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Sustainable IS Research In Developed Countries - A Chance For Sub-Saharan Africa?

Henning Krüp
Chair of Information Management, Goettingen, Germany, hkruep@uni-goettingen.de

Andre Hanelt
Chair of Information Management, Goettingen, Germany, ahanelt@uni-goettingen.de

SUSTAINABLE IS RESEARCH IN DEVELOPED COUNTRIES - A CHANCE FOR SUB-SAHARAN AFRICA?

Kruep, Henning, University of Goettingen, Humboldtallee 3, 37073 Goettingen, D, hkruep@uni-goettingen.de

Hanelt, Andre, University of Goettingen, Humboldtallee 3, 37073 Goettingen, D, ahanelt@uni-goettingen.de

Kolbe, Lutz M., University of Goettingen, Humboldtallee 3, 37073 Goettingen, D, lkolbe@uni-goettingen.de

Abstract

Information Systems (IS) could make a valuable contribution in solving the major problems of developing countries. This potential cannot be realized until one of the basic prerequisites of IS, energy, is lacking. The progress made in developed countries concerning sustainable and efficient energy production, management and consumption and the related IS open up new perspectives on the energy problem of developing countries. In this research-in-progress paper we create a vision of how the progress in the research field of sustainable IS and Energy Informatics made by developed countries can be transferred to enable efficient and sustainable energy supply in developing countries. We develop a research plan to generate a problem-focussed and prioritized research agenda for IS research, to make this vision come true. We focus on the world's poorest region- Sub Saharan Africa.

Keywords: Sub Saharan Africa, Sustainable Development, Sustainable IS, Energy Informatics

1 Introduction

Sub-Saharan Africa (SSA) is the region with the lowest level of technology in the world´s second largest continent. It is also the economically poorest region in the world with a GDP of $1.246 trillion US$ (World Bank, 2011). Especially the rural villages are technologically underdeveloped without access to any energy grid. This pertains 64% of the SSA with 600 million people living there (UN Data, 2011). In the last few decades the number of victims of tribal or civil wars raised up to over 8 million people. The HIV/AIDS quota in SSA is the highest in the world, with a prevalence of 5.5% while the world in total has got only a prevalence of 0.8% (World Bank, 2009). Also a lot of people die through the impact of malaria, typhus, yellow fever and other diseases, that are no matter in developed countries. Illiteracy is another big issue in SSA where 28% of the youth aged under 15 are not able to read or write and the share of children not finishing the primary class is with 30% (UN, 2010) relatively high.

There is a lot of different literature (Mbarika et al., 2005; Brown, 2007; Bernadi, 2009; Wouters, 2009) describing the benefits that could be gained in developing countries by information systems (IS). An example being eLearning systems. A lot of papers discussed and studied the adoption or problems with the adoption of IS in development countries (Godwin, 2006; Kifle et al., 2006; Meso et al., 2005; Ehikhamenor, 2002). One of the main problems are the high costs for new infrastructure in rural areas. As a result, most rural areas have not been connected to the energy grid or even telephone lines yet. Following the opinion of Toussea-Oulai and Ura (1991), and Mwesige (2003), we believe that if a basic infrastructure is not guaranteed, there will be no adoption of IS. In these regions it is not even a question of adoption or not, it is basically not possible to use IS without energy.

In developed countries, because of the rise of sustainability issues and political pressure (Thambusamy and Salam 2010), there has been a huge amount of research on how to increase energy efficiency and enable sustainable energy production. Furthermore IS research has focused on sustainable energy concepts. These insights could be beneficial for the SSA-region as well. Our assumption is that the progress made in developed countries can be transferred to enable efficient and sustainable energy generation, management and consumption in SSA and by that, make IS and the accompanying promised benefits accessible. With this research-in-progress paper we want to make the first step to answer the following research question:

How can the progress made in sustainable IS research in developed countries be transferred to enable efficient and sustainable energy supply in the SSA-region?

Although there have been some literature reviews about IS and development (e.g. Meso, 2008), there is a lack of research on how to transfer knowledge gained in modern IS research in developed countries to regions like SSA. Especially recent knowledge gains in the emerging field of Energy Informatics bear a huge potential to benefit SSA in terms of enabling efficient and sustainable energy supply.

