

THE CASE FOR DRIP IRRIGATION

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AGENDA



Part I - Overview

1. Netafim
2. The agricultural challenge
3. Water for agriculture
4. Drip irrigation

Part II – Internship Assignments

5. Research Questions
6. Literature review & Alfalfa
7. Theoretical framework
8. Next steps & references



OVERVIEW



- The first and leading drip-irrigation company in the world
 - How was the idea born?

...the largest tree in the farm seemed to be growing with no source of water...

The story of water engineer Simcha Blass, 1930's

- Drip irrigation = application of water and fertilizer directly into the root zone of the plant
- First drip device ready by 1959



- Kibbutz Hatzerim buys drip patent in early 1960's
 - Second to best alternative
 - Irony
- **The establishment of Netafim in 1966 by Kibbutz Hatzerim**
 - 1974 – Kibbutz Magal joins
 - 1978 – Kibbutz Yiftah joins
 - 1998 – Netafim Conglomerate
 - 2011 – Permira Investments gains control (66%)



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- 50 years of shaping the future
 - Products and smart irrigation solutions
 - Drippers, driplines, sprinklers and micro-emitters
 - Crop management technologies
 - Variety of uses
 - Agriculture, landscape, green-houses
 - Global reach
 - 4000 workers worldwide
 - 2,000,000 customers from 110 countries
 - 28 subsidiaries and 16 factories
- 2013 Stockholm Industry Water Award



THE AGRICULTURAL CHALLENGE



- “How can the world be fed in the future without putting irreparable strain on the Earth’s soils and oceans?” The Economist

Agricultural production must increase by 70% to meet 2050 global demand for food

Forecast by FAO

- Will population growth outpace food production?
 - Malthus pessimistic prediction not yet realized!
 - The role of technology

