Background Information of the Landscape (Karapinar Basin & Akgöl Subbasin) from which a Showcase Study of Turkey's is selected, for DS-SLM Project

General

Show case area to be reported within the frame of the project "GCP/GLO/337/GFF Decision Support for scaling up and mainstreaming of Sustainable Land Management (DS-SLM)" is old Akgöl Wetland area, which is part of Closed Konya Watershed of Turkey. Historically, it was one of the largest wetland ecosystems of Turkey in 1950s, having the surface area of 24.000 ha.

Akgöl Wetland is located within the borders of Konya Watershed of Turkey. Three dams were constructed, respectively, in the years of 1958, 1984 and 1988 (Ayrancı, İvriz and Gödet Dams). Those reservoired the water in the upland area and prevented surface run-on waters and karst aquifers reaching down to the Wetland. Subsequently, the water levels decreased in the reeds and wetlands leading to the reduction of living species in the area. The total surface area of Akgöl till 1960's had been around 21.500 ha.

More dryland emerged after these activities, and the old lake beds defined by a certain chemical, physical and biological soil properties, turned out to agricultural land within time. As such, significant land-use changes have occurred leading to a considerable change in the ecological balance of the entire wetland system. Time series by satellite images, picturing the historical background of the Showcase area of the DS-SLM Project in Turkey (Old Akgöl Lake Bed, Karapinar) is given in Figure 1.

Ramsar Convention

The Akgöl still contains marsh or open water and could be considered as last remnants of the Ancient Lake Konya. Therefore, the area has been declared as Class1 Natural Protection Area in 1992 and as a Nature Reserve Area in 1995 after the better recognition of the wetland ecosystems. Akgol Lake Wetland, as a part of the Ereğli Reeds or Marshes, is located within the borders of Great Konya Closed Watershed of Turkey at the southern end of Inner Anatolia region of Turkey. According to Ramsar Wetland Type Classification, Akgöl is declared as Class A- Permanent shallow marine waters. Systematically, the wetland is composed of shallow wetlands, reeds, saline steps and 5 freshwater lakes connected to each other although the wetland system is currently almost dried up and in the program of ecological revitalization of the lost or severely damaged wetland ecosystem.

Climate

Konya in the Central Anatolia Region of Turkey has 400 mm of rainfall per year and these are also considered to be dry in terms of the drought index. The Karapinar region as a part of the Great Konya Closed Watershed is also having as low as 300 mm rainfall per year and reported to be one the driest parts of the Turkey. In general, owing to the dominance of arid and semi-arid climates, the adverse effects of global climate change and drought are felt critically in the region. Recently, the area has become notoriously and unsustainably known for excessive groundwater pumping for irrigated agriculture.

Soils

The bottom of the former lake occupies an extremely flat area in the lowest and central part of the Basin. This plain has soils of lacustrine carbonatic clay or marl. In other terms, the former lake bottom is now very flat and occupies the central part of the area. Its soils are developed from highly calcareous clay, silt or sandy loam, generally called marl. Aeolian windblown deposits occur in a few places in the Akgöl depression, as well.