In this paper, we will first describe how electric energy is connected to different problems and needs in SSA. After that we will discuss the progress made in sustainable IS research in developed countries. Moreover, we will describe self-contained energy systems as a promising way to electrify SSA. Finally we will integrate these topics proposing a research plan which should lead to a problem-oriented and prioritized research agenda in the future. We do not present a concept, but rather a vision of how IS research could make a substantial contribution in solving one of the biggest humanitarian crisis at present.

2 Related work

2.1 Impact of electricity to rural regions

As indicated in a report of the french energy supplier EdF (2002) a reliable electric supply could raise the Human Development Index (HDI). In 2009 only 32% of the people in SSA had access to electricity (World Bank, 2009). Electricity could be a basis for a lot of solutions to basic problems in developing countries. Examples could be light for schools, so kids would have the chance to get educated after working the day on the fields. Electric pumps could bring water directly to villages. Also the chance for the education infrastructure in general could be improved, because villages with a stable water connection offer an incentive for teachers to move to it. The agriculture based outcome could be increased by electricity via pumps for irrigation. Refrigerators can be used, if electricity is implemented, to keep the food eatable for a longer time and also help the farmers to gain higher prices for their crops, because of not having that much pressure to sell them quick for a cheaper price. They can store the crops and sell it later for a better price. These are some of the main big potentials of energy, because it could help to reduce the risk of hunger crisis in a sustainable way. Fridges are also important for the health sector. Hospitals can store medication and do not need to buy it on demand, which would cause a long delivery time and higher costs. All these examples show the potential of electric energy for SSA.

Through electricity, SSA would also have the chance to benefit from various IS-progress in different areas. The already mentioned education infrastructure could be expanded and improved by eLearning-tools (Hosman, 2008). This would help to handle the lack of teachers in rural areas. Another big advantage would be an eHealth-solution to enhance rural medicical supply. (Wouters et. al., 2009)

2.2 Sustainable IS-Research in Developed Countries

The negotiations about the Kyoto Protocol from 1997 were the beginning for developed and even underdeveloped countries to focus on a more sustainable way of life. The adopting countries committed themselves to reduce the emission of greenhouse gases, relative to the value of 1990. The starting point for the reduction was in 2005 and new technologies were needed to reach the focused aim. So, at least in most of the developed countries, a wave of new subsidies were given out and a lot of research was done to find new sustainable energy generating technologies. Therefore the prices for photovoltaic (PV) systems are decreasing rapidly.

The 2012 climate change conference in Doha showed that all these efforts are not enough to reach the aim of a maximum 2 degrees Celsius increase in temperature, which was agreed on in the Kyoto Protocol. There is the need of a more sustainable way of life in all its different areas. The United Nations Environment Programme (UNEP), confirmed the Emissions Gap Report 2012. It revealed that there exists a large potential to reduce CO_2 emissions in the sector of energy and the transport sector (UNEP, 2012).

These developments are also visible in the IS research community (Califf et al., 2012). Melville (2010) conducted a literature review and laid out a research agenda on IS for environmental sustainability. Kossahl et al. (2012) provide a broad taxonomy of sustainable IS research. It becomes obvious that there have been a lot of research efforts with respect to IS supporting economic and environmental goals under the concept of Green IS in the previous years. The latter can be divided in Green in IS and Green by IS (Kossahl et al., 2012). One of the several subfields of Green by IS, is the energy sector. In 2010, Watson et al. (2010) coined the term Energy Informatics, describing a new subfield of IS research which deals with “analyzing, designing, and implementing systems to increase the efficiency of energy demand and supply systems” (Watson et al., 2010). The authors provide a framework in which IS connects energy supply and demand leading to a more efficient system that needs less energy. The review of the Energy Informatics literature by Califf et al. (2012) revealed, that the

research in this field can be categorized in discussing initiating, design and implementation and adoption and benefits of Energy Informatics. Moreover there are also some publications for practitioners. All together, this shows that in developed countries the field has evolved and has developed concepts ready for realization.