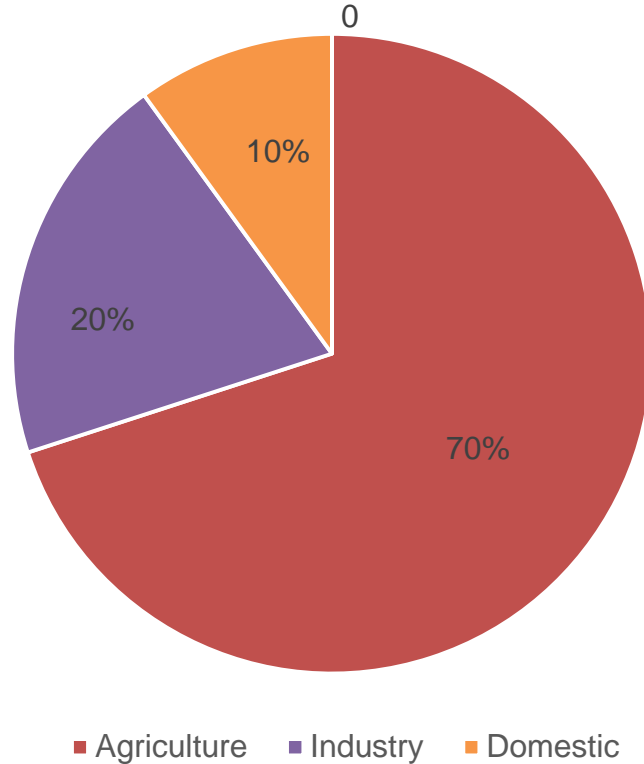


WATER FOR AGRICULTURE

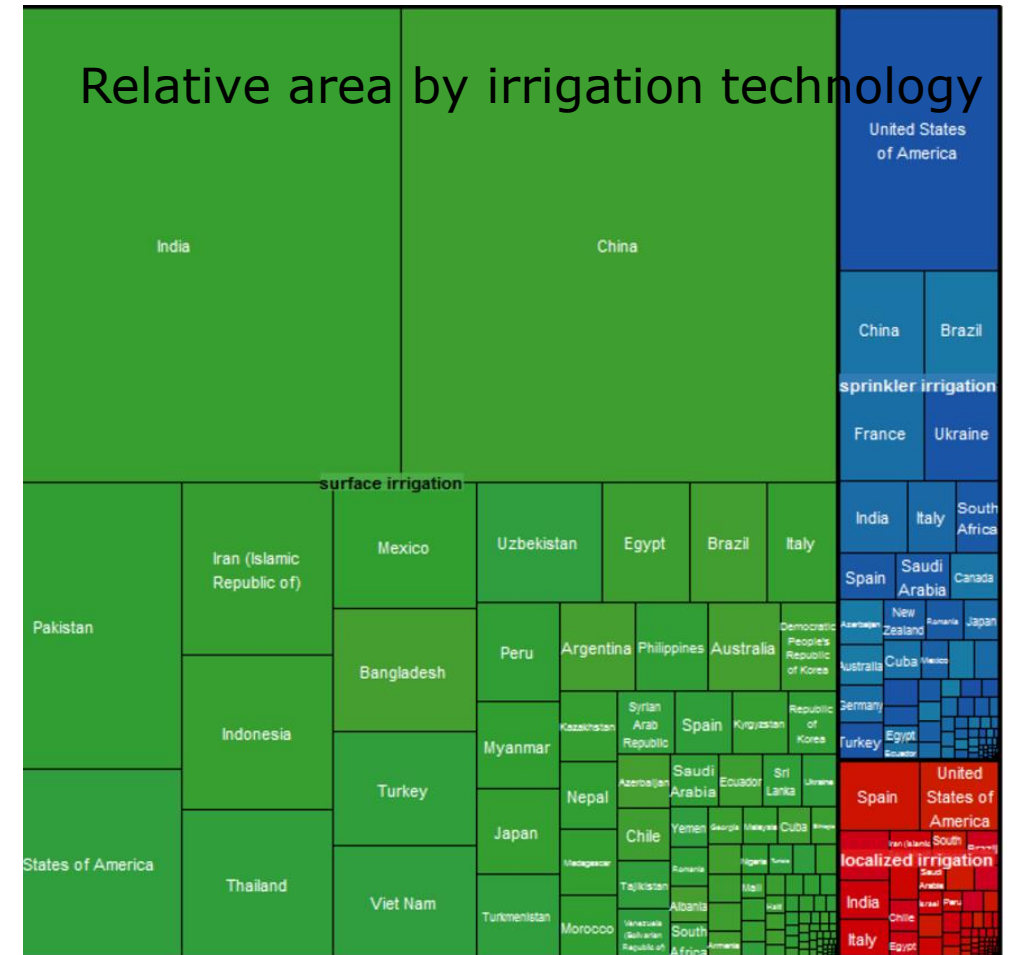


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Average Water Withdrawals Distribution



Relative area by irrigation technology



THE CASE FOR DRIP IRRIGATION



Global concerns:

Irrigation is crucial for food security



Water and fertile land are scarce resources



Environmental degradation



Drip characteristics:

- Higher & better yields
- Better protection from weeds and pest diseases

- Higher water use efficiency
- Allows production in lands less suitable for agriculture

- Less groundwater contamination
- Lower GHG emissions
- Minimum soil erosion

And yet, high investment costs and ongoing replacement costs make diffusion of drip technology far from over



INTERNSHIP ASSIGNMENTS



STEP I

DEFINITION OF RESEARCH OBJECTIVES



How do farm characteristics and irrigation technology characteristics affect Alfalfa farmer's choice of an irrigation system?

In particular, given a set of agronomic features and irrigation technology characteristics

1. Under which conditions will Alfalfa farmers choose to adopt the technology?
2. How will adoption of drip irrigation impact water, energy and fertilizer use?
3. What is the yield effect resulting from adoption of drip irrigation?