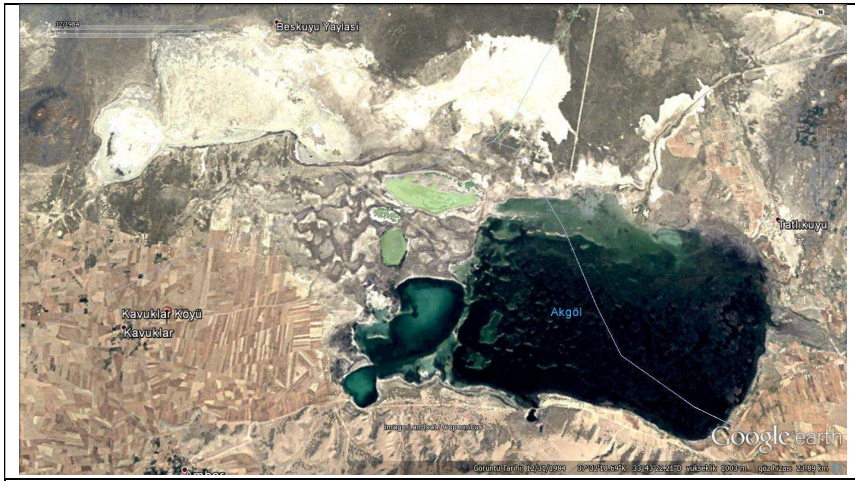


Photo 1. This is the photo of 1984, which shows the Akgöl Lake Wetland with a lake reservoir at full and surrounded by a smaller lakes and wetlands. North, Northeast and Northeast areas of the Akgöl Lake is deserted and degraded land of historical much larger wetland ecosystem, started drying up from the 1950s when its surface area was around 24.000 ha. In fact, the first dam was constructed in 1958 (Ayrancı Dam), which resulted in narrowing down of the Wetland. The total surface area of Akgöl till 1960's had been approximately 21.500 ha. From West and Southeast parts of the lake, having relatively higher elevation, agricultural plots are clearly discernible. South is the last parts of the Taurus Mountains, reaching out to the Wetland. Considering that the Taurus Mountain is one of the most important karstic region of the Turkey and dolines are characteristics landforms of this area, it is not so hard to envision how rich was the Akgöl Lake Wetland with water resources and related ecosystem functions and services.	**Photo 2.** This image of 1985 depicts the situation of the Akgöl Lake Wetland Ecosystem immediately after 2nd dam construction in 1984 (İvriz Dam). Decreases in the water levels in the lake and surrounding reeds and wetlands are profoundly clear. Particularly, the smaller lakes and reeds present at the Northwest tip of the main lake dries up, completely. The more the wetland ecosystem shrinks and the dryland expands. The light colored or whitish color of the land indicates calcium carbonate rich shallow soils with marn parent material, which is rather noticeable around main drainage canals in the area, where problematic saline and alkaline soils rich in boron and with very low infiltration extend. Since 1960s, it is estimated that almost 16.200 ha of the area has been completely dried.

Photo 3. This imagery from 1998 pictures the further drying of the Akgöl Lake Wetland ecosystems after 3rd dam (Gödet Dam) built in 1988. After a decade, continuous human-induced ecosystem degradation accelerated by the effects of the climate change caused critical changes in the area and is evident of irreversible start of converting lake, reed-beds and swamps to dryland environment.

Photo 4. Satellite image of 2008 displays the last stage of complete exsiccate of the main lake body in reference to Photo 1. Land use changes to agriculture is also visible eastern part of the lake. At last, during a span of 60 years, starting 1950s, old lake beds turned to the dryland in 2000s, and since then, the agriculture has been promoted.

