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Developing a mobile GIS application related to the collection of land data in soil mapping studies

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ABSTRACT

Soil is the one of the most important natural resources having direct and indirect effects on human life, foremost on food supply. Moreover, two of the most important sources used in many sectors such as agriculture, forestry, environment, planning, related to the conservation of soil, are soil maps and soil reports. There is a need for proper and up-to-date soil maps produced with support of technology to achieve sustainable management of land and soil successfully. In order to facilitate the collection of soil data on site in a correct, fast and reliable way in soil survey and mapping studies, and therefore to produce soil maps with high accuracy, a mobile GIS application called “Soil Data System” was developed in this study to work in mobile devices which are driven by Android 5.0 and above. The developed application was tested in “Abadan Erosion Control Project” implementation area, which is located in the boundaries of Ankara, Turkey and was completed in 2016 within the General Directorate of Forestry of The Republic of Turkey, and various findings were obtained after comparing the application with classical soil survey and mapping studies. As a result of the analyzes, it was observed that Soil Data System contributed positively to soil mapping process in many aspects such as accuracy, transparency and time.

1. INTRODUCTION

The soil covering the world like a thin carpet is an important natural resource that is the source of life on Earth. The soil, which is composed of air, water, minerals and organic materials, hosts many life forms and directly or indirectly provides the food needs of living beings. Despite all these important functions, unfortunately, soil is not considered as a renewable natural resource (URL 1). Under suitable environmental and climatic conditions, it takes 200 to 400 years for a soil layer of 1 cm to be formed, but the amount of organic matter in the soil is around 3000 years (URL 2).

Housing and food security pressures, improper agricultural practices and unplanned urbanization threaten the soil that plays an important role in providing food to people through agriculture. Because of this threat, countries aim to use land in the most efficient and efficient way by implementing sustainable land and soil management practices in the main sectors such as agriculture, forestry, reconstruction and environment (FAO 2018).

One of the most important sources used in applications and projects developed to ensure the accurate and sustainable use of land is soil maps (Güler et al. 2016). Soil mapping and related reports produced at the result of soil survey and mapping studies are used effectively in agricultural implementations, forestry activities, zoning plans, environmental management, land planning and management and different engineering branches.

The only soil map covering the whole of Turkey is `` Turkish Great Soil Groups`` map, which was produced by the General Directorate of Soil and Water in 1965 and until today several updates and

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improvement work has been made on. The map of the Turkish Great Soil Groups, which has been used by public institutions and the private sector for many years, has become out of date despite revisions made over the years (Tanrıkulu 2017). For this reason, many institutions and organizations, especially the public sector, carry out soil mapping studies with their own budgets in order to produce more accurate soil maps and use them in their projects. As most of these soil maps and reports produced by different institutions are not in certain standards and are not stored digitally, data sharing is also very troublesome; thus, it becomes difficult to avoid duplication and to stop wasting resources.

Soil maps are produced by using the characteristics of the soil taken from the plot through the relevant field studies and the sensitivity and accuracy of the soil data collected from the plot directly affect the last product, the soil map. However, in many soil-mapping studies, the data to be used in soil mapping production is not collected or cannot be collected from the plot with sufficient accuracy and sensitivity. For this reason, soil maps that do not reflect the current situation in the field are produced and have negative effects on the projects and works in terms of time, cost and accuracy.

The most important step of soil mapping and survey studies is undoubtedly the field studies. Since field studies are costly and time-consuming process, institutions, organizations and companies try to reach the most accurate data with minimum cost. In particular, some critical problems encountered in soil mapping studies where control is difficult and personnel experience is very important, can be listed as follows.

- ✓ In some field studies, moving the location determined for the profile to different places and collection of the data of different soil types because of not using or misusing the hand GPS.
- ✓ Inaccurate collection of data of soil profiles by unskilled personnel (such as soil moisture, lime and clay layers).
- ✓ Problems caused by the transportation and security of equipment and documents (GPS, camera, printed maps, survey reports, etc.) provided to the field personnel for use in the field (such as time and data loss).
- ✓ Inaccurate or incomplete entry of profile information in the field.
- ✓ Not photographing the profile points according to a certain standard and/or not matching with the correct profiles.
- ✓ Not being able to control the field study simultaneously by the project manager at the office.
- ✓ Not being able to share the data saved in the reports and tables in paper medium with different users and some data losses over time.

Although the advances have been made in the production of soil by means of remote sensing, autonomous soil profile analysis tools and drone techniques in recent years to prevent the problems encountered in soil mapping studies, the soil maps produced with these new techniques and methods don’t have the desired accuracy and sensitivity or they increase costs very much.

However, mobile devices such as smartphones, tablet computers, and developing internet infrastructure attract users, especially in the field of faster and more accurate data collection and managing field operations simultaneously. Geographical information systems give opportunity to analyze these data collected from the field in a fast and reliable manner and to produce thematic maps and result reports. The use of GIS and mobile technologies, especially in natural resource mapping, is financially advantageous too (Delibaş et al. 2015).

Today, geographic information systems, remote sensing and web-based mobile applications have been used frequently in many fields such as agriculture, environment and planning (Zelt and Dugan 1993; Tomko 2003; Sood et al. 2015; Marti et al. 2012; Eymen 2019; Dogan and Yakar 2018; Khorrami et al. 2019; Orhan et al. 2019). Geographic Information Systems and mobile data collection systems are used in more and more projects every day in the field of conventional land mapping, especially in the creation of land inventory, the establishment of a soil information system, the mapping of natural resources, and the reduction of cost and time (Weber et al. 2008; Solmaz 2010; Giardino et al. 2010; Lwin and Murayama 2011; Xiaolina et al. 2012; Abdelfattah and Kumar 2014; Sahu et al. 2015; Olyazadeh et al. 2017; Ernst et al. 2019; Iscan and Ilgaz 2017).

In this study, a web based mobile GIS application called Soil Data System, which helps the accurate and transparent collection of soil data from the field in soil mapping and survey studies, and also enables managers to monitor and manage all field studies has been developed.

2. MATERIAL and METHOD

2.1. Introduction of Study Area

The Abadan Erosion Control Project, which was completed in 2016 within the General Directorate of Forestry of the Republic of Turkey, was selected as the study area. The Abadan Erosion Control Project is a study carried out in 355 ha area within the Abadan neighborhood of the Pursaklar district of Ankara Province in Turkey (Figure 1). The satellite view and the ground view of Abadan Erosion Control implementation area is given in Figure 2 and Figure 3. During the field study phase of the project, 38 soil profile points were opened in the field for the soil mapping and survey section and the related soil reports were filled.

