



## Sustainable Agriculture through ICT innovation

### Mobile Assistant for Monitoring Plant Pests and Diseases

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#### ABSTRACT

The federal advisory services in Germany are legally obligated to provide a warning service for farmers. This is to alert in time about possible dangers to crops so that appropriate control measures can be taken. Recommendations are largely based on representative field observations of the first occurrence and the development of plant pests and diseases. For more than ten years, these monitoring data can be entered into and viewed online in the German advisory portal [www.isip.de](http://www.isip.de). Now mobile web pages have been developed to permit the input of data at the location of assessment. As a special feature, these web pages are fully functional even when offline, because the network coverage in the rural areas of Germany cannot be considered comprehensive.

**Keywords:** Mobile device, web application, monitoring, Germany

#### 1. INTRODUCTION

On behalf of the federal advisory services, the Information System for Integrated Plant Production (ISIP) delivers online decision support to farmers and advisors for more than a decade. ISIP co-operates thereby closely with the Central Institution for Decision Support Systems in Crop Protection (ZEPP), whose main task is to develop and maintain simulation models for plant pests and diseases. Using decision support systems (DSS) results on the one hand in advantages for the farmer who can optimize the application of plant protection measures and at the same time lowering their environmental impact. On the other hand, the advisory services disseminate their information in a much more efficient way.

The federal advisory services are legally obligated to provide a warning service for farmers. To achieve this, the most important plant pests and diseases are monitored periodically on regionally representative fields. As a rule, these monitoring data are taken down on-site on paper and are later transferred into ISIP web forms or other electronic systems. This procedure is so laborious and error-prone that a mobile, digital

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data logging is a long-term request by the service's staff. First approaches based on PDA technology did not yield the desired results, but gave valuable hints for the definition of a user-friendly application. The rapid spread of smartphones now offers a cost-efficient and universal technology that does not only allow a mobile data acquisition but moreover the possibility to send the data to a central server via mobile internet. Thus the aim was to develop a smartphone application that is independent on the mobile operating system but that also functions offline, because comprehensive network coverage cannot be taken as given in the rural area as the designated site of operation.

Parts of the application were developed in two different projects.

From 2009 to 2012, the iGreen project was set out to develop and realize a network of location-based services and knowledge, which integrates various public and private information sources. This network allows the realization of mobile decision assistant systems which facilitate the decentralized support and optimization of cooperative production processes, reaching improved energy efficiency, economic advantages, and environmental benefits. In this project, mainly the server-sided components of the system were developed.

In 2010, a project called "Demonstration Farms Integrated Plant Protection" was started. On selected farms, all plant protection measures are documented in detail. In addition, the motivation for these decisions has to be assessed, amongst others by closely monitoring the first appearance and the development of plant pest and diseases. Also in this project, the mobile monitoring application was further developed; especially the advisors gave valuable feedback to the usability.

## 2. MATERIAL AND METHODS

In order to provide an utmost compatibility with current mobile operating systems, the assistant system has been designed as a web application. This avoids the (costly) necessity to develop native apps in parallel and to distribute them in the respective app stores. Moreover, the update process of a web application is very simple so that new functionality can be made available without any difficulty. The system has successfully been tested on Android and iOS with the most common mobile web browsers. Sounding like a paradox, this web application can also be used without internet access. On the first download, the application saves itself to the local storage of the browser. Data can then be typed into the system anywhere at any time and send only to the server at the availability of a stable internet connection.

### 2.1 Components

The application consists primarily of one HTML5 file which contains all necessary web pages for input and administration of monitoring data. This file is dynamically generated by a JAVA servlet specific to the user and the assessment scheme and is

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stored in the local application cache of the browser for offline usage. The HTML file furthermore stores the following auxiliary components in the browser's cache:

- The jQuery mobile framework<sup>1</sup> to unify the graphical user interface and to guarantee the compatibility with the main browsers of the different mobile operating systems,
- the jStorage Javascript plugin<sup>2</sup>, which provides a key-value-database in the main browsers and
- a number of cascaded style sheets and images.

## 2.2 Workflow

Initially, the monitoring sites to be used with the application have to be fully defined by filling out the respective web forms in [www.isip.de](http://www.isip.de). Then the application is started by typing the URL <http://mm.isip.de> into the mobile browser. Since all further steps are specific to user and assessment scheme, a login to the ISIP system is necessary (Fig. 1). After a successful login, a list of links to possible assessment schemes is shown (Fig. 2). A click on one link opens a new browser window and starts the JAVA servlet which generates the HTML file. This file in turn automatically downloads the monitoring sites stored in ISIP – and the latest dataset as far as there is one – to the smartphone (Fig. 3).