ALFALFA – KING OF FORAGES

- Characteristics
 - Adaptable to various environments, high yield potential
 - Thirsty crop, but also water-use efficient
- Statistics
 - Worldwide: 30 million hectares
 - USA: 140 million tons, USD 8 billion value
 - California:
 - 9% of total US production
 - Production concentrated in Imperial, Kern, Tulare, Merced and Fresno counties
 - Irrigation:
 - 82% - surface irrigation
 - 15% - sprinkler systems
 - 3% - subsurface drip irrigation



STEP II

LITERATURE REVIEW - AN EXAMPLE



- “A Model to Assess the Economic Viability of Alfalfa Production Under Subsurface Drip Irrigation in California”
 - Model: Alfalfa yields as a function of seasonal water use (SWU)
 - SWU predicted from CIMIS stations data
 - Alfalfa yields predicted for CA regions
 - Modification factor introduced to capture agronomic variations
 - Cost equations developed
 - Profitability indicator developed
 - Thresholds of profitability calculated for each region
 - Market effects calculated (changes in net profits for industry)



STEP II

LITERATURE REVIEW - ANOTHER EXAMPLE



- “The Effects of Well Depth and Land Quality on the Choice of Irrigation Technology”
 - Model: profit is a function of land quality and well depth
 - Two problems solved:
 - Water use choice under traditional and modern technologies
 - Profit maximization given water use choice
 - Response of variables (water and energy use, output) to changes in parameters (land quality, well depth, prices)
 - Two production functions: quadratic, Cobb-Douglas (differs in elasticities)



STEP III

ANALYSIS OF INSIGHTS



- Various assumptions made in related studies:
 - All costs (other than fixed irrigation system costs) are the same across technologies
 - Groundwater is used for irrigation
 - Irrigation effectiveness depends only on land quality
 - Output is a function of effective water and land quality
 - No uncertainty / risks involved in adoption
- Different sets of assumptions may bring different results
 - How to create a model realistic enough but not too complicated?



STEP IV

BRAINSTORMING POTENTIAL DIRECTIONS



- What is missing in the literature?
 - Impact of irrigation system specifications on benefits from adoption
 - Impact of different types of water (recycled, brackish, etc.) on benefits from adoption
 - Impact of adoption on basin water level
 - Inclusion of dynamic / uncertain elements
 - Focus on alfalfa



STEP V

THEORETICAL FRAMEWORK



- Assumptions
 - Choice between traditional (gravity-based) and modern technology (drip)
 - Farmers are profit-maximizing agents
- Model outline
 - Calculate profits under each technology
 - Quantify effects from adoption (yield, water, energy, GHG emissions)
 - Aggregate to predict adoption patterns
 - Quantify industry-wide effects

Profit = difference between revenues and costs

- Revenues = Price * production function
- Production is a function of several agronomic features
- Costs include irrigation system fixed costs and variable costs (e.g. energy)



NEXT STEPS



- Work with Prof. David Zilberman and Netafim
 - Determine agronomic features to be included
 - Determine irrigation system characteristics to be included in analysis
 - Match expectations
- Develop the mathematical model
- Organize data (farm-level, GIS)
- Analyze results
- Publish report



REFERENCES - RESEARCH PAPERS



- A Model to Assess the Economic Viability of Alfalfa Production under SDI in California
- The Effects of Well Depth and Land Quality on the Choice of Irrigation Technology
- Irrigation Production functions with Water-Capital Substitution
- Increasing Water Use Efficiency in Alfalfa Production Through Deficit Irrigation Strategies Under SDI
- Technology Adoption in the Presence of an Exhaustible Resource: The Case of Groundwater Extraction
- The Economics of Water, Irrigation and Development
- Drip irrigation and Crop Yields: An Empirical Analysis in California
- Diffusion of Drip Irrigation: A Literature Review & Historical Analysis
- The Choices of Irrigation Technologies in California
- Sample Costs to Establish and Produce Alfalfa





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