Advanced Geomatics

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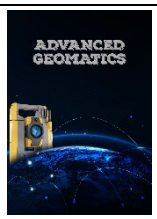

Village Law No. 3367 and Village Settlement Related to its Plan Applications: Example of Osmaniye Dereli Village

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Keywords

Village Layout Plan,
Land Planning,
Village Law No. 3367,
Village Settlement,
Plan Applications.

Research Article

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Abstract

The basic regulation regarding the management of villages is the Village Law of 1924. In this Law, the village; It is defined as a settlement with a population of less than two thousand, consisting of people living in collective or scattered houses with common goods such as mosques, schools, pastures, pastures, coppices, together with their vineyards, gardens and fields. The village administration is a local administrative unit formed by the voters in order to meet the local common needs of the village people. As of 2021, the number of villages in our country is 18,211. Although there is a general framework of the law described above, it is not exactly the case. As it is known, the concept of ownership in rural settlements is subject to slightly more stringent rules than the concept of ownership in urban life. In order to deliver the necessary infrastructure facilities at an affordable cost, the village settlement must be gathered at a collective point and operated in accordance with a plan. However, such a planning within the village borders, within the framework of the Zoning Law No. 3194, will cause great costs both in the construction and implementation phase, and it will take many years to reach the intended regular settlement due to the failure of the sale of the parcels to be made by the villagers. Thanks to the articles introduced in addition to the law numbered 3367, in case of applying the provisions of the law numbered 3194 to the parcels located within the borders of the village (pasture, field, etc.) owned by the public (pasture, field, etc.). The aim of this study is to offer regular new settlements that will meet the needs of people. In this study, the study carried out in Osmaniye Province Dereli Village is exemplified. Institutionally, the Special Provincial Administration, the Environment and Urbanization directorate, the Ministry of Agriculture and Forestry will be informed about the results of correspondence and the settlement plan of the Village Settlement Area Detection Commission will be carried out.

1. Introduction

In order for the Village Settlement Plan to be implemented, it is necessary to establish the commission that will make the planning first. Under the chairmanship of the Deputy Governor of the Village Settlement Area Detection Commission, the abolished Provincial Director of Public Works and Settlement (Environmental Urbanism and Climate Change Provincial Director), Cadastre Director, National Real Estate Director, Provincial Director of Agriculture, Provincial Director of Abolished Village Services (General Secretary of the Provincial Special Administration) and the relevant It is formed by the headman of the village. During the construction phase of the Village Layout Plan, the secretariat of the operations such as commission formation is carried out by the abolished Provincial Directorate of Village Services (Provincial Special Administration), and in correspondence to be made within this scope, the relevant directorate may assign technical personnel instead of the Provincial Director to carry out the transaction.

Institutional opinion letters are written from public institutions/organizations on whether there is any obstacle in making a plan in line with the minutes kept after the on-site study regarding the work to be done after the commission is formed.

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In the examination to be made, if the incoming letters are appropriate, the necessary planning work is started by the commission in the light of the current map, cadastral sheet and letters from public institutions and organizations, which will form the basis for the necessary planning stage. In the planning phase, necessary studies are carried out based on the relevant provisions of the Village Law No. 442, the Law No. 3194 on Zoning and the Law No. 3367.

2. Legal Basis for Implementation

The main reason for making a Village Settlement Plan; to produce housing-purpose parcels that can meet the needs of the village people and thus to make the village plan a settlement. For this purpose, necessary work will be carried out after the necessary planning after the work to be done on-site by establishing the necessary commission within the framework of the relevant legal regulations.

Village Settlement Plan; It is a subdivision plan apart from the Zoning Law No. 3194 and the related regulations, and the Additional Article 10 of the Law No. 3367 is related to the Village Settlement Plan: "The Commission prepares the village settlement plan according to the housing and general needs, taking into account the current and development status of the village. On this plan, the Ministry of Agriculture and Forestry carries out or has the works that determine the location of the parcels, without being subject to the provisions of the current Zoning Law and the regulation on this subject. provision is included.

Legislation on Village Settlement Plans is included in additional articles 9, 10, 11, 12, 13 and 14 of Law No. 3367 and Village Law No. 442.

- What kind of a way should be followed to make a village settlement plan? Who takes the decision, how to start the implementation?

- Additional Article 9 of Law No. 3367 - (20/5/1987-3367/1 art. additional 11th art. clause and the article number has been repeated.)

After the village headman takes the positive decision of the village elder council, he can request the preparation of the village settlement plan from his local authority. The village settlement plan includes the village settlement and development area.

- Which institutions are the members of the Village Settlement Area Determination Commission?

- Village Settlement Area Determination Commission Additional Article 10 – (20/5/1987-3367/1 art. Supplementary 12th that comes with art. provision and the article number has been repeated.)

If the request of the governor's office or the village headman is approved, it is sent to the Village Settlement Area Determination Commission for the preparation of the village settlement plan.

The Village Settlement Area Detection Commission, under the chairmanship of the Deputy Governor, consists of a technical staff from each of the local organizations of the Ministries of Finance and Customs, Public Works and Settlement, Agriculture and Forestry and General Directorate of Land Registry and Cadastre, and a village representative. When necessary, expert personnel from other relevant institutions are also included in this commission.

The commission prepares the village settlement plan according to the housing and general needs of the village, taking into account the current and development status of the village. On this plan, the Ministry of Agriculture and Forestry carries out or has the works that determine the location of the parcels, without being subject to the provisions of the current Zoning Law and the regulation on this subject. This plan is approved by the governorship, finalized and enters into force.

- How long is the objection period to the Village Settlement Plan? In how many days does the objection have to be answered?

- Objection to the Village Settlement Plan made by the Village Settlement Area Detection Commission Supplementary Article 11 – (20/5/1987 - 3367/1 art. with the additional 13th article. clause and the article number has been repeated.)

The decision of the commission and the village settlement plan are notified to the village headman. If no objection is made, it becomes final with the approval of the governor. Based on the decision of the village elders' council, the village headman may appeal against the commission's decision to the governorship within 30 days at the latest, and the objection is resolved within 15 days by the governorship. This decision is final.

Final decisions are implemented by the Ministry of Agriculture and Forestry.

- How are the immovables for which the Village Layout Plan will be determined?

- Additional Article 12 – (20/5/ 1987 - 3367/1 art.) additional 14th art. provision and the article number has been repeated; Amended: 27/5/2004-5178/6 art.)

the village settlement plan, areas allocated for housing and village general needs, areas such as roads and fairgrounds under the rule and disposal of the State, and immovables owned by the Treasury but not allocated for public service, following the examination in accordance with the provisions of Article 5 of the Pasture Law No. 4342, pasture, plateau and places that cannot be used as winter quarters, pastures and meadows automatically lose these qualifications with the approval of the village settlement plan.

However, within the scope of this article, the transfer of immovables that are owned by the Treasury but not allocated to public service is made by obtaining the opinion of the Ministry of Finance and registered in the land registry in the name of the village legal entity by the governorship.

- How is the distribution of the parcels that emerged after the Village Settlement Plan?

- Transfer of parcels that emerged after the Village Settlement Plan was made Supplementary Article 13 – (20/5/1987 - 3367/1 art. additional 15th art. clause and the article number has been repeated.)

The parcels registered in the name of the village legal entity, with a maximum size of 2000 m2 according to the village settlement plan, are sold to the needy people residing in the village and registered to the village population but do not have a house, by the decision of the council of elders, at the current price.

The sale price is collected in cash or in 5 equal installments at the most in 5 years and deposited in the village fund to be used in the development works of that village.

It is obligatory to construct a building on the parcels sold by the village council of elders within 5 years at the latest from the date of sale.

Rights holders cannot transfer or assign these places to others for a period of 10 years.

- Which Institutions/Organizations are responsible for the preparation and implementation of the Village Settlement Plan?

- Responsible institution/organization for the preparation of the Village Settlement Plan Supplementary Article 14 – (20/5/1987 - 3367/1 art. additional 16th _ art. provision and the article number has been repeated.)

Laws No. 6831 on Forest, Tourism Encouragement No. 2634, Protection of Cultural and Natural Assets No. 2863, Laws No. 7269 on Assistance to be Taken Due to Disasters Affecting Public Life and No. 2565 on Military Forbidden Zones and Security Zones Laws as amended by Law No. 1051 are outside the scope of this Law.

The Village Law No. 442, "The provisions of this Law are applied for the villages located in the adjacent area of the municipality with the proposal of the governor and the approval of the Ministry of Public Works and Settlement." Village settlement plan approvals made in adjacent areas are approved by the Ministry of Environment and Urbanization.

3. Special Provisions for Implementation

Aim

This regulation regulates the matters regarding the implementation of the Law No. 3367 dated 20/5/1987 on Adding 7 Additional Articles to the Village Law dated 18/3/1924 and numbered 442.

Scope

Except for the areas included in the scope of Forestry No. 6831, Promotion of Tourism No. 2634, Protection of Cultural and Natural Assets No. 2863, Aids to be Taken Due to Measures to be Taken Due to Disasters Affecting Public Life No. 7269 as amended by Law No. ; Determination of village settlement areas in villages, preparation of village settlement plans, establishment of village settlement area determination commission, decision-making and working principles, qualifications to be sought in those in need, determination of the current value of lands, sales and registrations, transfer prohibitions and principles of proper use are in accordance with the provisions of this regulation. done accordingly.

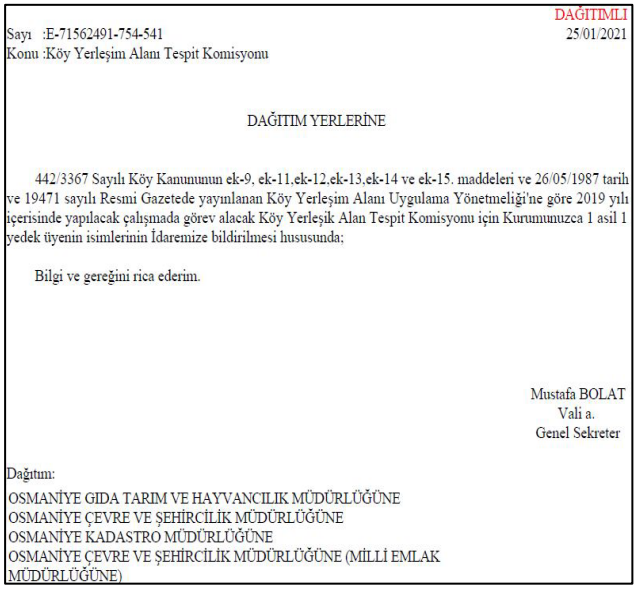
Rest

It has been prepared in accordance with the Supplementary Article 17 of the Law No. 3367 dated 20/5/1987, which was added to the Village Law No. 442 dated March 18, 1924.

As material, national and international articles, statements, Osmaniye Provincial Directorate of Environment and Urbanization, Osmaniye Provincial Directorate of Agriculture and Forestry and Osmaniye Special Provincial Administration data, correspondence, plans and reports were evaluated.

4. Application

The letter is written by the Village Settlement Area Detection Commission by the abolished Provincial Directorate of Rural Services (Special Provincial Administration) within the scope of the relevant legislation (Figure 1).



DAĞITIMLI

Sayı :E-71562491-754-541 25/01/2021
Konu :Köy Yerleşim Alanı Tespit Komisyonu

DAĞITIM YERLERİNE

442/3367 Sayılı Köy Kanununun ek-9, ek-11,ek-12,ek-13,ek-14 ve ek-15. maddeleri ve 26/05/1987 tarih ve 19471 sayılı Resmi Gazetede yayınlanan Köy Yerleşim Alanı Uygulama Yönetmeliği'ne göre 2019 yılı içerisinde yapılacak çalışmada görev alacak Köy Yerleşik Alan Tespit Komisyonu için Kurumunuzca 1 asil 1 yedek üyenin isimlerinin İdaremize bildirilmesi hususunda;

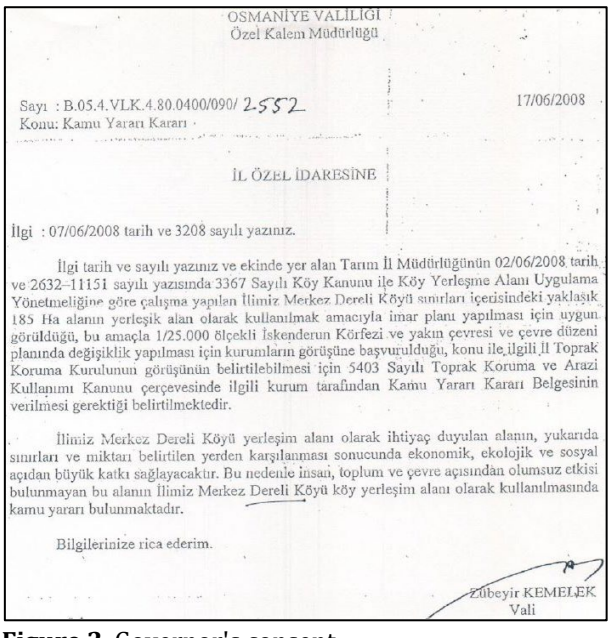
Bilgi ve gereğini rica ederim.

Mustafa BOLAT
Vali a.
Genel Sekreter

Dağıtım:
OSMANİYE GIDA TARIM VE HAYVANCILIK MÜDÜRLÜĞÜNE
OSMANİYE ÇEVRE VE ŞEHİRCİLİK MÜDÜRLÜĞÜNE
OSMANİYE KADASTRO MÜDÜRLÜĞÜNE
OSMANİYE ÇEVRE VE ŞEHİRCİLİK MÜDÜRLÜĞÜNE (MİLLİ EMLAK MÜDÜRLÜĞÜNE)

Figure 1. Example cover letter

After the commission is formed, a letter of assignment is written by the governorship in order to carry out the relevant work, and after this letter, the commission becomes ready to work in the areas determined by the governorship. The work is started after the necessary letter of consent for the Village Settlement Plan is written on the 101 block 107 parcel with pasture quality, which is located within the borders of Dereli Village in the central district of our city (Figure 2).



OSMANİYE VALİLİĞİ
Özel Kalem Müdürlüğü

Sayı : B.05.4.VLK.4.80.0400/090/ 2-552 17/06/2008
Konu: Kamu Yararı Kararı

İL ÖZEL İDARESİNE

İlgi : 07/06/2008 tarih ve 3208 sayılı yazınız.

İlgi tarih ve sayılı yazınız ve ekinde yer alan Tarım İl Müdürlüğünün 02/06/2008 tarih ve 2632–11151 sayılı yazısında 3367 Sayılı Köy Kanunu ile Köy Yerleşme Alanı Uygulama Yönetmeliğine göre çalışma yapılan İlimiz Merkez Dereli Köyü sınırları içerisindeki yaklaşık 185 Ha alanın yerleşik alan olarak kullanılmak amacıyla imar planı yapılması için uygun görüldüğü, bu amaçla 1/25.000 ölçekli İskenderun Körfezi ve yakın çevresi ve çevre düzeni planında değişiklik yapılması için kurumların görüşüne başvurulduğu, konu ile ilgili İl Toprak Koruma Kurulunun görüşünün belirtilebilmesi için 5403 Sayılı Toprak Koruma ve Arazi Kullanımı Kanunu çerçevesinde ilgili kurum tarafından Kamu Yararı Kararı Belgesinin verilmesi gerektiği belirtilmektedir.

İlimiz Merkez Dereli Köyü yerleşim alanı olarak ihtiyaç duyulan alanın, yukarıda sınırları ve miktarı belirtilen yerden karşılanması sonucunda ekonomik, ekolojik ve sosyal açıdan büyük katkı sağlayacaktır. Bu nedenle insani, toplum ve çevre açısından olumsuz etkisi bulunmayan bu alanın İlimiz Merkez Dereli Köyü köy yerleşim alanı olarak kullanılmasında kamu yararı bulunmaktadır.

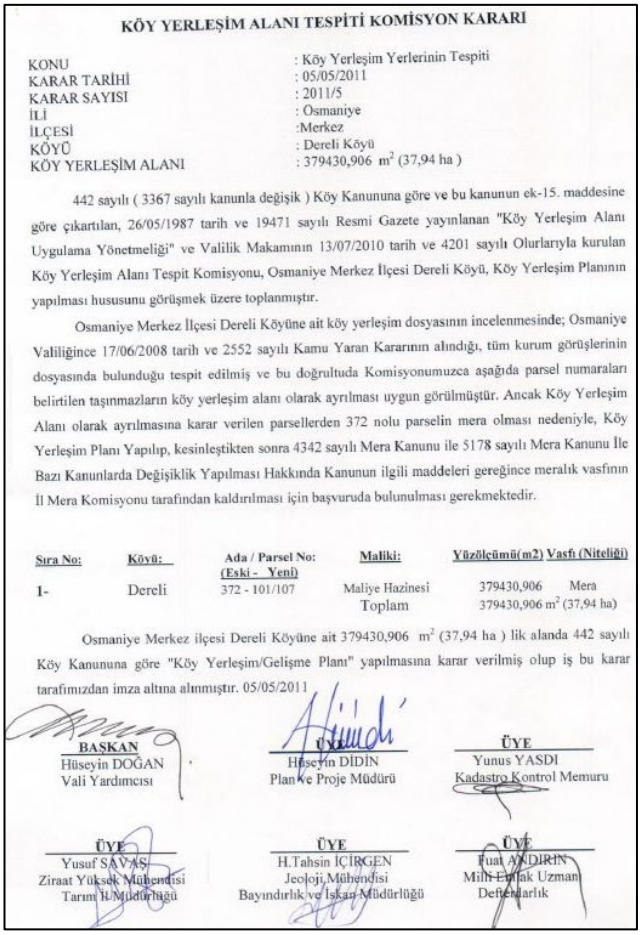
Bilgilerinize rica ederim.

