



REPUBLIC OF TURKEY  
MINISTRY OF FORESTRY AND WATER AFFAIRS  
General Directorate of Combating Desertification and Erosion



# AĞRI DOĞUBAYAZIT FLOOD CONTROL WORKS



*Forest and Water is Life.*





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2017 - ANKARA



*Forest and Water is Life.*





2



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Water Affairs

## PREFACE

All around the world, as in our country, floods and overflows are natural threats that have the potential to become costly disasters, claiming tremendous amounts of lives and properties. The frequency, intensity and damage of floods depend directly on slope steepness and topography, bedrock and soil structure, vegetation cover and various human activities, as well as sudden and intense showers.

For instance, while 120mm of rainfall in Antalya would not cause floods, sudden and intense rainfall of mere 20 to 30mm in Ağrı or Doğubeyazıt may lead to severe floods that cause life and property loss.

The region where Doğubeyazıt district is located has a steep, highly faulted and folded structure. Topographical structure varies immensely even over short distances. Soil has a high clay and lime content, and is of shallow to medium depth. Majority of land in the region is used as rangeland. Declination in vegetation cover, increase in erosion, and soil compaction due to over and/or early grazing in the region lead to the least amount of rainfall to trigger surface flows and eventually, floods.

The most effective way to mitigate floods and overflows is the re-establishment of natural balance through various flood and erosion control works and rangeland rehabilitation efforts, as well as flow regime regulation constructions in upper watersheds.

Floods occurring in Şalvar, Zengizor, Ganisipi and Sağdıç streams would often cause life and property loss in Doğubeyazıt district. And yet, villagers from the watershed objected to flood prevention terrace works. Once the villagers noticed that similar works completed in a neighbouring village do prevent floods while the rest of the neighbourhoods and villages still suffered from extensive damage and loss, however, they demanded the construction of prevention terraces in their village as well.

Our Forestry Department carried out gully and slope rehabilitation as well as terracing works in the villages within the watershed, while the Turkish State Hydraulic Works constructed dams on riverbeds. We have thus mitigated floods and overflows by preventing surface flow, rehabilitated rangelands, and reduced the loss of lives and properties. All the while, local communities offered full support and commitment to our efforts.

I would like to thank my colleagues who contributed to flood control works in Doğubeyazıt district, as well as our people who supported the projects without sparing any effort.



# CONTENTS

<b>FOREWORD .....</b>	<b>3</b>
<b>1.- INTRODUCTION.....</b>	<b>5</b>
<b>2.- PURPOSE AND INTRODUCTION OF THE PROJECT .6</b>	
2.1.- Purpose and Scope of The Project.....	6
2.2.- Location of the Project Site .....	7
<b>3.- SOCIO-ECONOMIC STATUS OF THE BASIN .....</b>	<b>9</b>
<b>4.- FLOOD DISASTERS IN THE BASIN .....</b>	<b>10</b>
4.1.- Causes of Floods In The Project Area.....	12
4.1.1.- Climatic Reasons .....	12
4.1.2.- Topographical reasons.....	13
4.1.3.- Land use status .....	13
<b>5.- FLOOD CONTROL WORKS IN THE BASIN .....</b>	<b>14</b>
5.1.- Grazing Planning.....	14
5.2.- Slope rehabilitation/ Terracing Works .....	15
5.3.- Placement of Corrugated Drainage Pipes for Water Evacuation .....	16
5.4.- Gully Improvement .....	16
5.5.- Watercourse/Riverbed Rehabilitation .....	18
5.6.- Seedling Plantation.....	19

# 1

## INTRODUCTION

In Doğubayazıt, in addition to the Hanibaba and İshakpaşa Flood Control Projects made in previous years, flood events were controlled as a result of the flood control project implemented in Sağıdıç Village between 2008 and 2014.

They stated that neither the city, nor the village had suffered from flood over the past 4 years; that the waters of streams were cleaner than before; that stream banks got greener; that they no longer overgrazed their animals; that constructed terraces held higher amounts of precipitation and snow waters; that grass productivity in rangelands increased; and that, as a result of all these improvements, the villagers now took better care of their rangelands.

As the flood control activities were planned together with the locals, their confidence was ensured, and requests began flowing in from neighbouring districts and villages for similar works to be carried out in their villages as well.