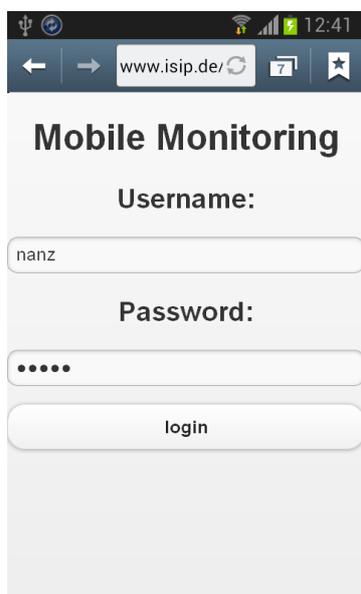


Fig. 1: Login to the ISIP server

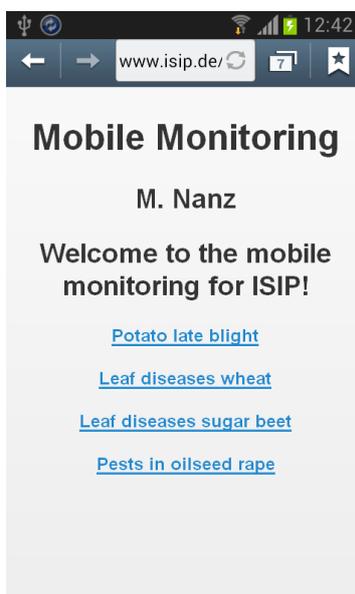


Fig. 2: Selection of assessment scheme

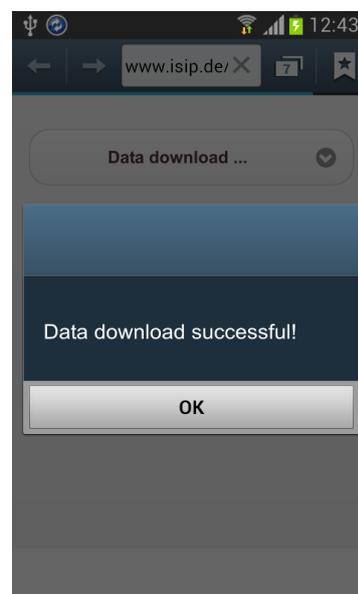


Fig. 3: Download of monitoring sites and data

<sup>1</sup> <http://jquery.com/>, <http://jquerymobile.com/>

<sup>2</sup> <http://www.jstorage.info/>

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Also in the local storage of the browser, all data are saved user and scheme specific. This ensures that no local data is lost, neither when the same user loads another scheme nor when another person wants to use the application on the same mobile device. When the data are successfully downloaded from the server, two new buttons appear on the main screen: 'Enter data' and 'End monitoring' (Fig. 4). The latter just closes the window without any further action and the user is taken back to select another assessment scheme. A click on 'Enter data' opens the entry form on which the first monitoring site is selected and the input fields are initialised with the values of the last data set (Fig. 5).

