

The Impact of North Atlantic Oscillation (NAO) on Olive Production in Greece

Sandra Ashhab
Shannon Buckley
Ben Chou

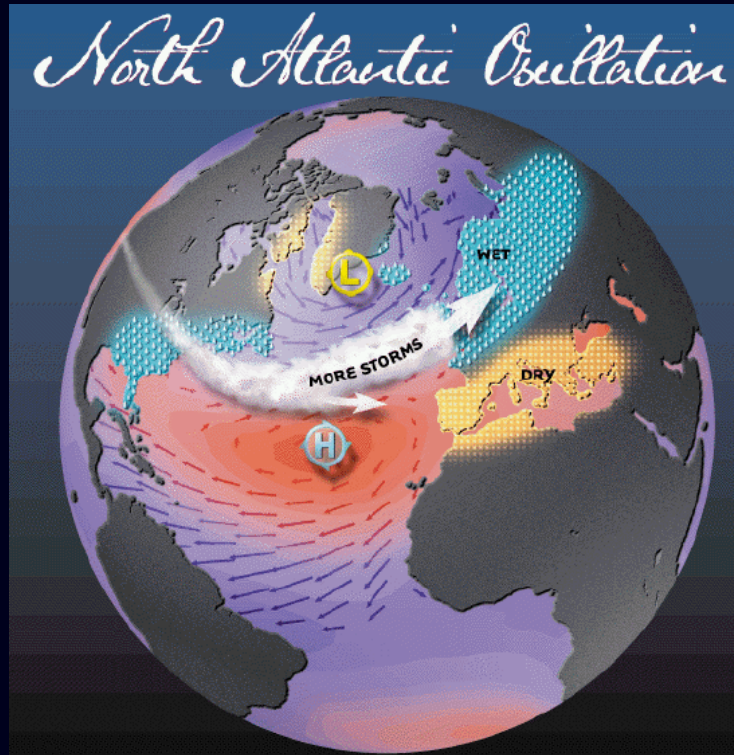
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introduction

- *Agriculture important part of Greek economy*
 - 15% of GDP, 12% of workforce
- *Olive is major crop*
 - the 3rd largest producer in world
 - 17% of worldwide production
 - 60% of cultivated land
 - 2.5 million acres
 - more than 132 million trees
 - producers mainly small farms



north atlantic oscillation



Positive NAO

- Drier conditions over Mediterranean

Negative NAO

- Increased precipitation over Mediterranean



questions to be addressed

- what decisions can small-scale farmers make with historical knowledge of NAO probabilities to maximize profit?
 - Pre-harvest/post-harvest
 - Pesticide, fertilizer
 - Harvest
 - Size of workforce



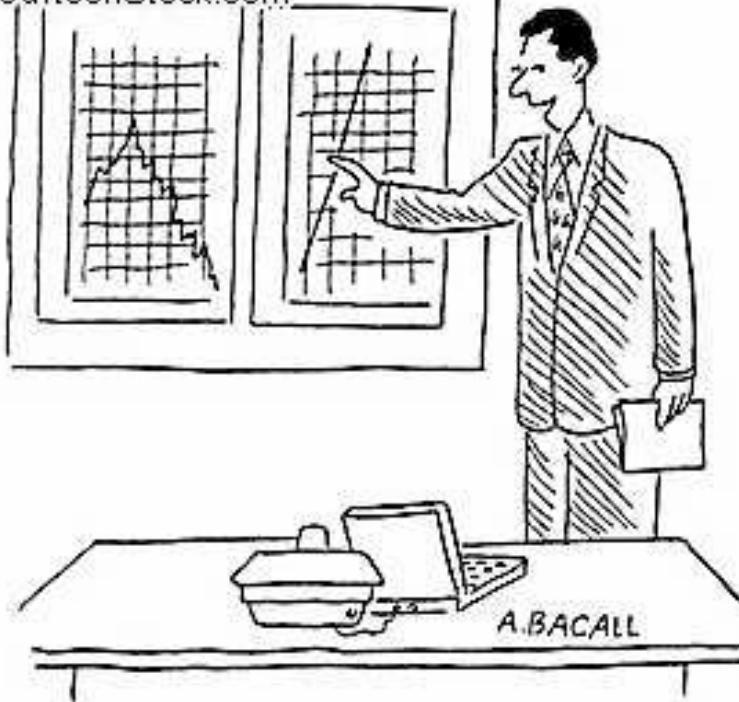
data



- olive production data from UNFAO STAT database
 - Period of 1985-2005
- NAO index from NWS Climate Prediction Center
 - Seasonal average (Sept-Mar) for 1985-2005
- gridded rainfall data from CMAP
 - Merged from rain gauges/satellite estimates

methodology

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"On the left, this year's reading scores. On the right, the same data digitally enhanced."

