



Experiences from a Development Project in Kenya – Baselines for Future Climate Information Systems

Jaakko Helminen, Balozi Bekuta Kirongo, Silvia Gaiani, Ezra Misaki, Mikko
Apiola, Erkki Sutinen

► To cite this version:

Jaakko Helminen, Balozi Bekuta Kirongo, Silvia Gaiani, Ezra Misaki, Mikko Apiola, et al.. Experiences from a Development Project in Kenya – Baselines for Future Climate Information Systems. 15th International Conference on Social Implications of Computers in Developing Countries (ICT4D), May 2019, Dar es Salaam, Tanzania. pp.366-377, 10.1007/978-3-030-18400-1_30 . hal-02285254

HAL Id: hal-02285254

<https://inria.hal.science/hal-02285254>

Submitted on 12 Sep 2019

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution 4.0 International License

Experiences from a Development Project in Kenya – Baselines for Future Climate Information Systems

Jaakko Helminen¹, Baloz Bekuta Kirongo², Silvia Gaiani¹, Ezra
Misaki³, Mikko Apiola¹, and Erkki Sutinen¹

¹ University of Turku, Department of Future Technologies, Turku, Finland

² University of Eldoret, Department of Forestry and Wood Science, Eldoret, Kenya

³ College of Business Education, Dar es Salaam Campus, Dar es Salaam, Tanzania

jaakko.a.helminen@utu.fi, balozibk@hotmail.com,
silviagaiani@yahoo.it, e.misaki@cbe.ac.tz, mvapio@utu.fi,
erkki.sutinen@utu.fi

Abstract. This paper explains our efforts in regards of hybrid climate services.

As one part of our research efforts and exploration in Africa, we have worked with the Marigat District in Baringo County, Kenya, where we first intended to help the farmers to replace the invasive *Prosopis juliflora* deep-root species by another deep-root species easier to keep under control. Data was collected through questionnaires with open-ended and closed-ended questions to find a baseline of community challenges and technology use. The lessons learned in the project inspired us to analyze the data by using the lens of Heeks' [3] design theories. The main outcome of this study is a hybrid evaluation and its discussion with future implications for future climate services.

Keywords: Climate information systems, Agriculture, Developing countries.

1 Introduction

During the recent decades, climate has started to change and so its variability as well. Hence the variety of climate impacts affecting everyday life especially in developing countries has changed and led to a growing need for hybrid and locally pertinent climate services. In line with this we started from the design research framework [1] as well as critical systems heuristics [11] and proceeded with local partners in a participatory way to imagine and co-create climate services for end-users in Kenya. In this article we focus on understanding the baseline situation and related technology usage for crucial farming and other decisions with using the method of Heeks [2] as one of our lens and tool, as well as with future needs for improved climate information systems in mind.

Another kick-off to our start came from the design-thinking paradigm [3,4]. We encountered *empathy* as its first stage of the inspiration space. According to Brown [3] the objective of the empathy stage is to experience a problem or an opportunity, which sets the relevant participants in motion. We joined a pre-negotiated program

and adapted our sub-project, described in this paper, to its larger objectives without losing our freedom to study problems and opportunities, which were pertinent for this project as well as its information systems, and included also the evaluation of our sub-project. Our preliminary data collection started by studying available local climate services and related general baselines in Marigat District, Kenya, with recommendations for actionable climate knowledge [5] in mind.

In the following sections we briefly describe the situations at the time of our field trip to Eldoret and Marigat District, Kenya. Then we cover the processing of parts of the interview material and introduce next the method, by which we evaluate the silvicultural information systems and the baseline data [2]. Thereafter we show pertinent results of the interviews as well as our evaluations of the baseline data and associated forestry information systems. In the context of the discussion and conclusions we mention the stalemate we encountered in Eldoret and Marigat District. The lessons learned inspired us to further apply and extend the evaluation method of Heeks [2] in the context of developing appropriate hybrid grass-root mobile climate services for local farmers in Kenya. Our suggestions include extending observations by Heeks [2] with suggestions that are based on co-creation and participatory design [3, 4]. Finally to conclude we share our inspirations with the readers.