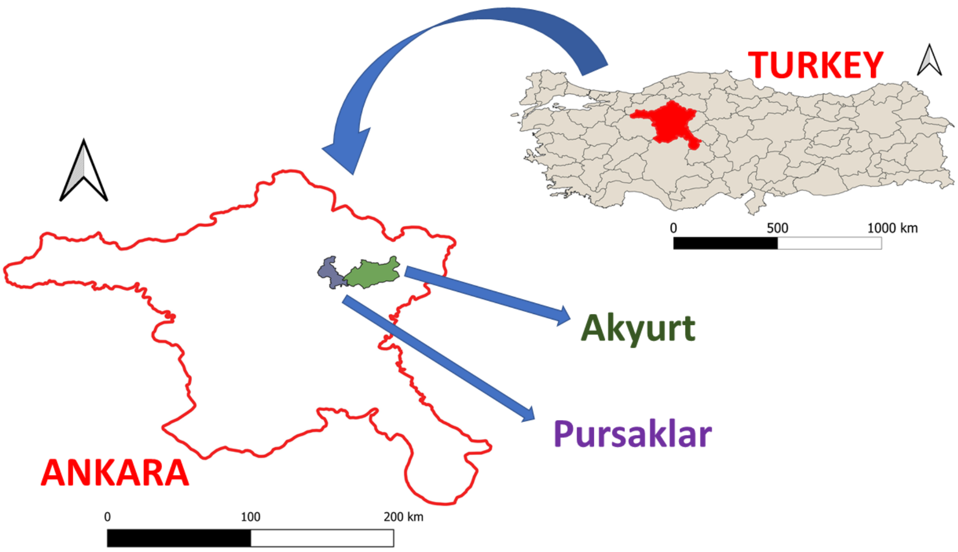


Figure 1. Study area

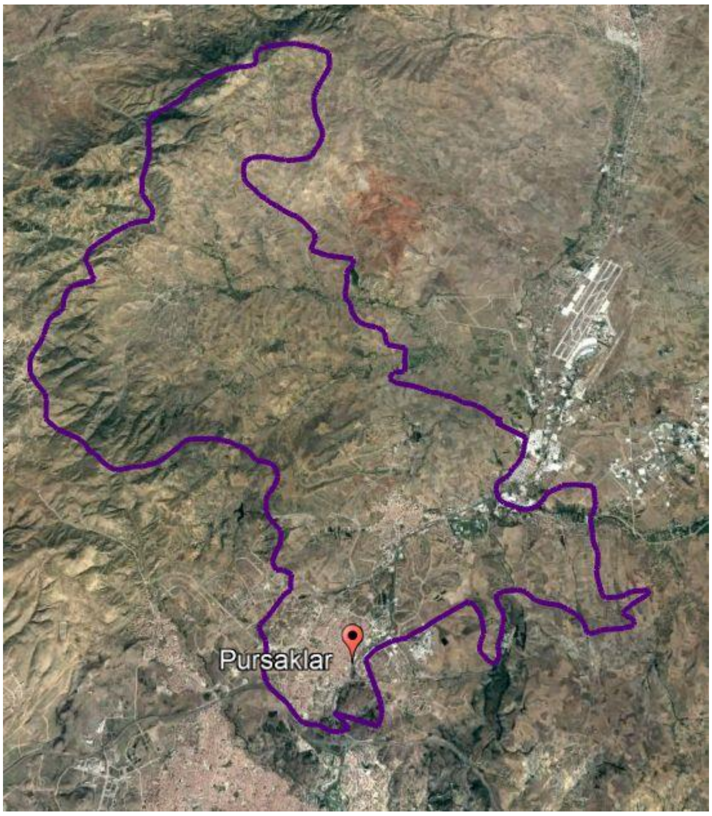


Figure 2. Satellite view of Abadan project area

Figure 3. Ground view of Abadan project area

2.2. Soil Map Production Process

During the soil mapping process, soil samples named as probes or profiles, the locations of which are determined on the map during the preparation phase, are opened in the field at field study and relevant data are collected. The physical and chemical information of soil is obtained from the profile points opened on the ground for use in soil map production. The physical properties of the soil are obtained by observation and some field test kits during the field study and processed in the reports or tables, while the chemical properties are obtained after analysis of the samples taken from the field in the laboratories. Depending on the intended use of the soil map, all profile points can be sampled and sent to the laboratory for analysis, as well as only some amount of soil sample representing the site can be collected and sent to the laboratory. Soil maps are produced in the light of the physical data collected from the field and the results obtained from the soil laboratory.

Although soil maps are produced on the same principle in general, they may differ according to their usage area. Soil analyzes and soil depth sought in a soil map to be used in agriculture are different from those properties required in a soil map to be used in forestry. Although the techniques and technologies used differ, the general lines of the production process of conventional soil maps conducted in particular in agriculture and forestry consists of the following steps;

- ✓ Before the field study, the locations of the profile points to be examined and sampled through the computer or print map are determined in the office. Profile frequency and distribution are determined according to the quality of the study to be performed. The coordinates of these profile points are printed and filed or simply entered into the hand GPS. In the absence of hand GPS, the planned profile points are marked on the map (usually with a 1/25000 scaled topographic map).
- ✓ The number of personnel is determined according to the number and intensity of the profile and the personnel is informed about the site; soil survey reports, maps, cameras (if any) and hand GPS (if any) are delivered to enter the information of profile points.
- ✓ Field personnel go to the field and reach the profile points to which they are responsible, with the help of hand GPS or map. It enters the information about the profile points manually into the study reports and collects the soil samples to be sent to the laboratory for analysis. If the profile points that the coordinates of which are determined in the office coincide with an unsuitable location in the field such as rivers, buildings and rocky areas, the field personnel shift the position of the profile point on the ground and process the coordinates of the new location on the survey report. The staff also records additional information to be used during the production of the soil map (such as the change boundaries of the soil pattern).
- ✓ After the field study, physical properties of profile points opened in the field are obtained from survey reports and chemical properties are obtained from analysis reports of soil samples sent to the laboratory. Soil map is produced in the light of observation and experience of the personnel in the field and of this information.