- assumptions
- correlations
- NAO index
- decision-making

assumptions

- Farm Size: 5 ha

- 150 trees/ha → **750 trees**
- Yield = 1110kg/ha → **5550kg**

- Labor:

- *Small Labor:* 5 men → 5 days → **1000€**
- *Large Labor:* 10 men → 2 days → **1250€**

- Fertilizer: 1 kg/tree → 750kg

- 447€/tonne → 335€
- Labor: 60 hrs (<5 min/tree) → 5 men/12 hr per day at 37€/day → 185€
- Total cost: **520€**

- Pesticide: 1.5 L/ha → 7.5L

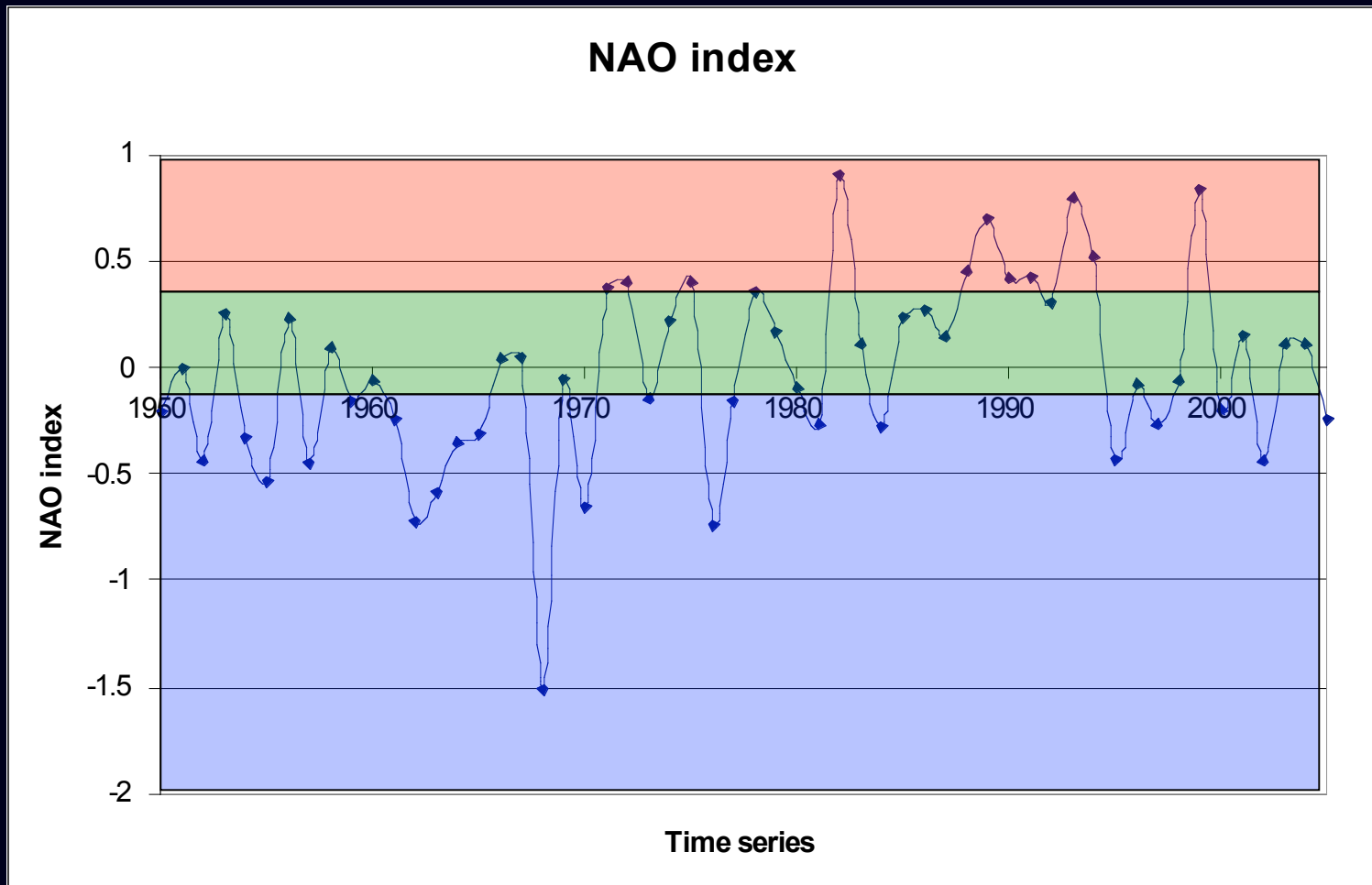
- 3.3€/L → 25€
- Labor: 60 hrs (<5 min/tree) → 5 men/12 hr per day at 37€/day → 185€
- Total cost: **210€**

