

# *Water Quality: A CGE-Micro Analysis for Egypt*

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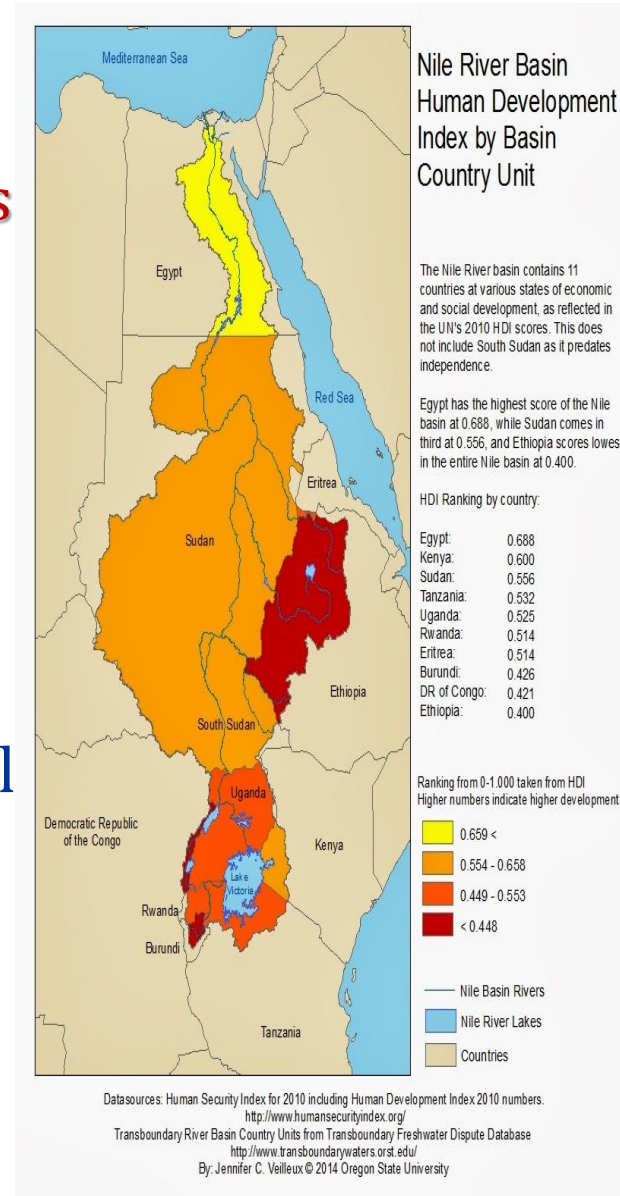
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**STAGE Model**



# 1. Water quality-agricultural productivity nexus

Semi-arid area Nile a main source of fresh water (95%) & irrigation water (83%)

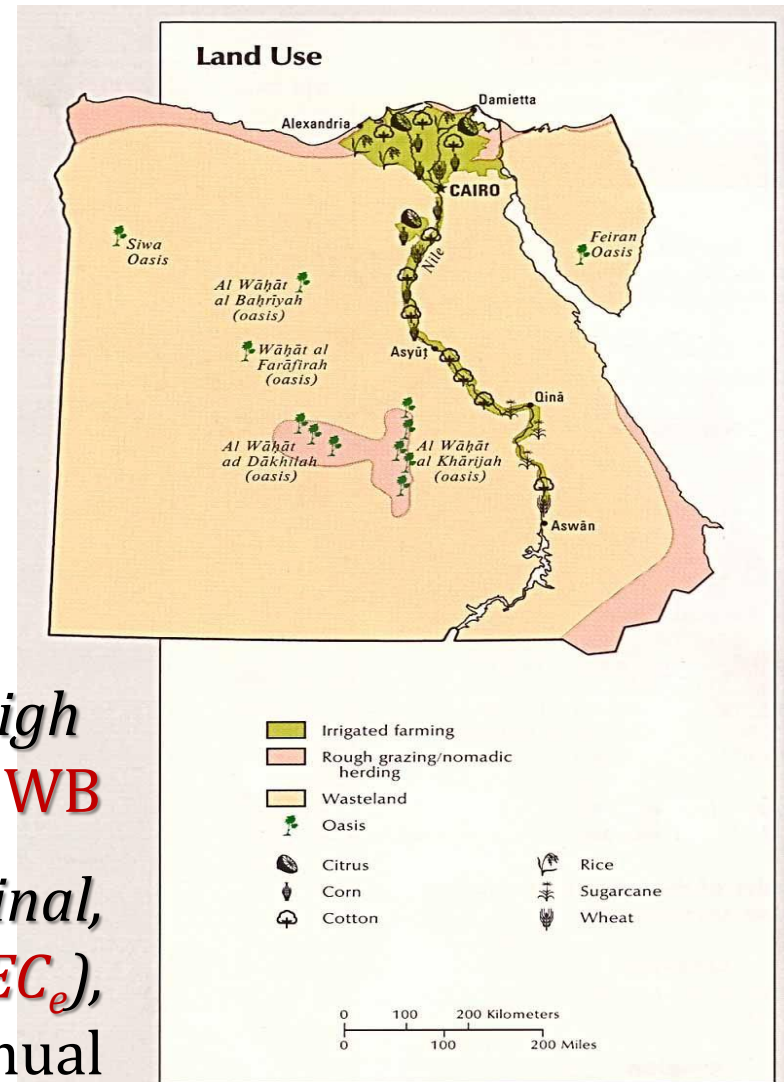
Other: groundwater, drainage, treated sewage water

4% of land agriculture, 85% in Nile Valley and Nile Delta

35% of agricultural land suffers from high salinity, 60% in the northern Nile Delta, WB

Empirical Case Studies: *WQI* is marginal, high values of electric conductivity ( $EC_e$ ), ↓ soil productivity by 46%. MWRI annual

cost of low quality water 2% GDP



## *Water quality deteriorates due to irrigation misconduct*

- Intensive exploitation of water/land; drainage network discharges wastes into the Nile mainstream
- Multi-cropping system; 3 irrigation seasons
  - **Winter** (November-May): wheat, fodders & broad beans
  - **Summer** (May-September): cotton & rice
  - **Nili**, i.e. Nile flood (September-November)
- Integrated Water Resources Management Plan (IWRMP) 2000-2017 to improve water quality and reduce salinity (162.7 billion L.E. = 34% gov. spending), 77% of which to improve irrigation water quality

Our study examines the cost-effectiveness of this mega project

## 2. *Water quality-public health-welfare nexus*

Access to safe water and adequate sanitation are inequitable

7.3 million lack access to safe water, among which 5.8 million are in rural areas

8.4 million lack access to adequate sanitation, mostly in rural areas, where 15% (compared to 1% in urban) has no access to adequate sanitation.



**Serious health hazards** that are linked to drinking water supplies include heavy metal poisoning, chemical pollutants, chlorinated solvents, bacterial and viral infections and salmonella.

**Diarrhea**, typhoid fever and E. coli are life-threatening illnesses. Diarrhea is the 2<sup>nd</sup> leading cause of death among under-5 children, (UNICEF, 2017). According to Ministry of Health and Population (MHB) 9% of the mortality of children under 5-years old is caused by diarrhea complications, (MHP, 2019)

## *2. Water quality-public health ... (cont.)*

**WB project (contributes \$550 million)** Sustainable Rural Sanitation Services Program for Results (SRSSPR) (2015-2020) ... improve existing water access & service; create new sanitation systems covering **769** villages in 7 governorates (rural Delta & Lower Egypt). By 2020, **800,000 poor Egyptians** will have benefitted from the program.