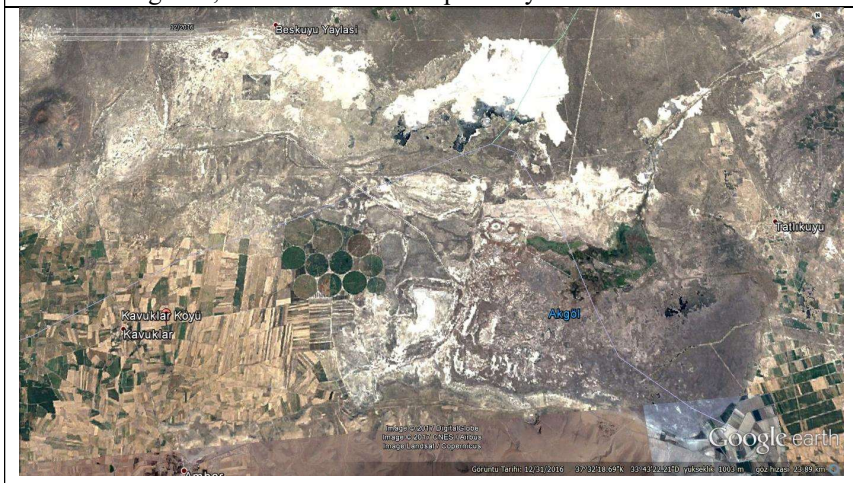


Photo 5. These two photos were the recent ones taken in 2016 and images the agricultural activities of UNSPED Agriculture and Livestock Company that we have aimed at showcasing in Turkey within the framework of DS-SLM Project. Where is the central pivot circular irrigation system is the location of showcase.

Figure 1. Time series by satellite images, picturing the historical background of the Showcase area of the DS-SLM Project in Turkey (Old Akgöl Lake Bed, Karapinar)

Photo 6. This is the recent photo (2018) showing the southeast border of the UNSPED farm, where the completely dried Akgöl lake bed is situated. Climate, soil and vegetative cover conditions, from this picture, are very much predictable.

The saline Akgöl subbasin or depression, where the DS-SLM Project showcase area is located, has no certain source of water supply except natural rainfall and the soil surfaces of the subbasin dries out completely in summer, leading to a thick saltcrust (Photo 7). The soils are poorly drained, always strongly salt-affected with patches of external solonchak, and flat and level.

Puffed solonchaks occur in several parts of the Basin, including the Akgöl subbasin. It forms by accumulation in the top 10 cm of sodium sulphate, which is the most common salt in the Basin. These needle-shaped sodium sulphate crystals separate the soil particles, thus causing a fluffy top soil (de Meester, 1970).