Zübeyir KEMELEK
Vali

Figure 2. Governor's consent

The Village Settlement Area determination commission initiates the necessary correspondence for the work to be done in the relevant area, and the commission committee announces the working date and time to the commission members with a cover letter.

After the on-site studies by the Village Settlement Area Detection commission, a commission decision is taken to make a Village Settlement Plan, but it is also emphasized that the relevant public institutions /organizations need to complete the relevant permitting process in order for this plan to be put into practice (Figure 3).



KÖY YERLEŞİM ALANI TESPİTİ KOMİSYON KARARI

KONU : Köy Yerleşim Yerlerinin Tespiti
KARAR TARİHİ : 05/05/2011
KARAR SAYISI : 2011/5
İLİ : Osmaniye
İLÇESİ :Merkez
KÖYÜ : Dereli Köyü
KÖY YERLEŞİM ALANI : 379430,906 m^2 (37,94 ha)

442 sayılı (3367 sayılı kanunla değişik) Köy Kanununa göre ve bu kanunun ek-15. maddesine göre çıkartılan, 26/05/1987 tarih ve 19471 sayılı Resmi Gazete yayınlanan "Köy Yerleşim Alanı Uygulama Yönetmeliği" ve Valilik Makamının 13/07/2010 tarih ve 4201 sayılı Olurlarıyla kurulan Köy Yerleşim Alanı Tespit Komisyonu, Osmaniye Merkez İlçesi Dereli Köyü, Köy Yerleşim Planının yapılması hususunu görüşmek üzere toplanmıştır.

Osmaniye Merkez İlçesi Dereli Köyüne ait köy yerleşim dosyasının incelenmesinde; Osmaniye Valiliğince 17/06/2008 tarih ve 2552 sayılı Kamu Yaran Kararının alındığı, tüm kurum görüşlerinin dosyasında bulunduğu tespit edilmiş ve bu doğrultuda Komisyonumuzca aşağıda parsel numaraları belirtilen taşınmazların köy yerleşim alanı olarak ayrılması uygun görülmüştür. Ancak Köy Yerleşim Alanı olarak ayrılmasına karar verilen parsellerden 372 nolu parselin mera olması nedeniyle, Köy Yerleşim Planı Yapılıp, kesinleştikten sonra 4342 sayılı Mera Kanunu ile 5178 sayılı Mera Kanunu İle Bazı Kanunlarda Değişiklik Yapılması Hakkında Kanunun ilgili maddeleri gereğince meralık vasfının İl Mera Komisyonu tarafından kaldırılması için başvuruda bulunulması gerekmektedir.

Sıra No:	Köyü:	Ada / Parsel No: (Eski - Yeni)	Maliki:	Yüzölçümü(m2)	Vasfı (Niteliği)
1-	Dereli	372 - 101/107	Maliye Hazinesi	379430,906	Mera
			Toplam	379430,906 m^2 (37,94 ha)	

Osmaniye Merkez ilçesi Dereli Köyüne ait 379430,906 m^2 (37,94 ha) lik alanda 442 sayılı Köy Kanununa göre "Köy Yerleşim/Gelişme Planı" yapılmasına karar verilmiş olup iş bu karar tarafımızdan imza altına alınmıştır. 05/05/2011

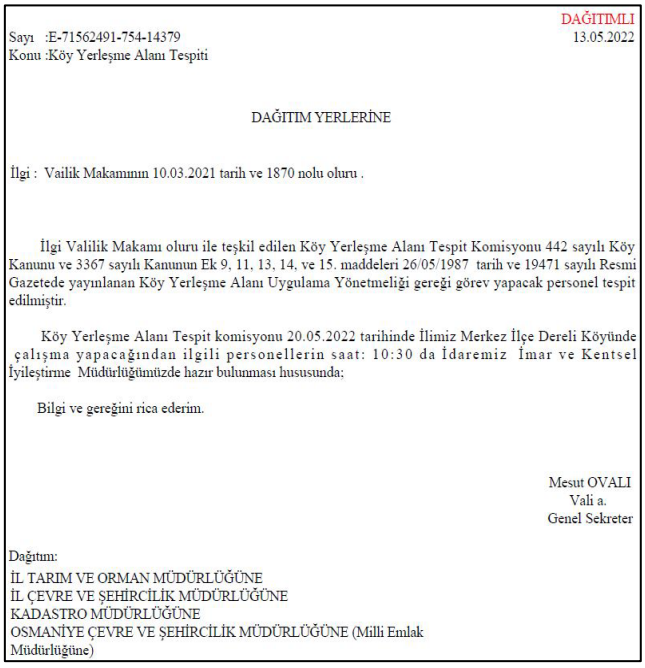
BAŞKAN — Hüseyin DOĞAN, Vali Yardımcısı
ÜYE — Hüseyin DİDİN, Plan ve Proje Müdürü
ÜYE — Yunus YASDI, Kadastro Kontrol Memuru
ÜYE — Yusuf SAVAŞ, Ziraat Yüksek Mühendisi, Tarım İl Müdürlüğü
ÜYE — H.Tahsin İÇİRGEN, Jeoloji Mühendisi, Bayındırlık ve İskan Müdürlüğü
ÜYE — Fuat AKDİRİN, Milli Emlak Uzman Defterdarlık

Figure 3. Detection Commission decision.

After collecting the necessary data, notifications to the commission members and the village headman of the day information determined by the Administration so that work can be done on site.

In the study carried out on site, the physical roads, private areas (Cooperative building, prayer hall, sports fields, etc.) structures on the immovable/immovables subject to the application are examined, and the demands of the village headman are taken. If the area where the Village Settlement Plan will be made is large, the Special Provincial Administration can do this work itself, as it is stated in the regulation. After the commission decision is taken, an opinion letter is written to other public institutions and organizations on whether or not there is a problem in making a plan related to the relevant area (Figure 8);

- Environment Urbanism and Climate Change Directorate
- Culture and Tourism Directorate
- Turkey Energy Distribution Inc.
- BOTAŞ directorate
- Unit directorates of the Special Provincial Administration
- Provincial Directorate of Health



DAĞITIMLI
Sayı :E-71562491-754-14379 — 13.05.2022
Konu :Köy Yerleşme Alanı Tespiti

DAĞITIM YERLERİNE

İlgi : Vailik Makamının 10.03.2021 tarih ve 1870 nolu oluru .

İlgi Valilik Makamı oluru ile teşkil edilen Köy Yerleşme Alanı Tespit Komisyonu 442 sayılı Köy Kanunu ve 3367 sayılı Kanunun Ek 9, 11, 13, 14, ve 15. maddeleri 26/05/1987 tarih ve 19471 sayılı Resmi Gazetede yayınlanan Köy Yerleşme Alanı Uygulama Yönetmeliği gereği görev yapacak personel tespit edilmiştir.

Köy Yerleşme Alanı Tespit komisyonu 20.05.2022 tarihinde İlimiz Merkez İlçe Dereli Köyünde çalışma yapacağından ilgili personellerin saat: 10:30 da İdaremiz İmar ve Kentsel İyileştirme Müdürlüğümüzde hazır bulunması hususunda;

Bilgi ve gereğini rica ederim.

Mesut OVALI
Vali a.
Genel Sekreter

Dağıtım:
İL TARIM VE ORMAN MÜDÜRLÜĞÜNE
İL ÇEVRE VE ŞEHİRCİLİK MÜDÜRLÜĞÜNE
KADASTRO MÜDÜRLÜĞÜNE
OSMANİYE ÇEVRE VE ŞEHİRCİLİK MÜDÜRLÜĞÜNE (Milli Emlak Müdürlüğüne)

Figure 4. Governor's consent

Figure 5. Satellite image of the parcel for which the Village Layout Plan will be made

- General Directorate of Highways
- Provincial Directorate of Agriculture and Forestry,
- AFAD provincial directorate

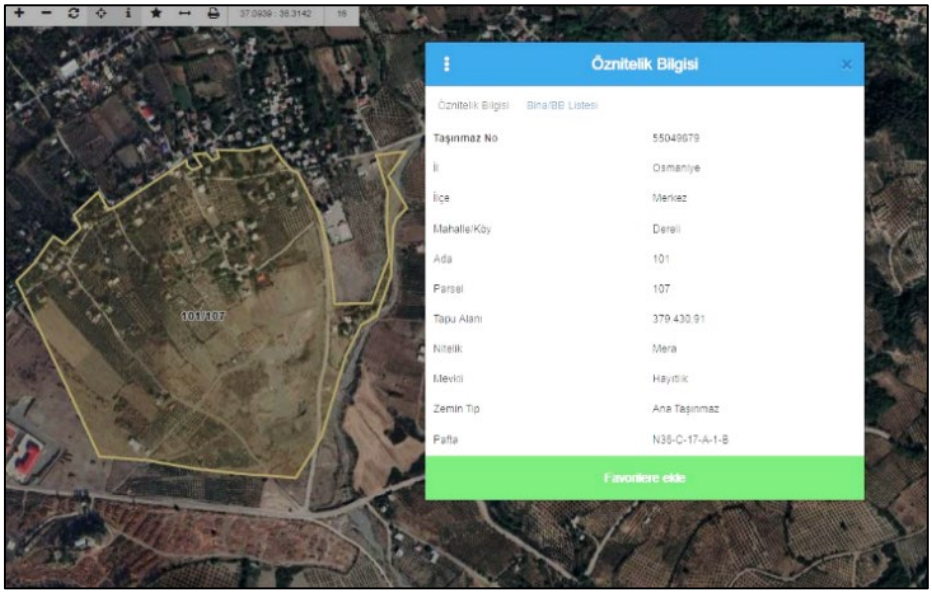


Figure 6. Information of the Parcel on which the Village Settlement Plan will be made

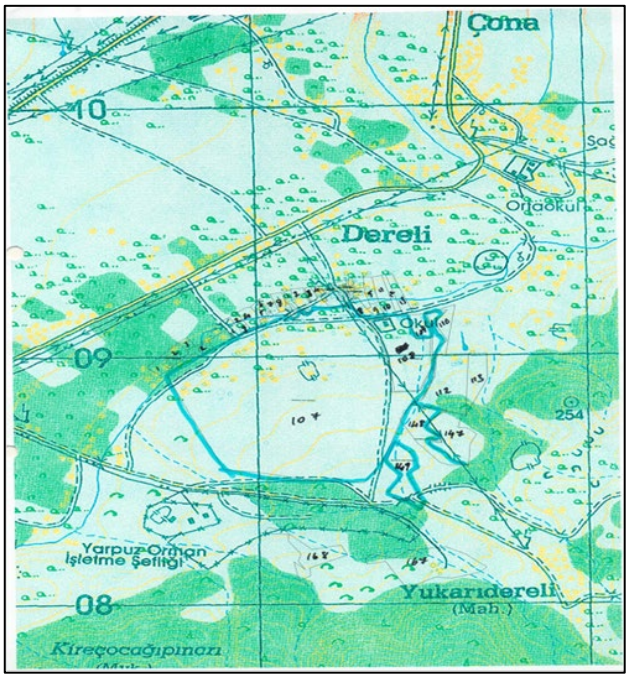


Figure 7. 1/25000 Scale Topographic Map of the Parcel for which Village Settlement Plan will be made

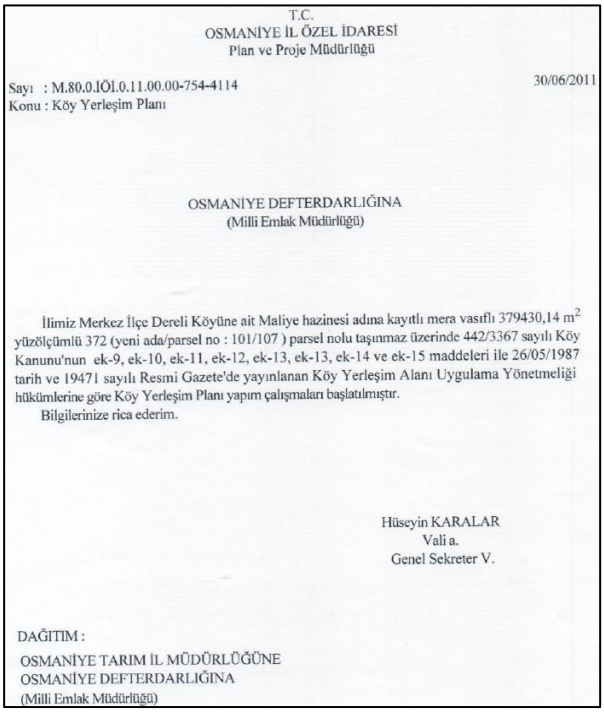
In case the letters from all institutions whose opinions are written are positive, a ready-made map is prepared/made in order to determine the topographical structure of the existing land and to form a base for the village settlement plan to be made.

The Village Settlement Plan, which will be prepared in accordance with the provisions of the regulation, will primarily be based on the cadastral map, but the current usage situation is seen as the primary factor in the preparation of the plan. Various structures (road, mosque, school, etc.) on the land are seen as the main element of the planning phase.

After the planning phase is completed, the minutes signed by the commission members and the draft plan are submitted to the Special Provincial Administration for correction. After the arrangement, the commission members sign the plan sheets and deliver a copy to the village headman.

The village headman has the right to object to the planning within 15 days, but the decision maker of the objection is the commission. After the planning and approval phase is completed, the relevant sheet becomes final with the approval of the Governor's Office.

After the plan made by the Village Settlement Plan Detection Commission, the registration file prepared/prepared by the Special Provincial Administration is signed by the commission members and sent to the Cadastre Directorate for technical control. After the necessary technical controls are made by the Cadastre Directorate, the relevant file is sent to the Land Registry Directorate for registration and the registration process is carried out.



T.C.
OSMANİYE İL ÖZEL İDARESİ
Plan ve Proje Müdürlüğü

Sayı : M.80.0.İÖİ.0.11.00.00-754-4114 30/06/2011
Konu : Köy Yerleşim Planı

OSMANİYE DEFTERDARLIĞINA
(Milli Emlak Müdürlüğü)

İlimiz Merkez İlçe Dereli Köyüne ait Maliye hazinesi adına kayıtlı mera vasıflı 379430,14 m^2 yüzölçümlü 372 (yeni ada/parsel no : 101/107) parsel nolu taşınmaz üzerinde 442/3367 sayılı Köy Kanunu'nun ek-9, ek-10, ek-11, ek-12, ek-13, ek-13, ek-14 ve ek-15 maddeleri ile 26/05/1987 tarih ve 19471 sayılı Resmi Gazete'de yayınlanan Köy Yerleşim Alanı Uygulama Yönetmeliği hükümlerine göre Köy Yerleşim Planı yapım çalışmaları başlatılmıştır.
Bilgilerinize rica ederim.

Hüseyin KARALAR
Vali a.
Genel Sekreter V.

DAĞITIM :
OSMANİYE TARIM İL MÜDÜRLÜĞÜNE
OSMANİYE DEFTERDARLIĞINA
(Milli Emlak Müdürlüğü)

Figure 8. Institution's opinion letter

Although the primary reason for making Village Settlement Plans is to meet the housing parcel needs of the village people, the planning will pave the way for a regular settlement within the village.

Our city, which is the subject of the examination, Dereli village, 101 block, 107 parcels, has been registered as pasture as seen in Picture-2. However, over time, various public (General Directorate of Highways, DSI, Special Provincial Administration) organizations, which have been occupied by the villagers for residential purposes and as an olive grove, have taken soil for various purposes due to the appropriate soil structure and disrupted the topographic structure of the land.

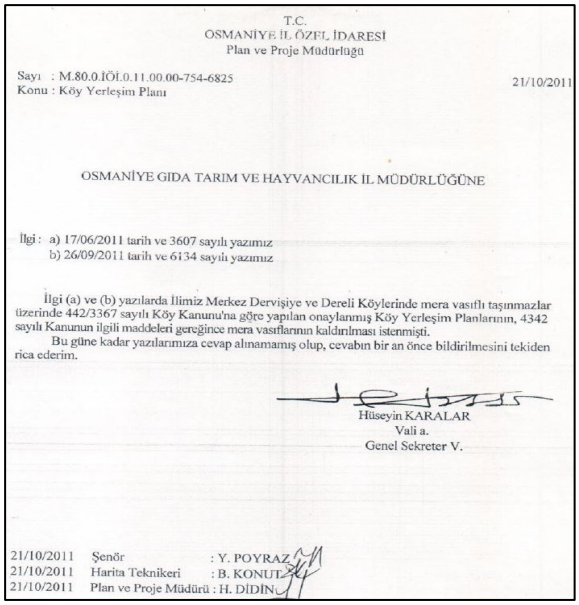
As mentioned above, since the relevant land is pastureland, in order for the Village Settlement Plan to be put into practice, the lands that have lost their pasture quality in accordance with the 14th article of the pasture law no 4342 should be made suitable for planning by making a change in type. However, before the change of breed to be made, within the framework of the principles specified in the pasture law, the price of 20 years of grass must be deposited into the account of the Ministry of Agriculture and Forestry. For this purpose, in addition to Dereli Village, a Village Settlement Plan was made in 2011 and 20 years of grass price was calculated by the Provincial Pasture Commission in line with this plan. The related plan could not be implemented due to the fact that the aforementioned grass price was not paid by the village headman (Figure 9).

In the course of time, due to the fact that the village people occupy more of the pasture-qualified immovable and the conversion of the land for residential purposes has increased, an attempt has been made to amend the relevant Village Settlement plan and to pay the price of 20 years of grass.

