THE POTENTIAL OF APPS TO STUDY SMALLHOLDER FARMING SYSTEMS AND MORE

Across the developing world, the rapid spread of mobile phones has led to a surge of mobile tools that allow users to access health, education and finance services. In agriculture, these tools can be used to obtain price data, weather reports and technical advice. While there is widespread consensus about the opportunities for economic growth and social empowerment that mobile tools offer users, one area has received limited attention so far: the potential to use mobile tools for research and for project monitoring and evaluation purposes.

By Thomas Daum, Regina Birner, Hannes Buchwald and Ansgar Gerlicher

During the last decade, mechanisation has received renewed interest among private actors, governments and development practitioners alike, especially in Africa. However, its intra-household effects are unclear. On the positive side, households using tractor services, for example, may be able to cultivate more land and achieve a higher yield. Yet, the expansion of land may increase the burden of labour for activities that are not yet mechanised, such as weeding and harvesting, which are often done by women and children. At the same time, activities that tend to be seen to more by males, such as land preparation, may be substituted by mechanisation services which are typically provided by male tractor operators. The potential changes of female time use may then alter the nutrition status of the household. So much for the hypotheses. To understand how mechanisation affects farm families in reality, we required data on time use and nutrition from different household members over an entire cropping season. For this purpose, we developed a picture-based smartphone app which allows respondents to record data themselves.

The smartphone app helped us obtain this data while also overcoming some of the challenges of existing time use research methods. Household surveys are cheap but prone to recall and social desirability biases. For example, one study found that men over-reported their contribution to household work by 70 per cent in the United States of America, a country where the concept of time plays a major role in society. Time-use diaries are an alternative but difficult to use if respondents cannot read or write and have no "modern" or clock-based concept of time. Given the lack of appropriate methods, reliable data on time use in smallholder farming systems is extremely scant, posing a challenge for researchers. Additionally, this makes it very difficult to prioritise and design good development programmes and to measure their effects.

Could mobile tools help researchers obtain more accurate data? After all, the rapid spread of mobile phones and tools in Africa suggests that rural populations are increasingly open to these technologies if they are well designed. Moreover, the more recent rise of smartphones now allows for the use of visual aids, which break down the text-barrier faced by low- and illiterate users. Many mobile tools have been severely criticised for this since it restricts their circulation to more well-off users who can also make better use of them. For researchers, this would be problematic as it can lead to selection bias.

SUITABLE FOR ILLITERATE USERS …

Therefore, we developed a smartphone application which allows respondents to record their daily activities only using pictures, so that even low- and illiterate users could participate (see Box on page 47). But still, would respondents understand how to use the app? And would they carefully record their daily activities?

To answer these questions, we conducted a study with 62 households in Zambia. These households ranged from families relying only on hand tools to households using tractor services to prepare their land. In each household, we gave the head, one spouse and either a boy or a girl a smartphone for three days at five fixed times during the 2016/2017 farming season. This allowed us to collect roughly 2,790 days of data on time use and nutrition during land preparation, planting, weeding, harvesting and processing. Our experience was that the participants generally found the use of the app exciting. One respondent found the app "easy to use and better than those questionnaires where you need to sit so long". Respondents also recorded their data with much discipline. Cleary, it was important to carefully introduce the app.

… AND WELL ADAPTED TO THE LOCAL SOCIO-CULTURAL CONTEXT

At village level, we placed particular emphasis on explaining why a smartphone app was used and how we selected the participating households. Otherwise, suspicions and tensions may have arisen. For example, one village was sceptical and at first believed that we were Satanists, a concern that we could overcome with careful explanation. At individual level, we found it crucial to carefully test the app and its illustrations. For example, one of our initial illustrations showed a person eating from a pot. This was not understood as eating

but as stealing, because people always eat together – and not directly out of the pot. We then had to change some of the illustrations by taking the local socio-cultural context more into account.

Training also played an important role. Respondents had no difficulties in understanding the app, but some were unfamiliar with using a touchscreen. So we allowed them to practise scrolling and touching first. In all cases, we trained the use of the app using some explanatory stories, such as the following: Mary goes weeding while carrying her baby, then she chats with a friend, then she eats some guavas. All users, ranging from 6 to 90 years, were able to use the app. Therefore, we concluded that smartphone apps can serve as a reliable, affordable and participatory tool for data collection in complex smallholder farming scenarios. So the app worked, but what about the result?

MECHANISATION – A HIGHER WORKLOAD FOR WOMEN AND CHILDREN?

As mentioned above, one of our research questions was whether agricultural mechanisation, especially during land preparation and when linked to the expansion of agricultural land, increases the work burden for women or children during weeding and processing times. Our early, as yet descriptive results suggest that this is not the case. In fact, we find that households using hand tools spend significantly more time on weeding than households that use animal or tractor services. The latter households expand their farm size, which results in a higher demand for weeding. However, they also use animals and/or herbicides for weeding. Furthermore, mechanisation may suppress weed growth. As a result, mechanisation does not increase female and children's time spent on weeding – the demand for weeding is compensated for by other technologies. In fact, our data shows that the time spent on weeding by females declines by nearly half, from around four to two-and-a-half hours a day.