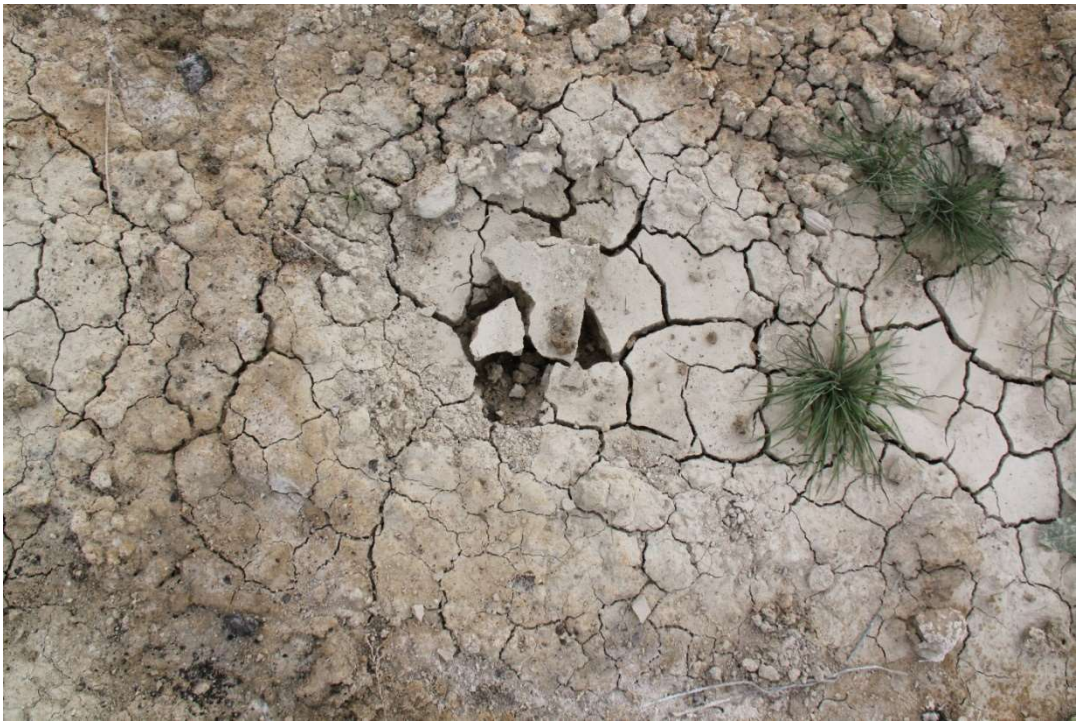


Photo 7. The surface of the Akgöl soil with a thick saltcrust in the dry season

Photo 8. The surface of the Akgöl soil after a heavy rain (Splash erosion, Surface Compaction and Crust Forming). Also note that hardship of climate risks the crop sustainability.

Topography

Having once been a lake, the central part of the Basin is flat and consists of several plains separated by terrain elevations. The most important plains are the Konya Plain, Hotamis Plain, Karapinar Plain, Eregli Plain and Karaman Plain. These plains are about 1010 m above sea-level. The outer limits of the area are clearly defined by where the uplands rise steeply from the plain. If the rise is more gradual, an arbitrary limit is set at the 1050 m contour, where agriculture usually becomes marginal through lack of surface soil or rough terrain.

The Akgöl plain has a dense pattern of drainage gullies indicating its function to transport excess surface water from the eastern catchment area to Akgöl (note this on the image time series given by Photo 1, 2, 3, 4, and 5). Previously, before the Dams were constructed, these gullies at the skirts of the Taurus Mountains had been serving to convey surface waters running on the Wetland.

Vegetation

The natural vegetation outside the irrigated areas is of hardly any economic importance. The uncultivated plains are overgrazed and support degraded steppe vegetation. Halophytic vegetation in strongly salt-affected soil near Akgöl, Karapinar Area.

In general, the natural vegetation cover can broadly be divided in four categories:
1. The species-rich vegetation of herbs and grasses in cultivated or protected areas with saltfree soils of the Terraces, Bajadas Colluvial Slopes and Alluvial Fans.
2. Herbs and grasses in ranged areas or slightly (internally) salt-affected soils of the above main land units and the Marl Plains.
3. Halophytes in the moderately and strongly (externally) salt-affected soils of the Alluvial Fans and Marl Plains.
4. Reeds and rushes in the slightly salt-affected marshy areas.

Land use types

Dry-farming. The large tracts of range are grazed communally and owned by the Turkish government. The area supports sheep, goats, cattle and horses. It is interspersed with dry arable and since World War II mera (grazing land) has been increasingly converted to tarla (agricultural plot). As throughout Central Anatolia, the main crop is winter wheat. There is some barley and oats on poorer soils. Yields depend much on the soil.
Salt-affected lands have produced poor arable which would be better under steppe vegetation. After the harvest, the land is kept under stubble and ploughed the next spring. This fallow practice is to conserve moisture and restore fertility. The ploughing in spring breaks upward capillary flow and reduces losses of moisture by evaporation. The ground is again harrowed in October before sowing. Hardly any fertilizer is used.
Irrigated arable farming. Even with irrigation many subtropical crops such as cotton, tobacco and citrus, fail because of the short frostfree season, poor drainage and consequent salinity, and poor soil. As in dry areas wheat is the main crop. The practice of fallowing has been retained, presumably to restore fertility in the absence of manure and fertilizers. Cereals are irrigated once in early spring. Sugar-beet, melons, alfalfa, sunflowers and fruit-trees require irrigation also in summer.

Prevailing problems

1. Problems of soil formation and salinity.
2. Wind erosion in dry periods (Photo 9).
3. Situated at an altitude of about 1010 m, the climate is semi-arid with cold wet winters and hot dry summers.
4. Water supply is limited and the area has no internal drainage, so salinization occurs easily in the lowest spots. But topography and most soils seem favorable for agriculture so that several attempts have been made in the last 60 years to improve agricultural conditions by irrigation, introduction of new methods, of implements and seed.
5. In areas dependent on natural rainfall, the aridity and drought force the farmer to dry-farming. Fertilizers are rarely used and yields are irregular and poor.
6. The choice of crops is limited by the short growth season.
7. Irrigated land has more possibilities but inadequate drainage systems and over-irrigation has salinized much irrigated land so that conditions became worse than under dry-farming.