2 The project and related consortium

In the context of the umbrella project on “Building further capacity in Kenya: Strengthening practical & ICT aspects towards multidisciplinary and community-engaged forestry education” (SFEK) we established a joint project “Holistic grass-root mobile climate services” (HGMCS) with the School of Forestry of the University of Eldoret, Kenya (SF/UOE) and Marigat Research Sub Centre of Kenyan Forest Research Institute (MRSC/KEFRI) as our local hosts, the School of Forestry of the University of Eastern Finland (SF/UEF) and the School of Computing of the University of Eastern Finland (SC/UEF). The Centre for International Mobility, Helsinki, Finland (CIMO) funded SFEK.

Based on the declaration of the Kenyan minister of agriculture *Prosopis juliflora* to be a noxious weed [6] we agreed unanimously with the local colleagues to focus on attempts to replace the invasive *Prosopis juliflora* deep-root species by another deep-root species, which could be kept easier under control in Marigat District, which is located 100 km east-northeast of Eldoret on the opposite side of the Rift Valley. From this point we started our preparations to keep an MSc (Forestry) course on “Forest Management in a Varying and Changing Climate (FMVCC)” with the deep-root species problem in mind. FMVCC took place under mission 2 of SFEK - “Improvement of forest education curricula at MSc and PhD levels”.

As noted, *Prosopis juliflora* is a recent invasive deep-root species in Lake Baringo area and has been discussed by [7]. By considering both its positive and negative effects to the local environment, people have preferred it to be controlled or eradicated [7]. It became clear that actions to eradicate *Prosopis juliflora* species and to replace it by another less invasive deep-root species were needed.

3 Crucial need for climate information

Climate change and changes in climate variability are among the most serious problems of the world today. Climate change may cause a number of uncontrolled sequences of fatal harms, and as is well known by recent reports by IPCC¹ it directly threatens the future existence of humankind. The negative effects of climate change are already being experienced globally, particularly in the Global South, mainly by the most vulnerable groups of people, and the situation is getting worse as time passes. Therefore, urgent actions are needed in order to adapt to changing climate conditions. Our observations confirm that climate change and the changes in its variability are pertinent factors in this semi-arid region, too, and it has become clear that local people, typically smallholder farmers and nomads need appropriately tailored climate services.

A number of new climate service projects are underway in Tanzania, Kenya, and Uganda, to name a few examples. A number of projects are still in their developmental stages. However, some evidence of successes have been reported for example by [8]. In their research in Kenya, it was shown that farmers, who received climate information were better in crop management and got higher yields, as compared to farmers in a control group [8]. Thus, while many projects are still in their beginning stages, and many mobile services for agriculture have failed or disappeared, evidence of benefits from new technologies is also starting to emerge, which is encouraging and gives motivation for future efforts.

4 Data and methods

4.1 Research questions

Based on our objectives to develop future hybrid climate services, our preliminary data collection was set to understand the available local climate information systems and practices to gain general baselines of the context in Marigat District, Kenya. In regards of understanding the baseline situation, our research questions were set as follows.

- 1) What are the current baselines for crucial information needs, current strengths, infrastructure, skillsets, climate information, and mobile usage patterns in Marigat District, Kenya?
- 2) How can the baselines for current information and development processes for climate and weather information systems be evaluated from the viewpoint of Heeks' [2] design-reality theories?

¹ <http://www.ipcc.ch>

4.2 Data collection protocol and informants

The data collection protocol was designed to explore the strengths and gaps in baseline and behavior items that are pertinent to hybrid climate services. During data collection, we encouraged the local farmers and nomads to adopt a participatory and co-creative attitude. In order to collect data about the general baselines, a questionnaire was developed. The questionnaire contained both quantitative items with scales such as “good”, “fair”, “poor”, as well as open-ended questions. The questionnaire contained six themes, which were: *community life, personal skills and expectations, local climate impacts and demands for pertinent climate services, ICT and its role in the daily life, livestock related items* as well as *first motivation for nomadism and collaboration to develop relevant local climate services* and finally *trust on other community members*.

The data was collected from the Marigat district in Kenya, from two communities: the Tugen-community and the Njemps-community. In addition to data collection, the visits included a two-week intensive course on climate services in Eldoret. In regards of numbers of respondents, there were a total of 27 respondents (10 females, 17 males). 15 respondents were from Tugen, and 12 respondents were from Njemps.