correlations

- precipitation and olive production: 0.55
 - (statistically significant at greater than 0.05 level, two sided)

- precipitation and NAO index: -0.38
 - (statistically significant at 0.1 level, two sided)

- olive production and NAO index: -0.47
 - (statistically significant at greater than 0.05 level, two sided)



**historical
probability**

(+): 18% → index > 0.4

(0): 43% → index < 0.4, > -0.1

(-): 39% → index < -0.1

nao and olive production

1570€/tonne

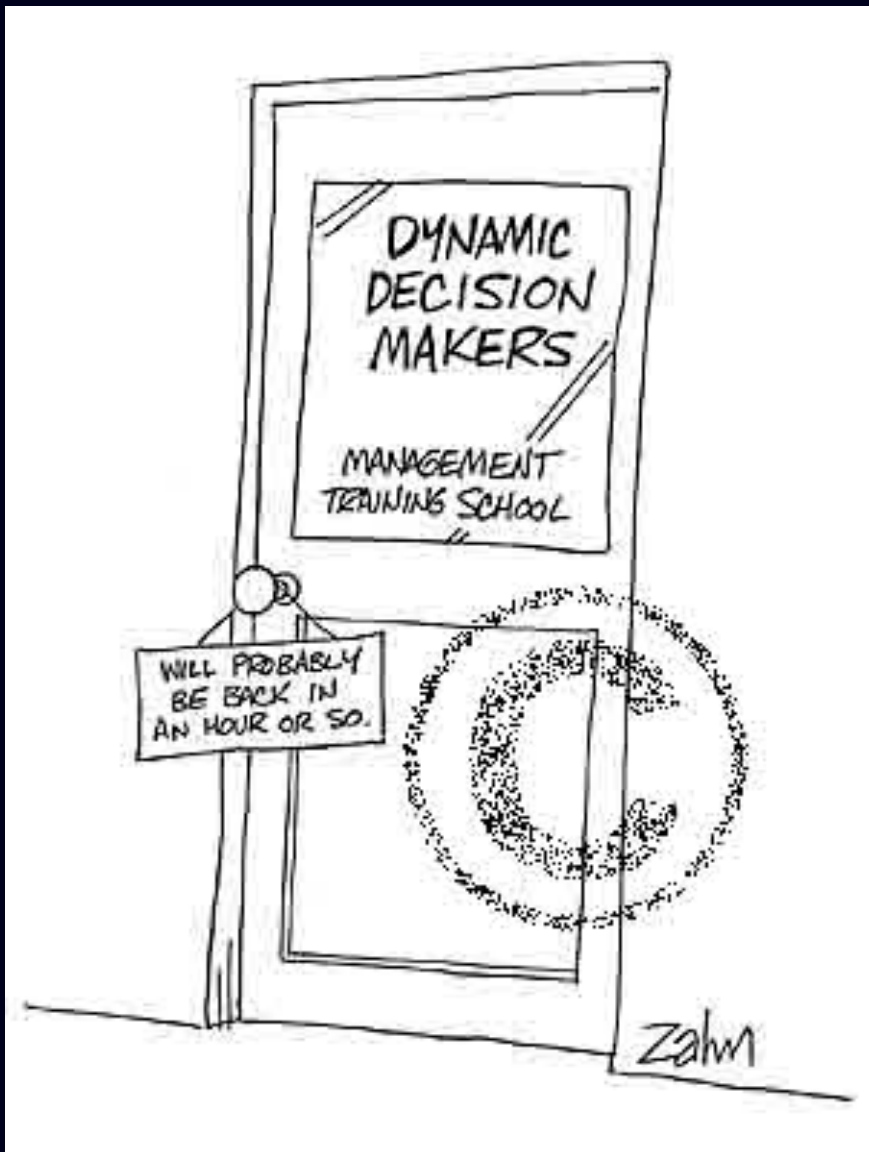
POSITIVE (+): $-4.2\% = 5.27$ tonnes \rightarrow 8272.33 €

