to carry the water to the beds instead (Kamassah, 2011; Opoku, 2011).

The history of common philanthropic activities in the Upper East Region constitutes another problem for IDE Ghana and ECLOF Ghana in particular. In other words, people are used to the fact that they often get assistance for free. This is for example reflected in donations for fences or well buildings. Without commenting on these activities, its history has an impact on IDE Ghana's project in the sense that IDE Ghana often has to clarify its role as a facilitator in an emerging treadle pump market, where treadle pumps are sold and not given for free (Ampofo, 2011; Mimpori, 2011; Ali, 2011; Kamassah, 2011).

In general, the whole supply chain reacts quite sensitively to loans. That is to say, the more loans are given, the smoother the process along the supply chain is.

4.3.2.1.4 Promotion

The fourth element in an efficient product-mix is promotion that needs to be adapted to the specific BoP environment so that a product also becomes accepted. In other words, farmers also have to become aware of the product or service. In the 4As model, awareness and acceptability refer to this aspect.

Generally, the AIDA-model can guide the promotion strategy (for more detail see appendix VI.g). Against this background, IDE Ghana has established the following promotion strategy covering both static and dynamic promotion tools.

Regarding dynamic promotion, IDE Ghana has based its approach on a bottom up venture starting at the village level. It has set the target to install pumps on so-called demonstration farms in villages and to identify community-marketing facilitators (CMFs) in order to introduce the technology to farmers (Malhotra, 2010). Their main responsibilities are to promote the treadle pump, to identify potential communities, to organise the farmers in the community and to demonstrate the treadle pump. Demonstration pumps address the need of farmers to make their own experiences with the pump while CMFs cater for necessary social interaction and follow-ups with individual farmers. CMFs further provide critical feedback on reporting defects. In other words, they are permanently in social interaction with farmers. Normally, when targeting a new community, the CMF approaches the community chief and introduces IDE Ghana. Upon his approval, he receives further information about farmers and starts to gather and form farm groups. General experience suggests that entering into contact to raise awareness of the treadle pump does not constitute a problem. Nevertheless, the abundance of different dialects and the necessary reliance on translators sometimes makes it difficult to speak directly to farmers despite the fact of locally employed staff (Ali, 2011; Mimpori, 2011).

Concerning static promotion, T-Shirts with the IDE emblem and photographs were distributed to IDE field staff in order to increase sales (Ali, 2011; Mimpori, 2011). In addition to active marketing by IDE Ghana staff, the dealers themselves have started to promote the treadle pumps with posters in their shops and the exhibition of treadle pump samples (Jagula, 2011; Kuvuga, 2011). With regard to IDE Ghana's promotion strategy, IDE Ghana has taken care of all initial promotion activities and associated costs to date. However, in long term marketing, costs also have to be incorporated in the product price according to a market-based approach.

In sum, IDE Ghana's practice concerning its product-mix overlaps and well exemplifies the theory, in particular of the four As in the broader framework of the four Ps.

4.3.2.2 Partnerships

Besides an efficient product-mix, the literature emphasises partnerships as a second key element for BoP ventures. Not only is it highlighted by the theory, but its importance is also confirmed in practice (for more details on partners see chapter 4.3.1.4). Partnerships are of utmost importance to acquire local knowledge and to

implement a sustainable long-term strategy. Technical partnerships and expertise, especially with IWMI, were important to assess the local situation in a more comprehensive and economic way. Besides comprehending the local situation, partnerships have been key to implement the project. This point complements the factor mentioned below, that is to say, finance. The partnership with ECLOF Ghana has been crucial to spur treadle pumps sales. Therefore, partnerships are also of utmost importance in the implementation of a BoP strategy.

4.3.2.3 (Micro-) Finance

The third key factor to the success of BoP ventures mentioned in theory, but also confirmed in practice, is finance. First, IDE Ghana is funded by so called patient capital (see chapter 4.3.1.3) that allows taking into account the risk of BoP venture. Secondly, microfinance systems seem to be crucial to the demand and the supply of irrigation technologies. Budget constraints are present everywhere, starting with the farmers, but are also pivotal for manufacturers and dealers. Nobody at the BoP has large savings and short-term thinking in terms of cash is predominant. In other words, nobody can afford to lock up his or her money. Even though IDE Ghana's treadle pumps are amongst the lowest priced irrigation technologies in Ghana, access to loans lower the entry barrier for acquiring irrigation technologies significantly. For instance, out of more than 270 treadle pumps sold, only two were bought in cash (Kamassah, 2011), which raises the question about affordability and prices per se (more detail see chapter 5.1.1). In other words, loans seem to tip the scales in favour of a much higher demand. Accordingly, finance issues are crucial to both, unleash the demand for irrigation technologies and develop its supply chain.

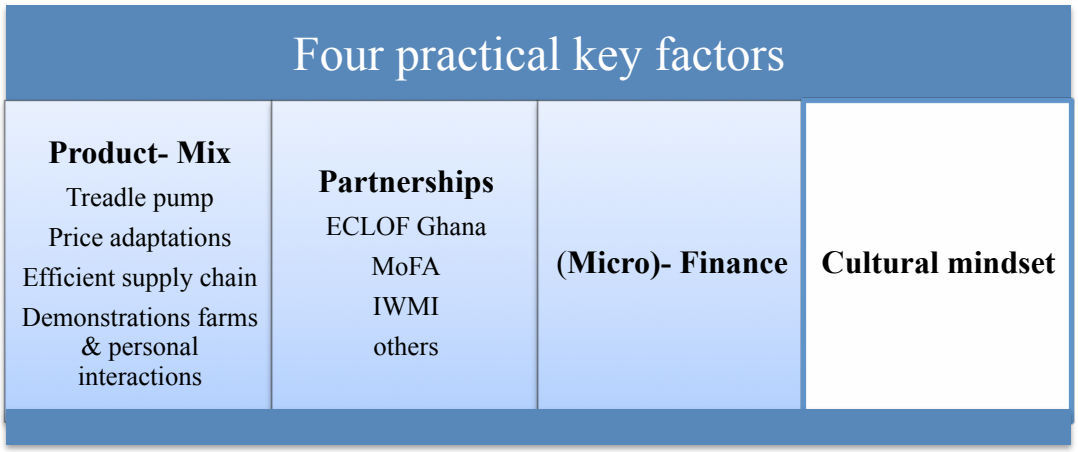
4.3.2.4 Practical implications beyond the theory: the cultural mindset

Even though the importance of the three factors mentioned by the theory were confirmed by the example of IDE Ghana, the practical experience of IDE Ghana brings forth a fourth factor, namely the cultural mindset (see **Figure 5**).

In other words, a change of the cultural mindset, not only of farmers but also of other actors along the supply chain is crucial. The change has to occur at a comprehensive level. First, farmers have to adapt their farming behaviour to completely new agronomic practises with the access to irrigation and the shift to higher value-crops. IDE Ghana has and continues to assist farmers in this transition with the help of demonstration farms and trainings. Secondly, the change of the cultural mindset also includes the farmers' and the other actors' thinking regarding to the role of NGOs or

BoP ventures. Many but not all Ghanaian farmers are used to benefit from philanthropic actions, which have induced a kind of "sit-and-wait" culture. In other words, farmers are accustomed to be helped and to get things for free. Hence, it has been essential for IDE Ghana to communicate its role as facilitator of a profit-making venture completely different from other NGOs present in the region.

Figure 5: Critical factors for BoP ventures beyond the theory *(Source: Own figure)*



5 IDE Ghana on the way towards BoP 2.0: Where to go

After having illustrated IDE Ghana's approach in the treadle pump market against the background of BoP theory, this section deals with the question of where to go with IDE Ghana and the treadle pump, especially with regard to the four critical factors; financing, partnerships, product- mix and cultural mindset. I will particularly deepen the analysis around future product and service developments from the financing point of view, because financing and affordability is key to a flourishing market. In other words, new models with regard to affordability are examined in relation to a future solar treadle pump. In addition, I will also make some recommendation concerning partnerships and the cultural mindset issue. Lastly, the role of IDE Ghana as facilitator in order to create a fortune with the BoP will be discussed.

5.1 Future roadmap around four key factors: Financing, product-mix, partnerships and cultural mindset

5.1.1 Affordability revisited: efficient product-mix and new financing models

Once again, affordability goes beyond cheap products. For instance, IDE Ghana's treadle pump is cheap and thus, very competitive in the irrigation sector in Ghana.

Nevertheless, only few pumps have been sold for cash. That is to say, it remains a high up-front investment for smallholder farmers. Credits rather than simple price reductions have made the product affordable in the case. The fact that credits are key to reduce the entry barrier significantly qualifies the role of cheap products, unless the latter are meaningfully cheaper. Therefore, new models concerning product/ service developments combined with financing or affordability in general are vital to make the treadle pump really affordable, sustainable and less dependent on credits. Last but not least, product developments are essential in order to address current criticism[20].