Project implementations for flood control are carried out by joint efforts of public and government agencies in other flood-prone basins as well as in this project.

The projects are designed to improve the infrastructure of forests, pasturelands, and agricultural lands, as well as to support fodder production and income-generating activities, all the while taking into account the opinions of locals, and the local conditions on the project site.

The flood control measures taken in the upper basin prevent surface flow of waters, and thus, the consequential occurrence of floods and overflows. This reduces the loss of life and property and the measures to be taken at the main watercourse.

**Flood occurrences were mitigated with the implementation of Hanibaba, İshakpaşa, and Sağıdıç flood control projects in Doğubayazıt district.**





# 2 PURPOSE AND INTRODUCTION OF THE PROJECT

## 2.1.- Purpose and scope of the project

The purpose is to prevent the loss of life and property due to floods and overflows in Doğubayazıt district, and its outskirts and villages.

The lands that are included in the project and the rivers discharging the water of these lands are located around İshakpaşa palace and Sağdıç village and flow directly to Doğubayazıt.

Doğubayazıt district centre, outskirts and villages often suffer floods and overflow due to the passing through them, causing loss of life and property.

These streams are; Şalvar Stream, Zengizor Stream, Ganisipi Stream and Sağdıç Streams.

Three flood control projects covering Şalvar Stream, Zengizor Stream, Ganisipi Stream and Sağdıç Streams basins have been implemented in the province of Doğubayazıt.

These are respectively Hanibaba, İshakpaşa and Sağdıç flood control projects.

**In Doğubayazıt, in the suburbs and in the villages, loss of life and property is prevented.**



## 2.2.- Location of the Project Site

The location of Doğubayazıt district, and the boundaries of the flood control project implementation site are shown below.

Hanibaba, İshakpaşa and Sağıdıç Flood Control Projects are located in Aras River Basin. The areas covered by the project constitute the upper basin of Doğubayazıt.

Doğubayazıt and Sağıdıç Village are located on the side of the flood site at the exit of the basin and on flood cone in some places.



*The General View of the Project Site from the Highest Point of the Basin, Terraced to Rehabilitate Pasture Areas in 2013. Terraces increase the vegetation cover by keeping the precipitation water in the soil and provide soil and water conservation.*





*Appearance of the Highest Area from the Lower Point of the Basin. In the Upper Part of the Micro Basin Through the Soil Conservation Facilities The lower parts of the basin are covered with vegetation cover.*

Doğubeyazıt district is located at 100 km distance from Ağrı province. The area has a steep, highly faulted and folded structure. Topographical structure varies immensely even over short distances. Soil has a high clay and lime content, and is of shallow to medium depth. Current land use category in the region is rangeland. As the pastures are for the common use of villagers, over and/or early grazing led to declination in vegetation cover, increase in erosion, soil compaction, and more frequent floods.

Project site is located in the Eastern Anatolian semi-arid cold climate zone, and falls within the high-altitude mountain steppe ecological category. The altitude of İshakpaşa area varies between 1700-2440 meters and the elevation of Sağdıçlar area varies between 1750 meters and 2413 meters.

The average precipitation amount in Doğubayazıt district has long been 329.4 mm, and average temperature has been 9.2 C°.

In these areas; High altitude, low temperatures, late and early frost incidents, early and lasting snowfall, and the sudden and intense summer and spring showers are the general characteristics of the climate of the region.



# 3 SOCIO-ECONOMIC STATUS OF THE BASIN

The source of livelihood in the district and the village is restricted agriculture and animal husbandry. In the agricultural areas, the villages grow sufficient fruits, vegetables and cereals to provide for their own needs. High altitude and low temperature is restricting the cultivation of agricultural products. For this reason, animal husbandry is a significant source of living at region.

A significant part of the basins causing erosion and flooding is used as grazing land for animals. Villages have a large number of sheep, few goats and cattle. The livelihood of the people is mainly derived from the sale of animal products such as livestock, wool, fleece, butter, cheese.

**In intra-basin villages, a large number of sheep, few goats and cattle are raised. The livelihood of the people is mainly derived from the sale of animal products such as livestock, wool, fleece, butter, cheese.**





# 4 FLOOD DISASTERS IN THE BASIN

Up until 2010, numerous flood disasters occurred in the basin claiming high numbers of bovines and ovines, as well as wide agricultural lands.