Photo 9. In dry season, wind erosion is one of the prevailing problems at the bottom of the former lake which has extremely flat area. In an open treeless areas wind is an important climatic factor and northerly winds prevail in winter. Overgrazing is inevitably lead to wind erosion.

Background Information of the UNSPED Agriculture and Livestock Company

The company started its agricultural enterprises in 2017. The land looked like that shown in Photo 4 (Figure 1). As noted before, it was in a state that the main lake body (Akgöl) was completely exsiccated, and the company purchased the piece of land outside of the Class1 Natural Protection Area (Ramsar Convention) for agriculture. Since then, the UNSPED has cope with many challenges and sought for some opportunities to perpetuate the agriculture in this very demanding environment.

Following are the potential SLM technologies and methodologies of the Showcase area of the DS-SLM Project in Turkey.

Photo 10. Central pivot circular irrigation system using up-to-date technology in larger agricultural plots for watering your crop field effectively and efficiently (use less water, precise timing and measurement of water application, minimized water loss due to evaporation and run-off, custom systems based on field and crop requirements, multiple crop versatility, higher returns, the ability to hedge against the weather and reduced risk of crop failure in dry years, spotty or sporadic moisture patterns, lack of early moisture, precision application of inputs, regular and exact chemical/ fertilizer treatments, reduced input costs, timely application, better nutrient management.

Photo 11. Fruit tree production with **dwarf or scrub apple species** to successfully cope with saline subsoil. **Tree netting** provide many advantages, too, to protect flowers from hailing and fruits from sunburning. Additionally, cold air sinks below surrounding air in the Akgöl depression hugging the ground and therefore frost is a real problem in the apple tree production. **Frost fans** have gained in popularity lately in the area because they can be used at any time, getting air from the inversion layer down into and mixing with the freezing air at ground level and are energy efficient. Recently, the government programs incentivizes the grower to use the frost fans to support apple production in the basin. Karaman Province competes with other provinces in apple production to lead at the national scale.

Photo 12. The UNSPED manages the land with **crop rotation of cereals / fodder legumes** to improve soil health and to support animal production in the farm.

Photo 13. In the milder years in the area, crop rotation with summer corn plantation after wheat seasonally gives sheep further opportunity to enjoy wheat reemergence after harvest for range grazing for couple of months starting in September till planting treatments and tillage in following March or April.

Photo 14. There is an increased fodder crop production in the farm. Different fodder crops are produces to feed the farm animals and as seen in the photo up-to-data harvesting machines used to bale fodder. Maize is one of the common fodder plant, which is incentivized by the governmental programs and useful under this semi-arid region where the evaporation is rather high.

Photo 15. Mixed crop-livestock systems further contributed by integration of animal production systems. Sustainable Land Management (SLM) is defined as the use of land resources, including soils, water, animals and plants, for the production of goods to meet changing human needs, while simultaneously ensuring the long-term productive potential of these resources and the maintenance of their environmental functions (WOCAT, 2007). Mixed crop and livestock systems contribute to a positive growth which is both ecologically and economically sustainable in the UNSPED farm. Moreover, integrated crop and animal production systems has been promoted in the area by the government incentives.

Photo 16 a. Drip irrigation in growing fruit trees (apple trees) at the construction stage

Photo 16 b. Drip irrigation in the fully established apple orchard

Drip irrigation is used in the UNSPED farm to grow apple trees since the method uses minimum water and labor for the optimum irrigation of the apple orchards in this arid and semi-arid climate of the Akgöl subbasin of the Central Anatolia.

