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November 2008



**Climate Change, Water and
Agriculture in Morocco's
Future**



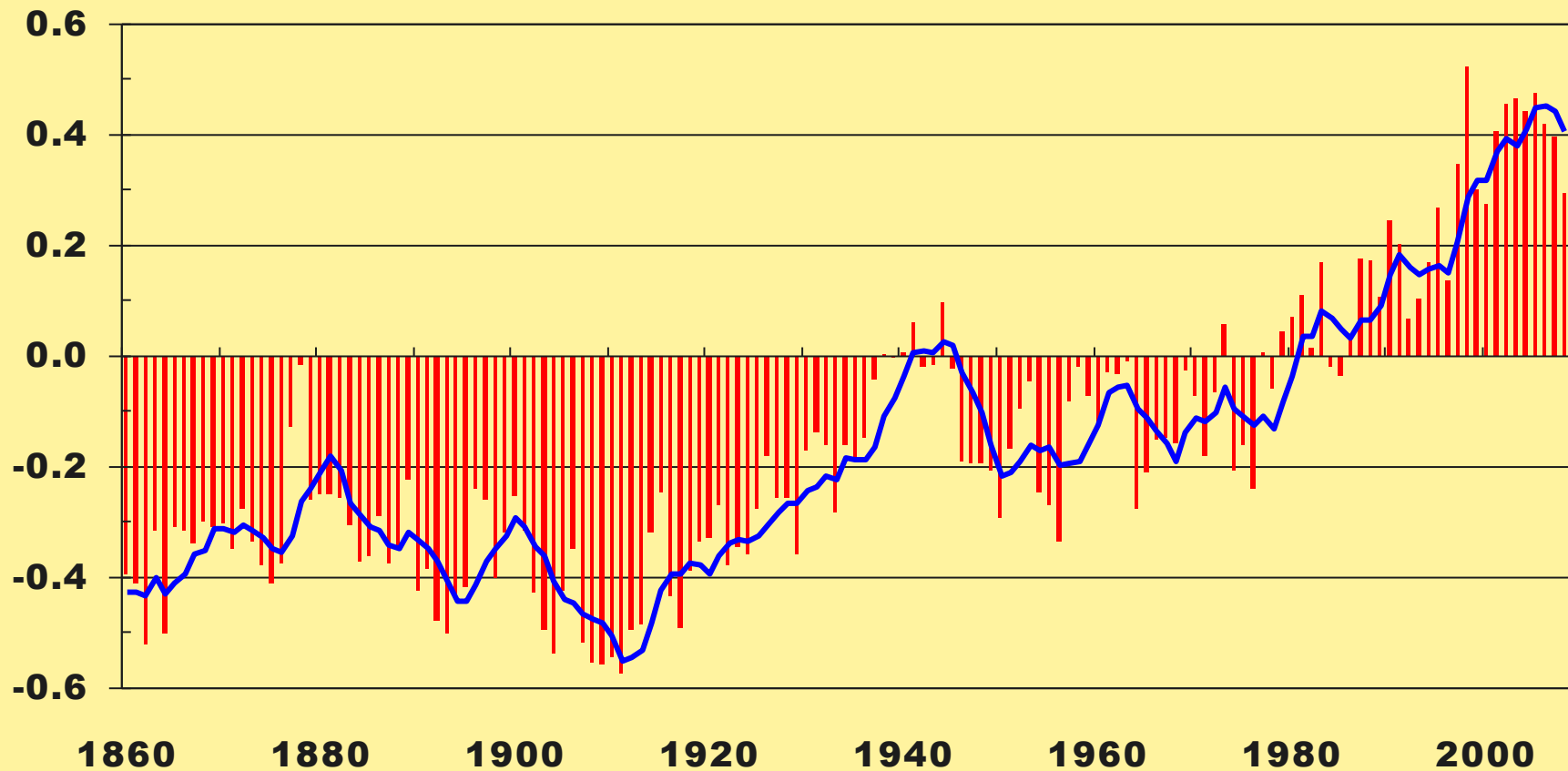
Main findings

- Climate change is happening and threatens mainly developing countries
- The poor in Morocco are particularly vulnerable due to their high reliance on agriculture
- Adaptation requires investing more in projects that reduce vulnerability to climate variability



Strong global warming observed

Combined land and marine global temperature anomalies (HadCRUT3v)
Expressed as anomalies relative to the 1961-90 period average in °C



Source: Brohan, P., J.J. Kennedy, I. Harris, S.F.B. Tett and P.D. Jones, 2006: Uncertainty estimates in regional and global observed temperature changes: a new dataset from 1850. *J. Geophysical Research* 111. See also <http://www.cru.uea.ac.uk/cru/data/temperature/#datter>.