The next part sheds light on possible product and service developments to meet the criteria of affordability, followed by a section on new complementary financing models. In detail, the development of a multifunctional solar treadle pump and package offers will be analysed.

5.1.1.1 Product development – the solar treadle pump

Despite the treadle pump introduction almost 30 years ago by IDE, it remains a suitable irrigation technology for BoP customers (see chapter 4.3.2.1.1). In other words, IDE Ghana can still go back to its roots, the treadle pump. Even more, with some modifications IDE Ghana can further push the treadle pump revolution in direction of an advanced green technology with a high potential of poverty reduction while generating profits for business and the poor of the world. In other words, key to future product development is multi-functionality (Heierli, 2010).

The treadle pump is used only during the dry season, which varies between three to four/five months[21]. In other words, during the wet season the treadle pump is stored and not used profitably. By making the treadle pump suitable for multiple purposes, so that it can be used profitably all year round, it becomes more affordable for smallholder farmers. Having the BoP 2.0 theory in mind and seeing diverse initiatives, such as ITT's pilot project with solar pumps (see chapters 4.3.1.4.5 and 4.3.1.5), IDE Ghana can modify its treadle pump to make it multifunctional while embarking on the above described reverse innovation process (see chapter 3.3.1.5). Seeing the abundant solar radiation in Africa, the complementation of the treadle pump with a solar panel would

[20] For instance, the product range may be enlarged with the rope pump that can lift water higher than the treadle pump in order to address criticism caused by dropping water tables.

[21] The dry season depends on external climatic factors and its length varies accordingly.

be one option towards this multifunctional product development[22]. A solar panel would make it further possible to irrigate the field alone[23], which is one of the criticisms brought forward by farmers using the conventional treadle pump besides the physical stress (Farmers, 2011). Moreover, solar panels can generate environmental friendly electricity[24] usable for other purposes than the mere pump function, such as for lighting or recharging cell phones. Smallholder farmers usually do not have access to electricity grids. Therefore, having an electricity source with the treadle pump further helps to make it more attractive and to embed it in the lifestyle of the BoP by catering for a clearly existing need (see chapter 3.3.1.2). This solar treadle pump model clearly goes beyond the mere treadle pump supply chain and emphasises opportunities stemming from solar service attached to solar treadle pumps (see also chapter 5.1.1.2).

A study carried out by the International Finance Corporation (IFC) and the World Bank in 2008 showed that only 39.2% of Ghanaian households are connected to the grids and "besides kerosene no other sources of energy are available to Ghanaian consumers" (IFC & World Bank, 2008, p. 54). Even though solar power is generally well accepted in Ghana, it is not really affordable for smallholder farmers.

From the technological point of view, different initiatives such as from ITT (see chapters 4.3.1.4.5 and 4.3.1.5) but also from other organisations and institutions have already started to develop promising pilot solar pumps[25]. The IFC and the World Bank (2010) also state that production cost of solar panels are dropping due technological advances and due to social entrepreneurs' efforts to offer BoP oriented product designs with special features. For example, solar panels can be used for multiple purposes such as treadle pumps, but also serve to recharge cell phones. To what extent solar treadle pumps or the solar panel can be produced locally, remains to evaluate. Collaboration between institutions will certainly be necessary to spread the technological knowledge for developing and producing solar treadle pumps.

Even though such pilots aim to be affordable for the BoP customer in terms of price, innovative financing models inspired by the micro-finance revolution are required

[22] The same principles are applicable to a potential introduction of a rope pump with a solar device with the exception of one technical difference: the rope pump can lift water higher than the classical treadle pump and will therefore need more power/ strength.

[23] Better garden design, such as channel systems, further mitigates this problem.

[24] Photovoltaic (PV) is the technical notion for the process of converting "solar irradiation into electricity" (Solar Industries, n.d.).

[25] For instance, the solar lab of the University of Applied Science in Biel, Switzerland, is currently testing a highly efficient and promising solar pilot compatible and deployable with treadle pumps. With a capacity of 40, 80 and 160 Watt, costs for a solar treadle pump are estimated at USD 490 (Heierli, 2010).

due to the fact that solar treadle pumps still constitute a high up-front investment. Again, affordability goes beyond cheap products, aspects of maintenance and user-friendliness also remain valid. In the following, we have a look at some possible new financing models (Painuly, 2008) to make a multifunctional solar treadle pump in Ghana affordable

5.1.1.1.1 Status quo: Partnering with financial institution – credit model

In chapter 4.3.1.4.1, the partnership between IDE Ghana and ECLOF Ghana has been presented. On one side, ECLOF Ghana provides credits to smallholder farmers for treadle pumps and other agro-inputs. On the other side, manufacturers and dealers deliver the irrigation technology with the assistance of IDE Ghana. In other words, the two functions of providing the technology and the credits are clearly separated between the two organisations.

The same model would be replicable or can easily be adapted to product amendments such as the introduction of the solar treadle pump. In other words, IDE Ghana has already established a model to make treadle pumps affordable to smallholder farmers. Based on this, the agreement between ECLOF Ghana and IDE Ghana can be renegotiated and adapted to the new product range. Even though this might be the easiest way, financial means of ECLOF Ghana are limited and may face limits if the consumer base grows and other actors within the supply chain seek credits. In an extreme case, the whole supply chain becomes solely dependent on ECLOF Ghana and can risk stagnating if the access to loans is reduced. For instance, if repayment rates are below a certain level, ECLOF Ghana stops the issuance of new loans for risk management reasons. This was exactly what happened at the end of the last dry season, when the demand stagnated with the decision of ECLOF Ghana to stop loans for the moment.

Additionally, with this model consumers immediately become owners of the pump, which implies that consumers are basically responsible for maintenance and eventual reparation. Even though IDE Ghana still takes care of those after-sales services in the initial stage, in the long run, smallholder farmers have to pay the cost going beyond any product warranty (for more detail see chapter 5.1.1.2).

One option to overcome dependence on one sole institution is to look for additional partnerships with other financial institutions. On the one hand, this way may also introduce a kind of competition between financial institutions and provoke better-tailored solutions that take the particularities of the plant cycle into account (see chapter

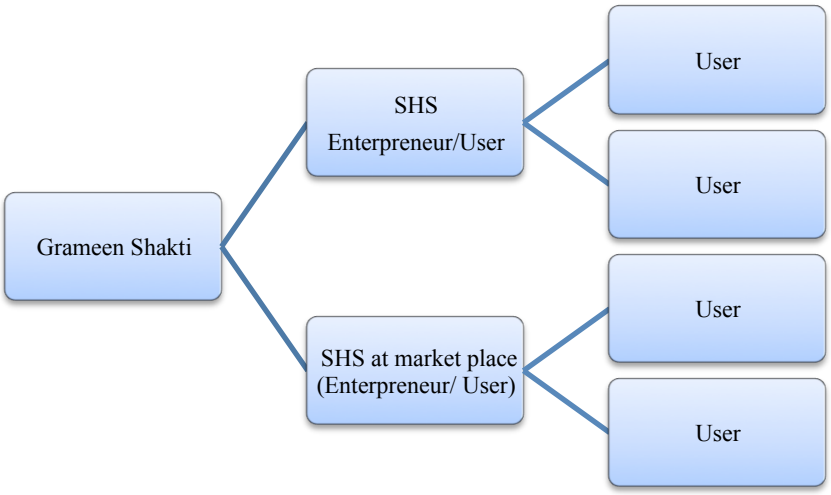
4.3.1.6). On the other hand, it remains questionable whether additional financial institutions can easily be found to offer such special credits. Moreover, sales are indirectly linked to the willingness of credit institutions. Against this background, it seems necessary to go beyond the status quo and explore other options.