The most important of the flood disasters took place in Dogubayazit district center and Sagdıç Village at 16.00 on August 08, 1997. 8 citizens lost their lives, 2 houses were demolished, 14 houses became inaccessible and 27 houses were damaged. Further loss of life or property were avoided as the rainfall came during day-time.

Such immense floods taking lives as well as bovines and ovines repeated during August and September in 2009.

On June 09, 2012 at 19.40, a 5-year-old girl lost her life when she got caught in rushing flood waters. In addition, sudden and intense showers caused many houses to be flooded, leading to enormous financial damages.

Various interviews in the district and the village, in addition to site inspections, revealed that locals suffer greatly from floods; that such floods recur all the while claiming lives, livestock and transportation routes, as well as decreasing agricultural production as they cover croplands with sediment.

Floods are caused by surface flow of water and overflows occur from the floods. The efficient and easiest way to control the flood and overflow is to reduce, delay or prevent the surface flow by performing slope and gully rehabilitation activities in the upper areas. With this purpose, project preparations started for the flood control in 2004.



*the bed widths are 10-15 meters and the bed depths above 2 meters in the lower parts of the basin.*

Even though the locals opposed the project due to the grazing ban in pasture lands at the beginning of the project, Sagdic villagers saw the decrease of the floods as a result of the project implementations in the neighbor villages, demanded similar works to be done in their villages.

In the meetings held with Sagdic villagers and the people of the district, it was explained to them that it is necessary to construct the absorption terraces for preventing the floods coming into village center, intermittent cage wire barriers at gullies so as to slow the flood's speed, and mixed cement barriers in broader streams.

It was stated that pastures would not be closed to grazing, and it would still be possible to graze livestock in the area. Even better, the terraces would increase grass productivity over the following years. Following the meetings with the villagers, an agreement was reached with livestock owners and farmers, and thus, flood control works were launched.



*Cage wire fence*



*Cage wire barrier*

# 4.1.- Causes of Floods in the Project Area

## 4.1.1.- Climatic Reasons

Types of precipitation, quantity, severity, duration, soil humidity before the precipitation, retention of the water by plants and evaporation constitute climatic reasons. The most important for the flood is the quantity, intensity, and duration of the extreme maximum high rainfall.

While the annual average total rainfall is low in region, excessive and maximum precipitation is causing the floods in a short time. Sudden and severe summer and autumn showers, which can vary between 20 and 40 mm, are particularly effective in the occurrence of floods.

As the intensity and duration of precipitation increases, the flow rate will also increase. The precipitation season is also important. The flood and overflow has a higher impact when soil has a dry season. As the heavy rainfalls in the region usually occur during the summer season, floods and overflows are more common in this season.

### Project Area Multi-year Climate Values

Observation Station : Dogubayazit

Altitude (m) : 1725

Observation Duration (year) : 30

Months	Meteorological Observation Values										
	Average Precipitation (mm)	Daily The Highest Precipitation Rate (mm)	Number of Days with Precipitation >=10 mm	Number of Days with Precipitation >=15 mm	The Number of Days with Average Snow Cover	The Highest Snow Cover Thickness (cm)	The Lowest Temperature (°C)	Average Low Temperature (°C)	Average Temperature (°C)	Average High Temperature (°C)	Average Evaporation (mm)
January	16.4	19.1	0.2	0	21.9	33	-23.6	-8.8	-4.4	0.6	-
February	23	27.5	0.3	0	18	48	-24.3	-7.6	-3.2	1.8	-
March	28.8	31.3	0.5	0	8.5	38	-25.0	-2.7	1.8	7	-
April	37.5	27	0.7	0	0.7	10	-12.2	3.7	9.1	14.6	-
May	57.6	31.5	1.3	0	0.0	3	-3.5	7.3	13.3	19	145.1
June	44.1	70.3	0.9	0	0.0	-	1.8	11.2	18.4	24.5	220.3
July	19	28.8	0.5	0	0.0	-	5.4	15.2	22.8	29.2	307.9
August	12.4	22.1	0.3	0	0.0	-	7.4	14.8	22.5	29.1	316.2
September	13.9	22.6	0.3	0	0.0	-	0.4	9.9	17.7	24.9	234.4
October	33.4	32.6	0.7	0	0.4	12	-6.4	4.3	10.5	17.2	-
November	24.8	24.5	0.6	0	4.6	40	-16.3	-1	3.7	9.4	-
December	18.5	15	0.3	0	16	35	-22.6	-6	-2.1	2.6	-
<b>Annual</b>	<b>329.4</b>	<b>70.3</b>	<b>6.6</b>	<b>0</b>	<b>70.1</b>	<b>48</b>	<b>-25</b>	<b>3.4</b>	<b>9.2</b>	<b>15</b>	<b>-</b>