2.3 Soil Data System

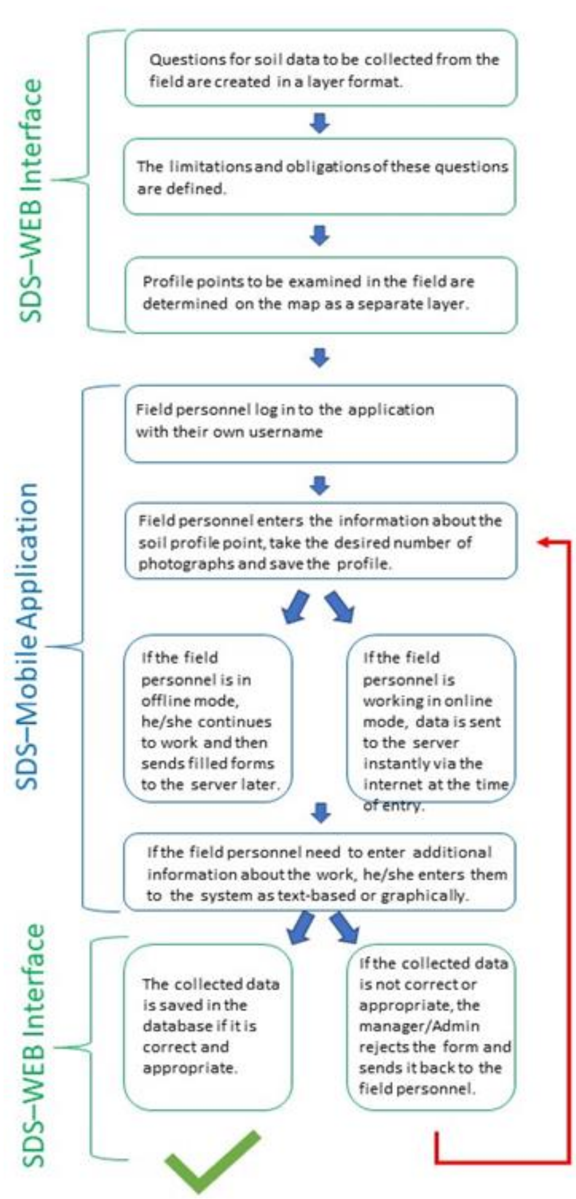
Soil Data System consists of a mobile application operated by Android and a web interface that is integrated with this application. While the mobile application was developed with a focus on the quality of the data collected from the plot, the web interface was designed mostly as admin panel and geoportal (Flowchart 1).

2.3.1 Web interface

The Web interface developed within the scope of the study enables project managers to coordinate the field studies conducted for soil mapping and also the authorized users to display via free base maps such as "Bing", "OpenStreetMap", "Here" and "Yandex" the field data collected from the plot. All users logging in to the web interface can act within their authority and display maps. For example, a normal user can only see work in a zone where he or she is allowed, or even view land data within his authority while a user with an admin role can create new user accounts and set privileges, while (Figure 4).

Users with administrative authority can create questionnaires of soil data to be collected in the plot via web interface and identify other details such as type of questions, data entry methods on the mobile device (numerical, multiple choice, text based, etc.), sections required to be filled and minimum and maximum number of photos to be taken per profile (Figure 5).

When field teams are online the project manager can monitor on the Web interface simultaneously and intermittently where each staff located is and what data are they collecting. Therefore, the web interface is an important tool for planning and managing soil and land works (Figure 6).



Flowchart 1. Soil data system

2.3.2 Mobile application

The Mobile Application was developed on the Android to make it more accessible for users and the development steps to be relatively more practical (Figure 7). The application is designed to work on all mobile devices, such as smartphones and tablets computers, computers with integrated GPS and camera (for photo capture), compatible with Android 5.0 and above.

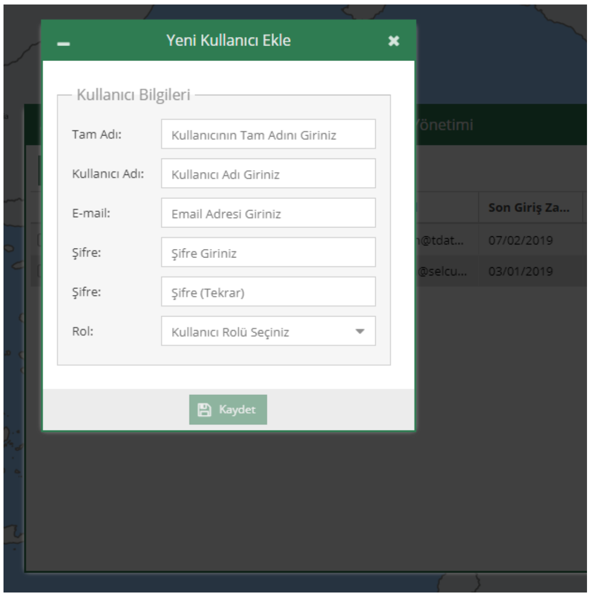


Figure 4. Web interface user creation window

Görünen Ad	Kolon Adı	Tip	Tanım	Benzersiz	Zorunlu	Etiket
Iskelet_Hacim	isklthcim	Çoktan Seçmeli	Iskelet	Hayır	Evet	Hayır
Struktur	struktur	Text		Hayır	Evet	Hayır
Kirec_%	kirec	Çoktan Seçmeli	Kirec	Hayır	Evet	Hayır
Ph	ph_	Double Precision		Hayır	Hayır	Hayır
Kok_Dagilisi	kokdagili	Çoktan Seçmeli	Kok_Dagilisi	Hayır	Evet	Hayır
Arazi_Yuzey_sekli	ays	Çoktan Seçmeli	Arazi_Yuzey_Sekli	Hayır	Hayır	Hayır
Toprak_Derinligi(M)	td	Çoktan Seçmeli	Toprak_derinligi(M)	Hayır	Hayır	Hayır
Toprak_derinlik(F)	toprakf	Çoktan Seçmeli	Toprak_Derinigi(F)	Hayır	Hayır	Hayır
Toprak_Suyu	ts	Çoktan Seçmeli	Toprak_Suyu	Hayır	Hayır	Hayır
Drenaj	drenaj	Çoktan Seçmeli	Drenaj	Hayır	Hayır	Hayır
Humus_Turu	humusturu	Çoktan Seçmeli	Humus_Turu	Hayır	Hayır	Hayır