5.1.1.1.2 Beyond status quo: Leasing and fee-for service models

LEASING MODEL: GRAMEEN SHAKTI IN BANGLADESH

Associated with Grameen Bank and based on its experience, Grameen Shakti enlarges the micro-credit logic to renewable energy technologies, namely solar energy (Grameen Shakti, 2009). Grameen Shakti works in Bangladesh and provides Solar Home Systems (SHSs) to poor people in remote areas who do not have access to electrical grids. With unconventional solar energy, people have got a valuable alternative to "light up homes, shops, fishing boats […], to recharge cellular phones, run televisions, radios and cassette players" (Grameen Shakti, 2009a). Its model functions as following (see **Figure 6**):

Figure 6: Grameen Shakti's model *(Source: Own figure based on Barua, 2003)*



Known as micro-utility systems, Grameen Shakti installs a SHS either at an entrepreneur's or a market place. In the latter case, it appoints an entrepreneur in charge. In both models, users regularly pay instalments to the entrepreneur for the load charges they receive. The entrepreneur pays Grameen Shakti for the SHS in return and sooner or later becomes the owner of the SHS. Key is its innovative financing model to overcome up-front investment problems: entrepreneurs only have to make a small percentage of down payments to Grameen Shakti and the remaining costs are paid by monthly instalments (Barua, 2003). Receiving payments for load charges sold to additional users

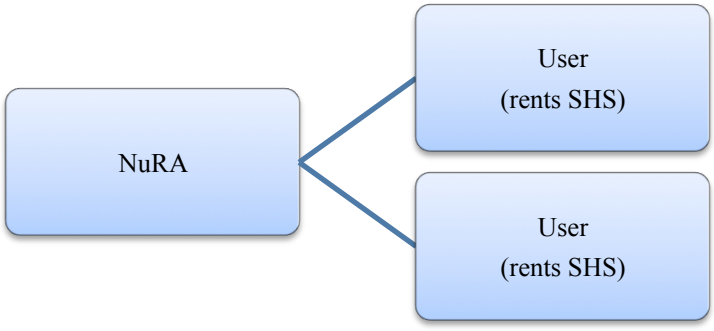
further splits the entrepreneur's cost. In addition, Grameen Shakti takes care of after sales services during the payment of the instalment period (Grameen Shakti, 2009b).

The difference to the partnership implemented by IDE Ghana and this model is that Grameen Shakti does not partner with any financial institution, but acts as both, technology provider and creditor. Moreover, in this model the consumer does not directly become the owner of the product and only has to take care of the maintenance once he becomes the owner. A study carried out by Isabelle Stauffer (2011) further shows that micro-leasing can be a more adequate model for smallholder farmers than a micro-credit based model, because no collateral is required to access micro-leasing. Furthermore, the provider remains owner of the product until the end of the leasing period and disposes of the possibility to confiscate the product in the case of non-payment (Stauffer, 2011).

FEE-FOR-SERVICE MODEL: NURA IN SOUTH AFRICA

NuRA is a business partnership between the Raps Utility and the Dutch Nuon working in the solar panel sector in South Africa. In 2002, NuRA got a concession from the government to "have exclusive rights to receiving subsidies for off-grid electrification in particular geographic areas […] for a period of five years, although the off-grid service contracts are to remain in force for a period of 20 years" (Aitken, Clark, Purcell, & Van Zyl, 2009, p. 4). In the following, the basic functions of the model are presented (see **Figure 7**).

Figure 7: Fee-for service model by NuRA *(Source: Own figure based on Aitken et al., 2009)*



Against a connection fee of ZAR 100, NuRA installs the SHS in a household and undertakes some maintenance and replacement service. It is a kind of a rental system, where the system costs are partly paid by the fee, partly it is subsidised by the government. "Then customers pre-pay a monthly tariff to NuRA and for this tariff they receive a service from NuRA" (Aitken et al., 2009, p. 10). Thereby, customers can

choose between a range of tariff packages according to their needs. NuRA has implemented a fee-for-service model, where the customer does not acquire the SHS per se in contrast to the credit model by Grameen Shakti or the current model implemented by IDE Ghana.

Besides, NuRA's experience also testifies known problems such as payment rates. Therefore, NuRA has introduced a pre-paid system and has explored technological options, such as automatic disconnection from the SHS by the hardware in the case of non-payment (Aitken et al., 2009).

5.1.1.1.3 Implications for a solar treadle pump by IDE Ghana

Seeing Shakti's leasing and NuRA's fee-for-service model, this section elicits implications of such models on a possible solar treadle pump introduction by IDE Ghana.

In both cases, scales are reached by the fact that end-users can split or reduce costs significantly by sharing the device or by paying fees for the service rather than the infrastructure. In other words, they can circumvent high up-front investments. Furthermore, repayment issues are smaller, because large number of users do not own the device and only pay a fee for the use of the service. Similar to the telecommunication sector, revenues stem from high user numbers who consume the pre-paid services in small portions.

Applying these findings on a solar treadle pump raises the question of how to split or reduce investment costs. From the technological point of view, the question is whether each treadle pump shall dispose of an own solar panel or whether a removable device can be connected with the treadle pump and recharged at a central solar panel station. In the following, both options are examined. In Ghana, SHS are not really common (IFC & World Bank, 2008), so that the option to connect treadle pumps to existing SHS remains limited.

SOLAR TREADLE PUMP WITH OWN SOLAR PANEL

A first option to consider is a solar treadle pump that disposes of its own solar panel, such as the solar treadle pump developed by the University of Applied Science in Biel[26]. The costs of this solar treadle pump are estimated at USD 490 per pump in the case of mass production (Heierli, 2010). Furthermore, the solar panels of this model can

[26] They have developed a solar treadle pump functioning without batteries, where "solar panels, electronics and motors will be connected to existing hand pumps and thus will replace the manual operation" (Heierli, 2010, p. 3.)

be used for other purposes. Even though the University in Biel could reduce the cost of a solar treadle pump already significantly, USD 490 are still a high up-front investment for smallholder farmers. An innovative model would be needed to finance such a solar pump. The first option is to extend the existing credit model adopted by IDE Ghana, that is to say, to increase the loans provided by financial partners such as ECLOF Ghana. However, as discussed in chapter 5.1.1.1.1, this option faces limits, for example, if repayment rates are low. Therefore, alternative financial models such as the model used by Shakti Grameen or by NuRA, are crucial.

Implementing a similar model to Grameen Shakti means that consumers lease the product in instalments. In contrast to the Grameen Shakti model, the treadle pump with integrated solar panel cannot really be shared with further users due to limited capacity and unless consumers join forces to share one solar treadle pump. To what extent this is convenient for customers depends on their relationship and needs. Moreover, further investment cost splitting is virtually impossible. The implications of the Grameen Shakti model on a treadle pump with its own solar panel is similar to the model currently in place by IDE Ghana and ECLOF Ghana: the purchase by instalments allows customers to circumvent high up-front investment by paying the product in small portions over a certain period of time, and thus making it affordable. The difference between this model and the one currently implemented by IDE Ghana is to whom farmers have to pay and the point in time, when the farmers become the owner of the treadle pump. In the case of the partnership, they have to repay the loans to ECLOF Ghana, in the model of Grameen Shakti, the entrepreneur has to pay the same institution from which he is leasing the solar treadle pump. Moreover, the farmer does not become the owner of the device immediately as in the model implemented by IDE Ghana, but only after the payment of the last instalment.

A fee-for-service model similar to the NuRA model in the case of a treadle pump with its own solar panel implies that farmers still need a treadle pump with a solar panel to enjoy the service. In this case, the farmers do not necessarily acquire the solar treadle pump per se. In other words, this case is based on a rental system, where farmers rent the solar treadle pump at a lower price. Thereby, revenues stem from regular paid fees rather than from selling the solar treadle pump per se. If we take the telecommunication sector as example besides NuRA, revenues stem from fees and not from the sale of cellular phones per se. Accordingly, different tariff packages containing specific electricity loads generated by the solar panel can be offered. In detail, farmers can buy

pre-paid cards to operate the solar treadle pump. One may even consider some subscription option similar to the telecommunications sector where mobile phones are basically given for free against a subscription. To what extent subscriptions are feasible at the BoP remains to evaluate. One may also criticize that solar treadle pump providers may not cover costs if counting solely on yields from operating fees instead of the product sale. It is especially true if the solar treadle pump can only be used during the dry season. However, if the electricity of the solar panel can be used for other purposes, such as lighting or recharging of cell phones, consumption rates possibly accelerate and also increase during the rainy season. With a multifunctional solar treadle pump long-term business relationships become more possible.

In terms of ensuring payments, other lessons can be taken from the NuRA and the Grameen Shakti model. In both cases, there is a first down payment to be made followed by further instalments or in the case of NuRA by a connection fee and further pre-paid payments to enjoy the service. In the case of non-payment, the provider has the advantage to be able to disconnect the consumer. In the current model of IDE Ghana and ECLOF Ghana, this option is rather difficult. By introducing a kind of switch in the solar treadle pump that can cut off the service of the solar treadle pump in the case of non-payment could contribute to more secure payment rates[27]. In the extreme, the solar treadle pump can also be confiscated again. The switch system is compatible with both, the Grameen Shakti and NuRA model. To what extent this switch can open new possibilities in terms of securing payments remains yet to be clarified.