FROM SPECIFIC EXTENSION SERVICES …

Although we focused specifically on time use and nutrition, we found a much larger untapped potential for the use of smartphone apps as a tool for data collection. Obviously, the activity set we used can be adapted. For example, a study focusing on livestock keepers could split our single "livestock activity" into several ones, such as herding, feeding, rearing, etc. Furthermore, the activity sets could be adapted to urban settings or to different occupations. Moreover, one could work with different "plug ins" besides the nutrition one which we adopted. For example, "plug-ins" could be designed to record data on fertiliser or pesticide use or the quality of extension and technical advice. Participants may also make videos or take photos that can be analysed by the researchers later on. The Makerere University in Uganda piloted a similar project that allows farmers and extension workers to take pictures to record the spread of the cassava mosaic disease.

Going some steps ahead, the built-in motion, environmental and position sensors of new smartphones provide a scope for further exploration. For example, position sensors could be used for geospatial studies focusing on land use changes, pastoralism, migration patterns or social movements and networks. Studies could combine (user-entered) data from mobile tools with remote-sensing data. Environmental sensors or an external weather station could be used to record weather data and thus link social and economic aspects of farming with the study of plant production. In addition, position sensors could be applied to validate agricultural plot-sizes, a crucial variable to calculate agricultural productivity which is often over- or underestimated in questionnaires. Sensors have the advantage that they can record data "en passant" without burdening the respondents.

… TO MONITORING AND EVALUATING DEVELOPMENT PROJECTS

The use of mobile tools may be a valuable opportunity not only for researchers but also for development practitioners. Instead of sending enumerators with pen and paper into the field, beneficiaries were able to record data themselves. The non-profit organisation Technoserve, for example, has already used an SMS tool ("Frontline Forms") to evaluate the impact of farmer training in Tanzania. Its tool is still text-based and thus difficult to use for

Does the workload for women increase with farm size? With the aid of the Time Tracker app, the working hours of each family member can be checked.

Photos: Hannes Buchwald

THE TIME TRACKER APP

The use of the app is straightforward. Participants click on the picture showing the activities they do (e.g. hoeing and carrying a baby) when they begin an activity. When they finish, they click on the picture again. This real-time recording rules out recall biases. We designed an additional "plug-in" for the activity of "eating". In this case, two windows open: the first one shows four differently filled plates, which allow quantities of food consumed to be recorded. The second one shows different food groups such as cereals, vegetables or fruits, which allow a recording of the diversity of food eaten. The smartphones used were blocked so that only the app could be used, which reduced the temptation to use the phones for other things besides data recording. It also enhanced the battery life to up to four days. The app has a second screen to crosscheck the data that was recorded and to correct potential mistakes. Both data recording and submission can be done offline. The collected data can be easily and quickly transferred from the smartphone to a laptop using a local Wi-Fi network. The app is open-source.

low- and non-literate users, but this shortcoming could be remedied using audio-elements and pictures. One could go some steps further and use mobile tools and apps not only for the evaluation, but also for the monitoring and management of development projects. The recording of data in real time would allow for quick adjustment and improvements to development projects once new opportunities or problems become visible. One should be careful, however, not to completely dismiss traditional ways to collect data in this context. Traditional data collection methods still have a lot to offer and are an important feedback mechanism. Specifically qualitative data collection methods are difficult to replace (and should not be replaced) because of their flexible and complex nature.

ETHICAL STANDARDS MUST NOT BE NEGLECTED

Clearly, some of the thoughts and ideas discussed above are easier to follow than others and should always be carefully weighed against existing data collection methods. Also, a number of them would need a strong focus on ethical standards, especially when private data such as GPS data are being employed. Additionally, smartphone penetration might still be too low in many areas to rely on mobile phones by respondents, which would lead to selection biases. So far, studies are likely to need to provide smartphones to the respondents. However, this may change in the next years given the recent and rapid rise of smartphones. Using them would then allow real "citizen science" studies.

In summary, the digital revolution does not only offer new development opportunities for users in developing countries, it also provides fascinating new pathways for researchers and development practitioners. Well-tailored mobile tools enable researchers to obtain highly valuable and accurate data – potentially in real time. Some of this data would be very difficult or impossible to collect using conventional data collection methods. Cleary, this benefits development practitioners. For them, access to accurate data is a key factor to design appropriate policies that allow increases in sustainable productivity on farms and reductions in hunger and poverty. This is also true for researchers: mobile tools and apps may allow them to tackle entirely new and so far neglected (but potentially crucial) fields of research. Many of these new fields may be transdisciplinary in nature. Overall, mobile tools and apps could enable us to get a much more nuanced understanding of complex smallholder farming systems in particular, and new and improved general insights into developing countries.

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