Figure 5. Web interface – Creation of data fields

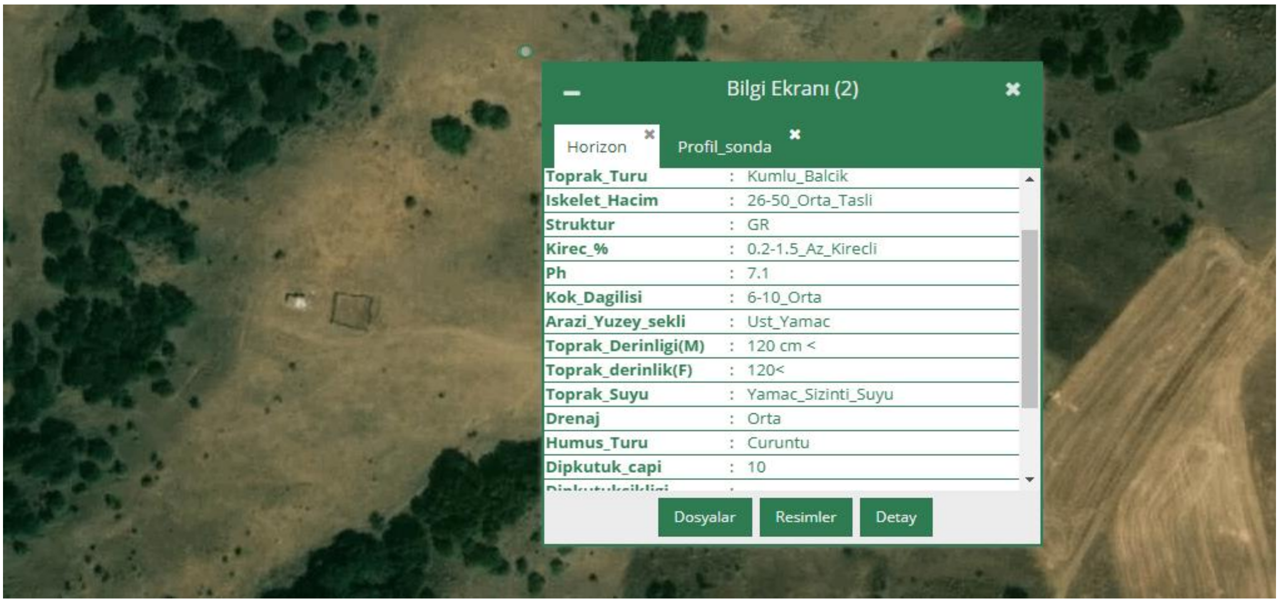


Figure 6. Web interface - Monitoring of collected soil profile data

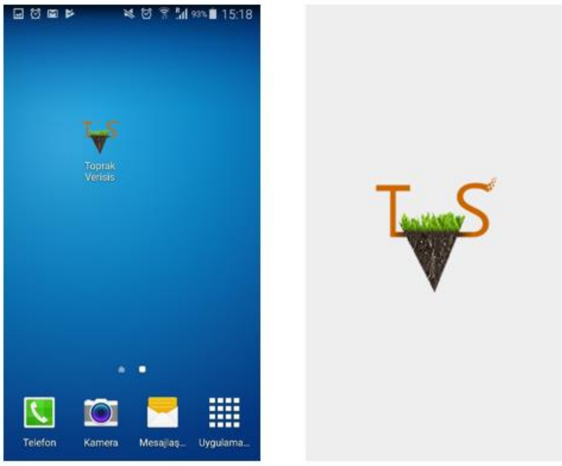


Figure 7. Soil data system – Mobile application short cut and login screen

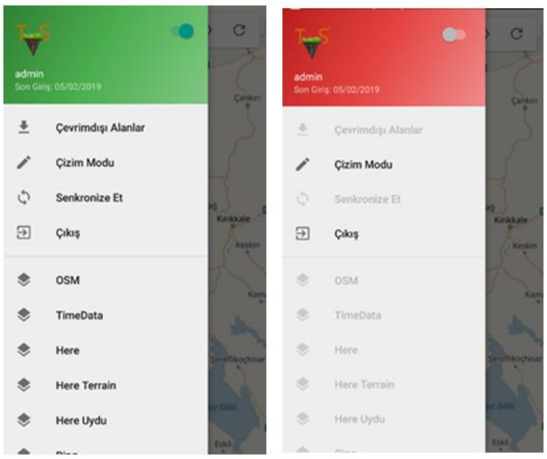


Figure 8. Mobile application online offline mod

During data collection, the mobile application automatically records the coordinates of the profile points with the GPS property of the used mobile device and does not allow the user to interfere. The mobile application can be used online or offline during the fieldwork (Figure 8). When working online, the collected data are simultaneously transferred to the web interface. In this context, if it is necessary to make changes in the previously formed questionnaires related to the data to be collected from the plot during the field study, the administrator can make the relevant change through the web interface and send it to the mobile application. When the users in the field log off and log in again the system, they can see the updated version of the modified questionnaire that has been sent to the mobile device via the application. In this way, field staff can make necessary corrections related to soil data to be collected while in the field without interrupting the field study.

If the necessity of taking photos during the field work is defined through the web interface, the field staff takes the required amount of photos through the mobile application and these photos are automatically matched with the related questionnaires and transferred to the database and thus to the web interface.

The mobile application supports free map platforms such as “Bing”, “OpenStreetMap”, “Here” and “Yandex” to provide convenience to the users in the field and offers them as a base for users (Figure 9).

In addition to collecting text-based and numerical soil data through the mobile application, users can also create geometric objects such as points, lines and areas on their mobile devices and add feature data to them. The capability, which gives the developed application a mobile GIS feature, enables the more accurate production of soil maps, which are the final product, more accurately, and also helps to add different details such as social problem areas or protected areas related to the study area to the study geometrically (Figure 10).

Since data entry techniques, methods, restrictions and authorities to be made through the mobile application are defined over the Web interface, the user cannot change such settings through the Mobile application. However, users can enter the web interface and make transactions with the web browser of mobile devices in the frame of their authority.