SOLAR TREADLE PUMP WITH REMOVABLE RECHARGING DEVICE

Applying Grameen Shakti's and NuRA's model in order to circumvent the high up-front investment by splitting or reducing cost, a solar treadle pump with removable recharging device is an alternative. The treadle pump in this case does not dispose of its own solar panel, but rather of a removable device that can be easily recharged at a central solar charging station. For instance, batteries are typically used as non-electric source. Different examples, such as "lanterns that use light-emitting diodes (LEDs) powered by batteries, which are in turn charged by […] small solar panels, have emerged as a cost-competitive [technologic] alternative" (Adkins, Eapen, Kaluwile,

[27] From the technological point of view, different organisations have already experimented with such prepaid devices. For example, "such a device has been developed by Antenna Foundation, Geneva, and will be adapted and redesigned for the solar pump by the University of Biel" (Heierli, 2010, p. 2).

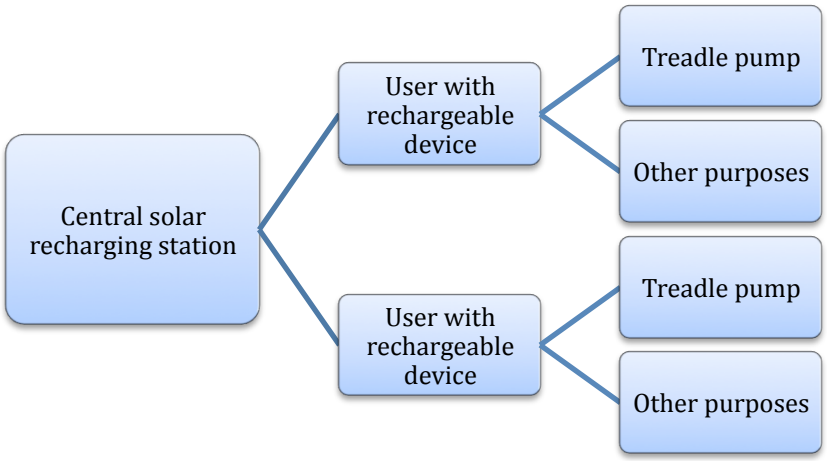
Nair, & Modi, 2010)[28]. In other words, a battery that can be recharged at a central solar station powers this version of a solar treadle pump. From the technological point of view, questions about the battery capacity, discharge cycle, durability and prices have to be clarified. Furthermore, from the ecological point of view, battery disposals put green solar energy into perspective. Therefore, further technological research is required to find a more sustainable solution to store energy than in batteries. However, the model with a central solar charging station at which smallholder farmers can recharge a removable device to operate the treadle pump, remains valid.

Against the background of the increasing multi-functionality of the treadle pump, the option of a removable device attached to the treadle pump is also more convenient than a treadle pump with its own solar panel. First, if removable, it can also be used more flexibly for other purposes in the household and it can easily be transported from the field to the house. Secondly, in terms of infrastructure, it is easier to maintain and operate one central solar panel serving as recharging station. Thirdly, in terms of knowledge, customers do not need to care about technical issues of the solar panel. Recharging only a box or battery also keeps the system simple. Fourthly, by installing one solar panel that serves as recharging station, cost splitting becomes possible. In other words, for consumers it is cheaper and simpler to pay for electricity they effectively consume and for the removable device, instead of making high up-front investments for a whole solar panel system.

Figure 8 illustrates a possible model for a solar treadle pump with a removable rechargeable device. A solar panel can be installed at a central place accessible to farmers similar to the Grameen Shakti example. In rural areas, it can be installed at the weekly market places, with agro-input dealers or in rural shops. Farmers dispose of a removable device such as a battery, which can be used to operate the treadle pump or for other purposes such as lighting or recharging mobile phones. In other words, the box is removable and can be used flexibly to power devices according to the farmers' needs.

[28] A similar concept is implemented in the Light for Education program by SELCO Solar Light Ltd. and the Naandi Foundation in Bangalore that recharges batteries at a solar charging station in the school for study lights of children (Heierli, 2011).

Figure 8: Framework for solar treadle pump *(Source: Own figure)*



In terms of financing, high up-front investments can be circumvented by applying the Grameen Shakti model or the partnership between ECLOF Ghana and IDE Ghana currently in place. In other words, only one individual, such as an entrepreneur or a dealer, has to acquire the solar panel system. Subsequently, he can recharge the user's removable devices against a fee that helps to amortize its investment costs. Again, different options are available to the entrepreneur to buy the system, such as by cash or instalments, that is to say, on credit or by leasing. The differences and the advantages of both models have been discussed in chapter 5.1.1.1. The user in turn pays for the service in cash, similar to the prepaid service in the telecommunication sector or the models implemented by NuRA and by Grameen Shakti illustrated in the previous chapter.

This model tends to neglect the question of the treadle pump acquirement per se but rather focuses on the service component of a solar treadle pump and its financing. In other words, it goes beyond the mere treadle pump supply chain and emphasises opportunities stemming from solar service attached to the solar treadle pump. However, this service component can be more profitable for businesses on the long run than the mere selling of the hardware. Nevertheless, farmers first need a solar treadle pump to become interested in buying electricity to operate the treadle pump. In other words, the initial question of how to make a solar treadle pump affordable to smallholder farmers gains momentum again. Stemming from the previous chapters, credit, leasing or renting models provide solutions to that issue. Even more, combinations of credit, leasing, rental and fee-for-service models have to be taken into consideration to make solar treadle pumps and any service affordable to smallholder farmers.

There are also different possibilities for the rechargeable device; it can be integrated directly in the treadle pump costs. Alternatively, it can be sold to farmers, who pay it in cash or by instalments. Otherwise, the rechargeable device can be let together with the treadle pump, analogue to the NuRa model.

Again, this model goes beyond the mere treadle pump supply chain and emphasises the role of solar service. As the word "multifunctional products" already implies other aspects than the mere treadle pump production such as linked services become important to generate higher incomes for both, customer and producer. In sum, doing business with the BoP is complex and multilayered and requests innovations on all fronts.

5.1.1.2 Embedded services and package offers

Based on the previous paragraph and in the light of the affordability factor, package offers and services become more important for both, consumer and producers. Providing services or complementary products can constitute a valuable additional income for producers and other actors (Heierli & Katz, 2007). But also smallholder farmers can benefit significantly from such offers. For instance, with adequate advisory services[29] going beyond strict product knowledge farmers can foster a favourable environment to maximise yields, and thus income. Generally, complementary services can be seen as the soft component to the hardware (Heierli & Katz, 2007) or as "integral part of business transaction" (Microlinks, n.d.), which aims at higher customer satisfaction. In other words, such package offers can also smooth the whole supply chain. Therefore, selling complementary services and products in packages can be profitable for both, farmers and producers/sellers (Heierli & Katz, 2007; Microlinks, n.d.).

Buying complementary products, such as seeds, can easily be incorporated in any existing loan scheme. For instance, IDE Ghana has already worked on this side by including in the loan a cash component allocated to buying seeds (for more detail see 4.3.1.6). However, soft components such as ongoing trainings or information services also have to be financed. IDE Ghana, for example, is still providing trainings at its own expenses.

In a market-based approach, the financing of such advisory services can be achieved through different options. Besides paying in cash for the extra service, such

[29] For example, better pest and disease management, after-sales services or adequate agro-inputs can increase farm productivity.

supplementary services can also be embedded in the cost structure of the product[30] (Kamassah, 2011; Heierli & Katz, 2007; Microlinks, n.d.). In a credit-based model, the credit structure can be enlarged to such software components. In other words, the loan can have a component allocated to services. In a leasing model, a standard service package can be included in the first down payment for instance. Lastly, in a fee-for-service model, tailored advisory services can be incorporated in different tariff packages.

In sum, there are multiple options to offer and cover costs for advisory services. Even though advisory services or so-called software components imply costs, the associated benefit can outweigh the former. Again affordability goes beyond the mere price. Product knowledge about efficient use and other critical inputs can maximize yields and thus, enable farmers to shorten (re-) payment periods and to increase their purchasing power in general. In other words, embedded services and package offers help to make the product affordable.

However, before producer/ sellers can give advice, they need to be educated in the first place. Furthermore, financial partners must be willing to integrate such complementary services and products in their scheme. Therefore, the critical role of partnerships also remains valid for package offers.

5.1.2 Partner scoping and cultural mindset

After having illustrated ways of possible product and service developments and new financing models to make the product affordable, this section deals with the two other critical factors in a future BoP business strategy of IDE Ghana.