Provincial Pasture Commission affiliated to the Directorate of Agriculture and Forestry calculated the price of 589.230.22 TL as the price of grass for 20 years, after which this amount was deposited into the account of the Ministry on 29/04/2022 by the village headman. At the same time, necessary arrangements have been made in the light of the topographical data of the land to be planned by the Village Settlement Area Detection Commission for the preparation of the relevant Village Settlement Plan (Figure 10), necessary planning has been made in line with the needs of the village, and signed and will enter into force after the approval of the Governor's Office.

After the approval of the Governor's Office, the necessary registration file for the plan is prepared and submitted to the Special Provincial Administration. After the necessary committee decision is taken by the Provincial Committee, the registration file is sent to the Land Registry Directorate for registration after the necessary checks are made at the Cadastre Directorate.

After the registration process, title deeds are created on behalf of the treasury. After the necessary decision is taken by the Village Settlement Area Detection Commission in order to transfer the title deed in accordance with the relevant law, work is carried out by the headman to determine the right holders. After the appraisal of these parcels transferred to the Village Legal Entity, sales or transfer transactions take place in line with the provisions of the regulation (Figure 11).



T.C.
OSMANİYE İL ÖZEL İDARESİ
Plan ve Proje Müdürlüğü

Sayı : M.80.0.İÖİ.0.11.00.00-754-6825
Konu : Köy Yerleşim Planı

21/10/2011

OSMANİYE GIDA TARIM VE HAYVANCILIK İL MÜDÜRLÜĞÜNE

İlgi : a) 17/06/2011 tarih ve 3607 sayılı yazımız
b) 26/09/2011 tarih ve 6134 sayılı yazımız

İlgi (a) ve (b) yazılarda İlimiz Merkez Dervişiye ve Dereli Köylerinde mera vasıflı taşınmazlar üzerinde 442/3367 sayılı Köy Kanunu'na göre yapılan onaylanmış Köy Yerleşim Planlarının, 4342 sayılı Kanunun ilgili maddeleri gereğince mera vasıflarının kaldırılması istenmişti.
Bu güne kadar yazılarımıza cevap alınamamış olup, cevabın bir an önce bildirilmesini tekiden rica ederim.

Hüseyin KARALAR
Vali a.
Genel Sekreter V.

21/10/2011 Şenör : Y. POYRAZ
21/10/2011 Harita Teknikeri : B. KONUT
21/10/2011 Plan ve Proje Müdürü : H. DİDİN

Figure 9. Qualification change letter

Figure 10. Village Layout Plan

5. Findings and Discussions

The production of Village Settlement Plans is a work done to meet the needs of the village people and it is a work that brings income to the treasury and the village legal entity. However, a large part of the work done is hindered by public institutions and organizations. Among the reasons for this, there are many bureaucratic obstacles as well as pasture-qualified immovables.

At the beginning of these is the fact that the planned plots are pasture quality. At the same time, it continues to exist as another factor in front of planning, especially in the planning made at the scale of our province, as the planning area is included in the Great Plain Protection

area determined by the Ministry of Agriculture and Forestry.

In addition, irrigation plans determined by DSI and current irrigation areas are another obstacle in front of planning. Although it is said that the current legislation provisions of the relevant institutions will not be included in the regulation, in the opinion letters asked to the institutions, these institutions express the issues in their own legislation as an obstacle to planning.

In these days, when our country and the world are in serious need of food, it is of great importance that the people of the village stay in the villages. Apart from these obstacles in front of planning, it appears as another obstacle in the approach of administrators in public institutions to this type of planning.

It is obvious that the construction to be made thanks to the methods used in the planning made in accordance with the provisions of the zoning law numbered 3194 (ground survey, ready-made map production methods) will cause the feet to touch the ground more. However, it is obvious that the resources to be spent for such a planning work are transferred to more productive subjects, which will open the door to a more efficient use of public resources.

The fact that our country is built on an earthquake zone makes it necessary to take the necessary precautions at the highest level, regardless of the ground at the planning stage. A planning that will take into account the geographical (climatic) changes experienced will ensure that the problems that will arise will be damaged at the minimum level.

Figure 11. Example of parcellation made in line with the plan (Central district Yeniköy Village)

6. Conclusion and Recommendations

Considering today's urban life and the need for rural production, although it is revealed how valuable the Village Settlement Plan is, there are large fees for the planning and implementation of the villages in real need, especially on the pasture-qualified immovables. There are difficulties in paying these fees by the administrations and the village people, and the necessary planning processes cannot be carried out because most of them cannot be paid.

In addition, it is ignored whether there is a geological obstacle in the planning stage where no geological survey is made in the areas where the plan is made, even if the building boundary, which is determined as A-2 (Permission for two-story separate residential buildings), is built in accordance with the earthquake regulations. While planning according to the conditions of the day, the main idea that is effective in a forward planning;

1. Considering the area leading to the land and social equipment facilities as a lost area,
2. The road widths excluded from the plan during the planning phase are daily plans,
3. The planned area is not large enough.

For the reasons mentioned above, planning only saves the day and cannot be a forward-looking process. Although there are deficiencies in the plans made, the realization of these plans will set an example for the plans to be made in the future and the disruptions in these plans will not be repeated once again.

The climate zone in which our country is located has the potential to host many agricultural products. One of the main problems in producing these products and bringing them into the country's economy is our lack of planning. In order for our country to develop, it is necessary for everyone to reach planned and cultural social opportunities in our villages equally. We will have passed the most important corner in the transition to a production economy if the necessary land is provided for

the villagers to be able to build housing and small-scale (breeding barns, dairy farms, small-scale greenhouses, etc.) businesses for future generations.

Author contributions

Nuri Erdem: Data curation, Writing-Original Draft Preparation, Validation, Data curation, Writing, Visualization, Control and Validation
Hüreda Yalçinöz: Conceptualization, Methodology, Software, Investigation, Software

Conflicts of interest

There is no conflict of interest between the authors.

Statement of Research and Publication Ethics

Research and publication ethics were complied with in the study.

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Vis-NIR Spectroscopy Coupled with Machine Learning Algorithms to Predict and Identify the Key Wavelengths of Soil Gypsum Content in Fars Province, Southern Iran

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Key wavelength,
PLSR model,
Savitzky-Golay filter,
Spectral reflectance.

Research Article

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Abstract

The use of soil spectral reflectance, which has been introduced as a new method in soil science, is widely used in estimating the physicochemical properties of soil. The purpose behind this research was estimating the amount of gypsum in surface soils of Fars province. Based on random sampling method, 100 soil samples were collected and measured by standard method. Spectral analysis of soil samples was performed using a spectrophotometer between the range of 2500-400 nm. After this stage, various preprocessing methods were evaluated and finally the percentage of soil gypsum was modeled using two models of partial least squares regression (PLSR) and support vector regression (SVR). Our results illustrated that best results for estimating the percentage of soil gypsum are related to the SVR model with Preprocessing Savitzky- Golay Filter with the first derivative. Also, according to RPIQ statistics, the estimation of PLSR model for the percentage of soil gypsum in the weak class is 1.02% and for the SVR model in the moderate class is 1.54%. In the present study, key wavelengths were defined as wavelengths which ranged around 750, 1400, 1570, 1750-1800, 2100, 2200 and 2338 nm and showed the highest correlation with gypsum content in soil.

1. Introduction

The use of visible-near-infrared spectroscopy has been introduced as a fast, inexpensive and non-destructive method that has a remarkable capability in estimating different soil properties (Cambou et al., 2016). Among various soil characteristics soil gypsum has great importance. Gypsum has more solubility than carbonates and therefore, is under the influence of leaching process, and this resulted in less amount in the soil (Chaternour et al., 2020). The amount of gypsum has significant effect on soil properties namely soil water retention, aggregate stability and soil structure; More than 25% gypsum content in soil has a negative effect on plant growth and soil resilience (Smith and Robertson., 1962). Due to the cost, time and difficulty of direct measurement of soil gypsum, the use of indirect methods such as soil spectral behavior and spectroscopy has become common (khayamim et al., 2015). So far, many studies have been done in this field, most of which have been researched on soil particle size, CaCO3 (Gomez et al., 2008), soil organic matter (SOM) (Ostovari et al., 2018) and soil moisture (Mina et al., 2021). In these studies, methods such as support vector Regression (SVR), partial least squares regression (PLSR), and principal component regression (PCR) have been utilized for assessing the corelation between soil properties and spectral data (Farifteh et al., 2007). The SVR method makes the use of the SVM's principles and rules for regression problems. Being famous for its supervision and non reliablility on parameters, SVR is a statestic-based learning method (Vapnik, 1996). such method has enough sufficiency in generalizing models which were trained to unseable data with a decent accuracy (Gholizadeh et al., 2013).on the one hand, The strength of SVR models are their effectiveness in working with data from many variables in high-dimensional (Karatzoglou et al., 2006) and their great ability to assess how variables are dependent on each other, so they can be predicted by a hyperplane which was fitted optimally

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to training datasets (Wu, W., et al 2018). On the other hand, there are some difficulties in selecting among various algorithims and choosing the optimized parameters for the purpose of improving prediction outcomes. The utilization of such models for optimizing predictive outcomes in soil properties is crucial (Deiss, L. et al 2020). In SVR models there are two features which need optimization. Firstly, we need to select the kernel function (in algorithm) and secondly, it is the noise tolerance in the epsilon loss function for each kernel. SVR models use various kernel functions and it includes :, polynomial, sigmoid , radial, and linear, and each kernel has parameters which should be optimized, and their potential suitability needs to be considered (Deiss, L. et al 2020).

One of the important steps in estimating the soil properties is using pre-processing spectroscopy (Ostovari et al., 2018). The preprocessing methods, using mathematical functions, corrected the nonlinear relations created in relation to the amount of light absorption, and by eliminating the noise, the clarity of the absorption characteristics improves and ultimately the calibration become better (Mina et al., 2021). Derivative methods are the most widely used pre-processing methods in spectrophotometric studies, amplified in poorly-recorded signal derivative methods and lead to improvement of soil properties (Stenberg et al., 2010). In most studies, they used First Derivative (FD) and Second Derivative (SD) methodology (Martins, 1989) and Standard Normal Variate (SNV) (Barnes, 1989) as an Inseparable technique in spectral modeling. Akbarifazli et al., 2021 conducted an experiment for the purpose of accuracy evaluation of visible and near-infrared spectroscopy in estimating SOM and its total neutralization value. They have used PLSR and SVR methods to estimate these parameters then compared their results. it illustrated that PLSR model outperformed SVR in estimation of the mentioned parameters. In another study Gholizadeh et al., 2013 explored the suitableness of Vis-NIR, which is between the range of 350 and 2500 nm, and mid-IR spectroscopy as an effective method for determining SOM quantity. Their result showed that spectroscopy method, specifically the mid-IR method which made use of the Least Squares Support Vector Machine (LS-SVM) algorithm can be a valuable tool to determine SOM quantity and quality. It should be noted that, they have used Savitzky–Golay in their research.

Also, studies have been reported in estimating the soil gypsum content using spectral reflections. Among these studies, Chaternor et al., 2020, has conducted a research in Khuzestan province which determined soil gypsum key wavelength. in this study soil spectrum was preprocessed using various methods including the Savitzky-Golay filter and two multivariate regression models including PLSR and SVR. Utilizing these methods allowed them to compare the estimated performance of soil gypsum content which revealed that SVR model presented better performance compared with PLSR. In another study, Khayamim et al., 2015 have used vis-NIR spectroscopy to evaluate this method's efficiency in quantification of gypsum content and carbonate content in soil. They compared the result of PLSR method with the routine standard laboratory technique and another feature-specific method using Continuum Removal (CR). Their results have shown that PLSR outperformed the other method in both mentioned soil properties. Also, the properties of calcium carbonate and gypsum were obtained from optimal accuracy with coefficients of determination of 0.45 and 0.8 respectively. (Khayamim et al., 2015). Hassani et al. (2014) estimated the properties of gypsum (RPD = 2.65), organic matter (RPD = 1.64) and calcium carbonate (RPD = 2.86) using spectral reflections. Gohari et al. (2017) used vis-NIR spectroscopy for the estimation of gypsum content, organic matter and carbonates in soil. their research showed better result in the percentage of gypsum and organic matter in the good class, while it showed worse result in the carbonates in the weak class due to the relative deviation of the model prediction.

Due to the importance of gypsum content, this research was done to estimate the percentage of soil gypsum with PLSR and SVR models using spectral data by applying Savitzky -Glaye filters with the first derivative.

2. Method

2.1. Study Area

Fars province was our chosen study area and it is situated in the south central region in Iran with coordinates 27° 2' to 31° 42' lat. and 50° 42' to 55° 36' long. The mean annual rainfall varies from 100 mm in the southern part to nearly 400 mm in the northern part.

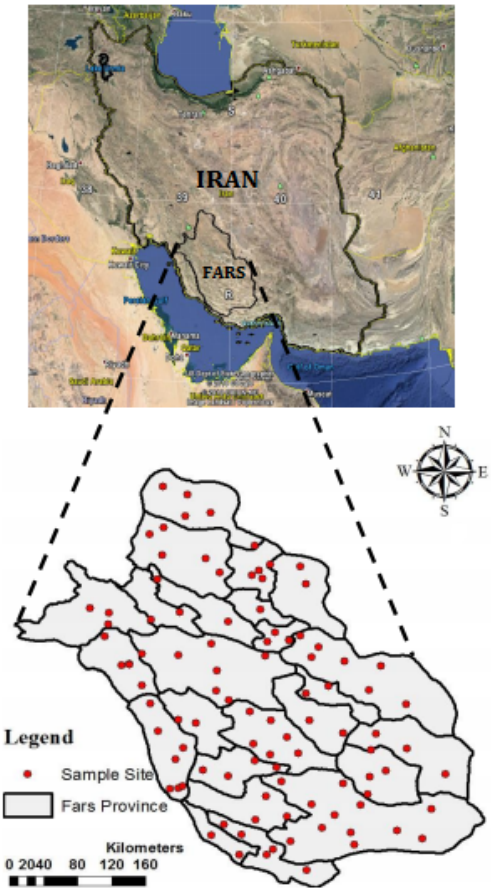

Figure.1. The sampling area map in Fars province in Iran.

2.2. Soil Sampling and Analysis

Sampling of soil was conducted randomly in 0 -10 cm depth. 100 soil samples were chosen and collected and then the samples were transferred into laboratory, they were air dried first and after that passed through a sieve which was 2 mm. Gypsum content was determined by acetone method (Nelson,1982).

2.3. Spectral Reflectance Measurement

Soil spectral data were determined using a spectroscopy device (NIRS-XDS) in the range of vis-NIR wavelengths (2500-400 nm). 20 g of each sample of air-dried soil with a size of less than 2 mm was placed in a special container and then 5 scans were performed on them (Figure 1, a). Due to the high noise at the beginning and end of the spectral data, the range of 449-400 and 2500-2451 nm was removed from the modeling process and then for the purpose of eliminating turbulence and environmental factors, and increasing the data's quality and obtaining better results, preprocessing of the Savitzky and Glaye filters with the first derivative was applied to the spectral data of soil samples (Figure 1, B).

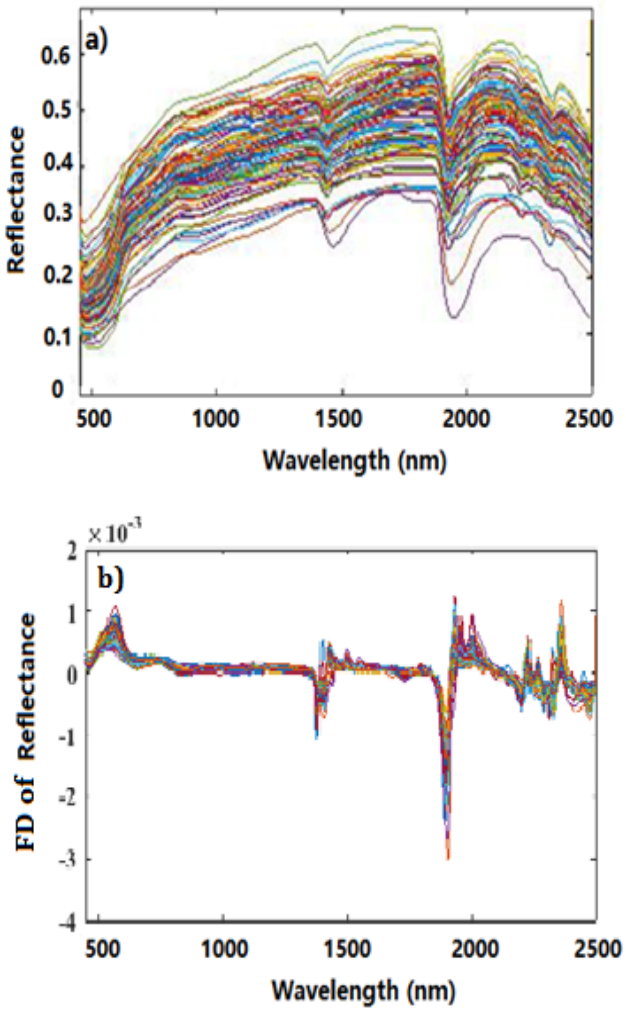

Figure. 2. The a) raw and b) preprocessed spectral reflectance data.