*This study captures several transmission channels:*

- 1. Indirect impacts on food security due to productivity & production gain*
- 2. Lower prices which can be imputed to improving water quality for agricultural uses*
- 3. Direct impacts due to cleaning contaminated water use & improving sanitation facilities*

# 1<sup>st</sup> nexus: does improving irrigation water quality compensate for water scarcity?

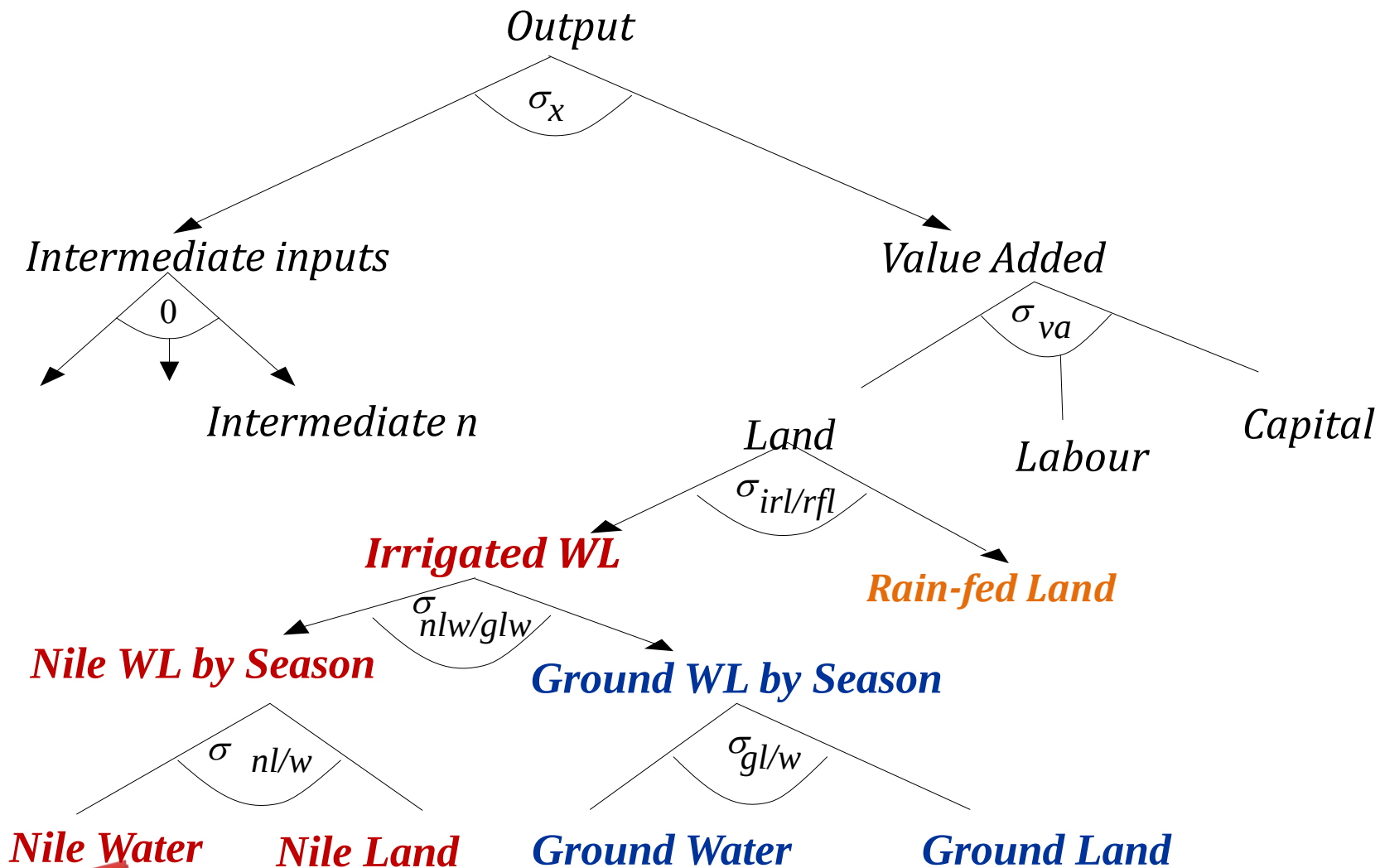
- Recently constructed SAM for Egypt 2008/09
- Developed version of STAGE 2
- Satellite accounts for water quality; agro-economic features  
(i.e. soil properties, water salinity & crop tolerance to salinity)

| No | SAM Agr. Activity                    | No                                                                                                                                                                                                                               | Commodity            | No | SAM Factors                           |
|----|--------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|----|---------------------------------------|
| 1  | Winter Wheat                         | 1                                                                                                                                                                                                                                | Wheat                | 1  | Labour                                |
| 2  | Winter Cereals                       | 2                                                                                                                                                                                                                                | Cereals              | 2  | Capital                               |
| 3  | Winter Sugar Beet                    | 3                                                                                                                                                                                                                                | Rice                 | 3  | Winter Nile-dependent Land            |
| 4  | Winter Fodders                       | 4                                                                                                                                                                                                                                | Vegetables           | 4  | Summer Nile-dependent Land            |
| 5  | Winter Fibbers                       | 5                                                                                                                                                                                                                                | Fruits               | 5  | Nili Nile-dependent Land              |
| 6  | Winter Medical Plants                | 6                                                                                                                                                                                                                                | Coffee Tea           | 6  | Year-round Nile-dependent Land        |
| 7  | Winter Vegetables                    | 7                                                                                                                                                                                                                                | Other Agriculture Fo | 7  | Winter Nile Water                     |
| 8  | Summer Rice                          | 8                                                                                                                                                                                                                                | Ores Minerals Gas    | 8  | Summer Nile Water                     |
| 9  | Summer Other Crops                   | 9                                                                                                                                                                                                                                | Food Products        | 9  | Nili Nile Water                       |
| 10 | Summer Sugar Cane                    | 10                                                                                                                                                                                                                               | Other Transportable  | 10 | Year-round Nile Water                 |
| 11 | Summer Cotton                        | 11                                                                                                                                                                                                                               | Metal machinery equ  | 11 | Winter Groundwater-dependent Land     |
| 12 | Summer Fodders                       | 12                                                                                                                                                                                                                               | Construction         | 12 | Summer Groundwater-dependent Land     |
| 13 | Summer Oily Crops                    | 13                                                                                                                                                                                                                               | Trade                | 13 | Nili Groundwater-dependent Land       |
| 14 | Summer Medical Plants                | 14                                                                                                                                                                                                                               | Financial Services   | 14 | Year-round Groundwater-dependent Land |
| 15 | Summer Vegetables                    | 15                                                                                                                                                                                                                               | Business Services    | 15 | Winter Ground Water                   |
| 16 | Nili Rice                            | 16                                                                                                                                                                                                                               | Social Services      | 16 | Summer Ground Water                   |
| 17 | Nili Other Crops                     | <b>SAM 2008/09</b><br>54 activities (23 agriculture: 7 winter, 8 summer, 6 Nili, 1 year-round & xAgri.); 16 commodities; 18 production factors (8 Nile-dependent & 8 ground-water dependent irrigation factors, labour, capital) |                      | 17 | Nili Ground Water                     |
| 18 | Nili Fodders                         |                                                                                                                                                                                                                                  |                      | 18 | Year-round Ground Water               |
| 19 | Nili Oily Crops                      |                                                                                                                                                                                                                                  |                      |    |                                       |
| 20 | Nili Medical Plants                  |                                                                                                                                                                                                                                  |                      |    |                                       |
| 21 | Nili Vegetables                      |                                                                                                                                                                                                                                  |                      |    |                                       |
| 22 | Fruits                               |                                                                                                                                                                                                                                  |                      |    |                                       |
| 23 | Other Agriculture, Forestry, Fishing |                                                                                                                                                                                                                                  |                      |    |                                       |