4.3 Data analysis

First, the questionnaire data was analyzed in the following way. In regards of closed-ended questions, the number of responses per each item were calculated, and modes (Mo) were counted. In regards of open-ended questions, the related qualitative responses were coded so that each item or category was first collected, and then the total number of mentions of that specific issue was calculated. Per each item reported in the results, it is clearly stated if the item was an open-ended or a closed-ended question. This analysis is presented in Sections 5.1-5.5.

Second, this baseline data was analyzed and evaluated from the viewpoint of the framework presented by Heeks [2], which is introduced in Section 4.4. The results of this evaluation are presented in Sections 5.6-5.12. The analysis of results proceeds following the Heeks’ [2] model, dimension by dimension, i.e. information, technology, processes, objectives and values, staffing and skills, management systems and structures and other resources.

4.4 The evaluation method of Heeks [3]

In order to evaluate forestry information systems of our interview sites in Marigat District Kenya, we applied the method of Heeks [2]. In our explorations we focused on the existing design-actuality gaps by recognizing as elements of design:

- components from the designer’s own context and
- conceived assumptions about the situation of the end-user.

Our evaluations followed Heeks [2]. We applied his dimensions of relevance:

- information (data store, data flows, etc.),
- technology (both hardware and software),
- processes (the activities of end-users and others),
- objectives and values (the key dimension, through which factors such as culture and politics are manifested),
- staffing and skills (both the quantitative and qualitative aspects of competencies),
- management systems and structures, and
- other resources (particularly time and money).

With pertinent parts of the conducted surveys and interviews as well as related discussions as input we evaluated these seven dimensions separately for the design, represented by the designer, and the actuality, represented by the end-users, by rating on the scale low – medium – high and by taking into account the discussion and ideas of [2]. We considered also the relevant findings from related work [2,6,8, 9,10,11].

5 Results

5.1 Community life

In regards of *quality of life*, on a scale of “Good”, “Fair”, “Poor”, and “Can’t assess”, the following responses were given by interviewees. A total of 7 interviewees (4 males, 3 females) considered their life to be “Good”, 11 interviewees considered their life to be “Fair” (7 males, 4 females), 6 interviewees considered their life to be “Poor.” One interviewee responded with the “Can’t assess” option. Thus, the mode (Mo) was “Fair”.

The interviewees’ perceptions in regards of the *prominent main needs* were investigated by using an open-ended question “*At present, what do you think are the main needs / requirements / demands of the community?*” From the answers, the following main needs were found. The most often mentioned *prominent main need* was *access to clean water* (n=18), followed by *education for children* (n=11) and *tree plantation* (n=3). In addition, *medical services*, *good roads*, *electricity*, and *irrigation and seeds* were each mentioned for one or two times in the data. Caretaking of handicapped or the lack of it was found also to be an issue.

The informants’ perceptions in regards of the *main strengths in their communities* were investigated by using an open-ended question. The data shows that among the mentioned strengths, *farming* (n=17) was the most often mentioned, followed by *keeping livestock* (n=15). The following strengths of the community were mentioned once or twice in the data: *charcoal burning*, *beekeeping*, *locally available resources*, *teamworking skills*, *fruit business* and *poultry rearing*. The community members were rather unanimous in regards of the main strengths.

In regards of the informants’ perceptions as to the *weaknesses in the communities*, this was also investigated by using an open-ended question. The results show that the most often mentioned weaknesses were *lack of water* (n=4) and *preparedness against*

drought (n=4). In addition, the following issues were mentioned once, twice or three times: *preparedness against floods, poor poverty reduction, infrastructure, education level, business skills, communication skills, access to markets, knowledge of people and leadership, lack of food, medicine, information, means of transportation, grass, electricity, technology, land possible to cultivate, skills, resources and livestock, financial constraints, reliance on sole traditional knowledge, exposure on cattle rustling, illiteracy, people afraid, slow change, alcoholism and laziness*. Thus, the informants' perceptions to the weaknesses differed quite much with each other, and the answers seemed not to be too unanimous.

5.2 Infrastructure

In regards of *infrastructure items*, the questionnaire asked the informants to classify the following items: *roads, means of transportation, health centers, housing, and support for nomadism* on a scale of “*excellent*”, “*good*”, “*acceptable*”, and “*poor*”. In regards of *roads*, eight respondents (n=8) considered the roads to be “*acceptable*”, while nineteen (n=19) considered the roads to be “*poor*”. No-one considered the roads to be either “*excellent*” or “*good*”. In regards of *means of transportation*, three (n=3) respondents chose “*excellent*”, six (n=6) “*good*”, four (n=4) “*acceptable*”, and fourteen (n=14) “*poor*”. Thus, in regards of roads and means of transportation, the modes (Mo) to both two questions were “*poor*.”