Photo 17. Roads for mechanical servicing of tractors, cultivators and other orchard machinery are kept grassed to control wind erosion. Grasses or herbaceous plants growing in the roads in between apple tree plots may also introduce some kind of biodiversity to the system.

Photo 18. Drip irrigation is getting very widespread in the UNSPED farm not only for fruit tree production but also corn planting because it is supported by incentive programs.

Photo 19. Land parcel planning under diversity of irrigation systems (circular pivot, drip and sprinkler irrigation systems) is also very critical in the farm from the perspective of sustainably and optimally making use of available land area. Depending upon the farm needs and irrigation system, parceling is key in determining land use types and crop patterns along with soil tillage and agricultural machinery. The UNSPED farm is planned such that small parcels left in the borders and midst of the pivots are not causing any loss of field.

Photo 20. Adapted sprinkler irrigation systems at the bordering plots to circular pivot systems. Note here the surface conditions of puffy soils with no any structure and very low organic carbon content, having physically very poor resilience and when these lands remain bare, wind starts eroding. That's why, keeping soil surface rough and covered by vegetation and residuals



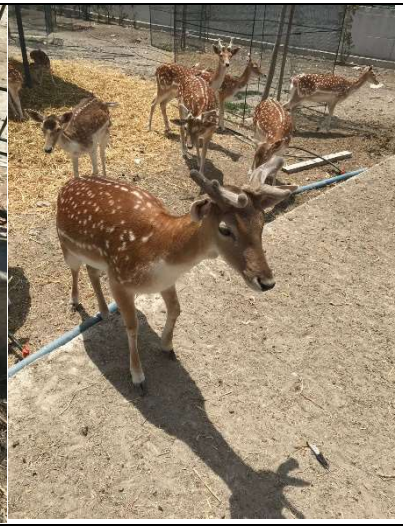



Photo 21. Community, accommodation and training facilities are constructed in small areas between circular plots to optimize the land for agricultural production, as well. There are also delineated habitats with semi-natural grasslands and trees/ shrubs for wildlife and domesticated animals (gazelle, owl, etc.).

Photo 22. Crop rotation with legumes (alfalfa), subsequently planted with wheat, corn and sunflowers. N-fixing legumes help poor soils of the Akgöl Lake Depression be improved in terms of organic matter and infiltration capacity. Furthermore, planting into residue (direct seeding, no-till planting) supports soil aggregate establishment and prevent soil from wind erosion.

Photo 23. An effective drainage system is very important in the UNSPED farm because soils are saline and have a very low permeability. In the irrigated agriculture, without excess water drainage salinity becomes a big problem. The image on the left shows the pattern of built drainage lines with white colors where salts concentrate. Excess waters are being drained to the Akgöl depression, where is the lowest elevation in the subbasin, which can be traced up with photo above left..

Photo 24. The UNSPED recycles farm manure nutrients sustainably. Manure is economic “Win”, due to its fertility value, and a soil quality “Win”, due to its organic matter. Manure management is done by separating it into liquid (right) and solid (left) fractions. Solid manure is stored on a waterproof floor and liquid is collected in the pondage and later used along with water depending upon the irrigation system.

Photo 25. Different types of solid manure spreaders are used. It is important to spread the manure as evenly as possible to avoid part of the field getting excessive nutrients and another part not getting enough. Equally important is spreading the manure over the whole farm since the most of the nutrients in the manure came from the cropland. This will also avoid potential accumulation of excess nutrients in fields.

Photo 26. Liquid part of the manure (urine) is conveyed to the crop fields and applied through irrigation water (Fertigation). The nutrients are thus carried into the soil in solution.

Photo 27. In some places of the farm where puffy like soils with no structure and texturally containing a lot of dust exist, volcanic raw material (basaltic material) is used being dispersed over fields to reclaim and improve soil physical properties. Saline soils could be reclaimed simply by leaching with good quality. This material is especially utilized when a new field is opened to agriculture (never tilled before) to grow barley or oat since no other grain is growable in the old lake bed, mostly for green manure (photo on the right).