## ***STAGE 2 CGE Model***

- Comp. Static variant of STAGE 2 CGE
- 5 level CES production function
- Water & Land are mobile across agriculture activities but not across irrigation seasons

# Production Flows in STAGE 2 CGE Model



# Satellite Accounts for Water Quality

## 1. FAO data on potential yield reductions under various levels of water salinity ( $EC_w$ ) & land salinity ( $EC_e$ ) for 71 crops

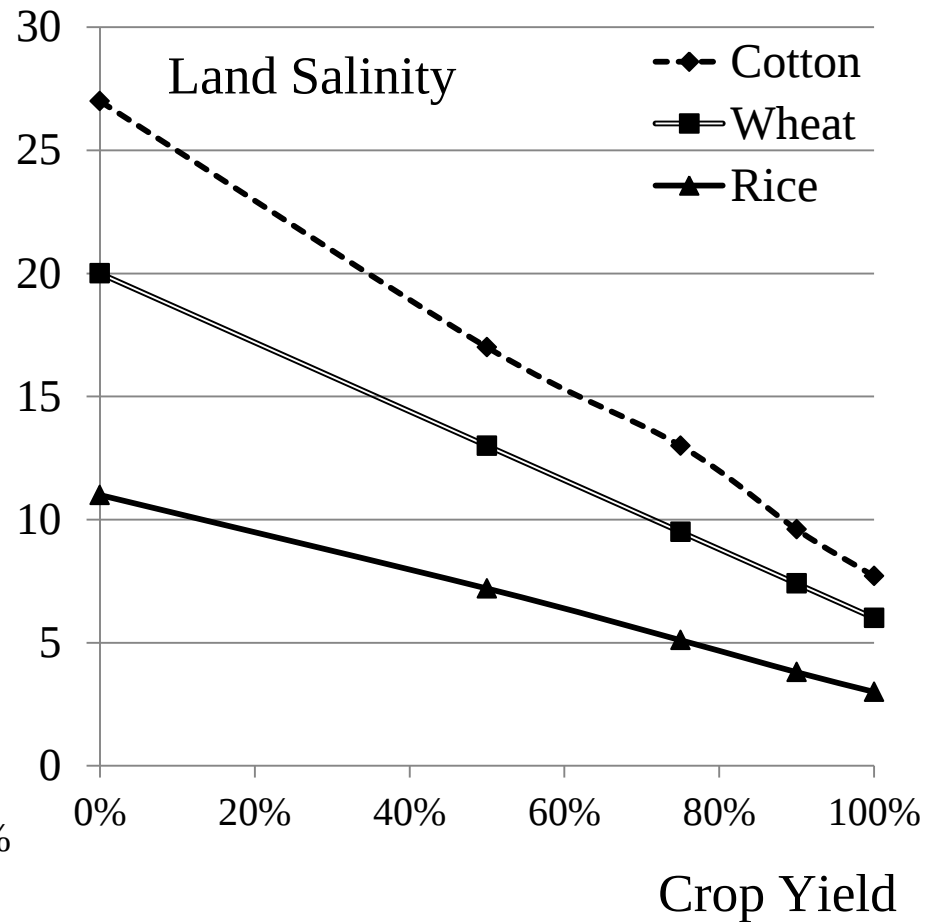
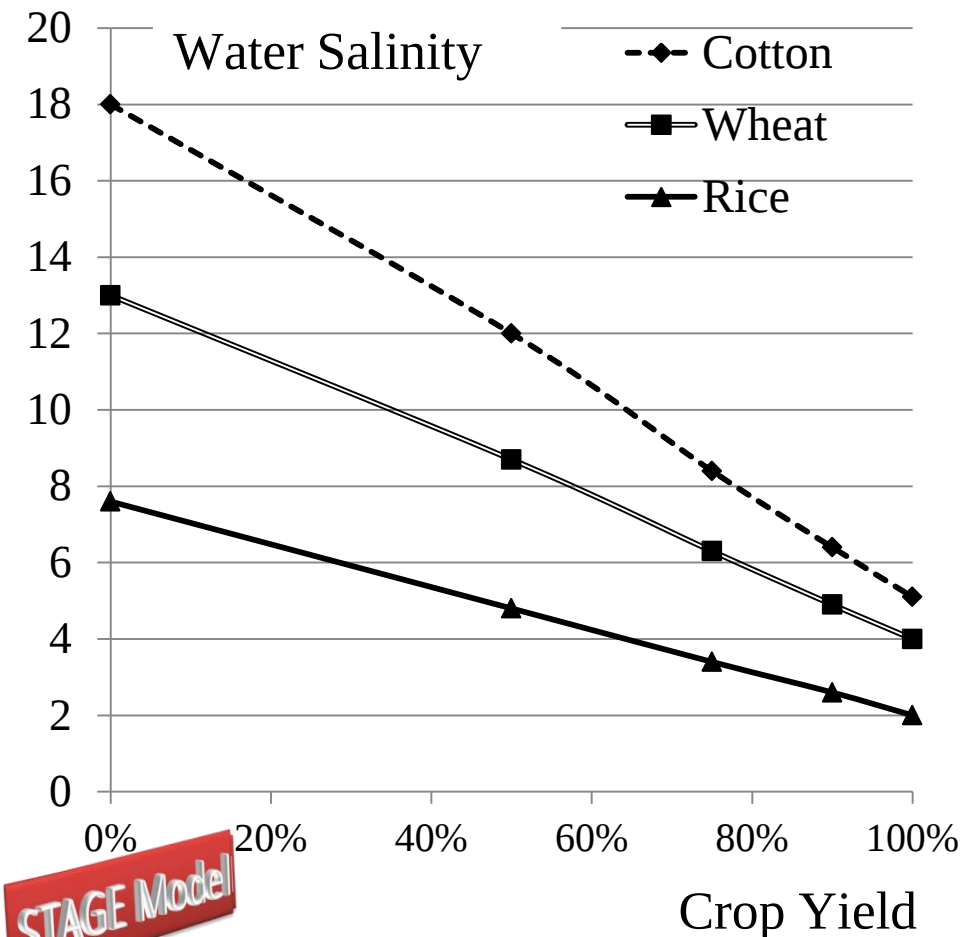
| Table 4 CROP TOLERANCE AND YIELD POTENTIAL OF SELECTED CROPS AS INFLUENCED BY IRRIGATION WATER SALINITY ( $EC_w$ ) OR SOIL SALINITY ( $EC_e$ ) |                                      |        |        |        |        |        |        |        |        |           |        |
|------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|-----------|--------|
| YIELD POTENTIAL                                                                                                                                |                                      |        |        |        |        |        |        |        |        |           |        |
|                                                                                                                                                |                                      | 100    |        | 90     |        | 75     |        | 50     |        | 0.00001   |        |
| FIELD CROPS                                                                                                                                    |                                      | 100%   |        | 90%    |        | 75%    |        | 50%    |        | 0%        |        |
|                                                                                                                                                |                                      |        |        |        |        |        |        |        |        | "maximum" |        |
|                                                                                                                                                |                                      | $EC_e$ | $EC_w$ | $EC_e$ | $EC_w$ | $EC_e$ | $EC_w$ | $EC_e$ | $EC_w$ | $EC_e$    | $EC_w$ |
|                                                                                                                                                | Barley ( <i>Hordeum vulgare</i> )    | 8      | 5.3    | 10     | 6.7    | 13     | 8.7    | 18     | 12     | 28        | 19     |
|                                                                                                                                                | Cotton ( <i>Gossypium hirsutum</i> ) | 7.7    | 5.1    | 9.6    | 6.4    | 13     | 8.4    | 17     | 12     | 27        | 18     |
|                                                                                                                                                | Sugarbeet ( <i>Beta vulgaris</i> )   | 7      | 4.7    | 8.7    | 5.8    | 11     | 7.5    | 15     | 10     | 24        | 16     |
|                                                                                                                                                | Sorghum ( <i>Sorghum bicolor</i> )   | 6.8    | 4.5    | 7.4    | 5      | 8.4    | 5.6    | 9.9    | 6.7    | 13        | 8.7    |
|                                                                                                                                                | Wheat ( <i>Triticum aestivum</i> )   | 6      | 4      | 7.4    | 4.9    | 9.5    | 6.3    | 13     | 8.7    | 20        | 13     |