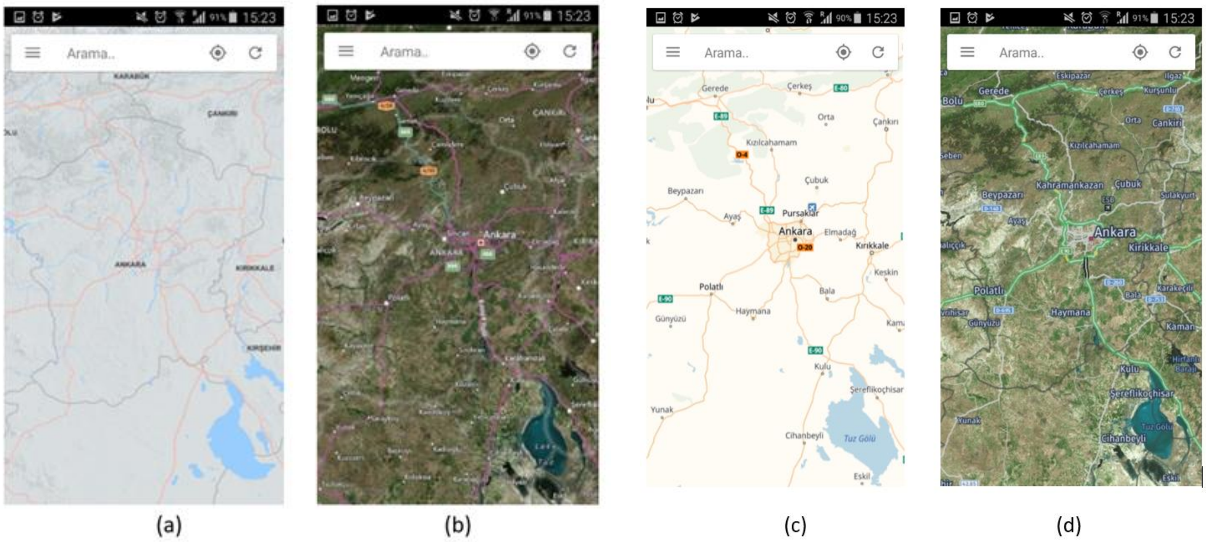


Figure 9. Base maps of mobile application (a) Open street map (b) Yandex satellite (c) Yandex map (d)Bing satellite

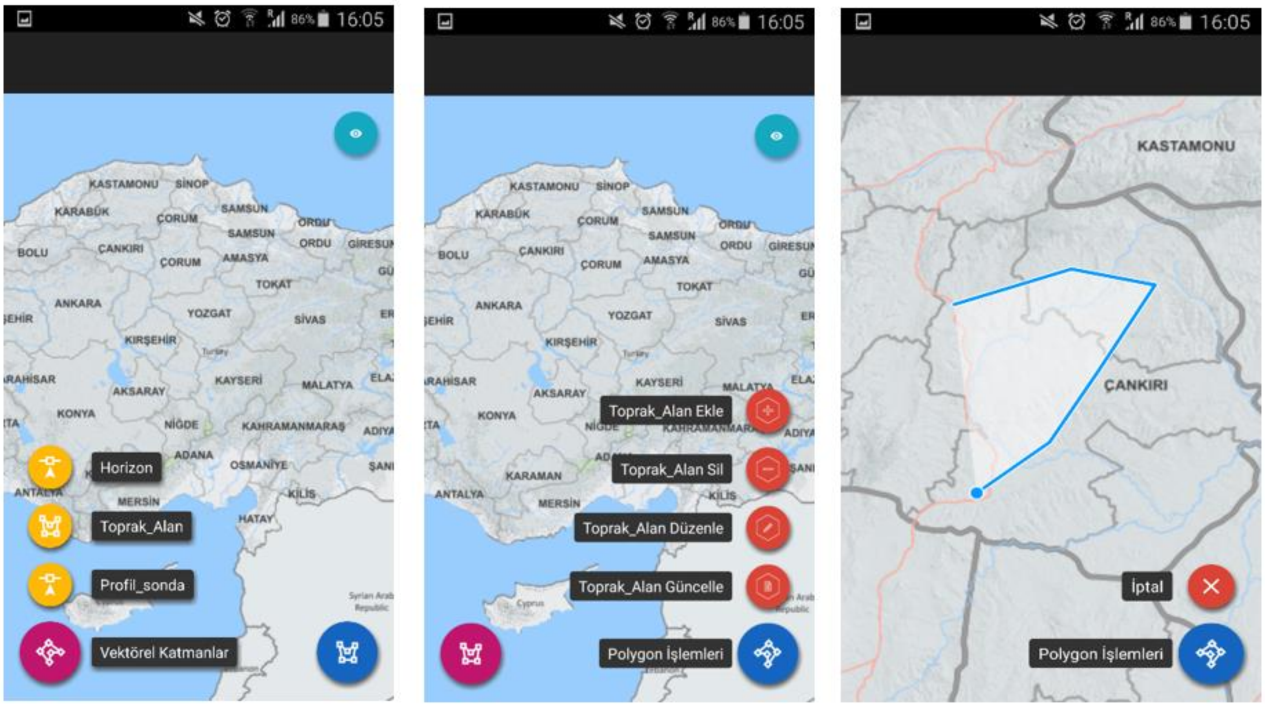


Figure 10. Drawing mod of mobile application

3. FINDINGS and DISCUSSION

In order to test the Soil Data System which was developed in order to contribute to the soil mapping and survey studies, firstly the copies of the soil survey reports and soil map of the "Abadan Erosion Control Project" were obtained from the project file. The account was created and authorized for the field personnel through the web interface of the Soil Data System. In addition, the questions in soil survey reports of the project were created through the Web interface and the authority and constraints of the questions were defined. Two interrelated layers were produced in order to facilitate subsequent analysis. (Profil_sonda and horizon) An independent layer (Toprak_Alan) has been created to draw fields and make annotation on the mobile device in the field (Figure 11). Before and during the study, the fieldwork team was contacted for the "Abadan Erosion Control Project" and detailed information was obtained about the field study carried out previously for the project (encountered difficulties, how they are solved, working time, etc.).

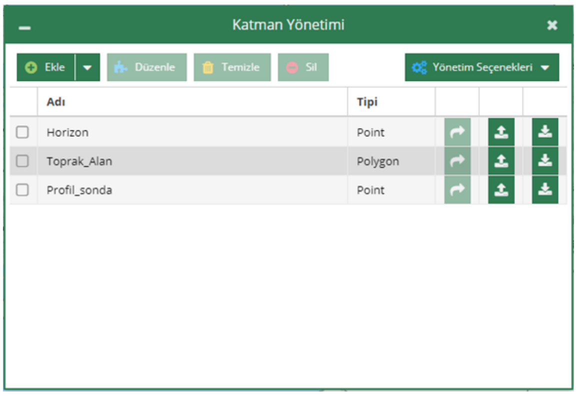


Figure 11. Soil data system – Layer window

Within the scope of the field study, the profile points opened previously were visited and the profile information was read from the soil survey reports on the paper and entered into the system via mobile device (Figure 12). Since the purpose of this application study is not to test the accuracy of soil profile information but the operation and efficiency of the system, the accuracy of profile and horizon information has not been taken into consideration. Since the time taken for opening the profile point, performing field tests and interpretation would be the same in both methods it was not added to the comparison while entering the profile and horizon information.