In regards of *health centers*, the responses were as follows: “*excellent*” (n=2), “*good*” (n=0), “*acceptable*” (n=10), “*poor*” (n=15). In regards of *housing*, the responses were as follows: “*excellent*” (n=0), “*good*” (n=2), “*acceptable*” (n=7), “*poor*” (n=15). In regards of *support for nomadism*, the respondents gave the following answers. No-one considered this issue to be “*excellent*”, three (n=3) considered it to be “*good*”, four (n=4) considered it “*acceptable*”, and twenty (n=20) considered it to be “*poor*.” Hence, in regards of all three questions in regards of health centers, housing, and support for nomadism, the modes (Mo) for the questions were “*poor*.”

In regards of the interviewees' *willingness to settle down*, this was queried with a scale of “*yes*”, “*no*”, “*conditionally yes*” or “*conditionally no*.” Of all the respondents, eleven (n=11) answered yes, and no-one answered “*no*”. Seven (n=7) answered “*conditionally yes*”, and five (n=5) answered “*conditionally no*.” For those who selected “*conditionally yes*”, an open-ended question was presented. The answers to that question were: *improved services to access water, grass, more land and trees around the village*. Other aspects mentioned included *harsh conditions, willingness to settle down, and demarcation of land*. In regards of suggested changes to the community, in the open-ended answers, the most suggestions centered around *land demarcation* (n=6), *access to clean water* (n=7), *quality education for children* (n=8), and *tree planting* (n=3).

5.3 Personal skills and expectations

In regards of *skills that the interviewees would like to learn in order to improve their livelihood*, this was queried with an open-ended question. 21 out of 27 interviewees

said that they wanted to learn new skills. The answers indicated the following. Improved farming skills were mentioned five times (n=4), bookkeeping skills were mentioned three times (n=3), driving was mentioned four times (n=4), ICT skills was mentioned once (n=1). Quite much other things were mentioned, too. These included: *skills in building irrigation canals, saloon hairdressing, cooking skills, charcoal burning skills, learning to sell, drip irrigation, buying and selling livestock, improving education level, masonry, animal breeding, and food planning.*

In regards of *expectations for the future*, the answers emphasized *electricity and water, improved infrastructure, and self-reliance*. In regards of past and present climate hazards the interviewees listed the following: *droughts (n=18), floods (n=13), diseases (n=7), people displacement because of floods (n=4)*. In addition, ‘hunger and poverty’ was mentioned several times.

In regards of *suggestions to improve actions of local authorities*, this was asked with an open-ended question. The suggestions included *fast responses to needs (n=3), improved collaboration (n=4), help in tree planting (n=3), early warning system (n=3), basic climate education (n=3), and improved education (n=1)*. Other suggestions were (each were mentioned once or twice): *access to clean water, change of river course, move livestock to grassland, getting subsidies, improved infrastructure, plant grass, access to health centers, access to medicine, assistance in selling livestock, assistance in farming, rebuilding houses, materials for new houses, increased government help, and donations and food*. Point of note is that responses to this question were spread on a wide scale, and no single issue was mentioned more than four times.

5.4 Local climate impacts and demands for pertinent climate services

In regards of *current access to climate and weather information*, the following was observed. For the questionnaire item “current access to climate and weather information”, the interviewees responded *yes* for six times (n=6) and *no* for twenty-one (n=21) times. In regards of *devices used to access climate and weather information*, radio was mentioned seven (n=7) times, television once (n=1), and indigenous knowledge fourteen (n=14) times. In regards of the *main need for climate and weather information*, the following items were mentioned: *information from mobile, radio and community meeting (barasa) (n=14), rain information (n=7)*. In regards of the *willingness of the interviewees’ to settle down in case that weather and climate information needs would be met*, the responses were *yes (n=26)*, and *no (n=0)*.

