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GROUNDWATER, DIESEL AND POLITICS NEXUS IN YEMEN

IMPLICATIONS OF 2011 DIESEL CRISIS

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Where is the diesel?

Groundwater, Diesel and Politics Nexus in Yemen

Objectives

- Understanding groundwater importance as a source of water supply in Yemen and the threats on sustainability of the source
- Presenting the dependence of Yemen agriculture on groundwater pumping
- Understanding the role of politics in pricing and use of diesel as energy source for groundwater pumping
- Studying the impact of 2011 Yemen diesel crisis on water pumping and agricultural activities

Groundwater, Diesel and Politics Nexus in Yemen

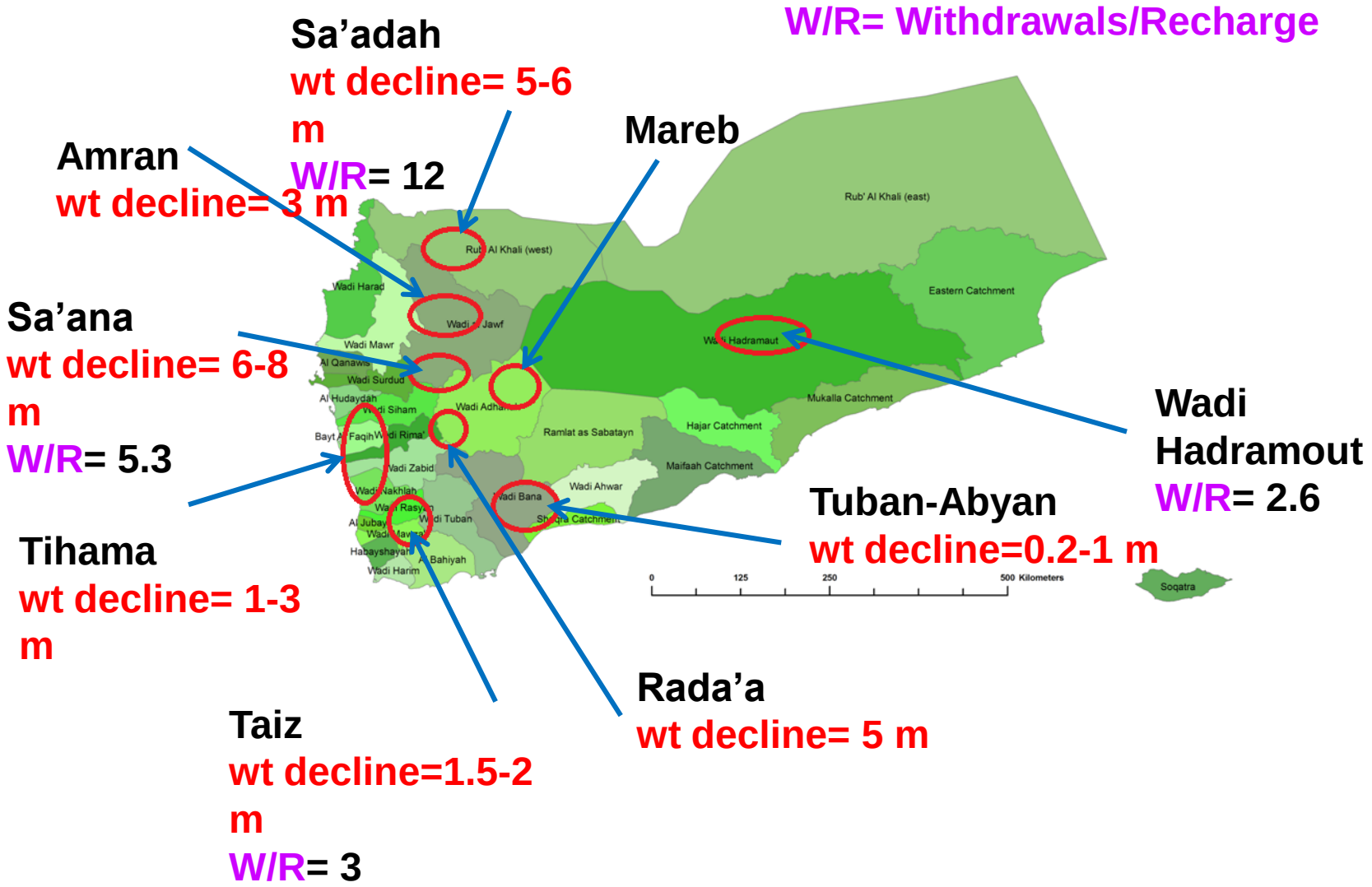
A glance on water balance of Yemen

Total water uses for all sectors	**3.4 BCM**	
Total annual surface runoff In the Wadis	**1.0 BCM**	
Total groundwater abstraction	**2.4 BCM**	
Annual groundwater recharge	**1.5 BMC**	
Annual groundwater depletion (deficit) (groundwater abstraction - groundwater recharge)	**0.9 BCM**	
Total renewable water resources (annual surface runoff+ groundwater recharge)	**2.5 BCM**	