STAGE Model

Ayers, R., & Westcot, D. (1985). Water Quality for Agriculture. *FAO Irrigation & Drainage Paper*, 29(Rev. 1)

## 2. linear interpolations: salinity levels & crop yields; mapped to the 23 seasonal crop activities in Egypt-SAM through **satellite accounts**

### Crop Tolerance to Variations in Water & Land Salinity



3. prevailing levels of water & land salinity : pre-estimated salinity levels; data MWRI; soil types & resilience

FAO/UNESCO, Egypt soils **clay soils** with **flood plain** features

Satellite images, 3 types of soil (with  $EC_e$  dS/m): **flood plain** (1.48 - 12.53), **lacustrine plain** (11.40 - 15.45), **marine plain** (17.40 - 20.34)

So, levels of soil resilience & water salinity are for **flood plain**, for cotton only **lacustrine plain's** parameters

Eventually, crop yield (point) elasticities to changes in salinity are computed

# ***Agro-economic Scenarios***

Cost/benefit analysis for gov. project (IWRMP): **-10%** in water salinity, **9.5** billion L.E. annual gov. spending

- **All scenarios** 34% increase in gov. spending
- **H-Yld** Full potential increases in crop yields
- **P-Yld** 70% of potential increases in crop yields
- **L-Yld** 50% of potential increases in crop yields

# Crop Yield Responses to Changes in Water Salinity (Percentage change)

|                             | H-Yld | P-Yld | L-Yld |
|-----------------------------|-------|-------|-------|
| Winter Wheat                | 0.04  | 0.03  | 0.02  |
| Winter Cereals              | 0.08  | 0.06  | 0.04  |
| Winter Sugar Beet           | 0.03  | 0.03  | 0.02  |
| Winter Fodders              | 0.26  | 0.18  | 0.13  |
| Winter Fibbers              | 0.29  | 0.21  | 0.15  |
| Winter Medical Plants       | 0.26  | 0.18  | 0.13  |
| Winter Vegetables           | 0.37  | 0.26  | 0.19  |
| Summer Rice                 | 0.19  | 0.13  | 0.10  |
| Summer Other Crops          | 0.16  | 0.12  | 0.08  |
| Summer Sugar Cane           | 0.07  | 0.05  | 0.04  |
| Summer Cotton               | 0.10  | 0.07  | 0.05  |
| Summer Fodders              | 0.10  | 0.07  | 0.05  |
| Summer Oily Crops           | 0.15  | 0.10  | 0.07  |
| Summer Medical Plants       | 0.10  | 0.07  | 0.05  |
| Summer Vegetables           | 0.37  | 0.26  | 0.19  |
| Nili Rice                   | 0.19  | 0.13  | 0.10  |
| Nili Other Crops            | 0.16  | 0.11  | 0.08  |
| Nili Fodders                | 0.18  | 0.13  | 0.09  |
| Nili Oily Crops             | 0.15  | 0.10  | 0.07  |
| Nili Medical Plants         | 0.18  | 0.13  | 0.09  |
| Nili Vegetables             | 0.37  | 0.26  | 0.19  |
| Fruits                      | 0.59  | 0.31  | 0.14  |
| Other agri forestry fishing | 0.20  | 0.13  | 0.09  |



# Macro-economic Analysis

## H-Yld

4% increase in GDP

- planned investments in water quality are worthwhile even with lower crop yield responses

HHs gain 28 billion L.E. (E.V.)

- Income and substitution effects explain the generated welfare gains.
- HHs experience 4% increase in income
- prices for most of HH consumption goods decline as supplies increase.

STAGE Model

|                                    | H-Yld                  | P-Yld | L-Yld |
|------------------------------------|------------------------|-------|-------|
|                                    | Real percentage change |       |       |
| <b>GDP (expenditure)</b>           | 3.98                   | 2.73  | 1.92  |
| Private consumption                | 3.49                   | 2.05  | 1.11  |
| Government consumption             | 2.91                   | 2.00  | 1.42  |
| Investment consumption             | 4.66                   | 4.66  | 4.66  |
| Import demand                      | 3.68                   | 2.04  | 1.26  |
| Export supply                      | 5.14                   | 2.88  | 1.78  |
| <b>Absorption</b>                  | 3.64                   | 2.51  | 1.78  |
| <b>Total domestic production</b>   | 3.96                   | 2.80  | 2.04  |
| <b>Total intermediate inputs</b>   | 3.49                   | 2.76  | 2.17  |
|                                    | Billion LE             |       |       |
| <b>EV on household consumption</b> | 28.21                  | 16.63 | 9.01  |
| <b>Household Income</b>            | 4.12                   | 2.84  | 2.02  |
|                                    | Percent                |       |       |
| <b>Household savings rate</b>      | -6.09                  | -3.63 | -1.98 |
| <b>Household income tax rate</b>   | 60.00                  | 59.76 | 60.81 |