5.5 Mobile technologies

In regards of *owned ICT technologies*, the following was found. Twenty-six (n=26) persons owned mobiles, twenty-four (n=24) a radio, eleven (n=11) a television, and four (n=4) a personal computer. The most often used ICT technologies were found to be mobiles (n=24), followed by radio (n=4), television (n=1), and personal computer (n=0). In regards of *usage patterns of mobiles*, the following was found. *Making and receiving voice calls (n=26), sending and receiving short messages (n=21), taking*

photographs (n=13), *accessing the internet* (n=11), *sending and receiving money* (n=7), and *listening to music* (n=1). All but one of the interviewees were of the opinion that ICT supported nomadism.

In regards of *communication patterns*, the following issues were mentioned: *communication on proper pastures* (n=11), *communication about access to drinking water* (n=6), *communication on need for help* (n=6), *communication on security issues* (n=7), *communication with veterinarian* (n=5). In addition, the following single issues were mentioned: *informing on animal conditions, business and marketing issues, cattle rustling danger, livestock auction dates, and livestock new breeds*.

In regards of *willingness to receive improved climate information*, the following was found. The responses to category “yes” were (n=24), and to category no (n=3). In regards of suggestions on how improved climate information would help in the future, the answers included the following: preparing land in advance (n=7), preparations against hazards (n=3), warnings for impending drought (n=1), and possibility to preserve food (n=1). In regards of the biggest risks for keeping livestock, the following were mentioned: *diseases* (n=11), *cattle rustling* (n=9), *droughts* (n=20), *prosopis juliflora pads* (n=2), *lack of water* (n=5). In regards of benefits of improved climate information to livestock production, the following were suggested: *proper timing for selling and buying livestock* (n=15). In addition, one interviewee pointed out the possibility for better timing in preparing tree planting. All interviewees indicated improved climate information would be beneficial to agricultural activities in the community.

In regards of *trust on other members of the community*, an almost unanimous trust was found. There were 23 of those who trusted everyone, and three (n=3) of those who trusted only a part of other members.

5.6 Heeks’ Design Reality Gap: Information

In the context of assessing the quality of community life, as noted in section 5.1, the mode (Mo) of answers was “Fair”. One qualitative comment in the data also read “*people are more informed.*” However, weaknesses in other responses in regards of lack of information, illiteracy, poor communication skills and poor knowledge, it was found that the informants were eager to utilize climate and weather information and related ICT solutions. The willingness to search for information was growing.

One important observation in regards of information was that in regards of some questions, such as *strengths, main needs, and infrastructure*, the respondents were quite unanimous in their responses. However, in regards of some other questions, such as *weaknesses, skills that the interviewees would like to learn in order to improve their livelihood, and suggestions to improve actions of local authorities*, the answers were not unanimous, but almost all participants had their individual views as to the most relevant issues. Thus, community members share quite strong common views into some important questions, while not to some others. For example, in regards of important skills for the future, almost each member had their own ideas.

In regards of climate information, the current access was assessed as “No” by most (n=21) of the interviewees, while “Yes” was selected considerably less (n=6). In re-

gards of *willingness to receive improved climate information*, “Yes” was selected (n=24) times, while “No” was chosen (n=3) times. This indicates that in regards of current weather and climate information, there is a design-reality-gap [2]. In regards of weather and climate information, the respondents were unanimous. In regards of information flow between officials and community people, there were some hints that the information flow was not optimal.

5.7 Heeks’ Design Reality Gap: Technology

While current access to ordinary mobiles was found to be good, access to other technologies came up mostly as needs or lacks, as seen in sections 5.3 and 5.5. There were signs of growing interest in terms of willingness to learn ICT skills. However, the current technology-usage patterns were found to be basic, and modern technology usage was at a very modest level. It must be noted that evidence of climate information systems with evidence of benefits to small scale farmers does not yet exist. Therefore, it is not a matter of *access* or *skills*, but a matter of future co-creation. In regards of future technologies for climate information, this project is at the inspiration stage with empathy as one of its primary tools, where problems and opportunities are first being experienced [3], before it becomes possible to build and test prototypes and later to implement fully operational technologies. The preliminary results indicate that future breakthroughs in technology will most likely happen through co-creation at the grass-root level.

5.8 Heeks’ Design Reality Gap: Processes

One of the hard processes in our original and agreed plan was the replacement of *Prosopis juliflora* with another deep-root species. According to [7], the eradication of *Prosopis juliflora* from its originally planted area in Baringo County would have cost some one million euros, which the local communities would not have been able to afford. Both this action and to get the expansion of *Prosopis juliflora* under control would have required financial support and specific policies from the authorities.