In order to compare the soil data entry times of the system developed with the classical method, data entry for each profile was made in two ways. At each profile point, data entry was made with the help of the system developed on the mobile device, and then data entry was made by the conventional method, in other words manually filling the soil survey reports, reading and recording the profile coordinates via hand GPS and taking photographs with a camera. In the field study conducted within the scope of the application study, it took an average of 30 seconds for each soil layer (horizon) to be entered into the Soil Data System via the mobile device. Therefore, it takes 60 seconds for the information of a soil profile with 2 horizons to be entered into the system via mobile device. This time includes photo shooting time too. In order to reapply the conventional soil survey and mapping studies, each soil horizon (layer) information was manually entered into the survey reports in the paper environment and as a result of this process it was observed that the input time of soil data of a horizon was 65 seconds on average. 1 photograph was taken for each horizon and the number and date of the photograph were recorded in a different book for later matching, with an average duration of 30 seconds per horizon. Consequently, the recording time of a profile with two horizons with two photographs was 190 seconds on average. The times obtained in this study are optimal and may vary according to the ability, capability and working conditions of the field personnel.

Due to the previously defined mandatory fields and restrictions through the web interface, there was no information field, in a word, soil data that was forgotten when entering data with the mobile application. Minimum 2, maximum 3 photo rule per profile determined in the office via web interface worked effectively in mobile application, photographs of all profiles were taken and transferred to the system automatically.

The location information (coordinates) of the profile points were received by the GPS feature of the used device and transferred to the server automatically associating to the relevant profile without allowing user intervention. When the user opens a new data entry form at each profile point, the system records the current location information (Figure 13).

Unlike conventional field studies, only mobile devices were used in this field study and documents, equipment such as files, stationery materials, cameras and hand GPS were not required to be carried. This equipment, documents and tools were only used to simulate the classical soil mapping work. Although mobile internet can be used due to mobile phones in the area where the field study is conducted, a part of the study was conducted in offline mode and at the end of the study, all the soil data collected in offline mode was sent to the server at once. The offline mode also has a significant positive contribution to the battery life of the mobile device. During the field study, a staff member with the authority of the manager in the office added 2 additional questions for the purpose of testing, and when the field personnel logged off the application for a few seconds and logged in again, field personnel observed that these new questions were successfully transferred to the device. During the fieldwork, the base maps were successfully loaded when the application was online and the nearby settlements and road information were tracked smoothly through the application, especially for transition to the site, possible emergencies and return. Finally, in the field study, the outer boundary of the project area was drawn by using the location information over the mobile device and some test-purpose information was recorded as attribute information. This area formed on the field was created in "shape file" format and transferred to the map portal automatically. The test-purpose line and point objects have been successfully created in the field and it is seen that all objects in the field can be produced with point, area and line objects when necessary.

Figure 12. Profile points on site

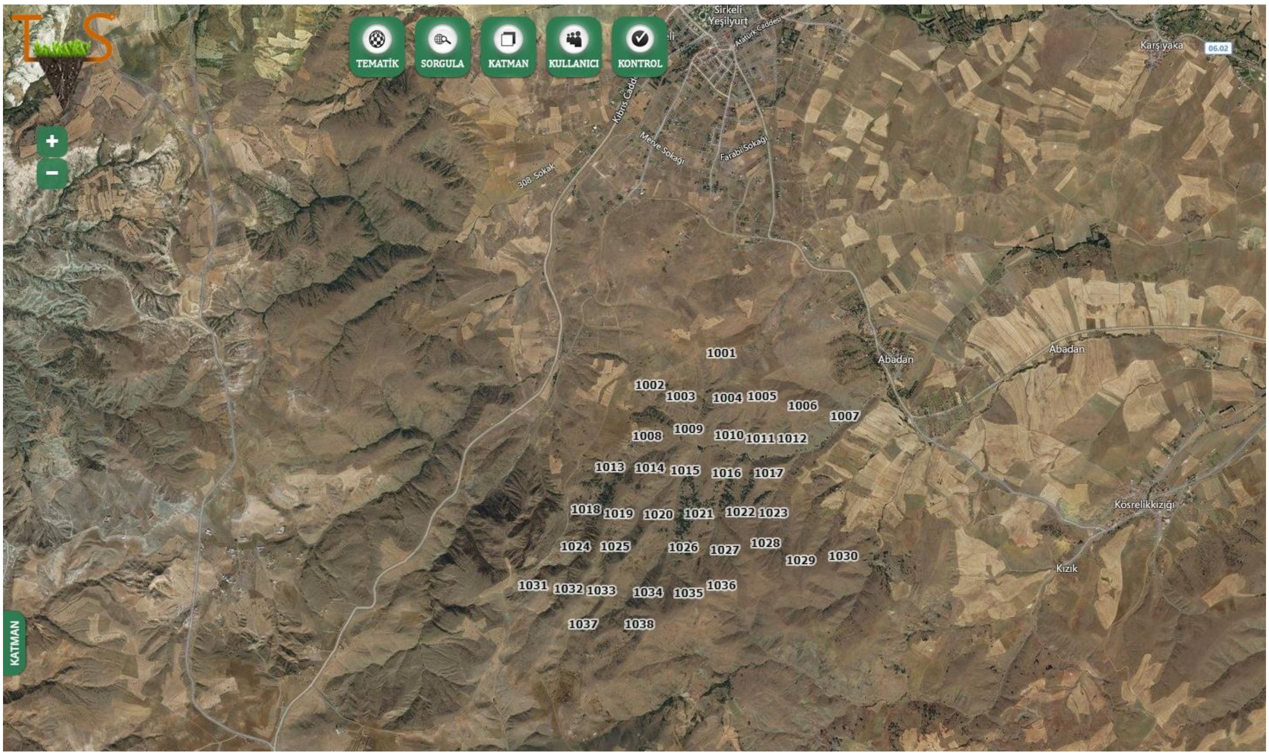


Figure 13. Profile points entered into the system via mobile application

According to the findings obtained as a result of the comparison of conventional soil survey and mapping studies with the developed mobile system; first of all, the system gives project managers a serious control opportunity, while providing practicality and rapid mobilization to the field personnel. Since the actual position of the profile points is obtained by the own GPS feature of the device, it could be assured that all profile points were opened in previously planned places since it does not allow external intervention. When the position of the profile point has to be shifted due to field conditions, the new position of the profile point was automatically saved in the system. In conventional soil mapping studies, field personnel often collect these coordinates from the site, since they have the coordinates of the profile points on the survey reports and the control engineers have no time and opportunity to go to each profile point on the site.