Agro-ecological zones

- Most favorable agricultural zone (fvrbl)
- Intermediate agricultural zone (intrm)
- Poor Southern agricultural zone (sthpr)
- Poor Eastern agricultural zone (estpr)
- Mountainous agricultural zone (atlas)
- Saharan agricultural zone (sahrn)

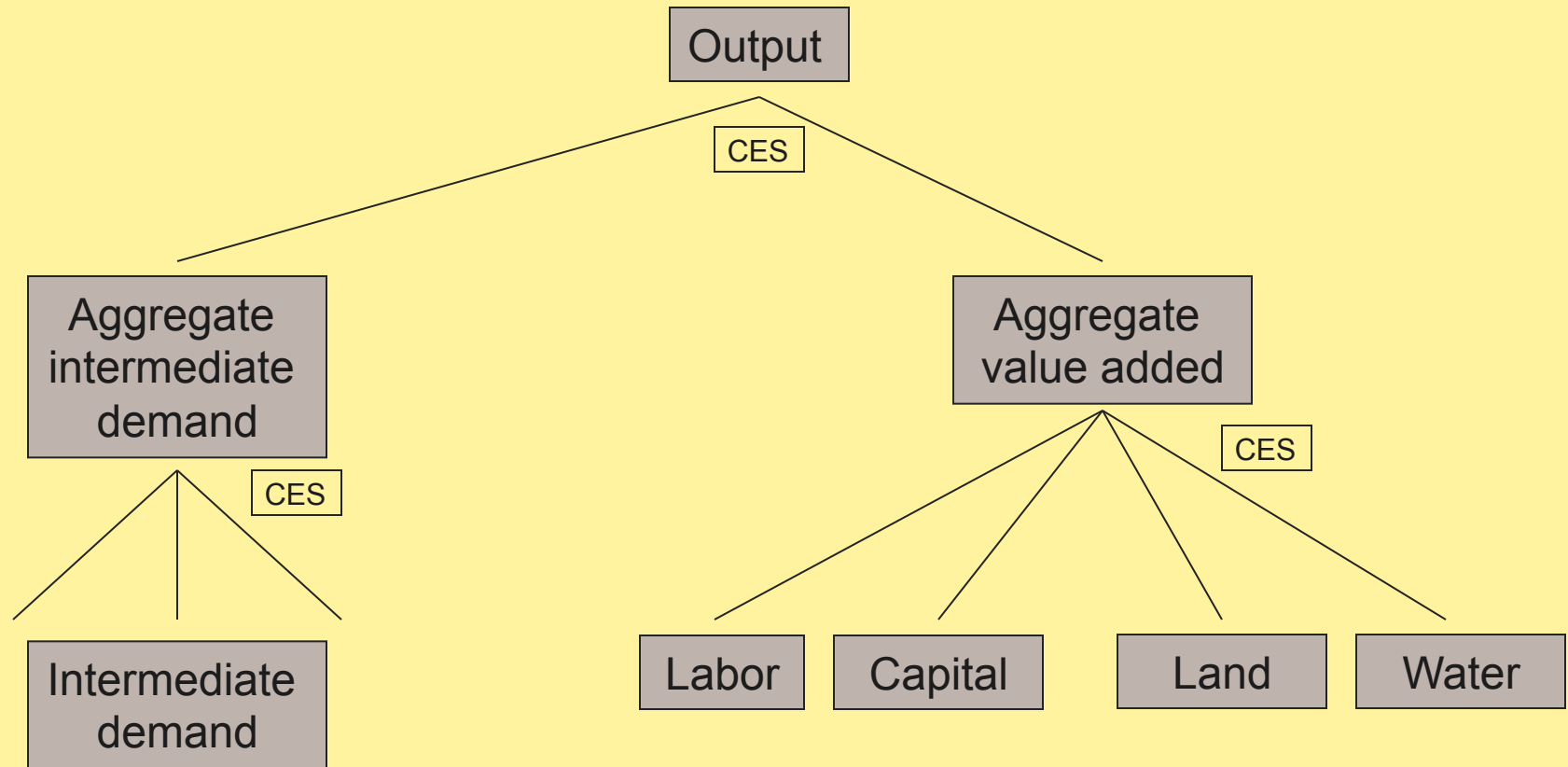


Sources of water

- Large scale irrigation—hydro (hydir)
- Other irrigation (othir)
- Rain-fed (rnfed)
- Not applicable (ntapp)