2.4. Modeling

To predict soil gypsum by utilizing the spectra, a multivariate regression and a Machine Learning (ML) technique were carried out, namely PLSR method (Haaland and Thomas, 1988) and SVR (Vapnik, 1995). PLSR is utilizes linear least squares regression which instead of using original input data uses new components and it can cope with multidimensional data (Mirzaei et al., 2022). On the contrary SVR owns special features that can handle data which might be complex and multidimensional. Easily extending them to a nonlinearl modified feature space. In current research, we have set the kernel and a specific type of SVR, namely linear function and epsilon-SVR, respectively; and Cost parameter (C) were fine-tuned by implementing a grid search systematic technique, and optimal parameters were selected by the minimum of RMSE which was acquired through holdout cross-validation. The Unscrambler X v. 10.4 and MATLAB 2019b software were used for spectral data processing and statistical analysis and modelling.

2.5. Model Evaluation

To predict the percentage of soil gypsum based on soil spectral reflectance, PLSR and SVR were applied. To evaluate the accuracy of the models, three statistical criteria including coefficient of determination (R2), Root Mean Square Error (RMSE) and Ratio of Performance to the Interquartile range (RPIQ) were utilized (Mina et al., 2022).

$$R^2 = \frac{\left[\sum_{i=1}^{n}(O_i - \overline{O_i})(P_i - \overline{P_i})\right]^2}{\sum_{i=1}^{n}(O_i - \overline{O_i})^2 \sum_{i=1}^{n}(P_i - \overline{P_i})^2} \quad (1)$$

$$RMSE = \sqrt{\left(\frac{\sum_{i=1}^{n}(P_i - O_i)^2}{n}\right)} \quad (2)$$

$$RPIQ = \frac{IQ}{RMSE}$$
$$IQ = Q_3 - Q_1 \quad (3)$$

3. Results

For the purpose of modeling, at first, the data were divided into two different sets including training data (70% of data) and also testing data (30% of data) randomly. Using t-test, there was no significant difference between the two datasets. Table 1 depicts a summary of statistics in the measured soil gypsum content in train and test datasets. All soil samples contained a low gypsum content with a mean of 0.97% and 0.99% for train and test datasets, respectively.

Table 1. Statistical analysis of gypsum content in soil, Range (including min and max), mean values, Standard Deviation (SD) and Coefficient of Variation (CV). a-significant difference (p< 0.05)

soil parameter	Gypsum	
	Train	Test
Unit	%	%
Range	0.2-3.98	0-3.90
Mean ± SD	0.97^{a} ±0.64	0.99^{a} ±0.68
CV (%)	65.97	68.68

The values of R^2, RMSE and RPIQ from modeling in estimating soil gypsum based on soil spectral reflections are illustrated in Table 2. The outcomes of Table 2 showed that SVR model has a higher performance in estimating the amount of soil gypsum than the PLSR model. SVR has the highest R2 (0.85, 0.73%) and RMSE (0.22, 0.39%) in both training and testing stages, respectively. In addition to RMSE, the accuracy of the model predicted by RPIQ was also evaluated. Classification is done by Lacerda et al., 2016 into 6 classes: Very Poor with RPIQ < 1, weak with RPIQ = 1 – 1.4, Moderate with RPIQ = 1.4-1.8, Good with RPIQ = 1.8-2, Very Good with RPIQ = 2-2.5 and Excellent with RPIQ >2.5. The SVR model has a moderate performance using spectral reflectance with Savitzky- Glaye filter with the first derivative, and PLSR has a poor performance in estimating the amount of soil gypsum.

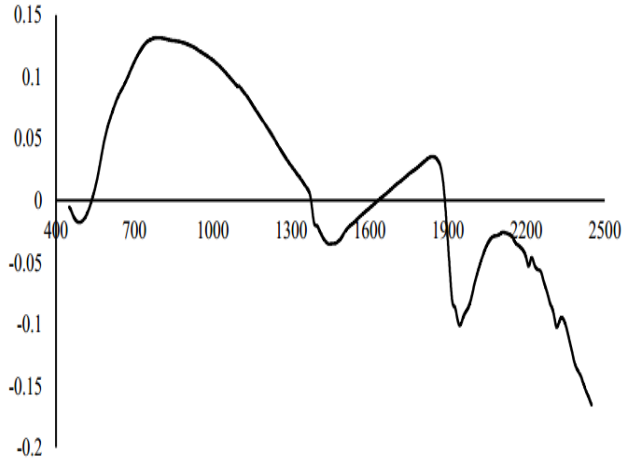

Figure. 3. Pearson's correlation coefficient between row spectral reflectance values across the range of Vis_NIR and soil gypsum

Table 2. Prediction result for gypsum using PLSR and SVR models. R^2 , RMSE, and RPIQ.

Method						
Model	Train			Test		
	R^2	RMSE	RPIQ	R^2	RMSE	RPIQ
PLSR	0.74	0.30	1.97	0.57	0.48	1.02
SVR	0.85	0.22	2.10	0.73	0.39	1.54

Figure 2 depicts the measured gypsum versus the predicted gypsum using PLSR and SVR models in the mentioned datasets. In both of them, the points show a well-scattered look around 1:1 line for SVR comparing with PLSR, that demonstrates better performance of SVR.

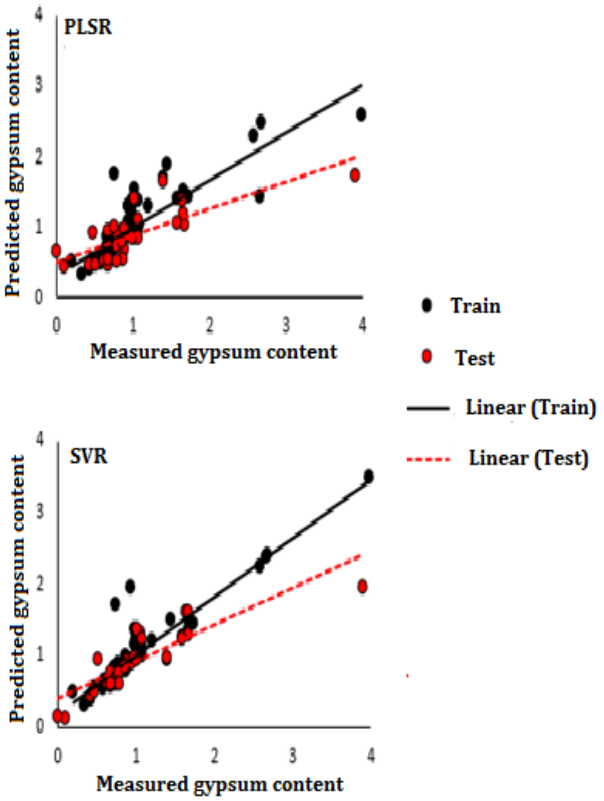

Figure 2. Scatter plots of predicted comparing with measured gypsum by PLSR and SVR. a) Train set (N=70), b) Test set (N=30). PLSR and SVR models.

Soil spectra representative depicts three specific absorption bands including 1414, 1915, 2212, and 2341 nm (Figure. 1). In Figure. 3 the Pearson correlation coefficient between the spectral reflectance and soil gypsum content ranging from 400 to 2500 nm is presented. It can be useful in identifying the bands which are considered to be the most influential ones. As it is conspicuous in Figure. 3, a relative high correlation between the measured values of soil gypsum and the soil spectral reflectance is clearly observed.

overall, the relationship between spectra and soil gypsum can be clearly seen in specific bands of near 1400, 1900, 2200, and 2340nm.

Absorption characteristics also demonstrate hydroxyl groups at 1915 nm, the bonding of hydroxides with iron, clay mineral networks, free and hygroscopic water at 1414 nm, magnesium and aluminum metals at 2212 nm (Clark et al., 1990). The peaks of absorption which happen nearly at 2341 nm are known to be related to CO3 groups in carbonate minerals in soil (Lagacherie et al., 2008, Gomez et al., 2008). The soil gypsum depicted the highest and most significant correlation (P < 0.05) with spectral bands including 750, 1400, 1570, 1750-1800, 2100, 2200 and 2338 nm.

4. Discussion

Among soil gypsum in the train and test datasets the t-test enumerated no significant difference. In the table 1 statistical description of soil properties in two sets of training and testing is presented. The standard deviation of the amount of gypsum in training set is 0.64 and in the test set is 0.68. This clearly shows that the test dataset is a good representation of the dataset.

It has been used as an input parameter in PLSR and SVR models to estimate soil gypsum using wavelengths of the visible-near-infrared range (400-2500 nm). In predicting the percentage of gypsum by two models PLSR and SVR, the highest value of R^2 and the lowest value of RMSE were obtained in each training and test sets (Table 2). The results of this study are consistent with the research which was done by Chaternor et al., 2020. The results clearly show that the SVR model is better for estimating soil gypsum than PLSR model. Research has been conducted using PLSR and SVR models in 72 soil spectral samples in Iran. Their results evidenced that SVR model has the highest performance in estimating soil CEC.

In another study, Khayamim et al. (2015) obtained an excellent yield (RPIQ> 2) for the amount of soil gypsum using the PLSR model.

Also, SVR had the shortest distance from the line (1: 1) and the best fit (Figure 2).

In general, according to Table 2 and Figure 2, the results clearly show that the performance of SVR is much better than PLSR for estimation of soil gypsum content. Therefore, it can be concluded that SVR is a more suitable multivariate method for soil spectral data.

According to Nawar et al. 2016 research, the range of changes in the concentration of soil properties has an undeniable role in the accuracy assessment of the regression model and with an increase in changes and data breadth and also an increase in range, the model's accuracy estimation increases.

Also according to the Wilding (1985), the extent in which the data with CV in the range of > 35 is considered as a large extent. In the present study, the CV for train and test datasets are 65.97% and 68.68 % respectively, which indicates the appropriate breadth in the Collected data and has improved the accuracy of gypsum estimation in both models.

In spectral curves there is a peak in the range of 700-750 nm which can be attributed to the highest reflectance owning to bright mineral's presence namely calcites and carbonates. Moreover, Iron oxides and organic matter greatly affect the reflectance in visible region, and their existence cause soil color to be darken and spectral reflectance to decrease (Hant, 1970). Chaternor et al. (2020) reported a noticeable correlation in wavelengths of 1450, 1550, 1700, 2100, 2200 and 2400 nm with gypsum. Hassani et al. (2014) similarly presented wavelengths of 1100-1200, 1450, 1500, 1550, 1650, 1950 and 2200 nm, too. Also, Harrison et al. (2012) mentioned the 1750, 1945, 2100-2200 and 2400 nm wavelengths which are related to SO4 group of gypsum. Also, Hunt (1970) have reported for gypsum wavelengths of 1100 and 680 nm, which were proportional with our results. Khayamim et al., 2015, have shown that the correlation between gypsum content and 1578 nm wavelength can be associated to gypsum amount in soil. Mina et al. (2021) introduced 1827 and around 2300 nm wavelengths in their research and Viscarra Rossel and McBratney (1998) presented Wavelengths around 1600, 2000, and 2100 nm in a model with the aim of estimating the mineral lattice. Wavelengths which are around 2340 nm can also be a representative of illite or the presence of muscovite minerals mixtures (Post and Noble, 1993).

5. Conclusion

In the current research, we have done an exploration in reflectance spectroscopy ability with the aim of estimating gypsum content in soil. All in all, the presented results clarified that a correlation between the soil gypsum content and soil spectral reflectance exist. Wavelengths nearly at 1900, 2338, 2200, and 1400 nm were identified as key spectral bands for gypsum content assessment. Choosing between the two models, the ML algorithm resulted in better performance comparing with the commonly used PLSR method. Our outcomes have proven that spectral reflectance is an undeniable efficient tool for sufficiently assessing large areas.

Therefore, it can be said that soil spectral reflections can be used as a rapid and alternative method in soil.

To obtain a comprehensible knowledge of ML method's performances in soil science studies, we suggest a comparison of other data mining techniques namely Random Forest (RF) and Artificial Neural Networks (ANN), for the future studies.

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Author contributions

Monire Mina: Methodology, Software, Formal analysis, Investigation, Resource, Writing – Orginal Draft, Visualization,

Mahrooz Rezaei: Coceptulization, Review & Editing, Supervision, Funding acquisition,

leila Hossein Abadi: Writing – Review & Editing, Software,

Abdolmajid Sameni: Methodology, Review, Funding acquisition, Supervision.

Conflicts of interest

There is no conflict of interest between the authors.

Statement of Research and Publication Ethics

Research and publication ethics were complied with in the study.

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Analyzing Domestic Water Consumption in Wana, South Waziristan, Khyber Pakhtunkhwa Province- Pakistan

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Abstract

This article is an attempt to analyze the domestic water consumption in Wana, South Waziristan in the Khyber Pakhtunkhwa province, Pakistan. In this regard, a detailed questionnaire based survey was conducted using simple random techniques. Global Position System was also used to acquire location of sampling units. Area having high-income groups and family size consume high amount of water. People having monthly income of less than 25000 PKR, consume 347 l/day and people having monthly income of 25,000-50,000 PKR consume 538 l/day. Similarly, people having monthly income of more than 50,000 PKR consume 749 l/day. The per capita consumption for small, medium and high-income group is 10, 22 and 48 l/day respectively. The total water consumption of small family, medium and large families' sizes is 423,642 and 831 l/day and the per capita consumption for these families are 6.4, 11 and 20 l/day. This study highlights the consumption of water by the family size and the income groups in Wana, South Waziristan. People are consuming more water as a result, the groundwater is depleting rapidly.

1. Introduction

Water is absolutely an essential element for survival of life on the earth (Lyu, 2019; Chen, 2018). Earth is the only planet where there is abundant water available but among these, only 2.5 percent of the Earth's total water is fresh water (Lewandowski et al., 2020; Hao et al., 2010). Only one-third of this fresh water is available for human use and more than half of this already being consumed by the growing human population (Lashari, 2007; Rahman & Parvin, 2009). It is estimated that about 99 percent of all liquid fresh water is in underground aquifers and about quarter of the world's population extract water from this underground aquifer (Gabriel & khan, 2009). Ground water is being used in all the types of activities. It contributes about 22% of the total fresh water resources of the globe (Norman, 1995; Foster, 2014; King, 2008). About 46% of its share is in performing the domestic activities and for the commercial uses (Kahlown, 2003; Limouzin, 2009). In industrial activities, this resource of natural water contributes about 24% and in agricultural activities, about 34% of the irrigation requirements are fulfilled by utilizing this water resource (Weigman, 2003; Villholth, 2006; Wada et al., 2014). Its purity and safety from the direct contamination make it more significant for human needs (Mackee, 2001; Todd and Mays, 2005). Its presence in abundance and its flexibility to extract attract the human beings towards its use (Bell, 1996; Laluraj, 2006).

This study is carry out to identify the amount of domestic water consumption in Wana, South Waziristan. Residents of Wana are facing problems due to shortages of water for domestic as well as for agricultural purposes. There is no proper mechanism for water usages. People use water irresponsibly and due to which the groundwater level has been decreasing. Ground water is safe to use because it is not expose to the human environment. It has been preferred in last millennia due to its good quality (Sravanthik, 1998; Clarke, 1991). Unfortunately, since last few decades' pressure has increased on this natural resource due to the

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contamination of surface water resources. It used for domestic, agricultural and industrial purposes (Mishra, 2003; Chowdhury et al., 2003).

In Pakistan, about 80 % of the diseases are due to the drinking of poor quality of water. In Pakistan, about 250,000 children die every year due to water born diseases and about 1/3rd of deaths are also happened due to the water related diseases (PCRWR, 2010). In Pakistan, only 25.6 % of her population has access to the pure water while remaining population drink contaminated water. This situation is more worsen in the rural areas due to their limited resources and the lack of awareness (Anwar, 2011).

2. Material and Methods

2.1. Study Area

South Waziristan shares about 70 km border with Afghanistan's Province Paktia. South Waziristan borders with North Waziristan in the north, Bannu and Lakki Marwat districts in the northeast, Tank and Dera Ismail Khan Districts in the east and Zhob District of Baluchistan in the south. The total area of South Waziristan is 6,231 km^2. Wana Plain is a large open valley about 12 miles long and 8 miles broad situated to the west of the Mehsud Highlands. The weather system of South Waziristan is with moderate hot summers and extreme cold winters. The winter season begins almost in November and remains until up to March. In winter, sometime the temperature falls below the freezing point. Similarly, summer season starts in May and continue until September. Most part of South Waziristan receives little rainfall as the area is out of the Monsoon region but areas of high latitude receives fair amount of rainfall. South Waziristan is mostly consists of rugged and rocky terrains. Hills appear to zigzag in every direction and there are no regular mountain alignments. Land for agriculture purpose is very limited. The chief plains of South Waziristan are the Wana Plain, the Zarmilan, the Bermal and and the Spain plain. The main reason behind the low percentage of agriculture land is the shortage of ground water and unavailability of rivers and streams. In most parts of the region, ground water is the main source of irrigation.

Figure 1. Location of Study Area

2.2. Data Collection and Analysis

This study has been conducted in Wana tehsil South Waziristan in KP Province. Primary data were collected from field survey and Global Positioning System (GPS). Secondary data were collected from concerned government departments. The methodology adopted for the achievement of desire objectives as suggested by Mahmood et al., (2020).

A semi-structured questionnaire of was designed. During questionnaire survey 170 household were interviewed. The respondents were asked regarding socio-economic characteristics of the households concerning respondent's occupation, monthly income in PKR, family members, sources of water and daily water consumption in liters. GPS was also used during the field survey to acquire the exact location of sample sites. These coordinates were used in GIS environment to develop sample sites map Fig. 2. The satellite image of Landsat 8 having 30m resolution was downloaded from United States Geological Survey (USGS) open source geo-database.