MAXIMUM PRECIPITATION (mm) :	1-HOUR	2-HOUR
10 YEAR FREQUENCY	20.7	24.5
25 YEAR FREQUENCY	26.3	31.6
50 YEAR FREQUENCY	30.5	36.9
100 YEAR FREQUENCY	34.7	42.3





#### 4.1.2.- Topographical Reasons

Due to the steep and rugged structure of the basin topography, especially in the areas where overgrazing has been done, the natural balance is rapidly deteriorated, accelerating the soil erosion process and as a result of those, it has been observed that the erosion and flood devastation have occurred. In areas where intense erosion lasts for longer periods, in severe, the stony and rocky areas appear on the surface in the underlying geological structure.

The most important streams of the basins that cause the flood are Zengizor, Shalvar, Ziyaret, Hocatasi and Ganisipi. Although the bed widths are 3-4 meters at the top of these streams, these widths reach 15-20 meters and the bed depths reach 3 meters in the lower parts of the basin.

Except for the precipitation season, the streams are dry. The slopes of the streams are bare, partly rocky and have deep valleys. The infiltration capacity of the soil is low. In the summer and autumn months, as the soil is dry and very hard, a significant part of the sudden and severe precipitation falls into the superficial flow without penetrating the soil, and this often causes the floods.

#### 4.1.3.- Land Use Status

Land use status of the flood basin is generally pasture. Where the slope is high, the characteristics of the pasture is degraded by the weakness of the vegetation cover.

In the creeks, there are woody plants in small number; haw, elm, wild plum, rose hip, etc. The slopes are covered with plenty of milkvetch.

Erosion and floods are less common in land covered with fine-grained pasture vegetation compared to characteristic degraded pasture. Because the vegetation reduces the amount of rainfall, intensity, and kinetic energy reaching the soil by interception. The plant cover has an infiltration capacity that can easily pass heavy rainfall into the soil without superficial flux.

The surface erosion increases due to the destruction of the grass cover, the destruction of the balance between soil, water and vegetation above the grass capacity and uncontrolled grazing at the pasture. As soon as pasture capacity has been exceeded, the vegetation of the pasture and the structure of the soil are deteriorated and cause the erosion.

# 5 FLOOD CONTROL WORKS IN THE BASIN

In Dogubayazit County, Hanibaba in 2004, İshakpaşa in 2009 and Sağdıç in 2012, Flood Control Projects have been done and implemented in order to minimize loss of life and property in settlements, protect agricultural areas, pasture areas, transportation roads from flood damage and to regulate the water flow of the basin. The work done is summarized below.

## 5.1- Grazing Planning

In case people in the region graze their animals on a planned basis, the local people will reduce the damages caused by the surface waters, and if they do the opposite, the rain waters causing the flood will be transported in main stream.

The first objective of the people in the basin should be to benefit from the pastures without disturbing the natural balance between the soil, water, plants. Vegetation is the protective and regulating factor against erosion. Without vegetation cover, it is not possible to control the water passing into the surface flow and transportation of the soil dragging down.

For the prevention of the flood, the grazing capacity should be calculated in the basin. The natural regeneration density should be protected and developed according to the grazing capacity of the pasture without imposing a grazing ban the pasture.

When the pastures are used for the grazing, they also should be rehabilitated. Vegetation should be developed by resting the pasture and dividing the pasture into parts. Thus, the reproduction and breeding of the plants are ensured by delaying the grazing.