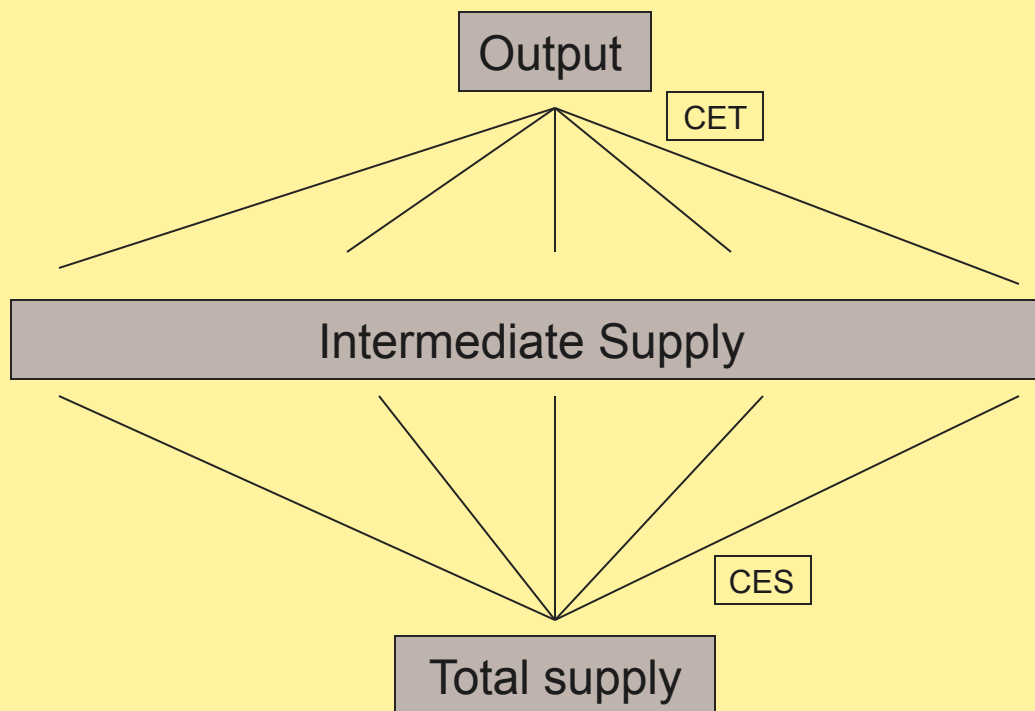
Crop production structure



Note: Structure is crop, region (AEZ) and water-sourced specific.