The monthly household income was classified in three classes. The first category consists of low income which has monthly income of <25,000 PKR (170 PKR= 1US$, 2021). Second category includes HH having

monthly income of 25,000-50,000 PKR; and the third group consists of high income which has monthly income of >50,000 PKR. These income classes were used to identify the variation in water consumption among various segments of the community.

Similarly, family size was classified into three groups, which are small, medium and large family. Families that have less than 10 members were categorized as small family. Similarly, family that consists of 10 to 15 members was categorized as medium and above 20 members was categorized as large families.

The daily water consumption was also categorized into three groups, namely low, medium and high consumption. The low consumption consume <50 liter per day, medium consumption is 50-100 liter per day and high consumption is >100 per day.

Frequency distribution was performed to make monthly income and family size classes of the surveyed households. The average domestic water consumption per day for each income and family size class was calculated using the following formula:

$$C=\sum N/n \quad (1)$$

Where "C" is the average water consumption per household per day, "N" is the numerical value of each observation and "n" is the number of observations. Average water consumption per person per day "c" was calculated using the following formula:

$$C= C/Fs \quad (2)$$

Where "c" is the per capita water consumption, and Fs is the average family size. The total consumption was calculated by using the following formula:

$$T= (p) \times (c) \quad (3)$$

Where "T" is the total consumption in liter per day and "p" is the total population.

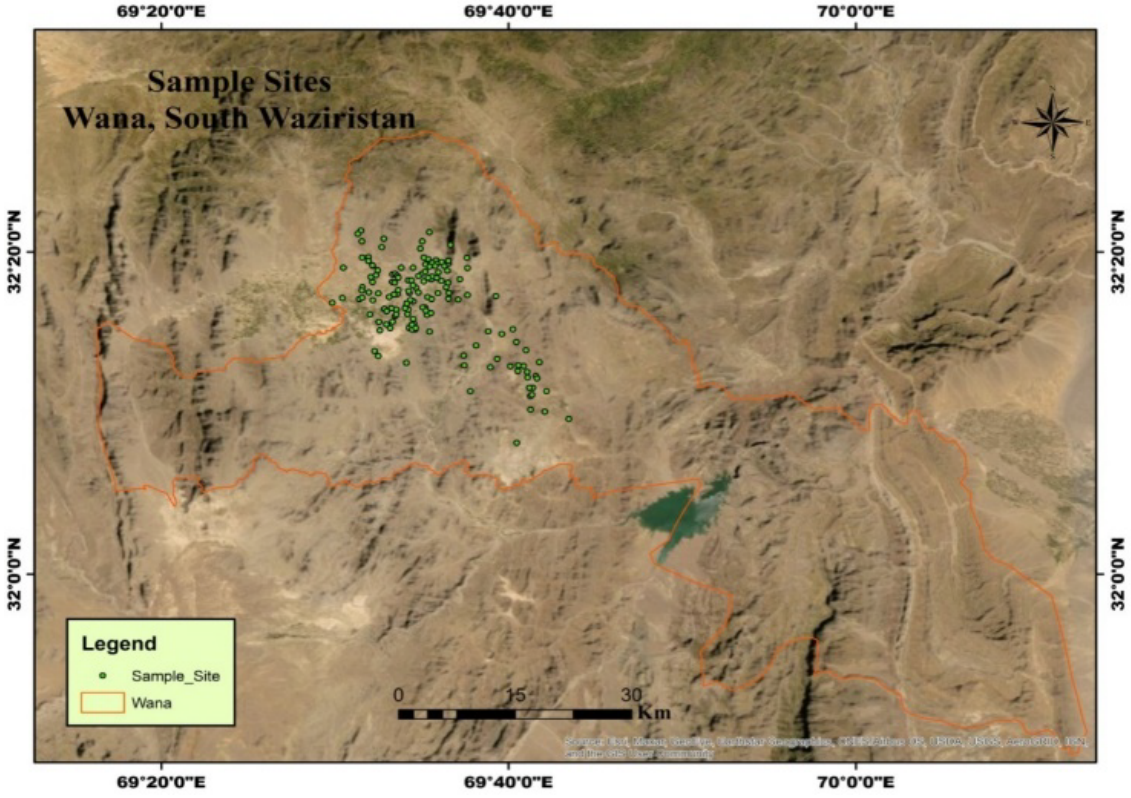

Figure 2. Sample sites map

3. Results and Discussion

3.1. Socio-Economic Characteristics of Studied Population

The age of respondents is ranging from 22 years to 73 years old (Table 1). The maximum percentage lies between the age limit of 10 to 35 years. This comprises of the 52%. The second major share is the age limit of 35-40 years and this makes the 41%. In this survey, only 6% respondents have the age limit more than 50 years. The frequency is also mentioned which shows the responses taken in the questionnaire survey.

Table 1. Age of Respondents in Wana

Serial No.	Years	Frequency	Percentage
1	<35 Years	89	52.35
2	35-50 Years	70	41.17
3	>50 years	11	6.47
	Total	**170**	**100**

*(Field survey, 2021)

The family sizes in the study area were categorized in three classes, small, medium and large family. Families, which have less than 10 members, were categorized as small family (Table 2). Similarly, family, which consists of 10 to 15 members, was categorized as medium and above 20 members was categorized as large families. As far as the family size is concerned, about half the population, which becomes 49% was a middle family. The other large percentage of the family size was of those people who were living in the large family structure (about 31%). In addition, the people living in the nuclear family were only 18%.

Table 2. Family size of the Respondents

Serial No.	Families Size	Frequency	Percentage
1	Small Family	32	18.82
2	Medium Family	84	49.41
3	Large Family	54	31.76
	Total	**170**	**100**

*(Field survey, 2021)

Monthly income of the respondents ranges from less than 25000 to more than 5000 PKR (Table 3). According to that survey and (with the frequency of 77), 45% people had the monthly income of less than 25000. The other group of population belonged to 40.58% and they had the income, which lied between 25,000 and 50,000, and only 14% percentage was having the monthly income more than 50 thousand.

This important data is about the daily water consumptions in the study area (Table 4). It is evident that about half of the population of the respondents had the daily domestic usage of 47.6%. The other percentage was 31% of the people who use the average water less than 50 liters. Moreover, the percentage of the people, which lies in between 50 to 100 liters, was 20%.

It is evident in the tabular data that majority of the pumps was electric pumps which makes the 60% of the data (Table 5). The other major use is of solar pumps. Solar pumps make the 26% of the total pumps in the region and 10% are the tube well. The data also reveals that hand pumps were only 4% and these hand pumps are mainly use for domestic purposes only.

The diameter of the pipeline of the water pumps and the capacity of these water pumps were classified in five groups that is from 1 inch to 4 inch (Table 6). 44% pumps had the capacity of the 3 inches. 16% were having the 4 inches diameter of the pipe. 22% pumps were those, which had the capacity of the only 2 inches. 9 % of the water pumps have the capacity of 2.5 inches and 7 % have 1 inches capacity which mostly falls in hand pumps category.

Table 3. Monthly Income of the Studied Population

Serial No.	Monthly Income (PKR)	Frequency	Percentage
1	<25000	77	45.29
2	25000-50000	69	40.58
3	>50000	24	14.11
	Total	**170**	**100**

*(Field survey, 2021)

Table 4. Domestic Water Consumption

Serial No.	Water Consumption Per day (Liter)	Frequency	Percentage
1	< 50	54	31.76
2	50-100	35	20.58
3	> 100	81	47.64
	Total	**170**	**100**

*(Field survey, 2021)

Table 5. Groundwater pumping in the study area

Serial No.	Groundwater Pumping	Frequency	Percentage
1	Electric Motor	102	60
2	Solar Pump	43	25.29
3	Tube well	17	10
4	Hand Pump	8	4.17
	Total	**170**	**100**

*(Field survey, 2021)

Table 6. Capacity of water Pump in Wana

Serial No.	Water Pump Capacity (Inches)	Frequency	Percentage
1	1	12	7.05
2	2	36	21.17
3	2.5	16	9.41
4	3	76	44.7
5	4	27	15.88
	Total	**170**	**100**

*(Field survey, 2021)

Spatial variation has been noted in water consumption. In the areas, where the families' sizes are large, consumption of water is also larger. Similarly, the areas that has high-income group consume maximum water. The water consumption increases with the increase in monthly income and size of the family. The Cross tabulation shows that in low-income group 6 and 16 HH were consuming water less than 50 l/day and 50 to 100 l/day respectively. In middle-income group 13 HH was consuming water from 50 to 100 l/day, while most of the high-income group were consuming more than 100 l/day (Table 7). Similarly, analysis further reveals that small families consuming less than 100 l/day. In medium size families, most of the HH are consuming water from 50 to 100 l/day while large families consume water more than 100 l/day (Table 9). Moreover, the water consumption increases as HH family size and monthly income increases. People having monthly income of less than 25000 PKR, consume 347 l/day and people having monthly income of 25,000-50,000 PKR consume 538 l/day. Similarly, people having monthly income of more than 50,000 PKR consume 749 l/day (Table 8). The per capita consumption for small, medium and high-income group is 10, 22 and 48 l/day respectively. The total water consumption of small family, medium and large families' sizes are 423,642 and 831 l/day and the per capita consumption for these families are 6.4, 11 and 20 l/day (Table 10).

Table 7. Family income level and water consumption cross tabulation

Income Level	Water Consumption			Total
	< 50	50-100	>100	
< 25,000	6	16	13	35
25,000-50,000	4	13	2	19
> 50,000	0	17	24	41
Total	10	46	39	95

Table 8. Per Capita Consumption by different income groups.

Monthly Income	Per Capita Consumption (l/day)	Total Consumption l/day
< 25,000	10	347
25,000-50,000	22	538
> 50,000	48	749

Table 9. Family size and water consumption cross tabulation.

Family	Water Consumption			Total
	< 50	50-100	>100	
Small Family	9	8	7	24
Medium Family	7	30	22	59
Large Family	5	8	10	23
Total	21	46	39	106

Table 10. Per Capita consumption by the Family size.

Family	Per Capita Consumption (l/day)	Total Consumption in l/day
Small Family	6.4	423
Medium Family	11	642
Large Family	20	831

4. Conclusion

The study concludes that the residents in the study are using ground water for domestic and agricultural purposes. Population is also increasing rapidly and this put immense pressure on ground water. The consumption of water is different among the different income groups and family sizes. Monthly income group and family size have direct connection with water consumption. Larger families consume more water as compared to smaller families. Spatial variation has been noted in water consumption. In the areas, where the family sizes are large, consumption of water is also larger. Similarly, the areas that has high-income group consume maximum water. The water consumption increases with the increase in monthly income and size of the family. Moreover, the water consumption increases as HH family size and monthly income increases. People having more monthly income consume large water as compared to people who have less monthly income.

5. Way Forward

The small and medium reservoirs under the present conditions are the only possible way to meet the impeding water crisis. As these small dams would be mostly in areas of water scarcity, hence the dam's effect on raising aquifer would be most significant, in supplementing the irrigation resources and extending cultivation. Large dams, no doubt will affect the recharging and raising of aquifer more, but that would be localized and in the same vicinity, whereas these small dams would do so in different localities and their impact will be more widely felt.

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Author contributions

Saddam Hussain and Shakeel Mahmood contributed eaqually in data analysis and writing of the manuscript. Shakeel Mahmmod reviewed and updated the final version of the manuscript.

Conflicts of interest

There is no conflict of interest between the authors.

Statement of Research and Publication Ethics

Research and publication ethics were complied with in the study.

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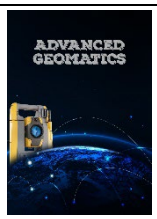

Least-Squares Spectral Analysis of Hourly Tide Gauge Data – A Case Study

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Abstract

Tide gauge observations are samples of geodetic time series realized depending on the time. These observations like other experimental time series might have trends, short gaps, datum shifts and unequally spaced data which usually make disturbing effects to the analysis. In other methods (e. g. classical Fourier Transform), trend is removed before the analysis, the others (i.e. short gap and unequally spaced data) are taken over by filling any interpolation techniques. In this case the editing may produce well-composed time series, but it may obliterate the useful information in the series or even introduce artificial signals. This means that unwanted results take place during the process. There is an alternative method, called the Least-Squares Spectral Analysis (LSSA) which can bypass these problems without editing or pre-processing. In the present study, hourly sea level observations obtained from the Antalya tide gauge in Turkey were analyzed by using the LSSA method. Consequently, five hidden periodicities were successfully determined from the sea level observations containing difficulties mentioned above.

1. Introduction

The fundamental aim of geodetic studies is to determine the shape and gravity field of the Earth. In this context, several geodetic observations, such as the distances, directions, height differences and gravity surveys are performed by different techniques. These geodetic observations are always effected from all physical forces or process on the Earth surface. Therefore, some observations are made depending on time or space in order to examine the physical process comprehensively (Abbak, 2007). For example, tide gauge data changing with the gravity effect of Sun and Moon, is the most well-known time series in geodesy. As being the independent observations, determining unknown parameters in random process (i. e. time series) is subject to investigate in geodetic statistics (e. g. Zeray Öztürk et al., 2020; Zeray Öztürk and Abbak, 2020).

The time series have many drawbacks bothering the analysis. Some of them are the presence of datum shift, trend, short gap, unequally spaced and weighted data in the time series. Several synthetic methods are used to bypass these difficulties in practice. For example, (i) trend is removed before the analysis; (ii) if the data has two or more datum shifts, every datum is analyzed separately, which means the disorder of complete analysis; (iii) provided that the time series has short gaps or unequally spaced data, the gaps and certain values are predicted and filled by the harmonic analysis or any interpolation technique (e. g. Craymer, 1998). The whole temporary solutions discussed above cause to a series of new problems in the analysis. Thus an alternative technique is developed without the corruption of originality of the data, which is called "Least Squares Spectral Analysis (LSSA)".

The LSSA method was first released and developed by Vaníček between 1969 and 1971 (Vaníček, 1969a; 1971). Therefore, the method was also named as "Vaníček Spectral Analysis" in geodetic literature (Taylor and Hamilton; 1972). Afterwards a wide range of researchers successfully applied the technique in geodesy and related fields such as electronic distance measurement, tidal data, superconducting gravimeter data, mesospheric temperature estimating and star positioning (Craymer, 1998; Abbasi, 1999; Omerbashich, 2003; Espy and Witt, 1996; Mantegazza, 1997; Abbak, 2005).

The main aim of the LSSA method is to find the hidden periodicity in the time series consisting of the difficulties

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mentioned above, and thus clarify the physical events that cause these periodicities. For this purpose, in this study an investigation was conducted in order to determine phenomena causing to the periodic changes in the sea level observations.

The paper starts with a brief review of the computational scheme of the LSSA method. Then, the structure of sea level observations is explained as an input data. Next, the LSSA method is applied to tide gauge data for the determination of the periodicities in the sea level changes. Finally, the results obtained from the current analysis are compared with astronomic counterparts.

2. Least Squares Spectral Analysis

2.1. Basic approach

The LSSA is an application of least-squares approach in the time series analysis. This method uses least squares principle to minimize the norm of the error vector of the time series, estimating the periodic components as well as non-periodic ones (Amerian and Voosoghi, 2011).

The experimental time series consist of the signal and noise. The noise disturbing on observation is divided into two components: random and systematic. An ideal noise called "white noise" is uncorrelated with any dependent variable. Nevertheless, in practice a systematic noise called coloured noise occurs and is correlated with one or more variables. Systematic noise can be defined by mathematical functions, but their magnitudes are not known in the time series. It is categorized by two types: periodic and non-periodic. The main aim is to able to determine these systematic noises (both periodic and non-periodic).

2.2. Mathematical Basics

The problem is following:

1. Vector of observation time: $t_i,\ i = 1,\ 2,\ \ldots,\ n$
2. Vector of observables: $\boldsymbol{f}(t_i)$
3. Vector of frequencies whose spectral values are desired: $\omega_j, j = 1,\ 2,\ \ldots,\ m$

The $\boldsymbol{s}(\omega_j)$ vector, the spectral value of the ω_j frequency, is sought by spectral analysis. There are several ways of computing a spectrum from a time series. Here we simply state the problem in the Least Squares Approximation (LSA). Thus the time series can be modelled by simple formula,

$$\boldsymbol{g} = \boldsymbol{A}\boldsymbol{x} \tag{1}$$

where $\boldsymbol{A}$ is the design matrix modelling the physical relationship between the observations and the vector of unknown parameters ($\boldsymbol{x}$). The parameters of the design matrix are summarized by:

$$\boldsymbol{A} = \begin{bmatrix} cos\ \omega_j t_1 & sin\ \omega_j t_1 \\ cos\ \omega_j t_2 & sin\ \omega_j t_2 \\ \vdots & \vdots \\ cos\ \omega_j t_n & sin\ \omega_j t_n \end{bmatrix} \tag{2}$$

For computing these parameters by least-squares approximation, differences between $\boldsymbol{f}$ and $\boldsymbol{g}$ functions will be minimum. Using the least-squares notation (e. g. Vanícek and Krakiwsky 1986), it is written,

$$\hat{\boldsymbol{r}} = \boldsymbol{f} - \hat{\boldsymbol{g}} = \boldsymbol{f} - \boldsymbol{A}(\boldsymbol{A}^T\boldsymbol{P}\boldsymbol{A})^{-1}\boldsymbol{A}^T\boldsymbol{P}\boldsymbol{f} \tag{3}$$

where $\hat{\boldsymbol{r}}$ is the residual vector, $\hat{\boldsymbol{g}}$ is the best approximation of $\boldsymbol{g}$ by the least-squares. Then spectral values can be calculated by the ratio,

$$\boldsymbol{s} = \frac{\boldsymbol{f}^T\hat{\boldsymbol{g}}}{\boldsymbol{f}^T\boldsymbol{f}} \tag{4}$$

If the spectral value is desired to compute for a frequency ω_j, the result is

$$\boldsymbol{s}(\omega_j) = \frac{\boldsymbol{f}^T\hat{\boldsymbol{g}}(\omega_j)}{\boldsymbol{f}^T\boldsymbol{f}} \tag{5}$$

In the geodetic literature related with the parameter estimation using the least-squares, it is essential important to evaluate the results statistically. Thus a great superiority of the LSSA method is that the significance of peaks in the spectrum can be tested statistically. Pagiatakis (1999) introduces a test as follows: a statistical test of null hypothesis $H_0 : s(\omega_j) = 0$ can be tested using a decision function by

$$s(\omega_j)\begin{cases} \leq (1 + (\alpha^{-2m/v} - 1)^{-1})^{-1}; & accept\ \ H_0 \\ > 1 + (\alpha^{-2m/v} - 1)^{-1})^{-1}; & reject\ \ H_0. \end{cases} \tag{6}$$

where α is the significance level (usually 5%), m is the number of frequencies participated in simultaneously estimation of the LSSA, and $v = n - 2m$ is the degrees of freedom including n equal to the number of data.