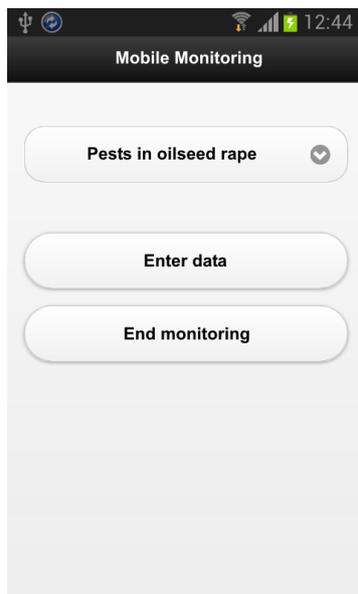


Fig. 4: Main screen without data in local storage

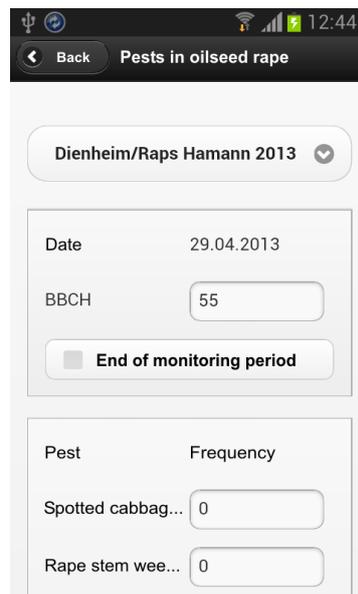


Fig. 5: Input fields for monitoring data

Data are entered either by check boxes or numerical input fields. Clicking on an input field selects its contents and opens the numerical key pad of the smartphone (Fig. 6). The main entry form receives the results of a monitoring site (Fig. 7). In the example of pests in oilseed rape, the total average of pests caught in the yellow trap(s) is entered. In the case of multiple traps per site, the user can click on 'Enter single values'. A new form shows up in which the catches of each trap can be entered. Finally, the results are averaged and copied into the main entry form. The data entry is finalised by clicking on 'Save data'. All data entered are saved to the local storage and the user is redirected to the main screen on which two more buttons are visible now (Fig. 8): A click on 'Upload data' initiates (a) the upload of all local data to the server and if successful (b) the erasure of the local storage and (c) the re-download of all data from the ISIP server. This procedure ensures that server and local database are always in sync. Clicking on 'Delete data from smartphone' erases the local storage after a confirmation prompt.

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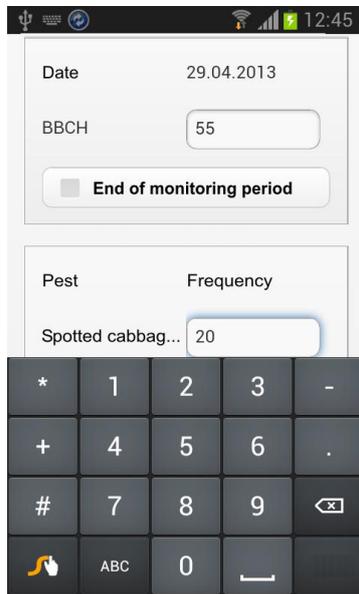


Fig. 6: Input of numerical data

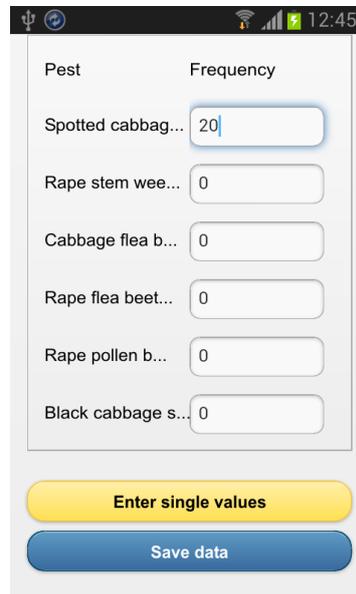


Fig. 7: Main entry form with single value entry and data storage

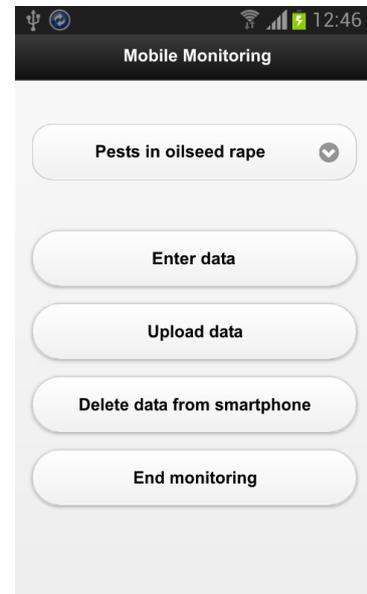


Fig. 8: Main screen with data in local storage

### 3. RESULTS AND OUTLOOK

In 2013, the application is used in the ISIP monitorings of pest and diseases in oilseed rape, cereals, potato and sugar beet in different German federal states. The first feedback from advisors is very promising. Special attention is paid to the security of data storage, because nothing is more aggravating than a data loss that cancels out a day's work. The application does, however, run very stable in this respect, so that the technical approach will be further pursued. Also the simple update process has proven advantageous: Bug fixing, additional assessment schemes, advances in usability and extended functionalities are rolled out to the user by just replacing the HTML file.

For the time being, monitoring sites have to be set up in ISIP prior to the actual data assessment. In the medium term it is planned to use GPS readings to (re)localise monitoring sites and to equip the system with offline maps for easier navigation.

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