# *Domestic Markets: % Change relative to baseline*

|                                  | Supply Price |        |        | Supply Quantity |       |       |
|----------------------------------|--------------|--------|--------|-----------------|-------|-------|
|                                  | H-Yld        | P-Yld  | L-Yld  | H-Yld           | P-Yld | L-Yld |
| <b>Wheat</b>                     | -0.80        | -0.32  | -0.14  | 1.61            | 1.24  | 0.90  |
| <b>Cereals</b>                   | -0.97        | -0.15  | 0.14   | 2.01            | 1.48  | 1.03  |
| <b>Rice</b>                      | -20.38       | -15.14 | -11.33 | 3.89            | 2.69  | 1.84  |
| <b>Vegetables</b>                | -20.91       | -15.54 | -11.58 | 4.90            | 3.26  | 2.15  |
| <b>Fruits</b>                    | -37.43       | -23.64 | -11.95 | 33.53           | 14.30 | 6.04  |
| <b>Coffee Tea</b>                | -12.54       | -8.91  | -6.44  | 4.13            | 2.85  | 1.93  |
| <b>Other agri</b>                | -7.19        | -5.03  | -3.55  | 0.49            | 0.31  | 0.12  |
| <b>minerals gas</b>              | 4.78         | 3.40   | 2.44   | 2.41            | 2.02  | 1.54  |
| <b>Food products</b>             | 1.81         | 0.87   | 0.32   | 3.62            | 2.24  | 1.33  |
| <b>Other transportable goods</b> | 0.80         | 0.93   | 0.90   | 3.36            | 2.54  | 1.93  |
| <b>Metal machinery</b>           | 0.05         | 0.58   | 0.73   | 2.59            | 2.15  | 1.79  |
| <b>Construction</b>              | 1.78         | 1.49   | 1.20   | 8.41            | 8.31  | 8.25  |
| <b>Trade</b>                     | 3.73         | 2.59   | 1.82   | 3.21            | 2.09  | 1.32  |
| <b>Financial services</b>        | 3.67         | 2.68   | 1.96   | 3.38            | 2.13  | 1.26  |
| <b>Business services</b>         | 2.89         | 2.19   | 1.64   | 3.12            | 1.99  | 1.20  |
| <b>Social services</b>           | 1.07         | 0.85   | 0.65   | 3.38            | 2.16  | 1.36  |

# Cross- sectoral Analysis

Fruits (almost  
triple)

Seasonal veg.  
+(30-37)% with  
increases in their  
exports

Rice output &  
exports expand  
by 13% & 64%



|                    | Baseline          |                 |                       | Production, % Change relative to baseline |        |        |
|--------------------|-------------------|-----------------|-----------------------|-------------------------------------------|--------|--------|
|                    | Level, Billion LE | GDP (share, % ) | Agri. GDP (share, % ) | H-Yld                                     | P-Yld  | L-Yld  |
| W. Wheat & Cereals | 20.36             | 1.9%            | 14.7%                 | 2.16                                      | 1.92   | 1.55   |
| W. Legumes         | 0.70              | 0.1%            | 0.5%                  | 12.73                                     | 9.98   | 7.68   |
| W. Sugar Beet      | 2.52              | 0.2%            | 1.8%                  | -48.88                                    | -37.27 | -29.20 |
| W. Fodders         | 21.88             | 2.0%            | 15.8%                 | 34.14                                     | 24.22  | 17.36  |
| W. Fibbers         | 0.12              | 0.0%            | 0.1%                  | 46.94                                     | 32.61  | 23.11  |
| W. Medical Plants  | 0.34              | 0.0%            | 0.2%                  | 33.32                                     | 23.41  | 16.70  |
| W. Vegetables      | 16.75             | 1.6%            | 12.1%                 | 30.15                                     | 21.23  | 15.24  |
| S. Rice            | 9.74              | 0.9%            | 7.0%                  | 12.78                                     | 8.73   | 6.05   |
| S. Other Crops     | 10.61             | 1.0%            | 7.7%                  | -13.11                                    | -9.47  | -7.19  |
| S. Sugar Cane      | 4.26              | 0.4%            | 3.1%                  | -37.31                                    | -29.03 | -22.36 |
| S. Cotton          | 3.49              | 0.3%            | 2.5%                  | -12.49                                    | -8.99  | -6.62  |
| S. Fodders         | 3.08              | 0.3%            | 2.2%                  | -12.02                                    | -8.65  | -6.36  |
| S. Oily Crops      | 1.81              | 0.2%            | 1.3%                  | -20.42                                    | -15.81 | -12.10 |
| S. Medical Plants  | 0.13              | 0.0%            | 0.1%                  | -9.19                                     | -6.45  | -4.65  |
| S. Vegetables      | 16.31             | 1.5%            | 11.8%                 | 35.22                                     | 24.77  | 17.77  |
| N. Rice            | 0.04              | 0.0%            | 0.0%                  | 8.50                                      | 5.55   | 3.64   |
| N. Other Crops     | 1.66              | 0.2%            | 1.2%                  | -13.92                                    | -10.57 | -8.02  |
| N. Fodders         | 0.36              | 0.0%            | 0.3%                  | 11.19                                     | 8.35   | 6.11   |
| N. Oily Crops      | 0.01              | 0.0%            | 0.0%                  | -14.54                                    | -11.13 | -8.43  |
| N. Medical Plants  | 0.00              | 0.0%            | 0.0%                  | 24.94                                     | 18.08  | 13.12  |
| N. Vegetables      | 2.51              | 0.2%            | 1.8%                  | 37.31                                     | 26.26  | 18.82  |
| Fruits             | 9.29              | 0.9%            | 6.7%                  | 195.06                                    | 76.51  | 29.36  |
|                    |                   |                 |                       |                                           |        |        |

# Commodity Exports (% change)

|                   | Baseline Exports   |              | % Change relative to baseline |        |       |
|-------------------|--------------------|--------------|-------------------------------|--------|-------|
|                   | Level (Billion LE) | Share (%)    | H-Yld                         | P-Yld  | L-Yld |
| Wheat             | 0.02               | 0.0%         | 4.08                          | 4.32   | 3.86  |
| Cereals           | 0.06               | 0.0%         | 24.89                         | 19.46  | 14.97 |
| Rice              | 1.56               | 0.6%         | 64.04                         | 44.51  | 31.55 |
| Vegetables        | 4.16               | 1.6%         | 71.98                         | 49.44  | 34.59 |
| Fruits            | 5.14               | 2.0%         | 323.34                        | 128.30 | 49.38 |
| Coffee Tea        | 3.32               | 1.3%         | 68.91                         | 47.87  | 33.82 |
| Minerals, gas     | 53.01              | 20.4%        | -9.74                         | -5.28  | -2.99 |
| Food products     | 20.90              | 8.0%         | -2.13                         | 1.19   | 2.37  |
| Other goods       | 47.41              | 18.2%        | -0.07                         | 1.02   | 1.09  |
| Metal machinery   | 22.90              | 8.8%         | 1.36                          | 1.72   | 1.39  |
| Construction      | 3.75               | 1.4%         | 4.26                          | 6.18   | 7.07  |
| Trade             | 86.83              | 33.4%        | -4.58                         | -2.12  | -1.04 |
| Financial         | 1.50               | 0.6%         | -4.15                         | -2.18  | -1.31 |
| Business services | 7.70               | 3.0%         | -4.48                         | -2.23  | -1.25 |
| Social services   | 1.77               | 0.7%         | 0.68                          | 1.42   | 1.39  |
| <b>Total</b>      | <b>260.00</b>      | <b>100 %</b> |                               |        |       |