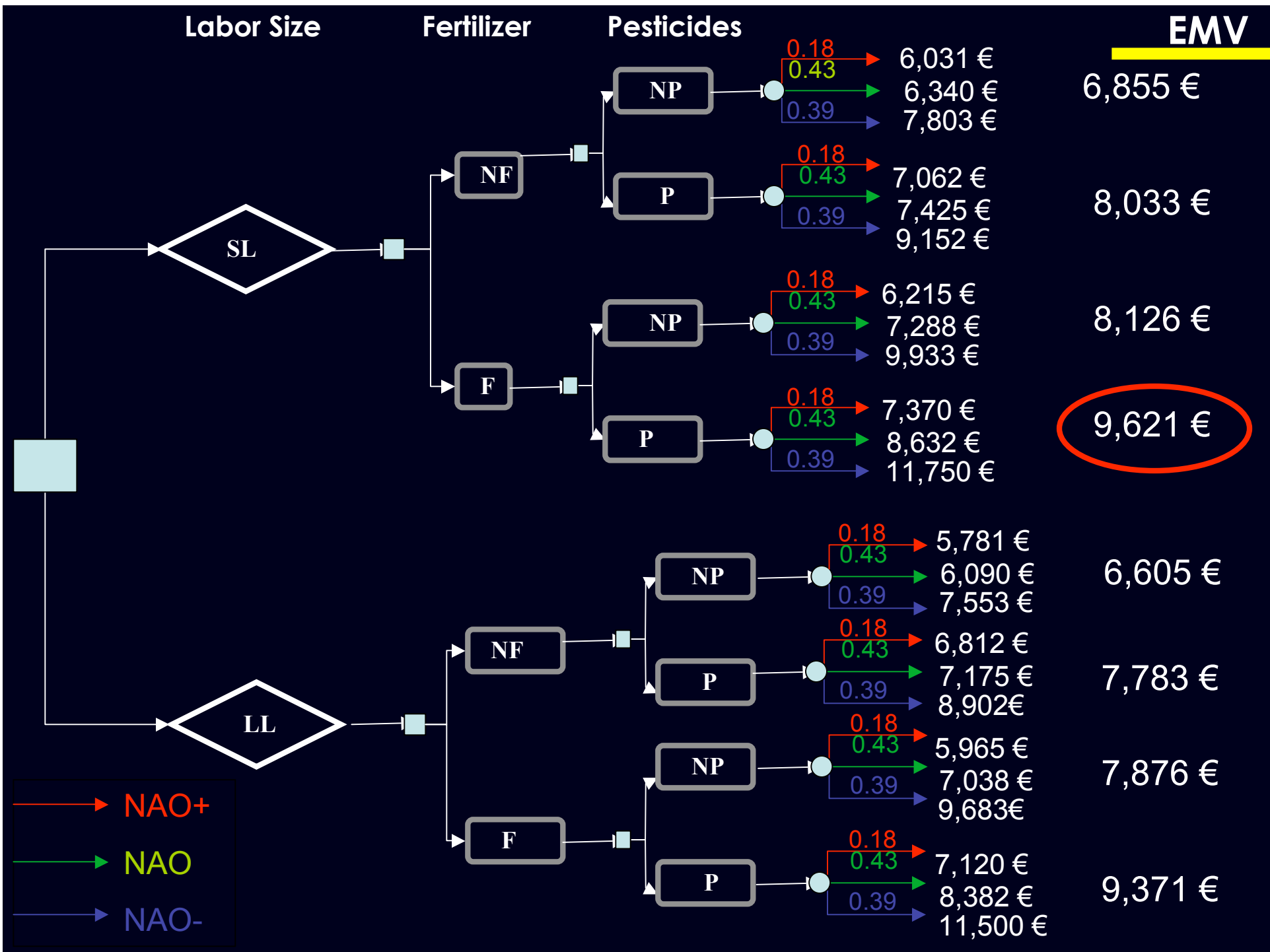
NEUTRAL (0): $0.0\% = 5.50$ tonnes \rightarrow 8635.00 €

