THE POSSIBLE EFFECTS OF CLIMATE CHANGE ON HAZELNUT FARMING IN TURKEY

(Climate change impact assessment study)

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key questions

✓ which climatic factors are effective on hazelnut yield?

✓ according to the this / these factor(s), how can we determine spatiotemporal changes of hazelnut cultivated area in the future?
Climate - agriculture relationship
In general, determining climate – yield relationship in present day condition, correlation coefficient and regression analysis were applied as method in the literatures (Kaufmann and Snell, 1997, Freckleton et al., 1999; Gadgil et al., 1999; Aleksandrov and Hoogenboom, 2000; 2001; Thompson, 1986; Stooksbury and Michaels, 1994; Perkey and Hayes, 2008).

For future analysis, particularly climate change scenarios data were used for temporal and spatial scale.

In this study both present and future analysis have done using these statistical methods.
Idea and Concept:

Climate-agriculture relationship
Climate-hazelnut relationship

Corylus Avellana

(Turkey vs. Italy vs. Spain vs. USA vs. Others)

(Area (hectar) vs. Production (ton))

(1960-2009)
Distribution of corylus in the world

Resource: Koksal, 2002
Study area and its surrounding
Main Objectives

- determination of the most effective climatic condition on hazelnut yield in present day conditions using statistical methods

- examination the spatiotemporal variation of hazelnut cultivated area according to the most effective climatic parameter in the future analysing

- assessment of these changes and developing adaptation strategies.
If we understand today’s conditions, we will predict future more correctly
Data (past-present-future)

Past & Present
(1993 - 2009)

Hazelnut data:
Production (ton)
Cultivated area (kg/hec))
Yield (kg/hec))

Climate data:
Average temp (°C)
Maximum temp(°C)
Minimum temp(°C)
Precipitation (mm)
Humidity (%)
Wind speed (m/sn)

Satellite data:
MODIS Terra (500 m.)

Future
(2011 - 2100)

Climate change scenario data:
Re-analysis data NCEP & NCAR (1961-1990)
A2 scenario data from ECHAM 5 RegCM3 (30 km res.)
Average ten years (2011-2020, 2021-2030...2090- 2100)
279 meteorological station data (1930-2009)

Altitude data:
GTOPO 30 digital elevation data (1 x 1 km)

MATLAB & ERDAS software
Methodology

- **Special climate requirements analysis** (defining climate thresholds of hazelnut)

- **Phenological analysis** (defining extreme meteorological events)

- **Pearson correlation coefficient and simple linear regression analysis** (relationship between climatic conditions and hazelnut yield)

- **Climate change scenario analysis** (determining the spatiotemporal changes of hazelnut cultivated area)
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Special Climate Requirements of Hazelnut

Annual mean temp: between 13 - 16 °C
Annual rainfall: > 700 mm.
Humidity (june-july): > %60

Extreme meteorological events; frost in flowering period and drought in fertilization and maturity period effective on yield
temperature (13 – 16 °C)
rainfall (> 700 mm.)
An example from a meteorological station which has the most production
precipitation
humidity
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Phenology of hazelnut

- **Formation of flower bud** (Spring / Summer)
- **Loss of leaves**
- **Dormancy**
- **Flowering**
- **Fertilization Maturity** (Summer)
### Absolute Minimum Temperature

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### Yield (kg / hec)

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Flowering period (April)
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Pearson correlation coefficient & simple linear regression

> % 70

• Understanding the relationship between dependent and independent variables
• Positive or negative effect of each climatic variables
Annual mean temp & yield

**DUZCE**

- Gumusova: $R = 69$

**KOCAELI**

- Kandira: $R = 61$
- Korfez: $R = 54$

**SAKARYA**

- Markez: $R = 55$
- Ferizli: $R = 55$
- Geyve: $R = 67$
- Karapürçek: $R = 55$
- Pamukova: $R = 54$
- Sapanca: $R = 57$
- Kocaali: $R = 53$
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Actual cultivated area: digital image processing

- MODIS Terra / Aqua Surface Reflectance 8-day Global 500m. data

- Product description:
- A MOD09A1 RGB image composed of surface reflectance data measured by 7 bands
- Referance points from Google Earth

- Unsupervised Classification
Temperature changes according to A2 scenario in Turkey
Spatiotemporal changes of hazelnut according to temperature and topography (altitude)
Temperature Stations Long Years Mean + [ A2 temperature (2021-2030) - REF ] 13-16 C below 1500m
results

✓ Temperature is the most important climate variable on hazelnut yield.

✓ Extreme events like as frost has dramatic effects on yield. But the frequency of these are rare and it is not easy to establish scientific approach with this data.

✓ A temperature increase up to 6 °C in the region over the next 90 years was identified depending on the future climate scenarios. And so it is concluded that the temperature change may cause horizantal and vertical movements of hazelnut farming areas.

✓ Taking this conclusion into account, it is predicted that hazelnut cultivation in the coastal zone of 0-250 meters height can be negatively affected and areas over 1500 meters height which are not suitable for farming today can become favorable for hazelnut planting due to vertical area changes.