Results driven by **1) tolerance to salinity; 2) water intensity**

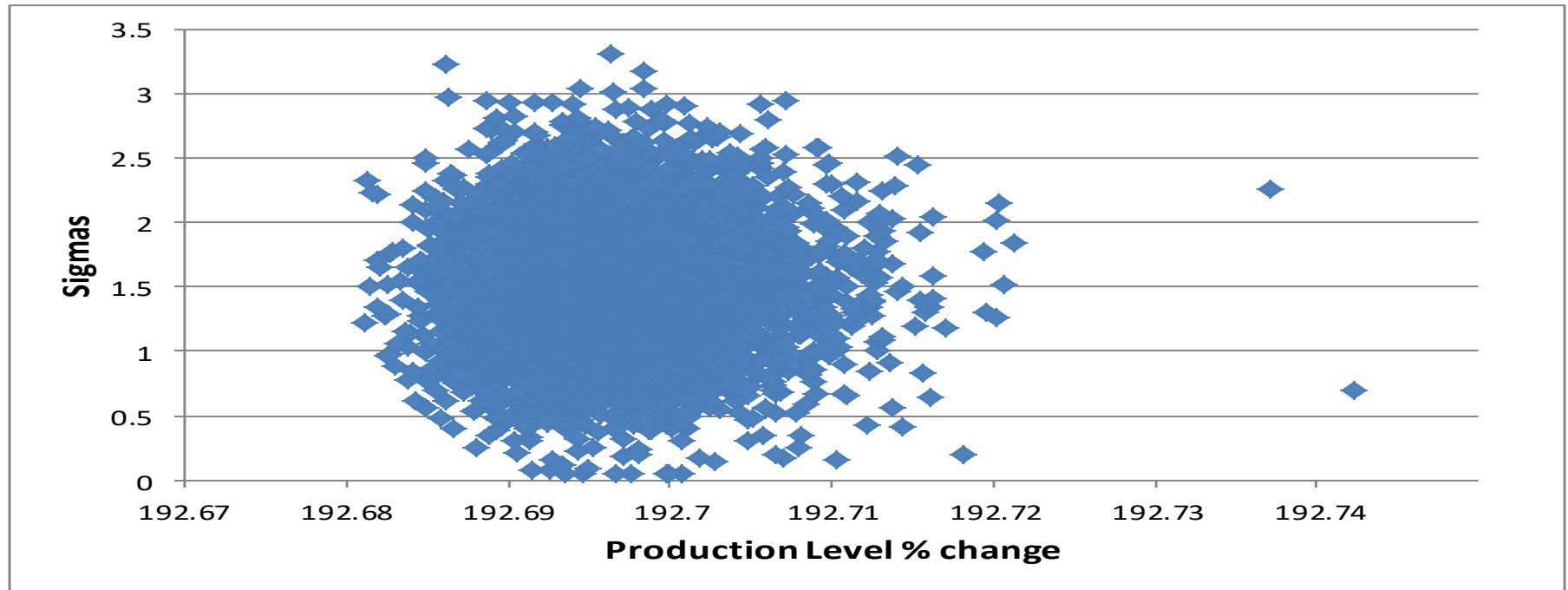
As salinity decline so the yields of crops that are less salt tolerant increase, relative to other crops, and the optimal output mix changes: reflecting the importance of the salinity constraint on the optimal mix of crops.

**Fruits and vegetables** salt-sensitive **Fruits**: 7% of agricultural GDP and half of agricultural exports. **Vegetables**: 26% of agricultural GDP and consume some 6% of Nile water. The expansions of these 2 sectors contribute significantly to the positive economy-wide impacts.

**Rice** is a water-intensive crop, cultivated mainly in the Northern Delta, and consumes more than 30% of annual Nile water and more than half of summer water. **Rice**: 7% of agricultural GDP, and 2<sup>nd</sup> important exporting crop (after cotton).

# *Systematic Sensitivity Analysis Scatter*

elasticity of substitution between water/land examined through a SSA using 5,000 Monte Carlo independent draws



SSA Scatter, Fruits (% production change versus sigma values)

Model results are clearly determined by the shocks more than the elasticities

*2<sup>nd</sup> nexus: improving water & sanitation quality:  
Socio-economic analysis*

2012/13 SAM (thousand L.E.): 232 accounts

14 production factors: capital, land

.... & 12 labour accounts: urban/rural; male/female;  
skilled/semiskilled/unskilled

10 HHs accounts: Urban/rural; lowest income (1) highest income (5)

**Main scenario:** Double Gov. spending on sewage & sanitation

## ***Preliminary results: Welfare*** (% Change relative to BL)

|                           | Birth Rate   | Education Spending | Health Spending | Water Sanitation Spending | Death Rate    |
|---------------------------|--------------|--------------------|-----------------|---------------------------|---------------|
| Households Urban 1        | -0.02        | 0.12               | 0.18            | 96.19                     | -12.64        |
| Households Urban 2        | -0.03        | 0.13               | 0.20            | 94.68                     | -12.51        |
| Households Urban 3        | -0.03        | 0.15               | 0.23            | 94.71                     | -12.52        |
| Households Urban 4        | -0.03        | 0.17               | 0.26            | 93.50                     | -12.41        |
| <b>Households Urban 5</b> | <b>-0.05</b> | <b>0.25</b>        | <b>0.38</b>     | <b>89.02</b>              | <b>-12.02</b> |
| Households Rural 1        | -0.02        | 0.11               | 0.19            | 93.53                     | -12.40        |
| Households Rural 2        | -0.02        | 0.12               | 0.22            | 89.46                     | -12.04        |
| Households Rural 3        | -0.03        | 0.13               | 0.25            | 88.06                     | -11.91        |
| Households Rural 4        | -0.03        | 0.14               | 0.29            | 84.70                     | -11.60        |
| Households Rural 5        | -0.03        | 0.16               | 0.38            | 80.28                     | -11.19        |

Welfare improvements for all HHs.

Effects (mostly) are more pronounced in Urban & at higher income levels.

## *Preliminary results: Food Security* (% Change relative to BL)

|                    | Food Price Index | Food Consumption | Income level |
|--------------------|------------------|------------------|--------------|
| Households Urban 1 | 0.09             | 1.19             | 1.11         |
| Households Urban 2 | 0.09             | 1.06             | 0.96         |
| Households Urban 3 | 0.08             | 1.06             | 0.95         |
| Households Urban 4 | 0.08             | 1.00             | 0.88         |
| Households Urban 5 | 0.08             | 0.91             | 0.70         |
| Households Rural 1 | 0.12             | 1.23             | 1.19         |
| Households Rural 2 | 0.12             | 1.11             | 1.05         |
| Households Rural 3 | 0.12             | 1.09             | 1.00         |
| Households Rural 4 | 0.12             | 1.10             | 0.98         |
| Households Rural 5 | 0.12             | 0.98             | 0.74         |

Food security improvements for all HHs.