3. Analyses of the Tide Gauge Data

3.1. Input data

By using the LSSA method, this study investigates tidal components in the sea level observation acquired from the tide gauge. The tide gauge is an observatory, which continuously records the instant sea level. The systems in the tide gauge are divided into two categories: analog and digital. Analog system is based on the drum which records the sea level (Fig. 1). The plotter over the drum reflects the sea level changes to the paper on the drum in real time. The data obtained from analog system is not suitable for the numerical analysis due to its graphical structure. Today this system is out of the date owing to the mechanical reasons and digitization errors.

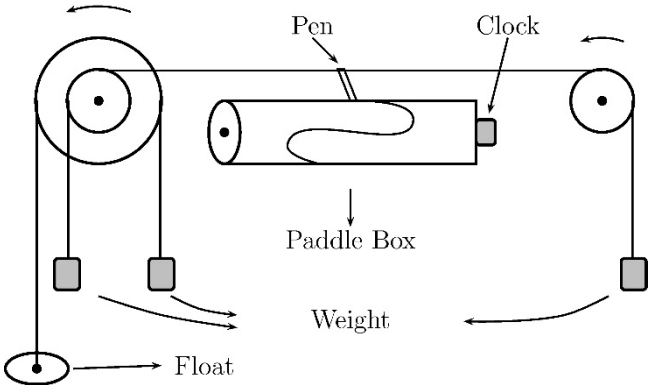

Figure 1. Analog system on tide gauge

Before the analysis, we should consider the structure of the sea level data more closely. The sea level observations are decomposed to three components (Ainscow et al., 1985):

$$\text{Observation= mean sea level + tides + atmospheric residuals} \quad (7)$$

where the components are related with the different physical process and uncorrelated with each other. The mean sea level is determined by averaging hourly data at least one-year long. The tides are the periodic sea level changes which are the consistent with some geophysical effects and are of the certain amplitude and phase. Atmospheric residuals are irregular variations related with weather conditions, which is so-called "surge effect".

Tides mentioned above are explained by Newton's gravity force. This force is summarized by

$$F = G\frac{m_1 m_2}{r^2} \quad (8)$$

where G is the Newton gravitational constant, r is the distance between m_1 and m_2. Provided that the Earth and Moon masses, and also distance between Earth and Moon are inserted to equation, the result is the gravitational force between Earth and Moon. The gravitation between the Earth and Sun can be achieved similarly. Both gravitations affect sea level changes in same periods with the movements of the Sun and Moon. Accordingly, tidal components are shown in Table 1.

Table 1: Short period Primary tidal components (ORNL, 2011)

Tidal components	Period (Sun time)	Description	Explanation
M2	12.42	Principal lunar	Semidiurnal
S2	12.00	Principal solar	Semidiurnal
N2	12.66	Larger Lunar elliptic	Semidiurnal
K2	11.97	Luni-solar	Semidiurnal
K1	23.93	Luni-solar diurnal	Diurnal
O1	25.82	Principal lunar diurnal	Diurnal
P1	24.07	Principal solar diurnal	Diurnal
Q1	26.87	Larger Lunar elliptic	Diurnal

After these explanations, we concern the source of error in the tide gauge data. Generally, three types of systematic noise contaminate time series from our point of view. Firstly, there can be a step function due to sudden changes in the tide gauge datum (possibly caused by vertical displacements). The dates of such step functions are usually well-documented, but their magnitudes may not be documented properly. Secondly, there may be a gradual change in the tide gauge datum due to sea level rise or land subsidence around the tide gauge, which is simply modelled by a linear trend. Thirdly, there are data gaps resulted from the equipment failures.

3.2. Numerical Application

In the application process, the observations obtained from the Antalya tide gauge in 1990 in Turkey were analyzed using the LSSA method. These observations belong to analog system of the tide gauge. Therefore, the Turkish General Directorate of Mapping (TGDM) digitalized them and then corrected for the outliers (TGDM, 1991).

Before the numerical analysis, at first the observations were plotted in month by month. Thus the datum shift and short gaps in time series are determined easily. While the observations are examined carefully, it is clear that there is a variety of difficulties in the time series (see, Fig. 2)

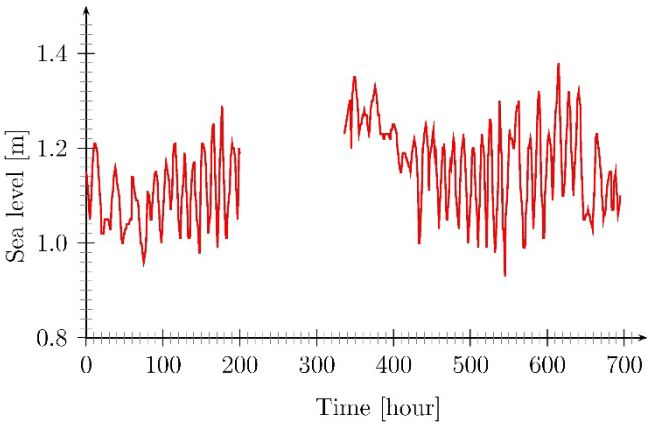

Figure 2: A sample data from the Antalya tide gauge (April 1990)

The software developed by Wells et al. (1985), was utilized for the analysis. This software was encoded in FORTRAN Programming Language by the LSSA algorithm. The interested reader can be found this program at the web page of LSSA (2022). The program

starts with input data and some settings (i. e. whether some known constituents such as the datum shift, linear trend etc., are present or not).

The hourly sea level data obtained from every month was analysed in a sequence. In order to predict the periods as possible as accurate, two spectral bands were used for this process: minimum, maximum and number of periods were selected as firstly 11.5h, 13.5h and 500, secondly, 23.5h, 26.5h and 500. As a result of this analysis, five periods were successfully estimated in the sea level observations (Table 2).

Table 2: The periods estimated by the LSSA method [hour]

Months	Period #1 (S2)	Period #2 (M2)	Period #3 (N2)	Period #4 (K1)	Period #5 (O1)
January	11,988	12,418		23,989	25,694
February	11,999	12,438	12,778	24,097	25,516
March	11,947	12,394	12,579		25,744
April	12,119	12,490	12,829	23,940	24,986
May	11,947	12,498	12,795	23,876	25,834
June	11,943	12,382	12,551	24,011	
July	12,051	12,406	12,604	24,032	25,564
August	12,040	12,414	12,583	23,869	25,968
September	11,995	12,394	12,637	23,876	25,818
October	11,973	12,406	12,612	23,826	25,475
November	12,014	12,450	12,787	23,742	25,959
December	11,976	12,422	12,720	23,862	
Average	12,00	12,43	12,68	23,92	25,66
Stand. Dev.	0,05	0,04	0,10	0,10	0,29

In order to check whether the results are compatible with astronomical values or not, a test was carried out by using the student distribution (t test). A null hypothesis $H_0 : \bar{x} = \mu_0$ can be tested using a decision function by

$$t_{test} = \frac{|\bar{x} - \mu_0|}{\sigma_x/\sqrt{n}} \begin{cases} < t_{\alpha,\, f}; & accept\ H_0 \\ \geq\ t_{\alpha,\, f}; & reject\ H_0 \end{cases} \qquad (9)$$

where α is the significance level (5%), f is the degree of freedom, σ_x is the standard deviation of the periodicity, $\bar{x}$ is the average value of the periodicity, and μ_0 is the astronomical value of the periodicity. As a result of the test, the periods derived from the analysis are well-consistent with the astronomical ones in a confidence level of 95%. This result shows that the LSSA method is successfully on determination of the hidden periodicity in the geodetic time series induced by the disturbing effects.

Although there are totally eight diurnal and semidiurnal tidal components, in the current study five of them can be determined by the LSSA method. The reasons of incomplete frequencies are evaluated that the other components might have low amplitudes, or that the dock position of the tide gauge might be unsuitable to sense the other components.

4. Conclusion

This paper has summarized the theory of the LSSA approach to spectral analysis of the time series. The LSSA is an efficient method to determine the periodicities of the experimental time series that have the difficulties. In other words, the LSSA can be carried out directly to the experimental time series without editing or pre-processing. Furthermore, all unknown parameters are found simultaneously, while a rigorous test is implemented to assess the significance of the determined peaks in the spectrum.

In order to exhibit the powerfulness of the method, a numerical application was accomplished in the sea level observations which were affected by many disturbances. As a result of the numerical analysis, five consistent periods were determined in those series. Consequently, the numerical analyses show that the LSSA method gives us reasonable results in the experimental time series. Thus it is strongly recommended that the method should be used in any geodetic time series, e. g. GNSS time series.

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Author contributions

R. Alpay Abbak designed the study, determined the analysis plan, investigated the results, and wrote the manuscript.

Conflicts of interest

There is no conflict of interest between the authors.

Statement of Research and Publication Ethics

Research and publication ethics were complied with in the study.

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The Outlier Detection with Robust Methods: Least Absolute Value and Least Trimmed Square

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Abstract

In geodesy and surveying, measurements usually have errors. These errors are called outlier measurements. In order to determine these points, outlier measurement test is performed. There are many different methods used to determine outlier measurement. The least squares (LS) method is the most common method to estimate the unknowns from outlier measurements. However, LS method can be easily affected by outliers which may cause wrong results. Classical outlier tests and robust methods are the two main approaches to detect outliers or reduce their effect. There are a lot of robust methods in literature. In this study, least square method (LS), least absolute value (LAV) and the least trimmed squares (LTS) are discussed. To compare the outlier performances of the methods, real data points are used to create a surface with a 2nd degree polynomial.

1. Introduction

Adjustment is important in surveying because the measurements which are made to determine the unknowns usually have errors. Therefore, redundant measurements are needed to increase the precision of the computed unknowns (Ghilani, 2017). Among the many methods, the least squares (LS) has been generally used to adjust the Gauss-Markov Model (GMM) in surveying, geodesy and different fields (Fang, 2015). However, outliers could happen in the measurements due to different reasons and they may affect the results, thus causing wrong assumptions (Erdogan, 2014). So, outliers must be detected or their effect must be reduced by using some methods. Classical outlier tests (Baarda, 1968; Pope, 1976; Koch, 1999) and robust methods are two main approaches in geodesy to detect outliers or reduce their effect (Sisman, 2010).

Classical outlier tests could be ineffective if outlier number is large. In this case, outliers can remain undetected. Moreover, even correct measurements can be detected as outlier wrongly (Berné Valero & Baselga Moreno, 2005). At this point, robust methods (Huber, 1981; Hampel et al. 1986; Rousseeuw, 1984; Rousseeuw & Leroy, 1987) are developed to be insensitive to outliers. Also, detection of outliers can be done by looking at the residuals from a robust method (Hekimoglu & Erenoglu, 2009). There are many robust methods such as M-estimators, least absolute value (LAV) and Generalized M-estimators, least median of squares (LMS) and the least trimmed squares (LTS) and so on (Hekimoğlu, 2005).

In this study, outlier measurements were determined by using a data set from Ondokuz Mayis University in Samsun. The solution was made with LS, LAV and LTS methods. Results were compared.

2. Method

The outlier performances of LS, LAV and LTS methods are analyzed in the study. They are briefly introduced in three different headings.

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2.1. The Least Square Method (LS) and Outlier Detection Procedure

The least squares method is explained by Carl Friedrich Gauss in 1795 and Legendre in 1805. LS objective function is $\|Pvv\| = [Pvv] = \min$. Unknown parameters are calculated with the following equation in this method (Sisman, 2014).

$$\underline{X} = \left(\underline{A}^T P \underline{A}\right)^{-1} \underline{A}^T P \underline{\ell} \tag{1}$$

Root mean square error (RMSE);

$$m_0 = \pm\sqrt{\frac{\underline{V}^T P \underline{V}}{f}} \text{ ; f = n – u} \tag{2}$$

The measurement errors of the LS method influence the residual of other calculations. Thus, this correction value may not always be due to an error in the measurement. This situation is called the spread and storage effect of LS method. Different solution methods can be conducted for the analysis of spread and storage method (Ayan,1992).

The point with the highest V value is removed from the cluster. The outlier measurement test is repeated with the remaining points. This process is continued iteratively until there is no outlier measurement (Kirici, Sisman, 2015).

2.2. The Least Absolute Value Method (LAV) and Outlier Detection Procedure

In the classical Gauss-Markov model, the unknown parameter (x) for a linear (linearized) parametric adjustment is determined based on the following functional and stochastic models (Simkooei A.A., 2003).

$$\begin{aligned} l + v &= A.x \\ D^T.x &= 0 \\ P &= Q_l^{-1} = \sigma_0^2 C_l^{-1} \end{aligned} \tag{3}$$

$v_{n\times1}$:vector of residual, $l_{n\times1}$: vector of observation, $A_{n\times u}$: rank deficient design matrix, $P_{n\times n}$: weight matrix of observations, $D_{u\times d}$: datum matrix of the network added to complete the rank deficiency of the design matrix, $O_{d\times1}$: zero vector, $C_{j(n\times n)}$: covariance matrix of observations, $Q_{l(n\times n)}$: cofactor matrix, σ_0^2: priori variance factor

LAV objective function is $||Pv|| = [P|v|] = min$. It contains the L1 Norm method and unknown parameters such as $\underline{X}$ and $\underline{V}$. The new unknowns for linear programming are arranged as follows.

$$\begin{aligned} X &= X^+\text{-}X^- ; \quad X^+, X^- \geq 0 , \\ V &= V^+\text{-}V^- ; \quad V^+, V^- \geq 0 \end{aligned} \tag{4}$$

The mathematical model and constraint equation for linear programming in the solution according to the LAV objective function are as follows (Bektas ve Sisman 2010).

$$\begin{aligned} &[A \quad -A \quad -I \quad I] \begin{bmatrix} X^+ \\ X^- \\ V^+ \\ V^- \end{bmatrix} = [\ell] , \\ &f = b^T X = [P|V|] = P^T V = p^T [V^+ \quad V^-] = min. \end{aligned} \tag{5}$$

By looking at the calculated V values at the end of the process, outlier measurement can be easily determined (Kirici 2016).

2.3. The Least Trimmed Square (LTS) and Outlier Detection Procedure

The LTS method (Rousseeuw & Leroy, 1987) is a high breakdown estimator. The objective function of the LTS is given as:

$$Min \sum_{i=1}^{h} P_i v_i^2 \tag{6}$$

Here, h, P *and* v represent the trimming parameter, the weight of the measurements and the residuals of the measurements respectively. When $h = n$ (measurement number), this is same as LS method. h is usually set to a constant number smaller than n (Mount et al., 2014). For the best robustness $h = [n + u + 1]/2$ (Rousseeuw & Leroy, 1987).

In this method, the h measurements which have the smallest squared residuals are searched for out of n measurements (Dilmac and Sisman, 2023). When the number of possible $\binom{n}{h}$ subsets is relatively large, a full searching of all possible subsets is prohibitive. Several algorithms (Hawkins, 1994; Atkinson & Cheng, 1999; Li, 2005; Koch et al., 2017) are proposed to overcome this issue. For this study, the FAST-LTS algorithm (Rousseeuw & Driessen, 2006) is discussed. A workflow that briefly explains this algorithm is given below (Figure 1).

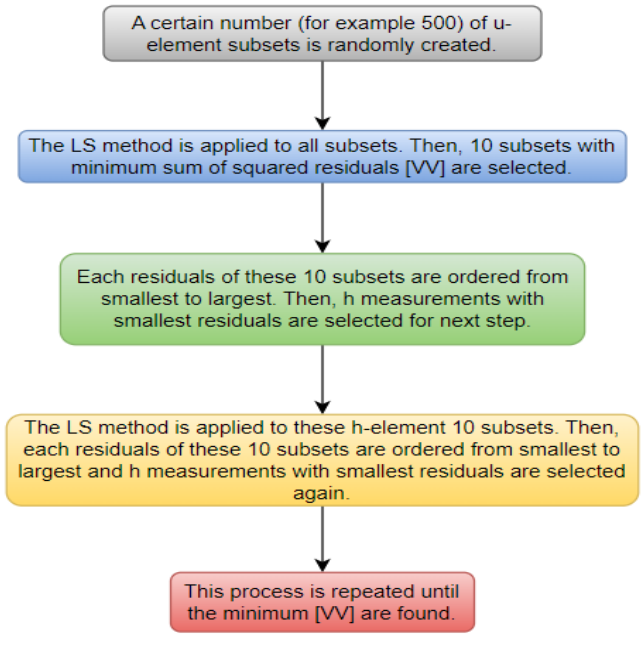

Figure1. The workflow of FAST-LTS algorithm.