2.3 Self-contained energy systems

The amount of projects to electrify Africa and even SSA is high. Lots of projects already showed that the implementation of solar based systems have these mentioned impacts and even more on peoples life (Hosman, 2008; Wouters et al., 2009; Wamukonya, 2007). Self-contained energy systems could be a chance to electrify rural areas in SSA. Solar Home Systems (SHS) for example consist in the simplest case of a solar panel, a battery, a converter and a consumer, which is mostly a light. Such independent energy systems based on photovoltaic energy seem to be perfect for countries in Africa, with more than 2500 hours of sunshine (Wamukonya, 2005). We estimate an energy output twice as high as it would be in Europe, because of this high number of sunshine hours. A wind generator for the production of energy by night is an additional possibility to enhance the SHS.

The basic idea of Watson et al. (2010), Energy + Information < Energy, hints at the potential of IS to improve such systems, which we want to discuss in the next section.

3 Sustainable IS for SSA

We believe, IS could be an important factor to create self-contained energy systems in a sustainable and efficient way. Especially the progresses made in sustainable IS research seem useful. Therefore, the Energy Informatics Framework by Watson et al. (2010) can be applied to models of self-contained energy. On the supply side several ideas of decentralized and sustainable energy production can be positioned. They have the ability to produce energy in a sustainable manner without grid-contact. The required resources, e.g. sunlight or wind, are existent. To realize this potential, it is necessary to integrate energy production and consumption by information systems. They have to track the consumption peaks to intelligently distribute electricity, when it is really needed. They can optimize the flow network by analysing data from sensor networks, respectively sensitized objects, which is visualized in Figure 1.

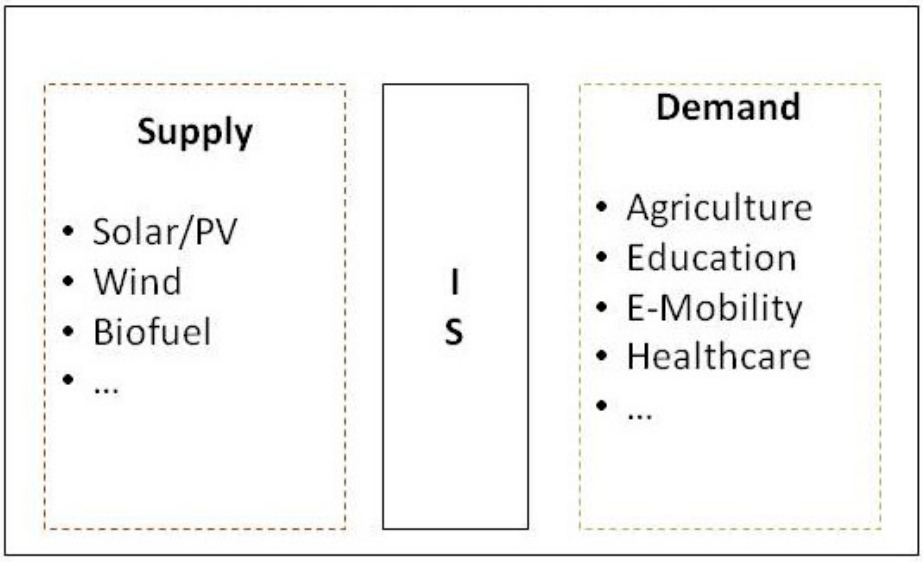

Figure 1. Self-Contained Energy System based on Watson et al. (2010)

Despite this potential of information systems for the electrification of SSA, there has not been much research on this topic. We refer to the findings of Peter Meso (2008), a literature review on western information journals, that the focus on Africa and therefore also on SSA is quite small in comparison to the count of published IS papers in total. He also argued, based on Walsham (2001), that the influence of "western perspectives" and "western theories" are critical because of the use of IS and the different culture (Walsham, 2001).

We belief that the research in developed countries is a chance for countries in Africa, because the new sustainable way of energy supply and consumption in developed countries could offer a chance to enable further technological applications. In the following, we want to describe our plan to develop a research agenda for IS research to support adressing the problems of SSA.