## *Preliminary results: Income Distribution* (% Change relative to BL)

|                            | Factor Price | Factor Income |
|----------------------------|--------------|---------------|
| Unskilled Urban - Male     | 3.32         | 3.39          |
| Unskilled Urban - Female   | <b>2.70</b>  | <b>2.77</b>   |
| Unskilled Rural - Male     | 3.16         | 3.24          |
| Unskilled Rural - Female   | <b>3.13</b>  | <b>3.20</b>   |
| Semiskilled Urban - Male   | 3.15         | 3.22          |
| Semiskilled Urban - Female | 2.28         | 2.36          |
| Semiskilled Rural - Male   | 2.85         | 2.93          |
| Semiskilled Rural - Female | 2.26         | 2.33          |
| Skilled Urban - Male       | 2.69         | 2.77          |
| Skilled Urban - Female     | 2.23         | 2.30          |
| Skilled Rural - Male       | 2.43         | 2.51          |
| Skilled Rural - Female     | 1.84         | 1.91          |
| Capital                    | 0.26         | 0.26          |
| Land                       | 0.25         | 0.25          |

Income distribution effects in favour of unskilled (versus semi & skilled);  
male (versus female) & urban versus rural labour

**Unskilled female rural labour** gain more than their urban counterparts

# *Concluding Remarks*

## *1. Improving irrigation water quality:*

- *Strong positive economy-wide impacts, exceed the investment cost.*
- *Even without reducing water requirements, should allow Egypt to achieve large increase in the production of various high value crops, which can be traded to purchase staples, e.g. wheat, and raise national income.*
- *Increase the availability & affordability of major crops and, hence, improve food security in Egypt.*

## *2. Improving water and sanitation facilities:*

- *Positive welfare and food security impacts.*
- *Favourable income distribution impacts.*

*The study illustrates the importance of including water quality as a variable in the analyses of water systems.*

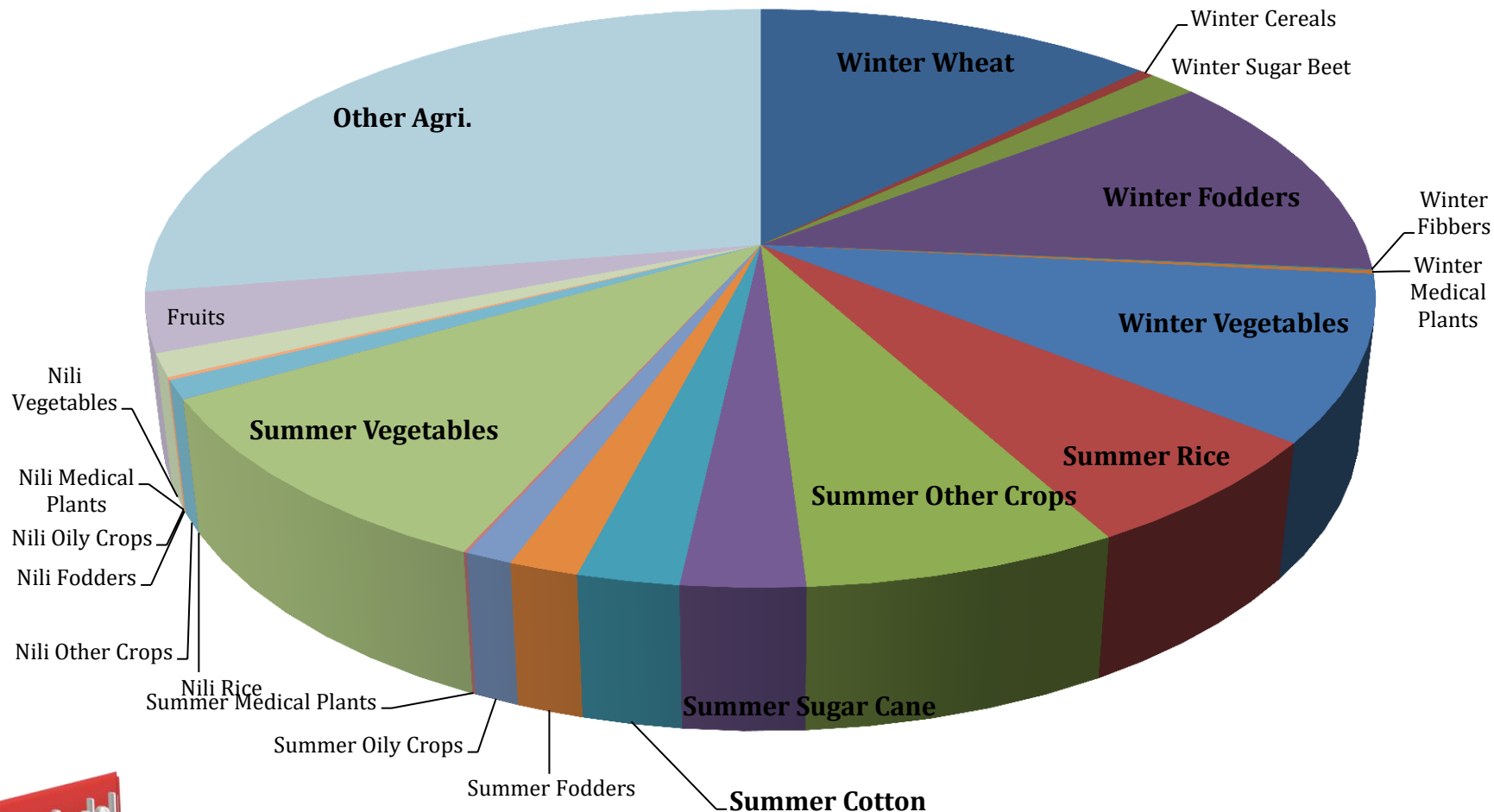
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***Thank you – feedback is appreciated.***  
***It will help us in our next publication!***

# ***BL Agricultural Structure***



|                           | Land % | Water % | Water /Land Ratio | Water Intensity<br>(million m3/1000 ton) |
|---------------------------|--------|---------|-------------------|------------------------------------------|
| <b>Winter Field Crops</b> |        |         |                   |                                          |
| Wheat                     | 20.0   | 9.7     | 0.2               | 0.5                                      |
| Cereals                   | 1.0    | 0.4     | 0.1               | 0.7                                      |
| Sugar Beet                | 2.0    | 1.1     | 0.1               | 0.1                                      |
| Fodders                   | 13.0   | 20.0    | 0.5               | 0.2                                      |
| Fibbers                   | 0.0    | 0.1     | 0.2               | 0.7                                      |
| Medical Plants            | 0.0    | 0.1     | 0.1               | 0.3                                      |
| Vegetables                | 6.0    | 2.4     | 0.1               | 0.1                                      |
| <b>Summer Field Crops</b> |        |         |                   |                                          |
| Rice                      | 9.0    | 23.0    | 0.8               | 1.9                                      |
| Other Crops               | 14.0   | 13.7    | 0.3               | 1.0                                      |
| Sugar Cane                | 2.0    | 5.9     | 0.9               | 0.2                                      |
| Cotton                    | 3.0    | 2.2     | 0.2               | 1.2                                      |
| Fodders                   | 4.0    | 3.3     | 0.2               | 0.2                                      |
| Oily Crops                | 2.0    | 0.8     | 0.1               | 1.2                                      |
| Medical Plants            | 0.0    | 0.1     | 0.3               | 0.3                                      |
| Vegetables                | 10.0   | 3.6     | 0.1               | 0.1                                      |
| <b>Nili Field Crops</b>   |        |         |                   |                                          |
| Rice                      | 0      | 0.0     | 0.04              | 0.12                                     |
| Other Crops               | 2      | 3.3     | 0.43              | 1.56                                     |
| Fodders                   | 1      | 0.0     | 0.00              | 0.00                                     |
| Oily Crops                | 0      | 0.0     | 0.06              | 1.14                                     |
| Medical Plants            | 0      | 0.2     | 0.18              | 0.39                                     |
| Vegetables                | 1      | 1.2     | 0.26              | 0.26                                     |
| <b>Year-round Crops</b>   |        |         |                   |                                          |
| Fruits                    | 8      | 8.9     | 0.3               | 0.4                                      |