First, least squares is applied with 500 randomly generated sets with u elements. From these 500 subsets, 10 subsets with the smallest [VV] are selected. The residuals for all measurements are calculated using the estimated X of these 10 subsets. Then, the residuals of these 10 subsets are ordered from the smallest to the largest and h measurements with smallest value are selected for next step. This cycle is repeated with 10 subsets until one of them gives the minimum [VV].

2.4. Case Study

In this study, a section of land located at Ondokuz Mayis University in Samsun province was chosen as the study area. A data set consisting of 411 points was used (Figure 2).

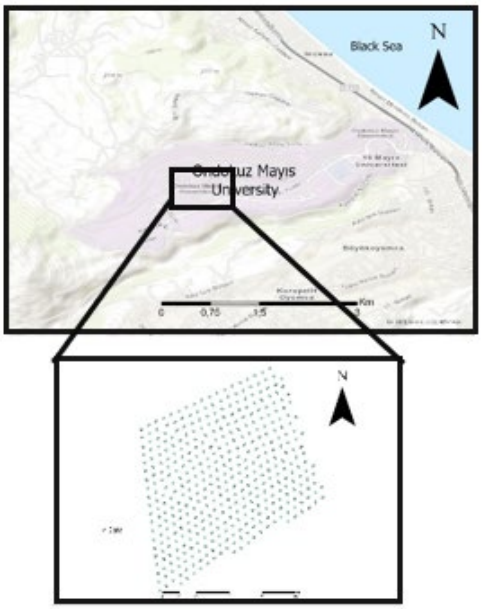

Figure 2. The study area and distrubition of 411 points

Points have X, Y and Z coordinates. By using these points, the polynomial surface is fitted with a 2nd degree polynomial. Then outlier measurement test was performed with three different methods.

3. Results

3.1. The Least Square Method

First, the LS method was tried. The method determined 14 out of 411 points as outlier measurement (Figure 3).

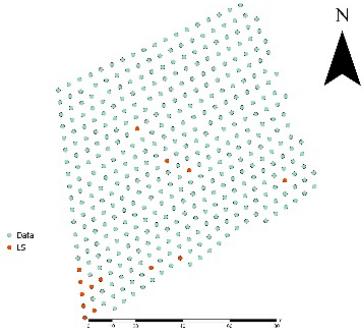

Figure 3. Outlier measurements of LS method

A compatible data group consisting of 397 points remained.

3.2. The Least Absolute Value Method

Then, LAV method was tried. The method determined 18 out of 411 points as outlier measurement (Figure 4).

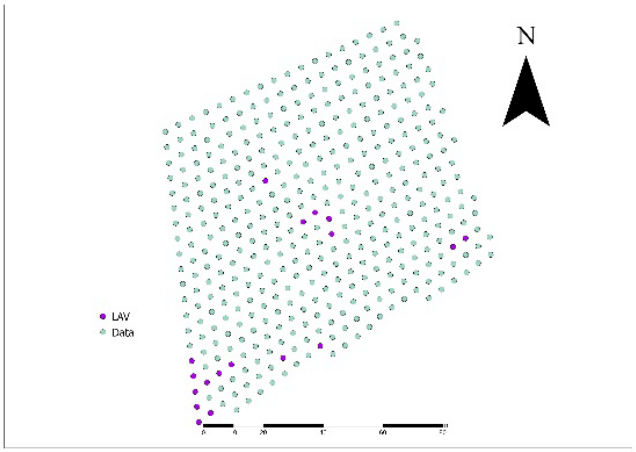

Figure 4. Outlier measurements of LAV method

A compatible data group consisting of 393 points remained.

3.3. The Least Trimmed Square Method

In LTS method, the trimming parameter h can be set between $\frac{n}{2} < h \leq n$. LS and LAV methods determined 14 and 18 points as outlier measurement. According to these numbers, h is set to 391. It means that 20 points could be outliers (Figure 5).

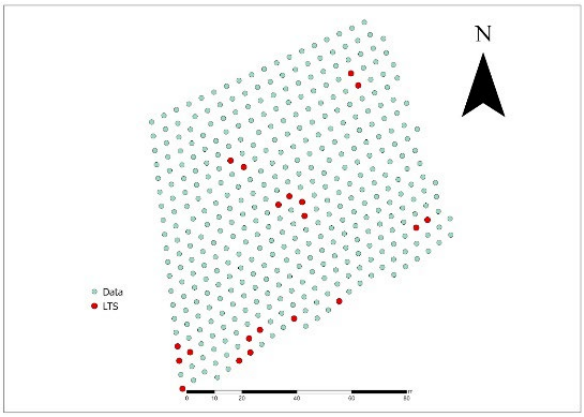

Figure 5. Outlier measurements of LTS method

4. Discussion and Conclusion

In this study, the outlier test performances of the LS, LAV and LTS methods are analyzed by fitting real data points to a surface with a 2nd degree polynomial. As a result, the LS and LAV methods found 14 and 18 outliers respectively. Considering outlier points of LS and LAV methods, 14 points of all 18 outliers found by LAD are common with those of LS (Figure 6).

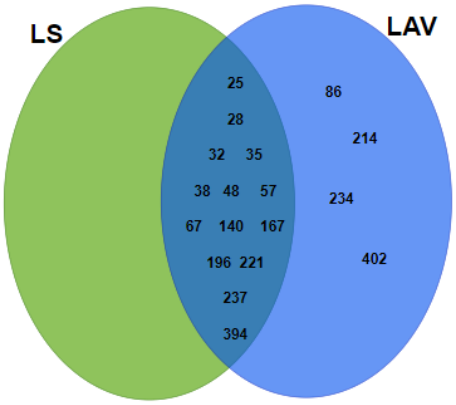

Figure 6. Venn diagram of LS and LAV methods.

LS and LTS have found 10 common outlier points which are less than LS and LAD (Figure 7).

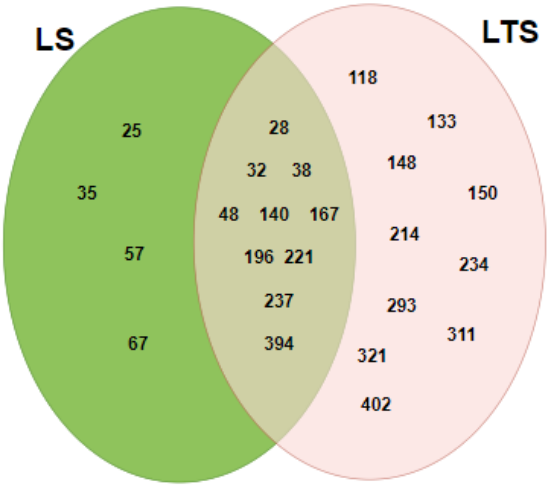

Figure 7. Venn diagram of LS and LTS methods.

Then venn diagram of all three methods are given in Figure 8.

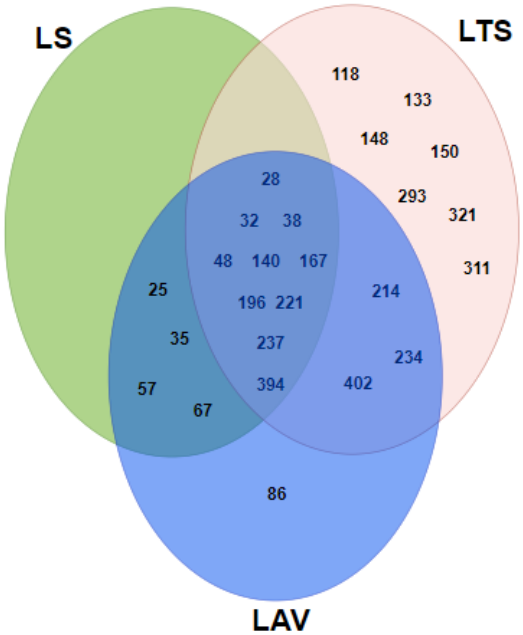

Figure 8. Venn diagram of LS, LAV and LTS methods.

The points determined as outlier measurements by the methods were removed from the cluster and RMSE was calculated (Table 1). Here, it is seen that the results are generally close to each other. But the smallest value was found in the LTS method. The largest value was found in the LS method.

Table 1. RMSE values of LS, LAV and LTS methods

Method	LS	LAD	LTS
RMSE (m)	0,1872	0,1829	0,1821

In this study, it is seen that the methods give close results compared to each other. Therefore, we can say that they can be used interchangeably. The study can be repeated by expanding the working area.

Author contributions

Ulku Kirici Yildirim and Hasan Dilmac worked together on methodology, writing, editing and review. **Yasemin Sisman** was the advisor of the study.

Conflicts of interest

There is no conflict of interest between the authors.

Statement of Research and Publication Ethics

Research and publication ethics were complied with in the study.

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Examination of the Performance of Precise Point Positioning Technique with Real-Time Products on Smartphones

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RT-PPP.

Research Article

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Abstract

This study evaluates the performance of a single-frequency GPS (Global Positioning System) positioning technique under real-time conditions using a smartphone. To assess the performance of the smartphone, GPS observations were recorded with the Geo++ RINEX Logger application on a Xiaomi Redmi Note 8 Pro and compared with measurements taken using a geodetic-grade CHC I80 GNSS receiver. Raw observation data were processed using Real Time-Precise Point Positioning (RT-PPP) technique with real-time satellite orbit and clock correction products produced by 4 different analysis centers (IGS, CNES, JAXA and Wuhan University). According to the results, it was seen that 4 different solutions made with only-GPS observations were consistent with each other both horizontal and vertical at millimeter level. In addition, an improvement of 89% to 98% was achieved in the root mean squared errors (RMSE) after convergence. Overall, this study demonstrates the potential of using single-frequency GPS observations on smartphones for real-time precise point positioning, which could have important applications in various fields including surveying, navigation, and location-based services.

1. Introduction

Advancements in satellite constellations, modernized signals, and positioning theory and algorithms have led to an increase in studies on geodetic-grade and low-cost GNSS receiver/antennas, including those integrated into smartphones (Zhang et al. 2021; El-Mowafy et al. 2020). Although early smartphones only provided position information using single-frequency and single-constellation satellites, the release of Android N (Nougat=Version 7) in 2016 enabled users of Android-based smartphones to access raw GNSS data, marking a significant milestone in precise positioning studies (Zhang et al. 2021; El-Mowafy et al. 2020; Xu et al. 2020). As a result, smartphones have become a focus of precise positioning studies due to their widespread usage and portability (Zhang et al. 2021; El-Mowafy et al. 2020; Xu et al. 2020).

Early studies identified GNSS antenna quality and cycle slip as the main issues affecting precise positioning using smartphones (Banville & Diggelen 2016). Subsequent studies evaluated the quality of raw measurements and position accuracy using linear polarized and external GNSS antennas with the Huawei Mate 9 smartphone (Siddakatte et al. 2017). However, until 2018, single-frequency GNSS observations were used for positioning, navigation, and timing applications on smartphones.

In 2018, Xiaomi introduced the Mi8 smartphone, which could collect dual-frequency GNSS raw observation data, enabling the evaluation of precise positioning performance using different techniques such as Real-Time Kinematic and Precise Point Positioning (Chen et al. 2019; Liu et al. 2021; Odolinski & Teunissen 2019; Robustelli et al. 2019; Wu et al. 2019). Although smartphones are low-cost and portable, they are sensitive to the multipath effect due to the GNSS antenna/chip used. GNSS receiver/antennas designed to minimize the multipath effect have advantages over the antenna/chip(s) used in smartphones. Moreover, the GNSS antenna/chip structure used in smartphones can cause interruptions in carrier-phase observations, which are widely used for high positioning accuracy (Paziewski et al. 2019; Zangenehnejad & Gao 2021).

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Recently, studies on point positioning using the Precise Point Positioning (PPP) technique with a single GNSS receiver under real-time conditions have gained momentum. This technique eliminates the need for a simultaneous reference receiver, network, or infrastructure compared to previous methods (Hosseini & Teunissen 2020). Along with the dual-frequency raw GNSS data collection capability of smartphones, PPP-based point positioning performance has been evaluated in both static and kinematic modes, achieving decimeter-level accuracy in static mode and a few meters in kinematic mode (Elmezayen & El-Rabbany 2019; Kulikov et al. 2019). In this study, we collected single-frequency GPS raw observations using a smartphone and a geodetic-grade CHC I80 GNSS receiver/antenna and evaluated their performance using the Real-Time Precise Point Positioning (RT-PPP) method.

2. Method

This study includes the RT-PPP technique based on only-GPS code and phase observations. In this context, the equations can be written as:

$$P_r^G = \rho_r^G + c.\delta t_r - c.\delta t^G + T_r^G + I_r^G + m_r^G + \varepsilon_{r,P}^G \quad (1)$$

$$\Phi_{r,j}^G = \rho_r^G + c.\delta t_r - c.\delta t^G + \lambda N_r^G + T_r^G - I_r^G + m_r^G + \varepsilon_{r,\Phi}^G \quad (2)$$

In these equations, the subscript r represents the receiver, while the superscript G represents the GPS satellite; The pseudorange and carrier-phase in P and Φ length units, respectively; ρ is the geometric distance; c is the speed of light in vacuum, δt_r and δt^s are receiver and satellite clock corrections, respectively; T_r^s indicates tropospheric delay along the signal path; I_r^s is the ionospheric delay along the signal path; λ is the carrier-phase wavelength; N_r^s is the initial phase ambiguity; m_r^s and ε_r^s represent the multipath and noise of the code and phase observations, respectively.

3. Results and Discussion

In this section, both the geodetic GNSS receiver/antenna and the android-based smart phone's information and observation datasets used in the experiments are introduced. In addition, the observations collected on the GNSS receiver/antenna(s) are shown with the RT-PPP method. Finally, the results of the positioning performance of the smartphone are presented using different GPS satellite orbit and clock products.

3.1. Experiment Design and Data Processing

In this section, the raw data collected in the experiments and their processes are mentioned. In the experiments, GNSS observations were made at 1 Hz sampling interval using CHC I80 GNSS receiver and Xiaomi Redmi Note 8 Pro model smartphone. Experiments were carried out in Gebze Technical University, Geomatics Engineering Department in November 2022 and lasted approximately 1.5 hours. The experimental setup is shown in Fig.1. GPS/GLONASS observations were collected in the experiments. However, the process was made with only-GPS observations.

Figure 1. The experimantal setup.

In the process steps, processes were carried out with the PPP technique by using the satellite orbit and clock correction information provided by 4 different analysis centers produced under real-time conditions. The first of these products, RTS products (IGS01/IGC01, IGS02 and IGS03 etc.) offered to the user under real-time conditions by the IGS analysis center, include satellite orbit and clock corrections by providing a continuous broadcast ephemeris stream. Thus, real-time applications, such as atmospheric water vapor measurement, remote sensing applications, hydrographic measurements, intelligent transportation systems, early warning systems, rapid hazard assessment and structural health monitoring, to obtain real-time precise satellite orbit and clock information, critical to its accuracy. However, since there were no processes during the experiment, a PPP-based solution was realized by obtaining satellite orbit and clock correction information from the CDDIS (The Crustal Dynamics Data Information System) archive, where the IGC01 broadcast stream was recorded. In a similar role to a secondary product, IGS-RTS, satellite orbit and clock correction products for GPS and GLONASS are routinely provided by the CNES (National Center for Space Research). The feature of CNES solutions is that the technique called undifferenced ambiguity solution is applied (Laurichesse et al. 2014). Thus improving the actual quality of the clocks for IGS-RTS. The use of these clock products allows for ambiguity resolution at the user receiver, achieving 1 cm horizontal precise point positioning accuracy. Satellite orbits and clocks created in real time are available in the CNES archive as sp3, clk and bia files a few minutes after midnight according to UTC (Coordinated Universal Time). Existing products are useful for post-process PPP software, but for users who want to test in real-time conditions. Therefore, PPP-based solutions have been realized with CNES real-time satellite orbit and clock products offered by the National Center for Space Studies. On the other hand, JAXA (Japan Aerospace Exploration Agency) has developed a precise GNSS orbit and clock prediction system called MADOCA (Multi-GNSS Advanced Demonstration tool for Orbit and Clock

Analysis). Using MADOCA products, user position can be calculated precisely with PPP technique. Also, since JAXA provides Real Time MADOCA product, this product was used for the third process. Finally, PPP-based solutions were realized with real-time satellite orbit and clock correction information produced by Wuhan University.

For these solutions, processes were carried out using the raw observation data recorded through the Geo++ Logger application of the Xiaomi Redmi Note 8 Pro model Android-based smartphone. In order to evaluate the positioning performance of the smartphone, a PPP-based solution was realized by using the raw GNSS observation data collected with a Geodetic-grade GNSS receiver and precise satellite orbit and clock correction products (Final product) produced by Wuhan University. The process steps of this technique in the experiments are shown in detail in Fig. 2 (Karadeniz et al. 2023). In this study, rtkpost application module of RTKLIB demo5_34a software, which is an open source software package for all solutions, was used.