On one of our first visits to Eldoret and Marigat, we found that in line with the findings by [7,9,10], the majority of people in Marigat argued that life would be better without the *Prosopis juliflora* species. For a long time prior to our visit there was no policy guiding the management of the plant but in effect from the end of 2008, when the minister for agriculture declared *Prosopis juliflora* as a noxious weed [6].

With this background in mind it was interesting to see both from our interviews and our surveys that in early 2015 almost nobody told any more of eradication of *Prosopis juliflora* in any of the questionnaires or other related talks. Instead, the local soft processes had been improvised to utilize it in handcrafts and also as raw material for a tuned power station. From our point of view a fast change of process had occurred, which was in complete conflict as to what had been agreed. Therefore, we conclude that lack of trust and commitment in agreed processes constituted a design-reality-gap.

5.9 Heeks' Design Reality Gap: Objectives and values

We came with the hybrid objectives of our hard process and with values, expectations, and biases rooted in all of the local cultures where the authors of this paper originate from. Hence the soft objectives of local people were not always understood. This convinced us about the need for participatory co-creation in technology projects. We found self-reliance as one important wish for the future. Motivation to nomadism was based both on financial gains by selling livestock and on tending a flock while searching for water and pasture. Trust on community members was almost unanimous and different from some other cultures. On the other hand, while trust was unanimous in regards of the objectives of some issues, such as the most important skills for the future, each community member had their own views. On other issues, such as important needs, the groups views were unanimous. In addition to trust between members, other important attributes in groups were the tolerance for differing viewpoints, and social-psychological issues of leadership.

5.10 Heeks' Design Reality Gap: Staffing and skills

Based on our interviews of community weaknesses, lack of skills and poor leadership were mentioned. On the other hand, bookkeeping appeared as a skill some community members wanted to learn (n=3). However, as seen in section 5.3, a number of other skills were mentioned too, including driving, hairdressing, cooking, charcoal burning, selling, masonry, breeding, food planning.

5.11 Heeks' Design Reality Gap: Management systems and structures

The interviewees asked us to list current inadequacies in the community baselines. However, management systems and structures were issues that our data did not deal in a great depth.

5.12 Heeks' Design Reality Gap: Other resources

In other resources we came up with education, poverty, hunger and financial constraints. The interviewees emphasized the need of education for children, even though it was mentioned also as a strength. The mentioned weaknesses included poverty reduction and financial constraints. Impacts of past and present climate hazards having affected livelihood had caused hunger and poverty. Local important responses included the demand for basic climate education and improved education. A general lack of almost all possible resources was permanent, which was in conflict to the answers to general ratings of *quality of life*, which participants assessed as "Fair" (section 5.1). It calls into question the reliability of answers to the question and possibly the tendency to give socially acceptable answers to questionnaires by outsiders. This observation contributes as one sort of design-reality-gap when future technologies or other interventions are planned.

6 Discussion and Conclusions

From this project we were left with some successes, some failures, and lessons learned. In regards of *Prosopis juliflora*, the problem still remains unresolved. It is obvious that our original hard process needed to be revised to become softer and to allow for improvisations. On the other hand, in line with the design-thinking paradigm [3, 4], we were able to experience local challenges, problems, and opportunities and collect reliable baseline data about the pertinent issues. This helped in building trust and connections in order to continue with possible future activities and initiatives. In discussing our results, we turn now to the specific research questions.

Research question 1 asked “*What are the current baselines for crucial information needs, current strengths, infrastructure, skillsets, climate information, and mobile usage patterns in Marigat District, Kenya?*” Our results showed the following.

First, the baseline data revealed a number of crucial needs in regards of equipment, access to resources, to medical care and to clean water, needs for educational resources, and demands for a variety of skill development opportunities. In regards of technology usage, the current usage patterns were mostly non-agriculture and non-climate related. The need for improved climate and farming information and services became clear, and this was one of the issues, where the locals were unanimous. In regards of some issues, the participants were unanimous. However, in regards of some other issues, such as the most important skills for the future, their opinions in regards of the most important lines of action differed quite much.