Firstly, partnerships have been proved critical in theory and praxis. Therefore, efficient and profitable partner scoping also remains key for the future. With regard to a potential introduction of a solar treadle pump, new technical partners from the solar energy sector are important. IDE Ghana has already started to collaborate with technical partners, such as ITT. However, additional partners may further contribute to the efficient implementation of such a project. In particular, the Lighting Africa program implemented by a common project of the IFC and World Bank[31] can deliver information concerning the solar sector in Ghana and lessons learnt from other solar

[30] IDE Cambodia, for example, implemented a franchising model by providing agricultural inputs with diverse technical advice. In the model, IDE Cambodia acts as franchisor and independent micro-entrepreneurs as franchisees, the so-called Farm Business Advisors. On the long term, the model shall be transformed in a social enterprise that is financially self-sufficient and independent from donors (IDE Cambodia, 2010).

[31] For more information see http://www.lightingafrica.org.

projects in Africa. In terms of embedded services, collaborations with MoFA should be increased in order to initially educate dealers for advisory services. Furthermore, partnering with local farmer organisations such as the Peasant Farmers Association of Ghana (PFAG) can serve that end.

Secondly, changing the cultural mindset of farmers and partially of producers is a big task and cannot be done by IDE Ghana alone. Collaborations with partners may help to shift behaviour in terms of farm practices. Furthermore, clear communication about IDE Ghana's role can mitigate the problem of confusing IDE Ghana with a philanthropic NGO. In some cases, especially in the relationship with the actors along the supply chain, signing a kind of memorandum of understanding might help to clarify IDE Ghana's role. Last but not least, the transformation of IDE Ghana as a facilitator into a real social enterprise may eradicate the misperception about IDE Ghana's role. This point will be discussed in the next section.

5.2 IDE Ghana 2.0: Facilitator or social enterprise

After having discussed different options in terms of future product and service developments, partner scoping and the issue with the cultural mindset, this section deals with IDE Ghana's role as facilitator. As discussed in chapter 4.1.1, IDE Ghana acts as facilitator for the establishment of a private irrigation technology sector, a market that works for the poor (Heierli & Katz, 2007). Nevertheless, IDE Ghana has been very active in the whole supply chain, from the production to the marketing side. Even though this may be necessary at the initial steps of such a project, a withdrawal may be challenging later on. Further problems stemming from the role as facilitator are primordially associated with the wrong perception of farmers, but to a certain extent also of producers. As mentioned in chapter 4.3.2.4 under the wording cultural mindset, farmers tend to perceive IDE Ghana as a philanthropic NGO whereas producers initially saw IDE Ghana as their employer rather than as an assistant to new business. Even though IDE Ghana has engaged to communicate its role as facilitator, it will have to continue to deal with this issue. Another disadvantage of the role as facilitator is that actors along the supply chain are more or less independent and cannot be pushed by IDE Ghana as contracted employees. Furthermore, IDE Ghana staff is currently engaging in providing the soft component of the product at its own expenses, that is to say, educating farmers in sustainable agriculture. Last but not least, building up a private supply chain takes a very long time. In India, for example, IDE India reduced its involvement after a period of around ten years and after having evaluated the treadle

pump market as mature. However, with IDE India's withdrawal "sales dropped gradually" (Heierli & Katz, 2007, p. 43). In other words, the reduction of IDE's involvement as facilitator is difficult. Therefore, it is realistic that IDE Ghana's contribution as facilitator is required for a very long time.

Against these facts, the background of BoP 2.0 theory and a potential future introduction of a solar treadle pump, the question arises whether IDE Ghana 2.0 should take the form of a social enterprise[32] rather than a facilitator[33]. Not only can IDE Ghana as social enterprise become financially self-sufficient on the long run, but it can also act more actively in general. Moreover, the above-discussed models regarding solar treadle pumps require a strong organisational centre and technological skills. Whatsoever, the transition from a facilitator to a social enterprise is a basic decision and a social enterprise can take different forms depending largely on the product and service development.

For example, if developing a solar treadle pump with its own solar panel, IDE Ghana can take the form of the lessor in the case of the establishment of a social enterprise. Alternatively, a local agro-input dealer can act with the assistance of IDE Ghana as a lessor to farmers. However, agro-input dealers still confront high-up-front investment problems and have to find solutions to the financing issues. In contrast, IDE Ghana disposes of patient capital to finance this model initially until the model becomes self-sufficient. Therefore, the transformation of IDE Ghana into a social enterprise can make perfectly sense.

In the case of a solar treadle pump with removable recharging device, a franchising model similar to the one implemented by IDE Cambodia can make sense. IDE Ghana can act as franchisor and agro-input dealers, for instance, as franchisees that dispose of a central recharging station and cater for recharging of the removable devices and providing agronomic training.

One point, which has not been discussed yet concerning a possible solar treadle pump, is a possible production of solar panels with the eventual removable devices in Ghana. The treadle pump per se can continue to be produced in Ghana according to the current system and adapted to the requirements of a solar treadle pump. However, for the solar panels and the eventual removable devices, new ways have to be found. Either

[32] For the definition of a social enterprise refer to chapter 3.3.1.3.

[33] The umbrella organisation IDE further states "IDE is a social enterprise dedicated to ending poverty in the developing world not through handouts, but by helping farm families access to tools and knowledge they need to increase their income" (IDE, 2011c, "Income is a Basic Need").

they will be imported or produced locally. Which one will make more sense remains to be investigated. In any case, the assembling will have to be organised. Against this background, it makes further sense to create a social enterprise where IDE Ghana can act as the wholesale company that procures and distributes the required parts of the solar treadle pumps to retailers, in this case, to the agro-input dealers. IDEal Tecnologías, "a social enterprise in Central America owned by International Development Enterprises" (IDE International, 2010, p. 2) that already acts on the premises of a wholesale company, can serve as an example to that endeavour.

Last but not least, by forming a social enterprise under the umbrella of IDE Ghana for the development of a future solar treadle pump brings the BoP 2.0 theory to full circle in the end, namely that a social enterprise is able to create a fortune with the BoP.

6 Conclusion

This thesis elaborates on the question whether smallholder farmers in Northern Ghana can get access to affordable irrigation technology with the help of a market-oriented approach. Therein, the thesis focuses on factors critical to a BoP venture and on finding new models in the case of shortcomings.

Three theoretical factors have been highlighted as critical: Firstly, an adequate product-mix that fulfils the requirements of the four As. Secondly, partnerships are essential to acquire necessary knowledge, to reduce costs in general and to acquire scale. Lastly, (micro-) finance is the most important key to successful business with the BoP. However, the theory has been reluctant to formulate detailed models that combine all three factors. Therefore, the BoP 2.0 theory needs refinements, especially in terms of finding innovative financing models together with product and service developments.

The empirical evaluation of the theory on the example of IDE Ghana has largely confirmed the theoretical framework. Besides an efficient product-mix and partnerships, microfinance is the key to a successful BoP business strategy implementation. Moreover, the empirical evaluation brings a fourth element forward, namely that of the cultural mindset that can hamper a successful implementation of a BoP strategy. Talking about the cultural mindset of a social group or a society raises many questions: Can a cultural mindset be changed? If at all, shall it be changed from an ethical point of view? How can a business venture incorporate cultural factors in the business model without changing a cultural mindset of potential customers? In other words, the case study further stresses the importance of thinking out of the box to integrate cultural

challenges in a successful business strategy to the end of creating a fortune with the BoP.

The theoretical and empirical discussion has further shown that affordability in terms of an efficient product-mix combined with innovative financing models is of utmost importance to succeed at and with the BoP. Therefore, the focus of further academic research and business developments should lie on finding creative models that combine multiple aspects, such as innovative financing models together with new product and service developments and in collaboration with partners, rather than looking at them in an isolated way. This point has been highlighted in the thesis by the example of the solar treadle pump. In this case, the solar treadle pump exemplifies only one way of a future roadmap for IDE Ghana. Future research may also examine other models and product and service developments. For instance, there might be areas, where a wind treadle pump can be introduced in a more efficient way than a solar treadle pump.

Moreover, the discussion of embedding services or package offers has emphasised opportunities stemming from services attached to a product. So-called soft-components of a product can be profitable for both, generating additional profits for corporations and making a product more affordable for smallholder farmers. Hence, the BoP not only constitutes a potential market place for products but it also encompasses opportunities for offering services.

In sum, the evaluation of the hypothesis has shown that smallholder farmers in Northern Ghana can get access to affordable irrigation technology with the help of a market-oriented approach. However, only if all the critical factors – partnerships, micro-finance, product-mix and cultural mindset – are addressed together, the triple goal of creating "business opportunity, poverty alleviation benefits, and environmental impacts" (London & Hart, 2011, p. 4) can be achieved.