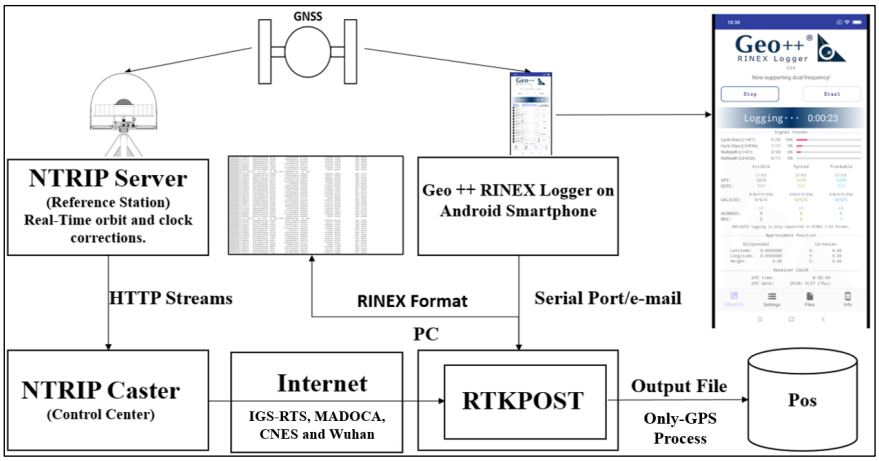

Figure 2. Schematic view of the RT-PPP method.

3.2. Positioning Performance with RT-PPP Method

In this section, raw GPS observations obtained from Xiaomi Redmi Note 8 smartphone are processed with RT-PPP technique in static mode, together with 4 different satellite orbit and clock information produced in real-time conditions. In the study, single-frequency GPS solutions were evaluated. In this context, a static mode RT-PPP solution was made using a single geodetic-grade GNSS receiver (CHC I80) to fairly evaluate the positioning performance of smartphones with single-frequency GNSS observations. Fig. 3 shows the epoch differenced time series of the solutions generated from both the geodetic-grade GNSS receiver and the smartphone throughout all experiment. In addition, statistical histograms of the epoch differenced obtained from the smartphone are given by taking the solutions obtained with the geodetic-grade GNSS receiver as reference. In the solutions of the referenced GNSS receiver, the Final product, which is precise satellite orbit and clock correction products and produced by Wuhan University, was used. The first line of the Fig. 3 shows the epoch differenced time series of the north, east, and up components, respectively, based on only-GPS observations.

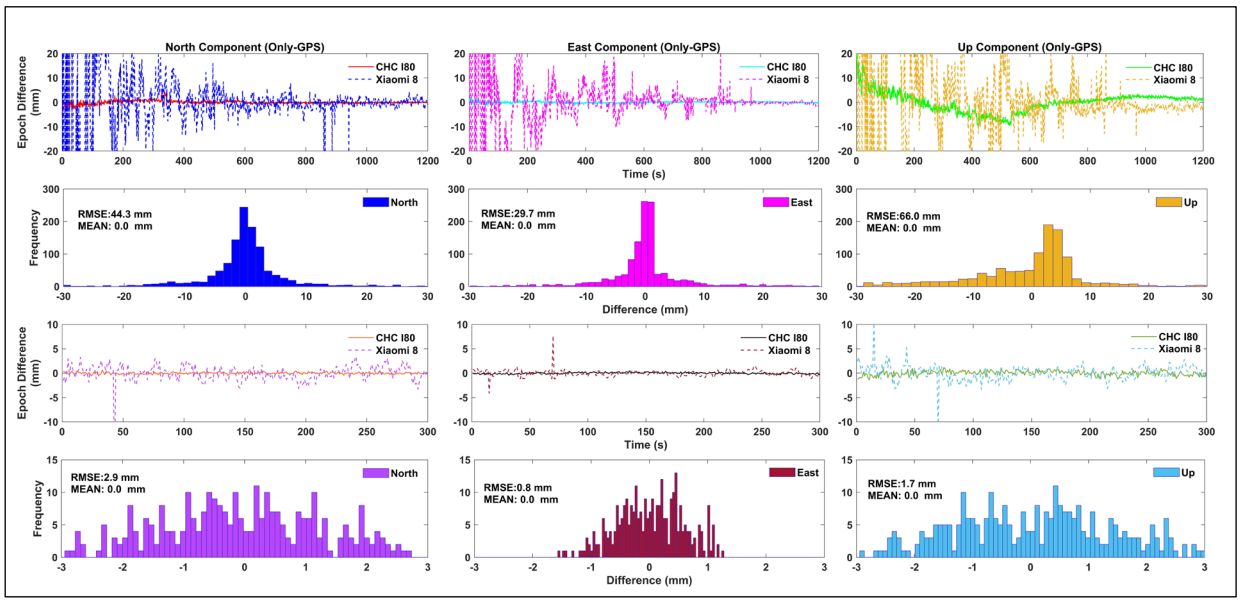

Figure 3. Epoch differenced time series and histogram distribution obtained using IGS-RTS products throughout the experiment and after convergence.

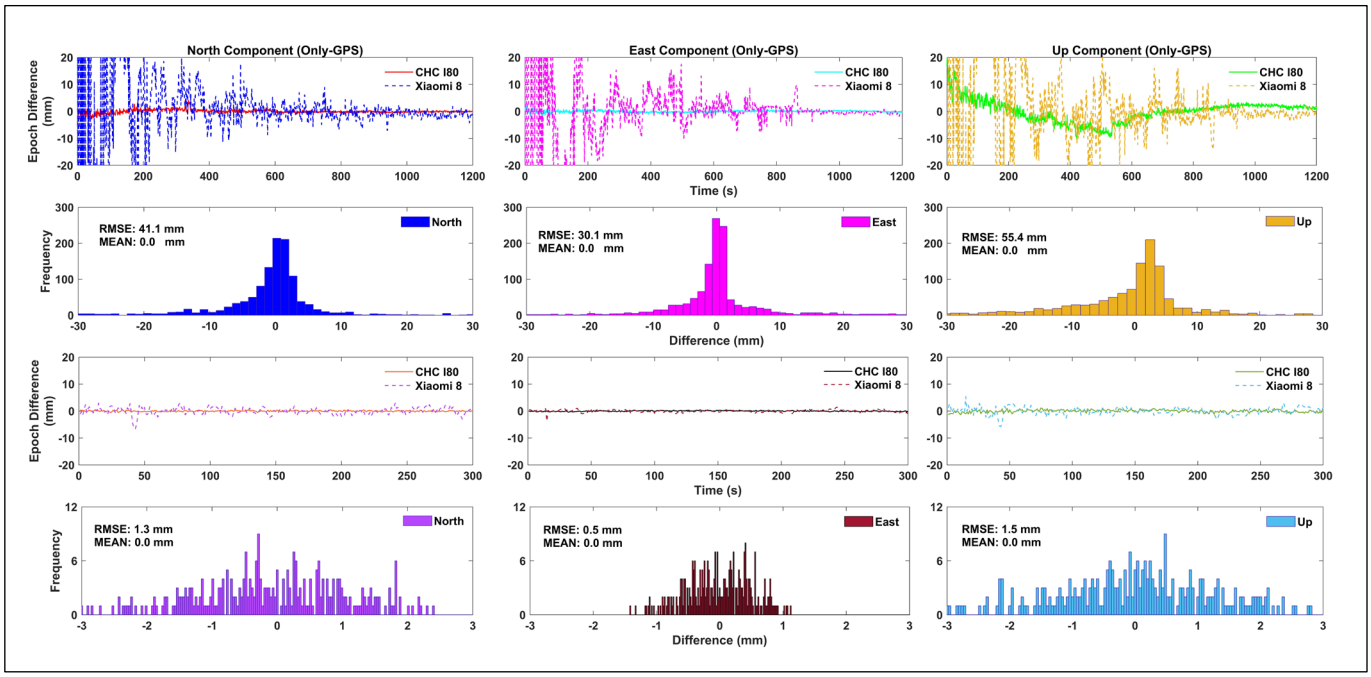

Figure 4. Epoch differenced time series and histogram distribution obtained using CNES products throughout the experiment and after convergence.

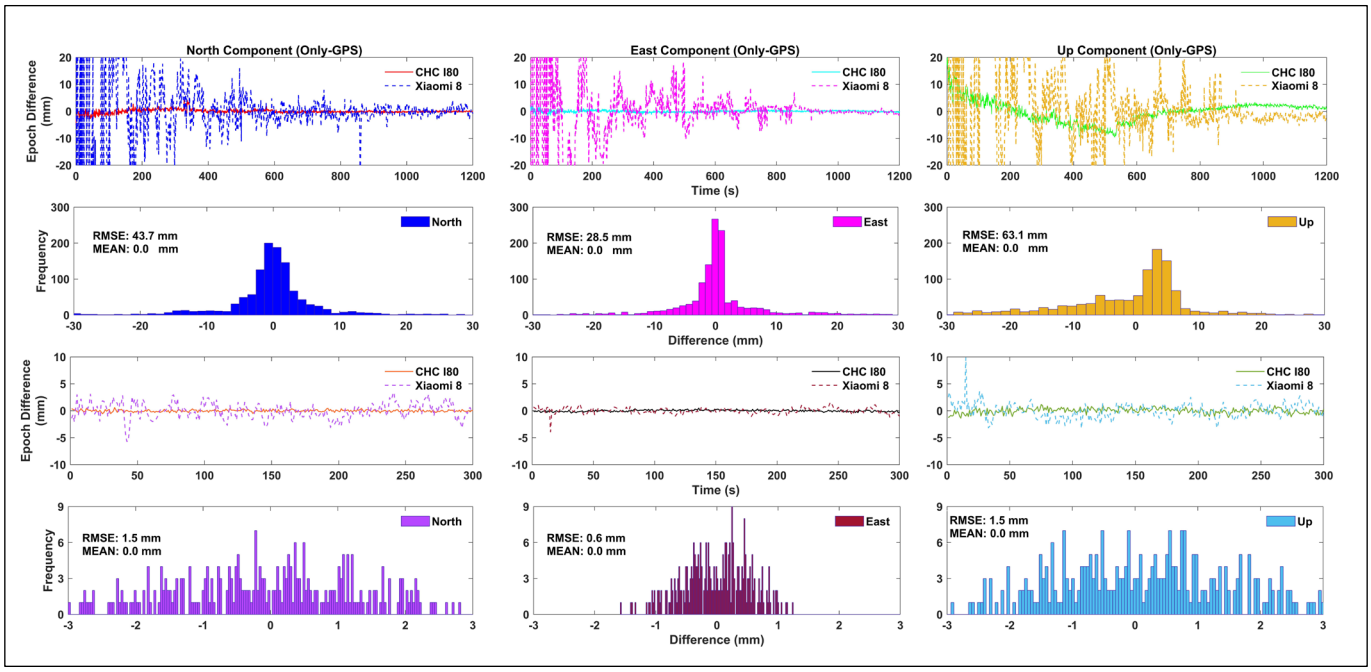

Figure 5. Epoch differenced time series and histogram distribution obtained using MADOCA products throughout the experiment and after convergence.

In the second line of the Fig. 3, the RMSE values and histogram distributions of the epoch differenced produced from the Xiaomi 8 smartphone are given in three different components, according to the geodetic-grade GNSS receiver referenced using the Final products produced by the Wuhan university. In the 3rd line of the Fig. 3, unlike the first line, the 300-second epoch differenced time series obtained after convergence is shown for both the smartphone and the geodetic-grade GNSS receiver. The positioning performance of the smartphone after convergence is applied as in the 2nd row of the Fig. 3, and the RMSE values and histogram distributions of the three different components are presented in the 4th row. According to the results, obvious fluctuations were observed in the time until the convergence time due to the integer phase ambiguity due to the nature of the PPP technique. In addition, the duty cycle technique required to preserve the battery life of the smartphone used in the experiment seems to reduce the quality of the measurements recorded by the smartphone. The absence of GPS observation data in each epoch leads to a longer convergence time for solutions. These gaps found in the GPS observations were corrected by interpolation. During all experiment, cycle slip is observed in the solutions synchronized from the smartphone. The signal received by the chipset causes cycle slip for many reasons. The most common of this

problem is caused by objects blocking the signal from the satellite from reaching the chipset. But the experiments were carried out on the roof of the building in the open sky. When the observations in the experiments were examined, it was interpreted that the cycle clips occurred due to the low signal-to-noise ratio of the GNSS chipset in the smartphone. Considering the PPP-based solutions produced from both receivers, the average number of GPS satellites participating in the solution is higher in the geodetic-grade GNSS receiver. This is an important criterion that affects the positioning accuracy of the smartphone. According to the positioning accuracy of the smartphone obtained using IGS-RTS products throughout all experiment, it is 53.3 mm in the horizontal component and 66 mm in the vertical component. This is 3 mm for the horizontal component and 1.7 mm for the vertical component after convergence. After convergence, an improvement of 95% for the horizontal component and 97% for the vertical component is observed in the time series in which the epoch difference is taken. It will become popular for many applications in smartphones, thus shortening the convergence time to improve positioning accuracy in single-frequency Android-based solutions. Fig. 4, Fig. 5 and Fig. 6 show a similar situation using products produced under real-time conditions from CNES, MADOCA, and Wuhan, respectively. When the effect of different real-time products on positioning accuracy on smartphones is examined, it is seen that there is an improvement between 89% and 98% in all solutions after convergence. In the solutions obtained using 4 different real-time products, the best result of positioning accuracy for both horizontal and vertical components was obtained by using CNES products. This is followed by MADOCA, IGS and Wuhan, respectively. However, when the RMSE values of 4 different solutions are examined, it is seen that there are differences at the mm level.

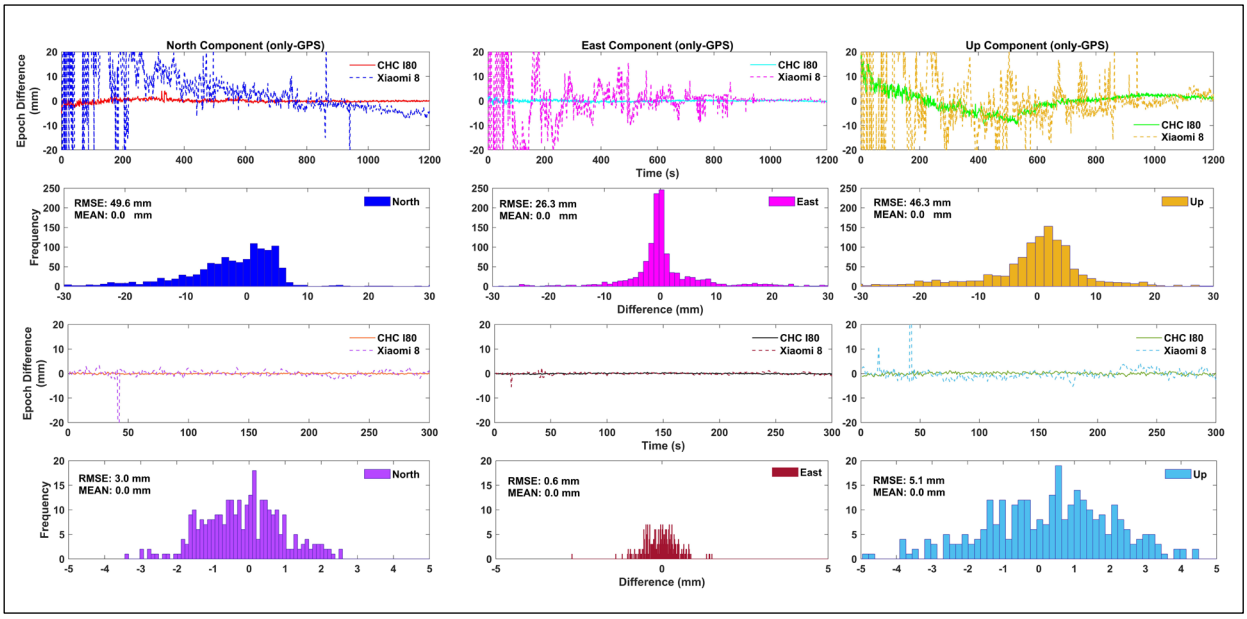

Figure 6. Epoch differenced time series and histogram distribution obtained using Wuhan products throughout the experiment and after convergence.

4. Conclusion

In this study, the positioning performance of single-frequency only-GPS observations collected statically with a smartphone was evaluated by RT-PPP technique. In the experiment, the data set collected with both the Xiaomi Redmi Note 8 smartphone and the geodetic-qualified CHC I80 GNSS receiver is solved with the PPP technique, which is a special case of absolute positioning. In order for the results to be evaluated fairly, solutions were obtained with the geodetic-grade GNSS receiver and the Final product, a precise satellite orbit and clock product produced by the Wuhan University. Raw observation data collected on a smartphone based on GPS observations were evaluated using 4 different real-time satellite orbit and clock correction products. According to the results, it has been seen that the solutions obtained with CNES products are more accuracy. However, the solutions obtained from IGS-RTS, MADOCA and Wuhan real-time products are in millimeters-level consistent with each other in both horizontal and vertical directions. After convergence, it is seen that there is an improvement between 89% and 98% for all 4 different solutions. Therefore, shortening the convergence time to increase the positioning accuracy of smartphones will increase the usability of smartphones for many applications. In addition, the features of the smartphone used in the analysis of the data are weaker than the smartphones used today. In future studies, it is considered to examine different combinations of dual-frequency satellites under different environmental conditions under real-time conditions. In addition, according to the method used, GNSS raw observation data will be evaluated in terms of positioning accuracy with the approach depending on the different signal-to-noise ratio as the weighting model. In addition, the usability of the developing smartphone technology in natural disasters in our country will be investigated.

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Author contributions

Hüseyin Pehlivan: Data curation, Writing-Original Draft Preparation, Validation, Control and Validation
Barış Karadeniz: Conceptualization, Methodology, Software, Data curation, Writing, Visualization
Barışcan Arı: Investigation, Software

Conflicts of interest

There is no conflict of interest between the authors.

Statement of Research and Publication Ethics

Research and publication ethics were complied with in the study.

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