BiG
500


BiG
500


SPORTSMAN
800

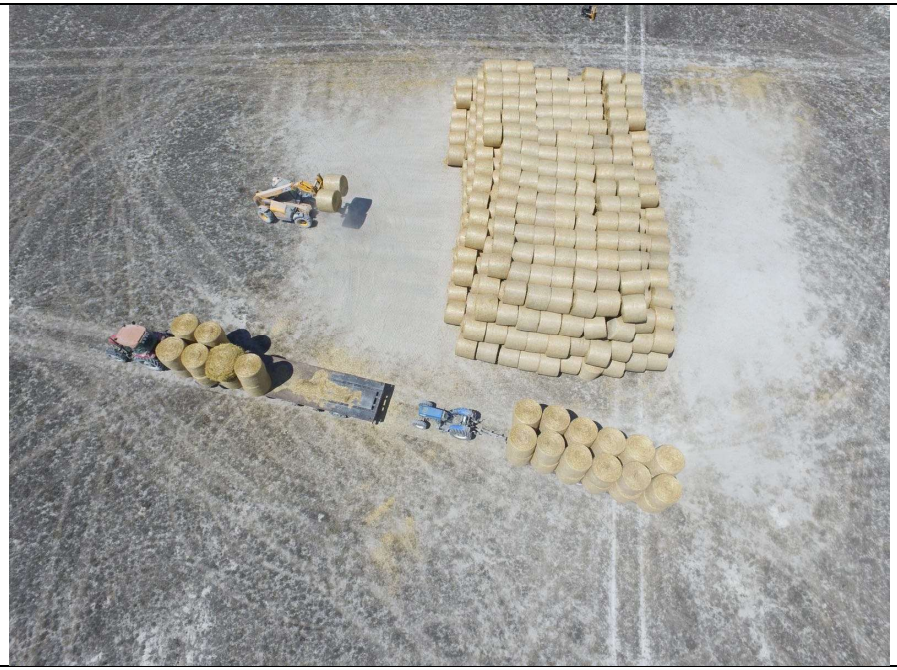
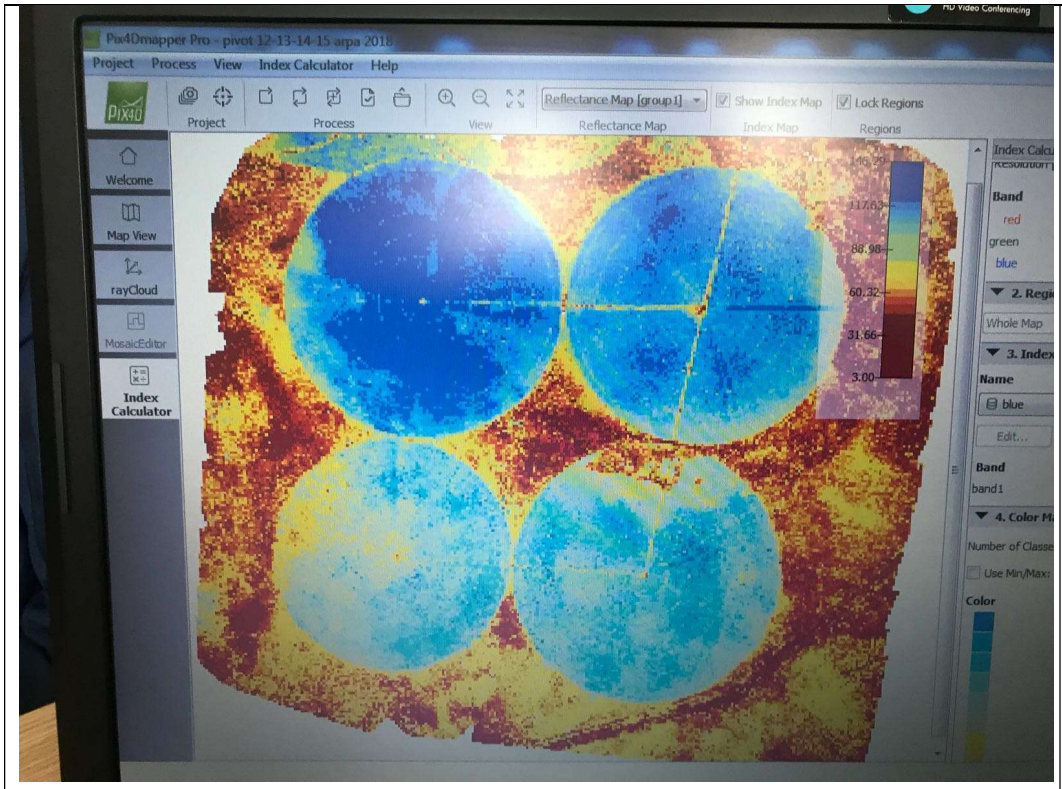