VI. Appendix

a. List of interviews

Date	Interviewee	Function/ expertise
21.02.2011	Aaron Ampofo Accra Block D7, Flat 5 Sakomono Accra	Vegetable expert
22.02.2011	Samuel Dogbe Dorob Water Engineering Services Mallam Junction Accra	Irrigation supplier
23.02.2011	Fred Kizitio IWMI, c/o CSIR Campus, Martin Odei Block, Airport Res. Area Accra	IWMI, soil specialist
28.02.2011	Victoria Adongo PFAG- Peasant Farmers Association of Ghana PMB 56, KIA-Accra +233 302 254518	Famer association
08.03.2011 19.04.2011	Regassa Namara IWMI, c/o CSIR Campus, Martin Odei Block, Airport Res. Area Accra	IWMI, water specialist
09.03.2011	Asante Opoku Kumasi	Project engineer (IDE Ghana)
09.03.2011	Emanuel Asante Suame Magazine Kumasi	Treadle pump manufacturer
09.03.2011	Master Life Suame Magazine Kumasi	Treadle pump manufacturer
10.03.2011	Musah Abdul Rashid Suame Magazine Kumasi	Treadle pump manufacturer
14.03.2011	Kulaya Kutgna Navio/ Kulyia (Upper East Region of Ghana)	Farmer
14.03.2011	Addah Francis Navio (Upper East Region of Ghana)	Farmer
14.03.2011	Amidu (A.) Musah (Upper East Region of Ghana)	Treadle pump installer
15.03.2011	Wediamo Tiberu Nwagua (Upper East Region of Ghana)	Farmer
15.03.2011	Yerberi Bajuawure Navio (Upper East Region of Ghana)	Farmer
15.03.2011	Atusigi Ananto Doba (Upper East Region of Ghana)	Farmer
16.03.2011	Sebastian Fellah (Upper East Region of Ghana)	Treadle pump installer
16.03.2011	Monica Jagula Navrongo	Treadle pump dealer
16.03.2011	George Kuvuga Paga	Treadle pump dealer

16.03.2011	Navid Ltd. (James) Nayagia	Pipe supplier
17.03.2011	Samuel Tettah Kamassah M9 Estate Bolgatanga	Program manager IDE Ghana
17.03.2011	Torbi Daniel Ujoranyi Bolgatanga	ECLOF Ghana
18.03.2011	Yussif Ali (Babugu) Bolgatanga	Market development officer (IDE Ghana field staff)
18.03.2011	Reuben Mimpori Bolgatanga	Market development officer (IDE Ghana field staff)
18.03.2011	Prosper Akanamba Bolgatanga	Field technician (IDE Ghana field staff)
18.03.2011	Michael Woon Bolgatanga	Intern (IDE Ghana field staff)
08.04.2011	Bob Nanes C667/14, Nii Kwabena Bonnie Crescent, Dzorwulu Accra	IDE Ghana country director
26.04.2011	Leslie Light Denver 10403 W Colfax Ave. #500 Lakewood, CO 80215 USA	IDE, Denver

b. Questionnaires

The interviews were conducted in a structured and semi-structured way. The basic structure in all interviews follows a wide-ranging set of questions concerning the general situation, followed by inquiries about the marketing mix (product, price, placement, promotion), the implementation, finance, partners and trainings. According to the individual function of the interviewee, questions might have slightly differed from the following standard set of questions and adapted to the specific situation of the interviewee. In the case of significant differences, the questions are given below:

Standard Questionnaire

All interviewees were more or less asked this set of questions.

General

- Can you give me a short overview about yourself, your function and duties?
- What have you done in the project so far?
- From your perspective, what are the biggest challenges/ opportunities regarding to the project in Ghana?
- What are the internal strengths and weaknesses of IDE regarding the project?
- What are critical factors for success?
- With how many farmers are you working together?
- How many pumps have been sold so far?
- Can you already say something about the impact of treadle pumps on poverty?

Marketing- Mix

Product:

- What have you first done concerning the product?
- What are the strengths/ weaknesses of the product?
- Does it need a lot of maintenance/ training/ follow up?
- Do farmers like the product (general feedback)?
- Are there any product development initiatives in sight?
- How do you assure quality (control)?
- What are the biggest challenges concerning the product?

Price:

- What's the price structure of the product?
- What's the price limit for customers?
- Do you have any price reduction strategies (discounts, allowances…)?
- How do you reduce the financial entry barrier for customers?
- What's the biggest challenge/ opportunity concerning pricing?

Placement/ distribution

- How do you organise the distribution?
- How have you identified and approached the specific actors within the supply chain?

- What are the distribution channels and how is it physically organised (logistic)?
- What is the biggest challenge/ opportunity concerning the placement?
- Who is installing the pump and how is it done? Any problems?
- What do you require to install the pump?

Promotion

- What are the promotional goals and how do you reach them?
- How many demonstration farms do you have?
- Besides demonstration farms, do you do any other promotion?
- How do you finance the promotion?
- What/ how do you plan to scale up?
- What is the biggest challenge/ opportunity concerning promotion?
- Where do farmers order?
- How do farmers perceive IDE Ghana/ ECLOF Ghana?

Implementation

- How did you implement those things?
- What have you done in terms of personnel (training etc.)?
- What are the financial requirements?
- How do you monitor the results?

Finance

- How is the financing organised?
- What is the current contact with ECLOF Ghana?
- How did you craft the contract with ECLOF?
- Do you seek to approach other financial institutions?
- Do you see any problems related to financing?
- How is the repayment rate to date?
- Do you intend to collaborate on other issues besides the initial investment of pumps?

Partners

- How do you choose your partners?
- With whom are you working together? On what? Any problems?
- Do you have any future projects concerning partnerships?

Trainings

- What have you done in terms of trainings?
- Who are you teaching?
- What resources do you need?
- Are there any problems regarding trainings?

Miscellaneous

- What are your next steps?
- According to you what are the biggest problems/ opportunities to tackle in the future?
- Do you have any comments?

Additional specific questions for certain interview groups:

If not relevant to the context, certain parts of the above mentioned questions were not asked in these situations.

Financial institution: ECLOF Ghana

Loan

- How does your loan system work?
- How do you get into contact with farmers?
- On which basis do you give loans?
- How do you verify these criteria?
- Do you ask for any collateral?
- How big is the loan/ interest rate?
- What are the terms and conditions?
- Can farmers get more than one loan?
- How many clients do you have so far?
- Do you give any financial advice to farmers?
- Do you have any current problems?
- Do you already have any repayment rate experience?

Partnership with IDE Ghana

- How do you work with IDE Ghana?
- Do you have any problems?

Future prospect

- Do you expect to give loans on a large scale?
- Do you have the means to give loans on a large scale?
- Do you plan to give loans to other actors in the supply chain?
- Can you imagine transforming the loan scheme into a profit organisation?
- What is the biggest problem to tackle in the future?

Partners

- Can you give me a short overview about yourself, your position and expertise?
- Can you give me a short overview about your collaboration with IDE Ghana?
- What are the biggest challenges and opportunities during the collaboration (regarding your task)?
- Do you have any other experience with collaborations/ treadle pumps?

Farmers

General

- How many hectare of land do you own/ use for farming/ irrigate with the treadle pump?
- What do you produce in the dry season/ rainy season?
- How many times do you harvest?
- Where do you sell your crops?
- Do you have any difficulties buying quality seeds/ fertilizer/ pump/ selling produce?
- How did you irrigate your field before buying the treadle pump?

Treadle pump

- Do you like the treadle pump?
- Does the treadle pump help you? If yes, how?
- Is it difficult to use the treadle pump?
- How many treadle pumps do you own?
- For how long do you operate the treadle pump a day and at what time of the day?
- Who operates the treadle pump?
- How did you learn about the treadle pump?
- Why did you buy the treadle pump?
- What do you do if the treadle pump is broken?
- Do you have any problems with the treadle pump? And if so, what would make it easier?

Future prospect

- Do you intend to use the treadle pump next year again?
- Do you intend to plant different crops next year?
- Do you intend to buy more treadle pumps?
- Would you recommend the treadle pump to somebody else?
- What is the biggest problem associated with the treadle pump and how would you solve it?

Finance

- How do you finance the treadle pump?
- Would you buy it even if it cost more?
- Did you get a loan for the treadle pump?
- Do you like the loan system?
- Do you have any problems regarding the loan?
- How long did it take until you received the money?
- When do you think, you will be able to pay the loan back?

Installation and wells

- Who installed the treadle pump? Any problems?
- How many wells do you have?
- How deep are your wells?
- Do you have any problems with the wells?

Trainings

- Do you receive any training (pest and disease control?)?

Role of IDE Ghana

- How often are you in contact with IDE Ghana and about what?
- How do you see IDE Ghana?

Miscellaneous

- What is the biggest problem you are currently facing?
- Do you work with other organisations, associations etc.?