In conventional soil mapping studies, the control engineers or project managers have to accept coordinates of profile point because most of the time they don't have time to go and check all the profile points.

This developed system brings a serious solution to this problem. In particular, the studies carried out by staying connected to the Internet during the work can be monitored simultaneously by the project manager or control engineer, thus correcting errors or deficiencies during fieldwork.

In the system, which was developed in place of the equipment and devices such as paper/printed maps, soil survey reports and charts, cameras, hand GPS used in conventional soil mapping studies, only one mobile device (smart phone) and mobile power supply (Power bank) were used. These equipment and devices used in conventional soil mapping work lay a serious burden and responsibility on field personnel in the later hours of field work. In particular, if the soil surveys and report on the paper environment where the profile information is entered cannot be brought to the office environment in full, it is necessary to go back to the field in order to complete the soil mapping study. While moving back to the field has a very negative impact on morale and motivation for the whole team, it is also a waste of time and cost. Through the Soil Data System, all data is transmitted to the server and thus to the control engineer or project manager without any burden on the user wherever there is internet access (mobile internet or WIFI),

The mobile application of the Soil Data System requires an Internet connection for a few seconds at the first login only to withdraw the user's authorization and identification from the server. After logging in the application with the user name and password, can be worked offline (in offline mode) until the end of the operation. This feature has been added to the application by considering the fact that many regions where soil surveys are conducted are in forested and agricultural areas away from the city centers. Another advantage of offline operation is the capability to use the battery of the mobile device more economically. In the studies that are more sensitive and project manager guidance is required, field staff may be asked to work online and field data sent to the server while the staff is in the field will be reviewed simultaneously by the control engineer or project manager and if necessary, some soil profile surveys may be required to be redone.

In many soil mapping and survey studies, it is not obligatory to take photographs of the pits of the soil profiles and their surroundings. In the studies that photograph is obligatory, photographs are taken with cameras or mobile phones, which can lead to transfer, storage and photo-profile matching problems. Thanks to the application developed, it is possible to make photo of the profiles obligatory and define the upper and lower limitation for the number of obligatory photographs per horizon. The taken images are encoded by the software and assigned to the corresponding profile automatically. In this way, there will be no need to carry out operations such as matching or naming images with profiles and each profile in the system will be kept with its own photographs. The project manager or control engineer may define some rules over the system depending on the type or region of the work performed (4 pieces for north, south, east and west directions, 2 for each horizon to see the general structure of the area, etc.). These profile photographs can be displayed on the map along with other soil features.

Soil maps are produced with the profile data opened in the field and analysis reports from some samples and observations made in the field and generally strengthened with experience. Profile information and analysis reports are documented in a way, even on paper, but it is not easy to graphically document the observation in the field. With the help of the mobile application developed, it is possible to produce the information to be used as vector in soil map production such as pattern changes on the surface of the field, topographic ridges and geological changes, and attribute information of these graphical data can be entered if desired. In the field study, the field personnel drew a draft soil map during the study, entered various attribute data and sent it to the main server over the internet along with the other data. These data are not permanent and are only produced to support the soil map production process and can be exported in "shape file "or "Kml" format if desired.

When comparing the soil map of Abadan Erosion Control Project produced with the classical methods and the mobile application of the Soil Data System and the draft map drawn in the field by hand, the project boundaries overlap to a great extent, which in turn contributes greatly to the soil map production process in terms of accuracy and speed (Figure 14 and Figure 15).

In addition to the many advantages of the Soil Data System, it can be shown that the charging of the mobile device used as a disadvantage is not sufficient for field works. Today, there are also mobile devices with very strong battery capacity, but the cost of these devices is considerably high. In order to eliminate this disadvantage, backup power supplies (power bank), which are also included in the fieldwork, can be used. However, the device's backup battery or a backup mobile device with the Mobile application installed may be available. Since the data resides on the main server, closing and opening the mobile application in the field or continuing to collect data with another mobile device with the same user name does not affect the operation. The fact that the Soil Data System is completely electronic can be considered as a disadvantage. It may be complicated to use, especially for middle-aged and older users. Project managers may solve this problem by optimizing the system according to the skills of the personnel they own or by providing the necessary training.

According to the data obtained at the end of the application study, it took about 3 times longer to record the data of a soil profile point with 2 horizons, including 2 photo shoots (one photo per horizon) than the Soil Data System mobile application in the classical method. In the classical method, the data is manually entered into the soil survey reports on paper and then the data must be re-entered into the related software during the map production process and the photographs taken per profile should be transferred to the computer, considering all these processes, the time taken to transfer the data collected from the field to a digital medium is much longer.