## BL Factor Intensity by Agricultural Activity (Percent)

|                             | Labour | Capital | Nile-land | Nile-water | Ground-land | Ground-water | Rainfed-land | Total |
|-----------------------------|--------|---------|-----------|------------|-------------|--------------|--------------|-------|
| Winter Wheat                | 13.8   | 56.4    | 20.0      | 3.4        | 1.8         | 0.2          | 4.5          | 100   |
| Winter Cereals              | 22.2   | 29.8    | 34.6      | 4.6        | 1.3         | 0.0          | 7.5          | 100   |
| Winter Sugar Beet           | 12.3   | 64.2    | 16.9      | 2.8        | 0.0         | 0.0          | 3.8          | 100   |
| Winter Fodders              | 2.5    | 83.7    | 6.0       | 5.1        | 0.4         | 0.0          | 2.2          | 100   |
| Winter Fibbers              | 14.4   | 59.0    | 18.4      | 3.8        | 0.1         | 0.0          | 4.3          | 100   |
| Winter Medical Plants       | 10.2   | 68.7    | 15.3      | 2.2        | 0.2         | 0.0          | 3.4          | 100   |
| Winter Vegetables           | 7.7    | 84.1    | 5.8       | 0.8        | 0.4         | 0.1          | 1.3          | 100   |
| Summer Rice                 | 13.8   | 54.1    | 6.1       | 20.6       | 0.1         | 0.0          | 5.2          | 100   |
| Summer Other Crops          | 23.1   | 47.0    | 17.0      | 7.4        | 0.6         | 0.1          | 4.7          | 100   |
| Summer Sugar Cane           | 11.4   | 70.1    | 2.3       | 13.1       | 0.1         | 0.0          | 3.1          | 100   |
| Summer Cotton               | 24.7   | 59.0    | 10.9      | 2.7        | 0.0         | 0.0          | 2.6          | 100   |
| Summer Fodders              | 4.8    | 77.8    | 9.7       | 2.7        | 2.2         | 0.4          | 2.4          | 100   |
| Summer Oily Crops           | 15.1   | 62.5    | 15.6      | 2.4        | 1.0         | 0.0          | 3.4          | 100   |
| Summer Medical Plants       | 12.1   | 64.6    | 14.6      | 5.0        | 0.0         | 0.0          | 3.8          | 100   |
| Summer Vegetables           | 11.4   | 74.3    | 10.4      | 1.3        | 0.4         | 0.1          | 2.2          | 100   |
| Nili Rice                   | 11.4   | 54.3    | 13.4      | 0.5        | 17.6        | 0.2          | 2.7          | 100   |
| Nili Other Crops            | 23.0   | 47.2    | 12.9      | 9.9        | 2.3         | 0.2          | 4.4          | 100   |
| Nili Fodders                | 5.5    | 76.9    | 10.9      | 0.0        | 4.5         | 0.1          | 2.1          | 100   |
| Nili Oily Crops             | 18.4   | 39.7    | 30.4      | 1.8        | 3.6         | 0.0          | 6.1          | 100   |
| Nili Medical Plants         | 11.8   | 56.4    | 5.3       | 21.2       | 0.0         | 0.0          | 5.3          | 100   |
| Nili Vegetables             | 11.4   | 73.6    | 8.5       | 2.9        | 1.3         | 0.1          | 2.2          | 100   |
| Fruits                      | 14.4   | 63.2    | 9.5       | 4.7        | 4.8         | 3.4          | 0.0          | 100   |
| Other agri forestry fishing | 58.0   | 42.0    | 0.0       | 0.0        | 0.0         | 0.0          | 0.0          | 100   |

## BL Factor Shares in Agricultural Value Added (Percent)

|                             | Labour | Capital | Nile-land | Nile-water | Ground-land | Ground-water | Rainfed-land |
|-----------------------------|--------|---------|-----------|------------|-------------|--------------|--------------|
| Winter Wheat                | 12.9   | 12.6    | 29.8      | 10.7       | 27.2        | 9.7          | 25.2         |
| Winter Cereals              | 0.7    | 0.2     | 1.8       | 0.5        | 0.7         | 0.0          | 1.4          |
| Winter Sugar Beet           | 1.4    | 1.8     | 3.1       | 1.1        | 0.1         | 0.0          | 2.6          |
| Winter Fodders              | 2.5    | 20.1    | 9.7       | 17.3       | 7.4         | 2.3          | 13.1         |
| Winter Fibbers              | 0.1    | 0.1     | 0.2       | 0.1        | 0.0         | 0.0          | 0.1          |
| Winter Medical Plants       | 0.2    | 0.3     | 0.4       | 0.1        | 0.1         | 0.0          | 0.3          |
| Winter Vegetables           | 5.9    | 15.5    | 7.1       | 2.0        | 5.2         | 2.4          | 5.8          |
| Summer Rice                 | 6.2    | 5.8     | 4.4       | 30.7       | 0.9         | 0.0          | 14.0         |
| Summer Other Crops          | 11.2   | 5.5     | 13.3      | 12.1       | 5.2         | 2.6          | 13.8         |
| Summer Sugar Cane           | 2.2    | 3.3     | 0.7       | 8.5        | 0.3         | 0.0          | 3.6          |
| Summer Cotton               | 4.0    | 2.3     | 2.8       | 1.5        | 0.0         | 0.0          | 2.5          |
| Summer Fodders              | 0.7    | 2.6     | 2.2       | 1.3        | 5.2         | 3.0          | 2.0          |
| Summer Oily Crops           | 1.3    | 1.2     | 2.1       | 0.7        | 1.3         | 0.1          | 1.7          |
| Summer Medical Plants       | 0.1    | 0.1     | 0.1       | 0.1        | 0.0         | 0.0          | 0.1          |
| Summer Vegetables           | 8.5    | 13.3    | 12.4      | 3.2        | 5.0         | 2.1          | 10.0         |
| Nili Rice                   | 0.0    | 0.0     | 0.0       | 0.0        | 0.6         | 0.0          | 0.0          |
| Nili Other Crops            | 1.8    | 0.9     | 1.6       | 2.5        | 2.9         | 0.9          | 2.0          |
| Nili Fodders                | 0.1    | 0.3     | 0.3       | 0.0        | 1.2         | 0.1          | 0.2          |
| Nili Oily Crops             | 0.0    | 0.0     | 0.0       | 0.0        | 0.0         | 0.0          | 0.0          |
| Nili Medical Plants         | 0.0    | 0.0     | 0.0       | 0.0        | 0.0         | 0.0          | 0.0          |
| Nili Vegetables             | 1.3    | 2.0     | 1.6       | 1.1        | 2.4         | 0.5          | 1.5          |
| Fruits                      | 6.2    | 6.5     | 6.5       | 6.6        | 34.1        | 76.2         | 0.0          |
| Other agri forestry fishing | 32.8   | 5.7     | 0.0       | 0.0        | 0.0         | 0.0          | 0.0          |
| Agr. Value Added            | 100    | 100     | 100       | 100        | 100         | 100          | 100          |