This subject has been explained in detail to the owners of the animals in the village and their opinions were taken. Local community said that they will practise alternate grazing without damaging the pasture or reducing the grass productivity. This approach expedites and facilitates the flood prevention works in the micro basin, where wide pasture lands are located.

Later, in the field studies, it was observed that local villagers were grazing their animals without stressing the grazing capacity of the observed that local villagers were grazing their animals without stressing the resulting in the development of the natural vegetation of the pasture and biological diversity.

*The Biological Richness of the Basin has Increased in Protected Areas.*



## 5.2- Slope Rehabilitation/ Terracing Works

The aim was to minimise damages from potential floods by delaying the merging with main watercourses of waters in surface flow due to intense and prolonged rainfalls in eroded and steep slopes. For this purpose, of the 1264 hectares of total project site, of which 105 hectares is allocated to Hanibaba project, 1453 hectares to İshakpaşa project, and 1264 hectares to Sağdıç project; absorption terraces were constructed on 1400 hectares, and natural vegetation cover was promoted, and grasslands and prairies were protected in the remaining 1482 hectares. Eventually, most of the water flowing on the surface is kept on the terraces built.

A significant increase in grass productivity has been achieved due to the water retained in the terraces. Thus, not only flood and erosion damage was reduced, but also more animals could benefit from the pastures as the grass productivity increased. There have also been significant increases in the income of people living in the region.

The terraces were built to be 60-100 cm. in depth, 120-150 cm in width and a 25-30% inwards slope so that they would not hinder the grazing of the animals. They were built in such a way that there would be spaces between terraces, rather than a continuous terrace, and in a flattened shape rather than steep bumps, so as to facilitate the passage of animals.



*Slope Rehabilitation with Suitable Excavation Terrace. Terraced terraces are inclined in order to prevent soil movement.*





### 5.3- Placement of Corrugated Drainage Pipes for Water Evacuation

The corrugated pipes were placed in appropriate locations in order to prevent the slope waters from damaging the existing roads and the terraces which are below the roads.



*The corrugated Pipe was placed on the roads.*

### 5.4- Gully Improvement

A gully is an eroded waterway with steep edges and erosion, formed by intermittent sudden flood waters. They are most commonly seen in steep landscapes, and in arid or semi-arid lands of weak vegetation.



*Systematic lattice wire barrier prevents soil transporting in gullies*

Sediment transported from gullies reduces the yield in agricultural areas. It causes economic damages by filling channels of water, ponds and dividing agricultural lands. Moreover, as gullies reduce the humidity of nearby agricultural lands, such lands turn into dry lands in no time, subsequently reducing product value.

- Erosion was prevented by mitigating bed and bank carvings.
- Floods were mitigated by slowing down water flow, and thus, agricultural lands and settlements were protected.
- Soil and water balance has been re-established and the groundwater has been positively affected.
- Increase and improvement of vegetation cover has been encouraged.
- Landscape value of lands has been increased.

However, the expected results can only be obtained if measures against gully erosion are implemented together with surface erosion prevention measures. For this reason, necessary studies on gully erosion and surface erosion in micro basin have been done together.

Lattice (grid) wire barrier are constructed in gullies in equal intervals. Therefore, the feeding of main watercourses, which cause the floods, by tributary channels was reduced, and the destructive power of water was alleviated.



*Stabilised and green gullies where the rear of wire barriers are filled with transported sediments.*



## 5.5- Watercourse/Riverbed Rehabilitation

It is the most effective rehabilitation method to prevent erosion by decreasing the speed of the water, reducing dragging force by reducing the bottom slope in the streams. For this purpose, single or staged constructions are established perpendicular to the axis of the stream.

Such single or a series of (systematic) constructions are built in streambeds with a view to protect the beds in flood-prone streams; to establish buttresses for collapsing stream banks and to reinforce steep embankments; to reduce sediment transportation in streambeds; to store excess sediments at appropriate locations; to mitigate material movement and to regulate water flow by establishing a controlled inclination in streambeds.

Such constructions could be erected using a variety of materials, including; stone, concrete, wood, gabion, and earth (with a cement sluice). Stone and concrete are the most often used materials in our country.

As for watercourse/bed rehabilitation; ground sills, dwarf walls, check dams, sediment-storage dams, and various permeable and percolator constructions are established. Check dams are the most efficient of such widthwise structures.