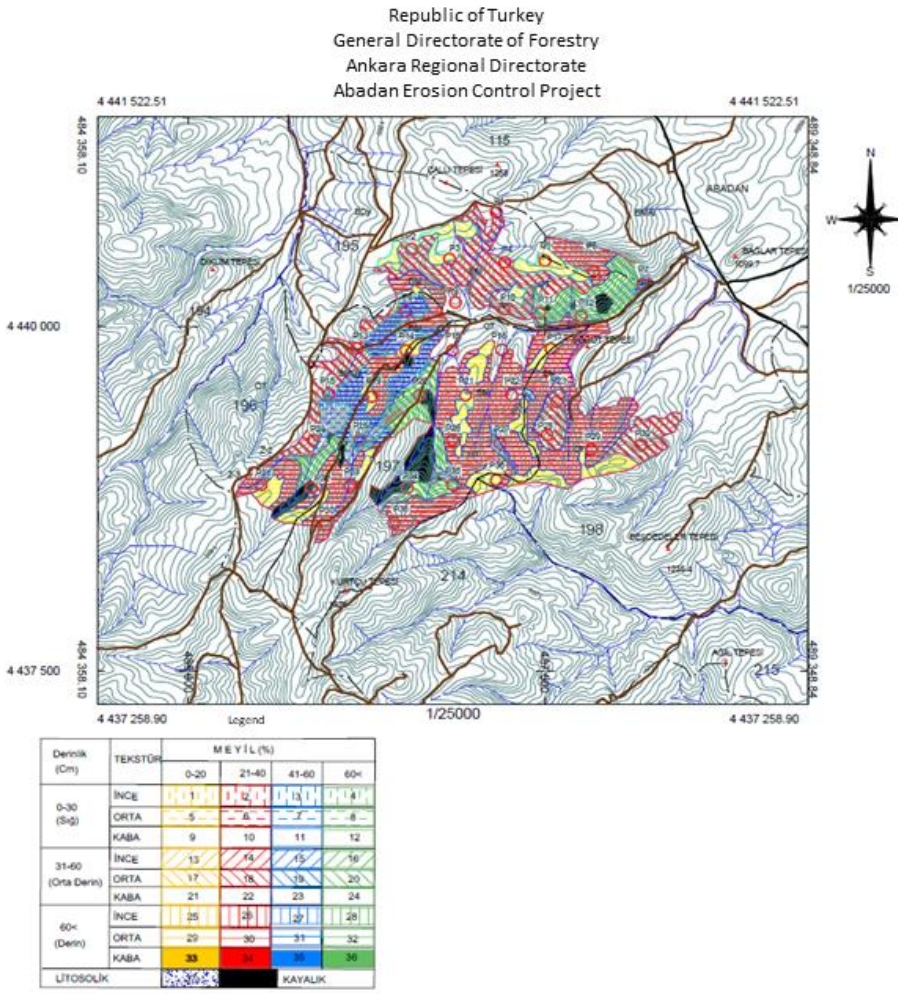


Figure 14. Soil map produced by classical methods

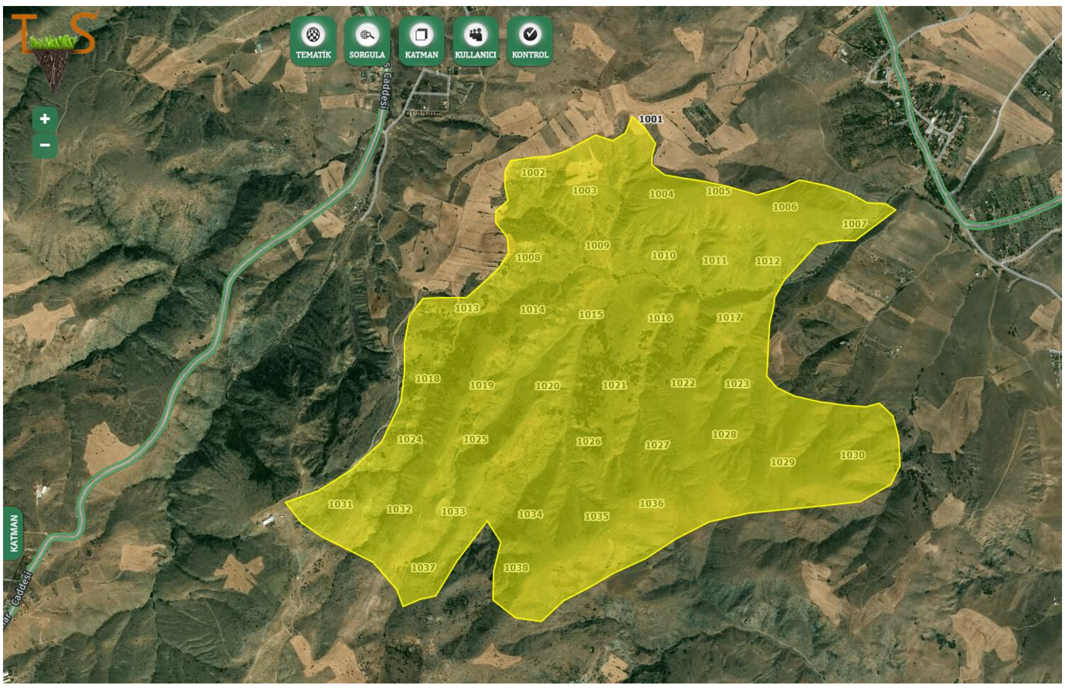


Figure 15. Project area created in the field via mobile application

4. CONCLUSION and PROPOSALS

Soil Data System has been developed with the aim of increasing the accuracy of soil data collected from the field in soil survey and mapping studies, ensuring coordination in field surveys conducted for soil survey studies and supporting the production of highly accurate soil maps as a result product. With the results of analysis of these systems and laboratories, the final soil map can be produced faster and more economically. Soil Data System also provides the opportunity to make more systematic and organized soil mapping studies in the field.

Today, the age range of mobile device usage, especially on smart phones, has widened due to the reasons such as ease of internet access, connection speeds, the introduction of mobile devices for almost every segment, the desire of people to access information without losing their mobility and increasing the power of social media. Since this mobile equipment owned by the Soil Data System users is developed in accordance with the internet connection and mobile application habits, the adaptation time of the users to the system is very short, which makes a positive contribution to conducting the soil survey and mapping studies carried out in a more effective manner.

The Soil Data System has been developed in the Android operating system, which is used on more mobile devices and can be accessed relatively easily by users. In order to reach more users, it is useful to adapt the system to other mobile platforms such as IOS and Windows Mobile that have considerable users. In addition, the installation of the mobile application of the system to the application markets of these platforms (Google Playstore, Appstore etc.) to be presented to users and updates to the software to be delivered to users through these mobile markets will be positive in terms of accessibility of the Soil Data System.

It is very important that this system, which is closely related to current technological developments, does not lose its actuality. In this context, continuous monitoring of hardware innovations and updates in mobile operating systems and adapting the developments to the benefit of the users will enable the Soil Data System to remain up to date and continue to contribute to soil survey and mapping studies.

Soil Data System; will contribute positively to the rapid, transparent and accurate production of soil maps that will provide base and support to many projects such as protection of biodiversity and increase of forest asset especially food safety, which is carried out and will be carried out for the purpose of conservation, efficient use and transportation of the soil to the future. In addition, it could also be an important model for the data sharing problem among institution with GIS compliant standard soil data production.

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