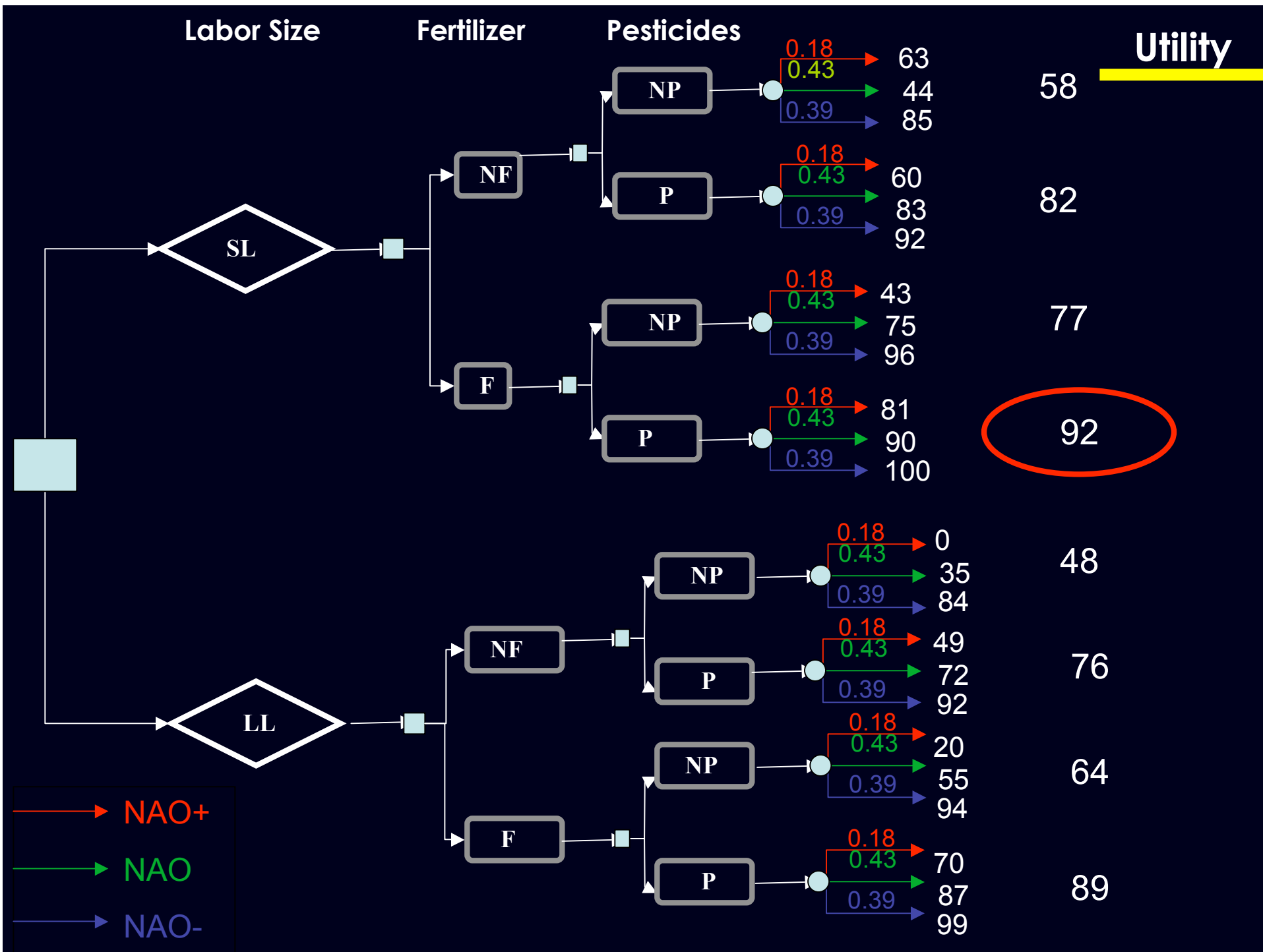
NEGATIVE (-): $+20.4\% = 6.62$ tonnes \rightarrow 10362.00 €