Ground sills, dwarf walls, check dams and sediment-storage dams were built in the watercourses in Doğubayazıt flood-prone basin.



*Ground sills and check dams built at regular intervals in a streambed/Watercourse*

## 5.6- Seedling plantation

At terraces on highly steep slopes where grazing is difficult or impossible, a total of 296,000 seedlings selected from locally suitable species (including Silverberry, Mahaleb, Berberis, Rosehip, and False Acacia) were planted on 575 hectares of land, of which 5 hectares is located in Hanibaba project site, and the remaining 570 hectares in İshakpaşa site. Despite the high-altitude, the survival and adaptation percentages of these seedlings is substantially high.

Seedling plantation activities were excluded at the terraces established in Sağdıç Village project sites so as not to prevent animal grazing. On these particular terraces, both animal grazing and natural grass regeneration are practised.

In brief, of the total 2882 hectares of project site, 1400 hectares were terraced; of which 575 hectares were planted, and 825 hectares were left barren without any seedling plantations so as not to prevent animal grazing.



*Locally suitable species were planted on the İshakpaşa terraces*



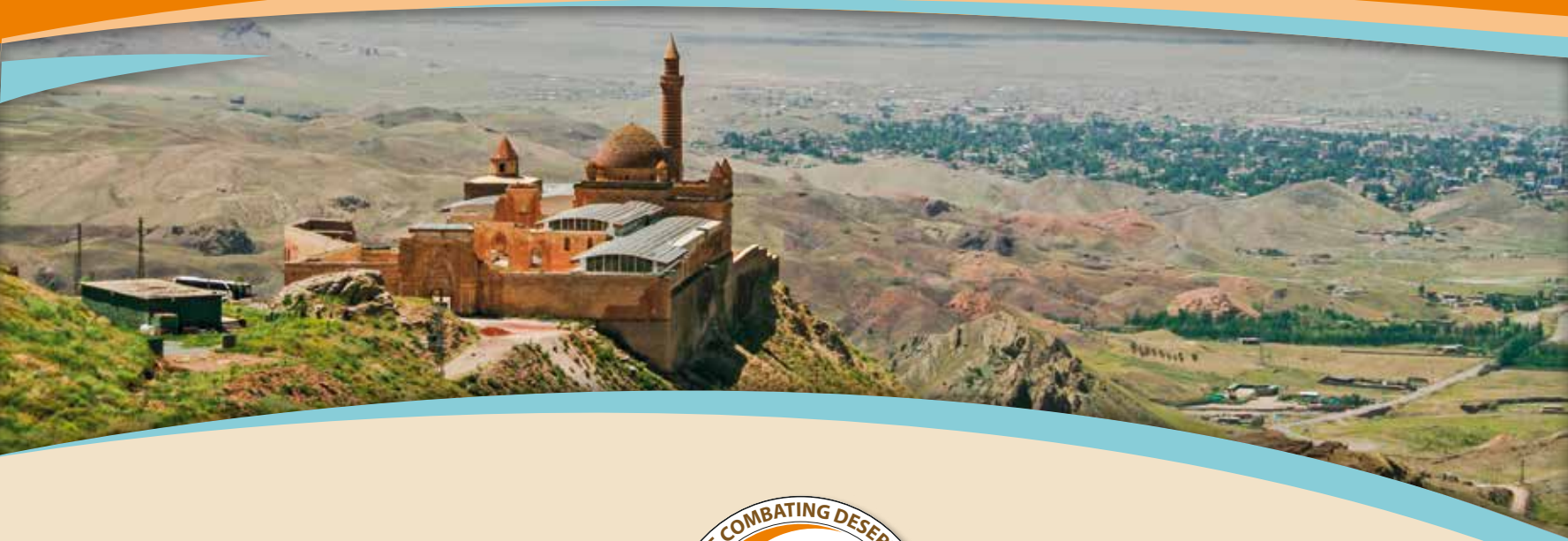
The projects include activities to improve the infrastructure of forests, pasturelands, and agricultural lands, as well as to support fodder production and income-generating activities, all the while taking into account the opinions of locals, and the local conditions on the project site.

20









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August - 2017

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