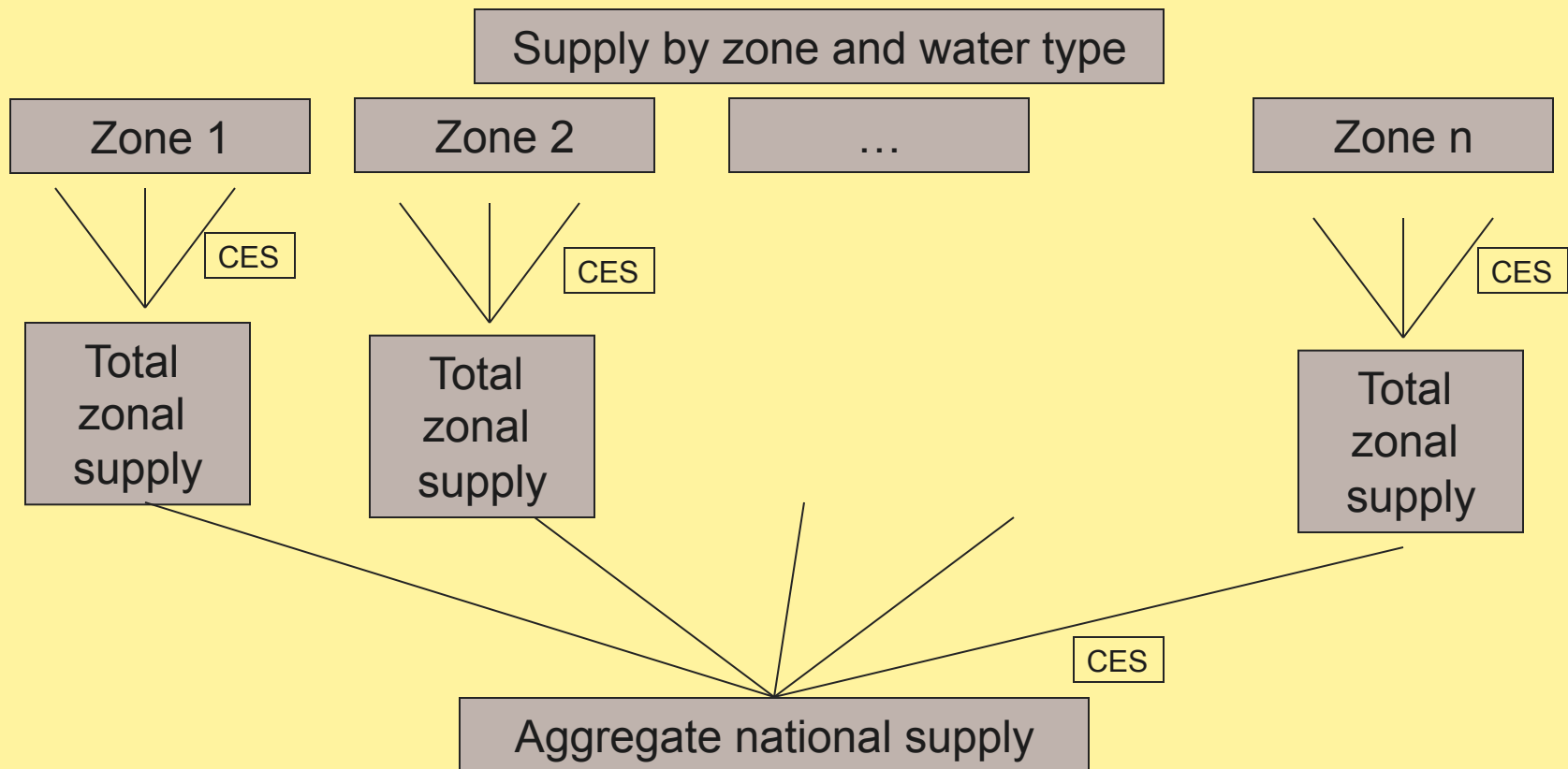
Supply by zone and water type



Note: Multi-input, multi-output production structure.



National markets



Note: Nested CES aggregation—first within each zone across water types, second across zones to form national supply.



Model sectors

- | | | |
|----------------------------|--------------------------|---------------------------------|
| 1 Hard wheat | 18 Olives | 35 Fishery |
| 2 Soft wheat | 19 Clementines etc. | 36 Dairy |
| 3 Barley | 20 Other citrus | 37 Raw sugar |
| 4 Other grains | 21 Grapes | 38 Refined sugar |
| 5 Grain legumes | 22 Almonds | 39 Hard wheat mill |
| 6 Sugar beets | 23 Apples | 40 Soft wheat mill |
| 7 Sugar cane | 24 Dates | 41 Raw oil |
| 8 Other industrial crops | 25 Other fruit | 42 Refined oil |
| 9 Tomatoes | 26 Other crops nes | 43 Whole olives |
| 10 Potatoes | 27 Agric. byproducts | 44 Olive oil |
| 11 Onions | 28 Fallow land | 45 Other food processing |
| 12 Melons | 29 Pasture land | 46 Chemical industries |
| 13 Watermelons | 30 Bovine meat | 47 Refined petroleum |
| 14 Other vegetables | 31 Sheep etc | 48 Electricity & oth. utilities |
| 15 Other indus. vegetables | 32 Poultry | 49 Other industries |
| 16 Alfafa | 33 Other meat production | 50 Private services |
| 17 Forage crops | 34 Forestry | 51 Public services |

Livestock by zone



Concluding remarks

- Best adaptation policy is reinforcing development policy
 - more irrigation
 - expanding infrastructure and hardening if necessary
 - agricultural R & D and extension services
 - enhance viability of urban growth poles facilitating rural to urban migration
- Research agenda
 - ...