Groundwater, Diesel and Politics Nexus in Yemen

State of groundwater basins of Yemen

W/R= Withdrawals/Recharge



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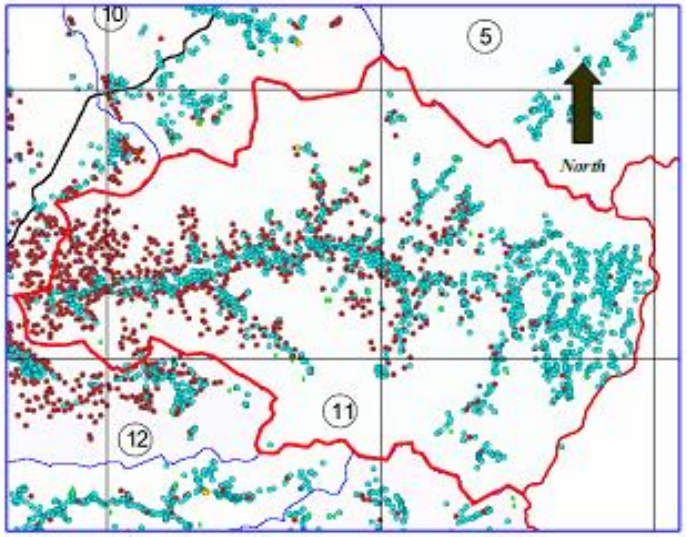
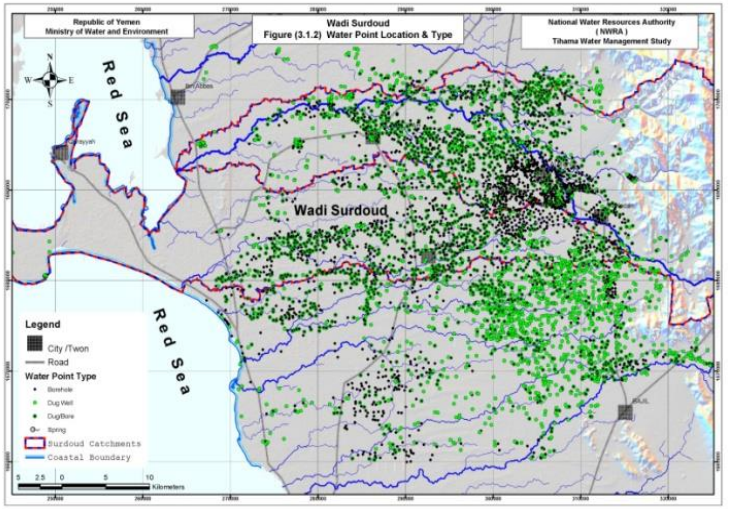
Anatomy of Yemen's Wells



Total wells in Yemen: 70,000
Number of drilling companies 3
Number of drilling rigs 656

Wells distributions within Wadi As'sir catchment area (Dark spots designate dug wells) : Wadi As'ssir has the highest well density in Sana'a Basin