Our recommendations included the need to focus on areas where the collected information showed largest diversity and to think carefully, which parts of the data are crucial. As changes in current strengths, infrastructure and skillsets can occur even in a short time, follow-up studies are needed for these items. The awareness and access of climate information demanded strengthening in order to enhance the use and the learning of climate knowledge [5]. The use of mobile technology seemed to be wide and the leading way for communication. This provides a platform for future climate services. In regards of designing those services, co-creation and participatory design are recommended. In one way or the other, a number of stakeholders, who may not otherwise communicate very well with each other, need to be included in the design processes. Building commitment and trust is a crucial factor here. Projects that start with good intentions end too often when commitments and priorities change.

Research question 2 asked “*How can the baselines for current information and development processes for climate and weather information systems be evaluated from the viewpoint of Heeks’ [2] design-reality theories?*” Our results show the following.

Our answers show that the dimensions of information, technology, processes, staffing and skills as well as management systems and structures are closely related to the operational aspects of climate and weather services. In addition, these dimensions overlap with the objectives and values as well as some other resources when we build hy-

brid climate services. For us, it was crucial to update our understanding with the interviews in regards of the local current baseline. First, we could see that a part of the responses were reasonable coherent, whereas some others were quite diverse. We may ask, how we could achieve a reasonable consensus. Should we encourage people for co-creative cooperation and take first steps to absorb, not just climate information, but to process it to climate knowledge in their minds.

Second, we face the challenge to narrow the design-reality gaps in terms of Heek's [2] model. Beside climate knowledge, this is another life-long exercise. Third, we see improvisation (Heeks, [2]) as a vital tool for narrowing design-reality gaps. Fourth, with the ever-hectic changes in our environment we need agility in our responses. Hence, we would like to see agility to be extracted as an explicit new dimension from other resources in Heek's [2] model. Last but not least, we would recommend that evaluation would become an inseparable part of any development project.

References

1. Hevner, A. R., March, S. T., Park, J., and Ram, S. (2004) "Design Science in Information Systems Research," *MIS Quarterly*, (28:1), pp. 75-105.
2. Heeks, Richard (2002) "Information Systems and Developing Countries: Failure, Success, and Local Improvisations," *The Information Society*, (18:2), pp. 101-112.
3. Brown, Tim (2009) "Change by design: how design thinking transforms organizations and inspires innovation," Harper Collins, New York, USA.
4. Both, Thomas (2016) "Design Project Scoping Guide," Hasso Plattner Institute of Design at Stanford, Stanford University, Palo Alto, California, USA. Open access at <https://dschool.stanford.edu/resources/design-project-guide-1>
5. Meinke, H., Nelson, R., Kokic, P., Stone, R., Selvaraju, R., and Baethgen, W. (2006) "Actionable climate knowledge – from analysis to synthesis," *Climate Research*, 33, pp. 101-110. Open access at www.int-res.com/articles/cr_oa/c033p101.pdf
6. GoK. [Government of Kenya] 2009. The Kenya Gazette of 9th January, 2009, Vol. CXI - No. 2
7. Maundu, P., S. Kibet, Y. Morimoto, M. Imbumi and R. Adeka (2009) "Impact of *Prosopis juliflora* on Kenya's semi-arid and arid ecosystems and local livelihoods," *Biodiversity*, (10: 2-3), 33-50, DOI: 10.1080/14888386.2009.9712842
8. Rao, K., Hansen, J., Njiru, E., Githungo, W., Oyoo, A. (2015) Impacts of seasonal climate communication strategies on farm management and livelihoods in Wote, Kenya. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) / CCAFS Working Paper no 137 (2015).
9. Kipchirchir, Koech O., Kinuthia R. Ngugi and R.G. Wahome (2011) "Use of Dry Land Tree Species (*Prosopis juliflora*) Seed Pods as Supplement Feed for Goats in the Arid and Semi Arid Lands of Kenya," *Environmental Research Journal*, 5 (2), pp. 66-73.
10. Mwangi, Esther and Brent Swallow (2008) "Prosopis juliflora Invasion and Rural Livelihoods in the Lake Baringo Area, Kenya," *Conservation and Society*, 6(2), pp. 130-140.
11. Ulrich, W. and Reynolds, M. (2010) "Critical systems heuristics," in *Systems Approaches to Managing Change: A Practical Guide*, M. Reynolds and S. Holwell (eds.), Springer-Verlag, London, UK, pp. 243-292. Link to the chapter <http://oro.open.ac.uk/21299/1/systems-approaches>.