Photo 28. Last six photos show that the UNSPED has a large machinery park for intensive farming activities.



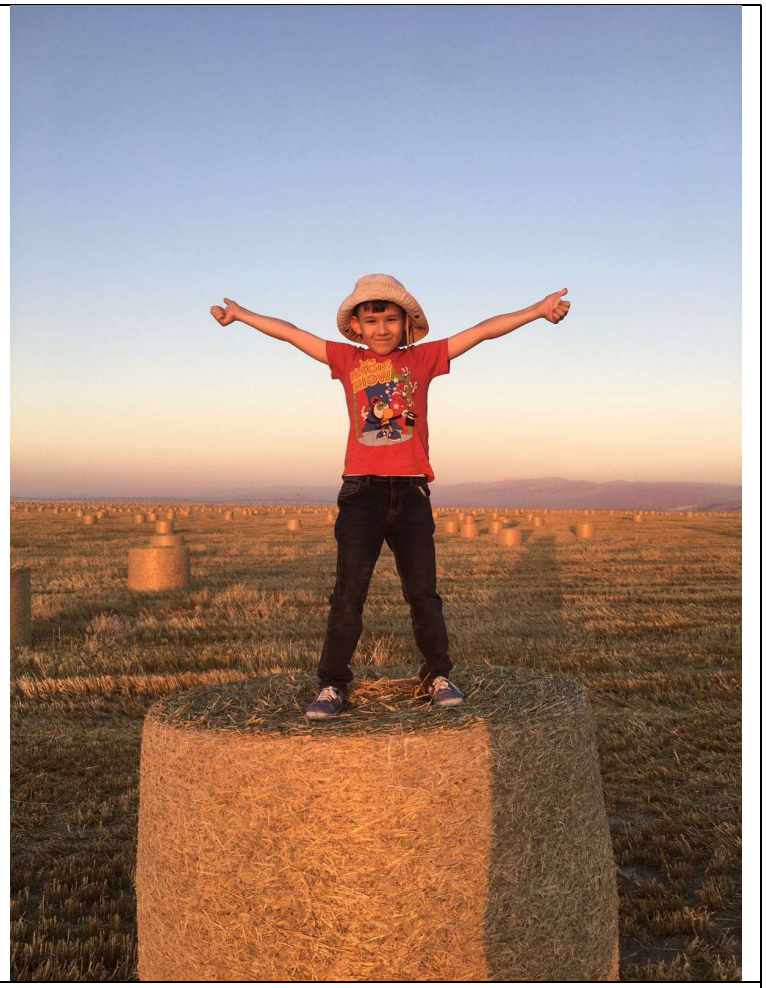


Photo 29. Drone taken photo to keep abreast of yield in the plots, being analyzed in the computer by image processing.