Dealers, manufactures and other suppliers

This type of questions was adapted to the specific situation.

- How did it happen that you started to deal in/produce treadle pumps?
- How many treadle pumps do you deal in /manufacture on average?
- Do you work alone?
- How satisfied are you with the treadle pump dealing/ manufacturing?
- What is your main business?
- What is the share of the treadle pump dealing in your business?
- How do you organise the ordering/ distribution? How long does it take?
- What do you need to order/ produce and where do you get it from?
- How do you produce? Do you get any help?
- What are the prices of the different components?
- How do you handle the risks associated with the ordering?
- Do you have any problems with ordering?
- How do you/ your clients get into contact with your clients/you?
- Do you store the different components? Any problems?
- To whom do you sell?
- What is the selling price?
- Do you do any marketing for the treadle pump?
- Is the dealing in treadle pumps positive for your income?
- How do you perceive IDE Ghana?

c. Wrong dominant assumptions

Prahalad & Hart (2002) name six wrong dominant assumptions that have diverted businesses from BoP markets do date (p. 4):

*"**Assumption #1**: The poor are not our target consumers because with our current cost structures, we cannot profitably compete for that market.*

***Assumption #2**: The poor cannot afford and have no use for the products and services sold in developed markets.*

***Assumption #3**: Only developed markets appreciate and will pay for new technology. The poor can use the previous generation of technology.*

***Assumption #4**: The bottom of the pyramid is not important to the long-term viability of our business. We can leave Tier 4 to governments and nonprofits.*

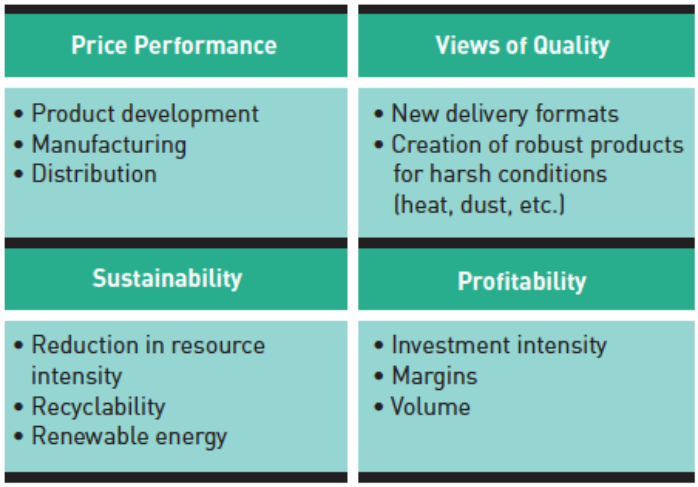
***Assumption #5**: Managers are not excited by business challenges that have a humanitarian dimension.*

***Assumption #6**: Intellectual excitement is in developed markets. It is hard to find talented managers who want to work at the bottom of the pyramid (p. 4)*"

d. Dimensions requiring innovation and guiding principles

Figure 9 illustrates dimensions, which corporations have to rethink in detail. To give an example, BoP consumers cannot afford very expensive products and services. Therefore, corporations have to work with lower margins, and profits stem from volumes. Alternatively, corporations can also enhance the buying power of consumers by providing them with better access to credits (Prahalad & Hart, 2002).

Figure 9: Dimensions requiring innovation *(Source: Prahalad & Hart, 2002, p. 6)*



Prahalad further names twelve principles, which shall guide the innovation process:

1. "Price performance" (Prahalad, 2006, p. 28) has to meet the needs of the BoP, which goes beyond mere price reduction.
2. "Hybrid solutions" (Prahalad, 2006, p. 30), that is to say, advanced technologies and old infrastructures have to merge.
3. "Scale of operations" (Prahalad, 2006, p. 32) can be reached only if solutions are transferable to other BoP markets.
4. Innovation must follow a "sustainable development" (Prahalad, 2006, p. 33) of resources.
5. "Identifying functionality" (Prahalad, 2006, p. 34) in the product development that meets the BoP needs.
6. "Process innovation" (Prahalad, 2006, p. 37) in order to access customers.

7. “Deskilling of work” (Prahalad, 2006, p. 38) adapted to the skills and conditions of the BoP.
8. “Education of customers” (Prahalad, 2006, p. 40) requires new approaches of advertising.
9. Products and services must be “Designed for hostile infrastructure” (Prahalad, 2006, p. 42) .
10. “Interfaces” (Prahalad, 2006, p. 43): product and services should be adaptable to customer heterogeneity.
11. “Distribution” (Prahalad, 2006, p. 44) channels must be adequate to reach customers.
12. Breaking with “conventional wisdom” (Prahalad, 2006, p. 45) to develop and adapt products to market evolutions.

e. The 4As

The 4As stand for affordability, availability, acceptability and awareness (see **Figure 10**). It is a framework going back to Jamie Anderson, Costas Markides and Niels Billou to "articulate best practices as companies deal with the challenges of serving low-income customers in developing markets […]" (Anderson & Billou, 2007, p. 3).

Figure 10: The 4As *(Source: Own figure based on Anderson & Billou, 2007)*

f. Political map of Ghana

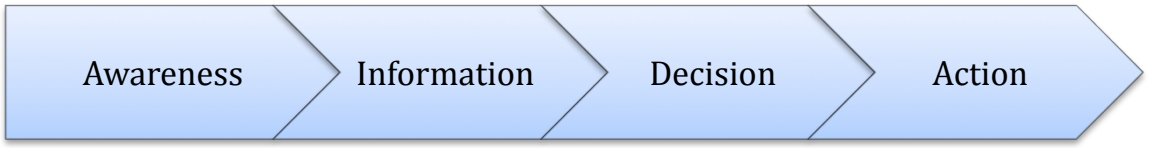
IDE Ghana has initiated its programme in the northern part of Ghana, namely in the Upper East Region of Ghana (see **Figure 11**). In detail, it has started with targeting smallholder farmers in the Kassena-Nankana District before expanding to other areas. The treadle pump production is located in Kumasi.

Figure 11: Target area *(Source: IDE Ghana, n.d., p. 3)*

g. The AIDA- Model

The Awareness-, Information-, Decision- and Action- (AIDA)- Model, which is illustrated in **Figure 12**, helps to formulate the promotion strategy in order to scale up sales. The AIDA- Model "describes the decision making process of customers before they buy a new product" (Heierli & Katz, 2007, p. 38), which is different for each individual.

Figure 12: AIDA – Model: decision making process of customers *(Source: Own figure based on Heierli & Katz, 2007, p. 38)*