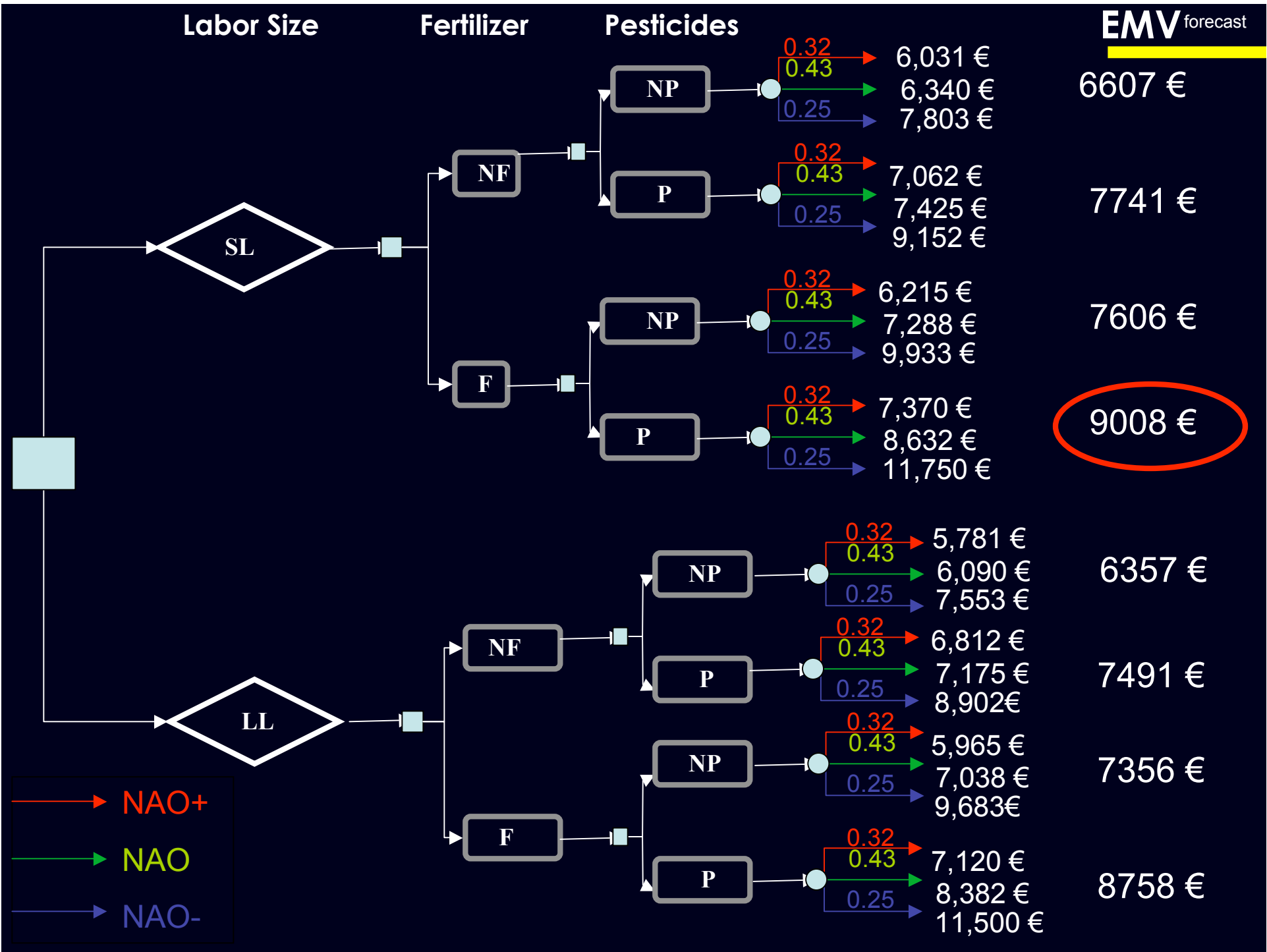
decision making

- EMV
- Utility









and the winner is...

using EMV: **small labor, fertilizer and pesticides**

using UTILITY: **small labor, fertilizer and pesticides**

using FORECAST: **small labor, fertilizer and pesticides**

problems, caveats, and uncertainty

- limited olive production data
- unpredictability of NAO
 - limited historical record
 - deficiencies in predicting probability
- many assumptions
 - decisions may change as assumptions are changed
- market forces (affecting prices)
- not all costs accounted for
 - environmental damage from pesticide/fertilizer
 - benefits of harvesting crop quicker

***“Those who have knowledge, do not predict,
Those who predict, do not have knowledge.”***

- Lao Tzu

Chinese philosopher 604-531 B.C



From slide presentation, ["What is NAO ?"](http://www.met.rdg.ac.uk/cag/NAO/naochap2000_files/v3_document.htm) keynote opening speech by D.B. Stephenson at AGU NAO conference, Ourense, 28 Nov - 1 Dec 2000. http://www.met.rdg.ac.uk/cag/NAO/naochap2000_files/v3_document.htm.