4 Theoretical foundation and methodology

We use the basic task-technology-fit model as the theoretical lens for the foundation of our research model following Musa who employed this concept to derive SSA-specific IS solutions in the health sector (Musa, 2012). According to Goodhue and Thompson (1995), a good fit between the applied technology and the respective task in question has a positive impact on the utilization of the technology and the performance of the task execution (Goodhue and Thompson, 1995). While the seminal authors focused on an individual level of analysis, Zigurs and Buckland (1998) adapted it to the group level (Zigurs and Buckland, 1998). This broader perspective is relevant for this study as we concentrate on the tasks of groups (e.g. the population of a certain target-area for a self-contained energy system). As we have laid out earlier, we see efficient and sustainable energy generation as the bottle neck to enable further developments e.g. educational improvements or extended medical supply. The recent developments in sustainable IS research (most notably Green IS and Green IT) represent the ground for the relevant technology component of the model. Our vision is, that a good fit between these two areas will create IS being helpful to realize efficient self-contained energy systems. These will further enable applications towards sustainable welfare. According to the theory both goal dimensions, utilization and performance, will be positively influenced (Goodhue and Thompson, 1995). These theoretical assumptions guide our research plan, which is illustrated in Figure 2.

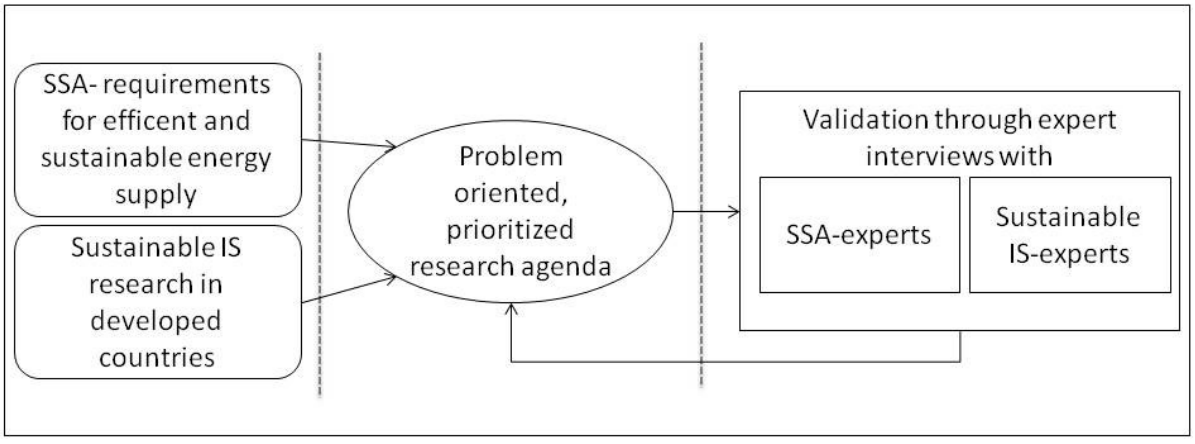

Figure 2. Research plan

First, we will conduct a structured literature review following the principles of Webster and Watson (2002) in addition to following the methods of Lecy and Ellis (2006) in the two main fields sustainable

IS and the SSA-requirements for efficient and sustainable energy supply based on proceedings of major conferences and high-quality journals. However, as we look at research fields which are still agile and changing rapidly we will also pay attention to other journals and proceedings to get a holistic overview.

Based on these findings we will generate an initial research agenda for IS research to solve problems of SSA described above. We will also attach priorities to the agenda topics. To validate this research agenda and priorities, we will conduct several expert interviews with specialists from the two fields in question and adapt the agenda according to the experts.

5 Conclusion

In this paper we described how new IS concepts concerning sustainability issues in developed countries could enhance the general development of the poorest region in the world. Thereby we created a vision on how IS could be used to support and optimize the generation, management and consumption of electric energy in self-contained energy systems. The new technologies and the big potential of continents like Africa, with a high amount of sunshine hours per day could lead to a closer connection between developed and underdeveloped countries like those in SSA.

We found that a lot of research in developed countries is suitable to the needs of development countries. Especially the topic of smart energy management and also energy management in vehicles are new topics for the IS community with interests in both, developed and underdeveloped countries. To realize this potential, we laid out a research plan that could bridge the gap from the status quo to the desired outcomes. We suggested some topics that need more research, or even basic research. According to the needs of the regions, we therefore integrated priorities into the agenda.

Based on the facts mentioned above, we think that an energy information system for the rural villages would have a positive impact on the use and efficiency of the new energy system. We also showed some possibilities to gain sustainability through the impacts of energy and therefore the chances for new income possibilities.

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