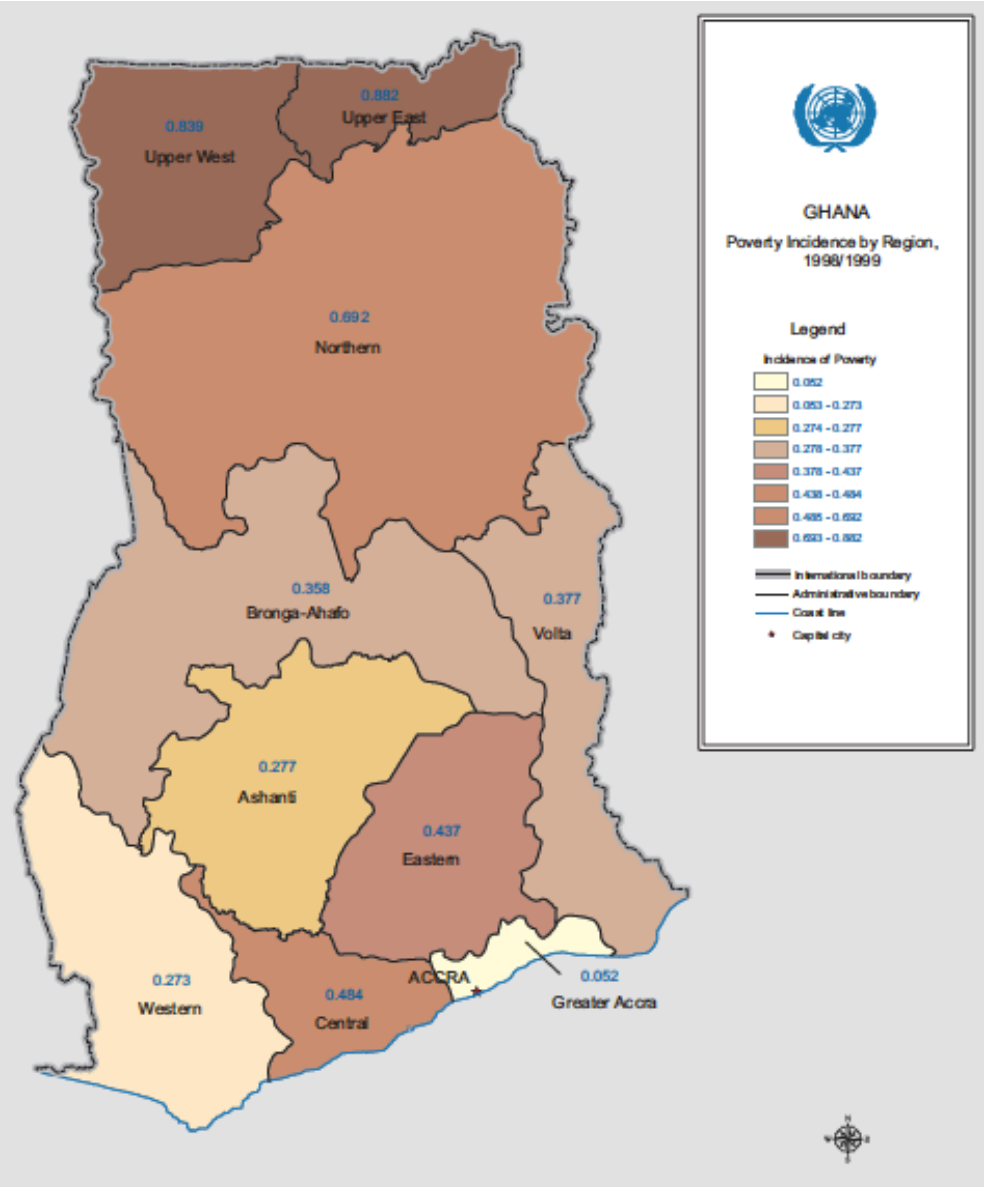


First, customer's awareness has to be raised. It requires multiple strategies, because farmers act according to different behaviour patterns and cannot be treated as a unique set of customers. For example, a traditional farmer may be more reluctant towards new technologies. Hence, his awareness is developed much more slowly than that of a more innovative-characterized farmer. In the context of irrigation technologies, the process starts with the persuasion of the farmer that they "can have a more profitable farm" (Budinich, Manno-Reott, & Schmidt, 2007, p. 5). Secondly, customers seek to gather specific information regarding the product. Based on that information, they will make a decision and put it into action. The buying action may occur quite some time later than the desire of acquiring the product, which is typical for poorer people, because they often need more time to collect the required financial means. Promotion must address these different needs in the decision-making process of customers and develop corresponding tools (Heierli & Katz, 2007).

h. Poverty distribution by region

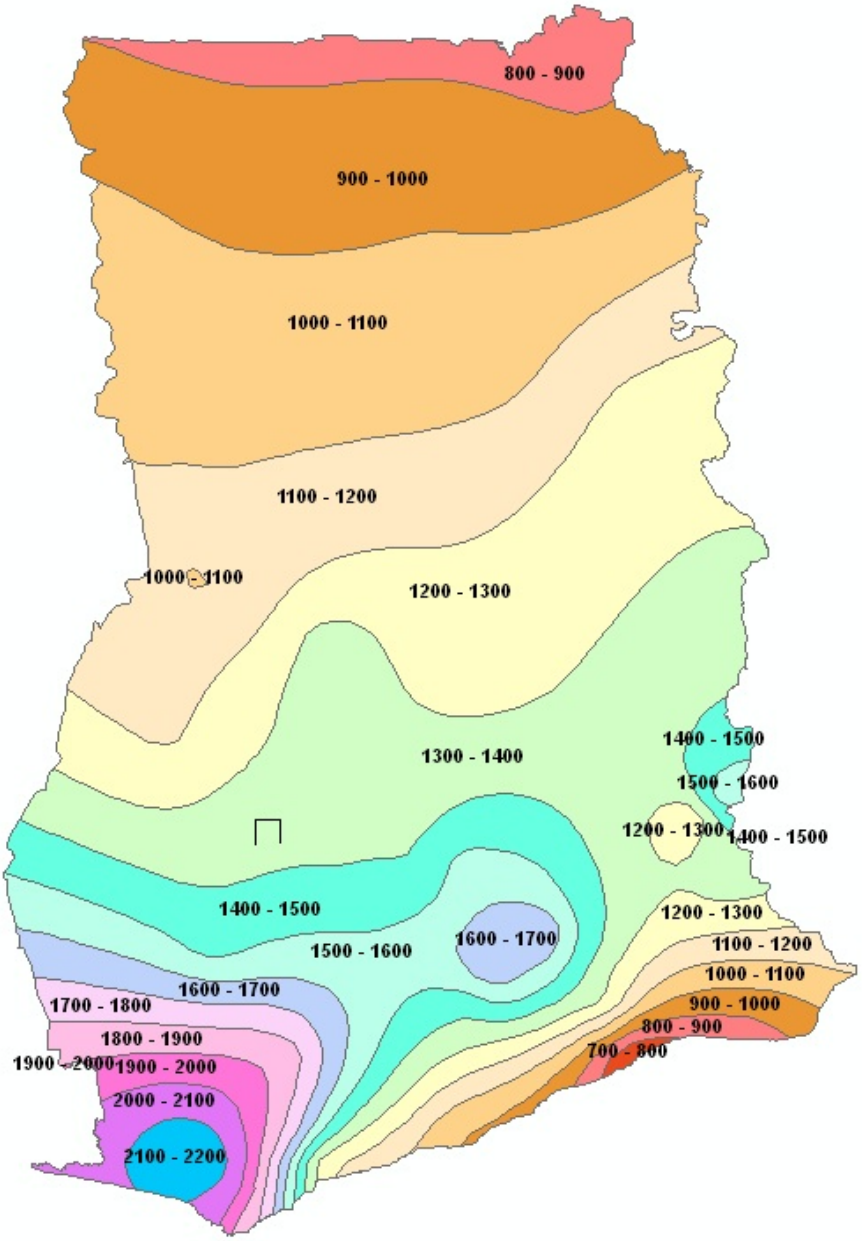
Figure 13 shows "the head count incidence, which is a common poverty measure that indicates the proportion of the population whose consumption level is below the poverty line" (Woldemariam & Mohammed, 2003, p. 5). Even though the numbers are not very up to date, the general picture of the poverty distribution by regions remains valid with the densest pockets of poverty in the northern parts of Ghana.

Figure 13: Poverty distribution by Region *(Source: Woldemariam & Mohammed, 2003, p. 10)*



i. Rainfall patterns in Ghana

Figure 14: Ghana's rainfall isohyets *(Source: Namara, n.d., p. 12)*



j. Current irrigation practices

Table 2 summarizes the farmer interviews conducted by IDE Ghana in 2010. Even though some farmers dispose of petrol pumps, the bulk of the interviewed farmers do not employ any irrigation technology (42.9%) or use simple buckets (7.1%) (Farmers, 2010).

Table 2: Current irrigation practices *(Source: Own table based on Farmers, 2010)*

Current irrigation practice: *How do you get water to the field?*					
		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Bucket	1	6,7	7,1	7,1
	Petrol Pump	5	33,3	35,7	42,9
	None	6	40,0	42,9	85,7
	Bucket and Pump	2	13,3	14,3	100,0
	Total	14	93,3	100,0	
Missing	System	1	6,7		
Total		15	100,0		

Table 3 shows the results of the farmer interviews to the question of how they apply the water to the field. Here again, many of the farmers (42.9%) do not pursue any irrigation practice with regard to water application to the field. Others use floods or furrows. In fact, nobody seems to apply any advanced technology such as sprinklers.

Table 3: Current irrigation practices: water application *(Source: Own table based on Farmers, 2010)*

Current irrigation practice: *How do you apply the water to the field?*					
		Frequency	Percentage	Valid Percentage	Cumulative Percentage
Valid	Flood	4	26,7	28,6	28,6
	Furrow	3	20,0	21,4	50,0
	None	6	40,0	42,9	92,9
	Flood and Furrow	1	6,7	7,1	100,0
	Total	14	93,3	100,0	
Missing	System	1	6,7		
Total		15	100,0		

k. Different types of wells

Figure 15: Lined well *(Source: Own figure)*

Figure 16: Well without lining *(Source: Own figure)*

l. The treadle pump

Figure 17: The fixed only treadle pump *(Source: Own figure)*

Figure 18: Mobile treadle pump *(Source: Own figure)*

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b. Online resources

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- http://rru.worldbank.org/thenext4billion
- http://www.smidoghana.org/

VIII. Declaration of Authorship

" I hereby declare

- that I have written this thesis without any help from others and without the use of documents and aids other than those stated above,

- that I have mentioned all used sources and that I have cited them correctly according to established academic citation rules."

November 14, 2011, Annemarie Lagger

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