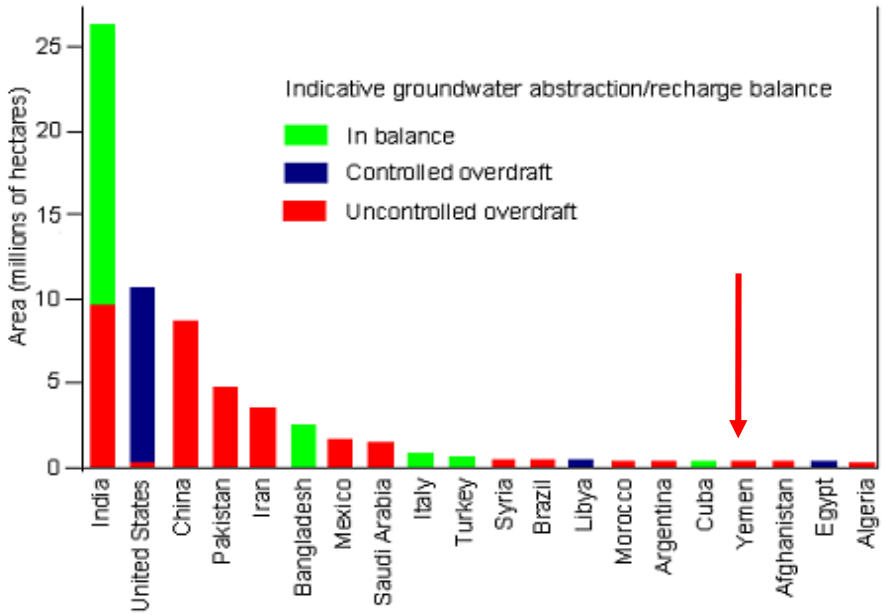


Distribution of bore holes in Wadi Surdud Plain (NWRA,2008)

Data source: NWRA inventory of wells, 2009

Groundwater, Diesel and Politics Nexus in Yemen

Groundwater mining: A fundamental threat to the wellbeing of the Yemeni people



Top 20 Groundwater-abstracting countries.

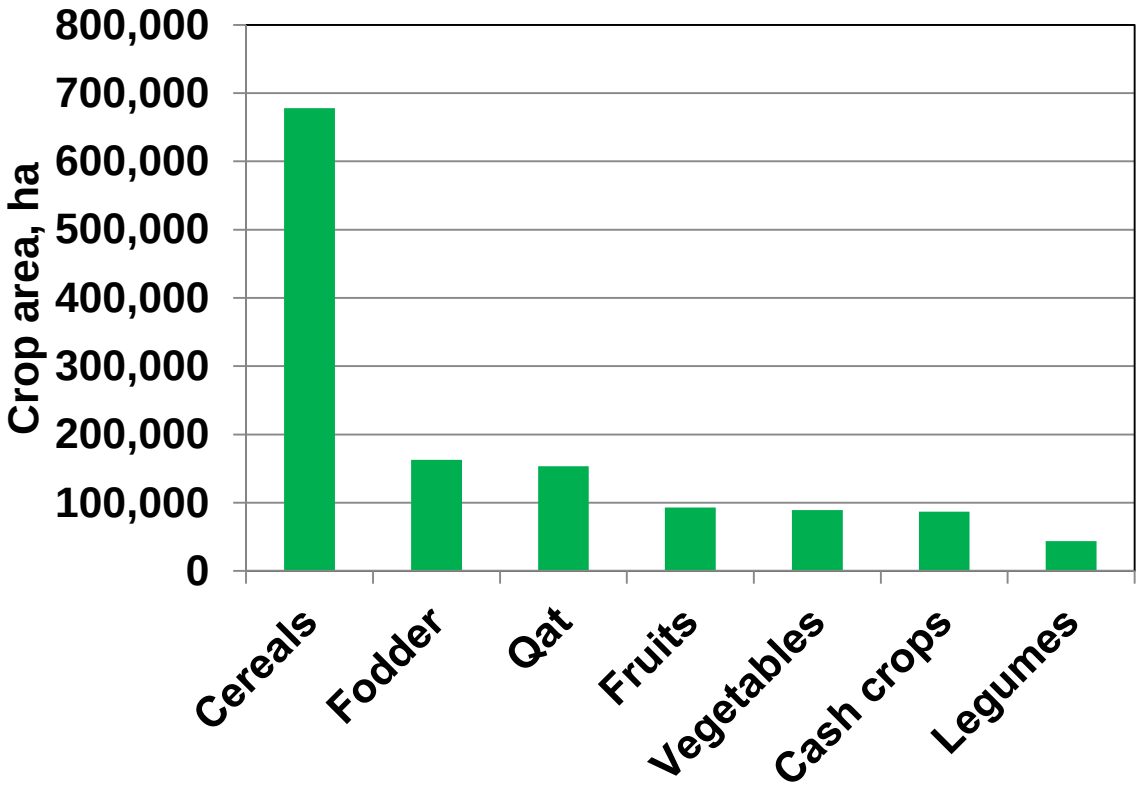
Source: IWMI, 2007

"The problem of groundwater mining represents a fundamental threat to the wellbeing of the Yemeni people. In the highland plains, for example, abstraction is estimated to exceed recharge by 400 percent"
John Briscoe

Water resources management in Yemen-Results of a consultation.

Groundwater, Diesel and Politics Nexus in Yemen

Overview of Yemen's agriculture sector : Agricultural crops area for the year 2009



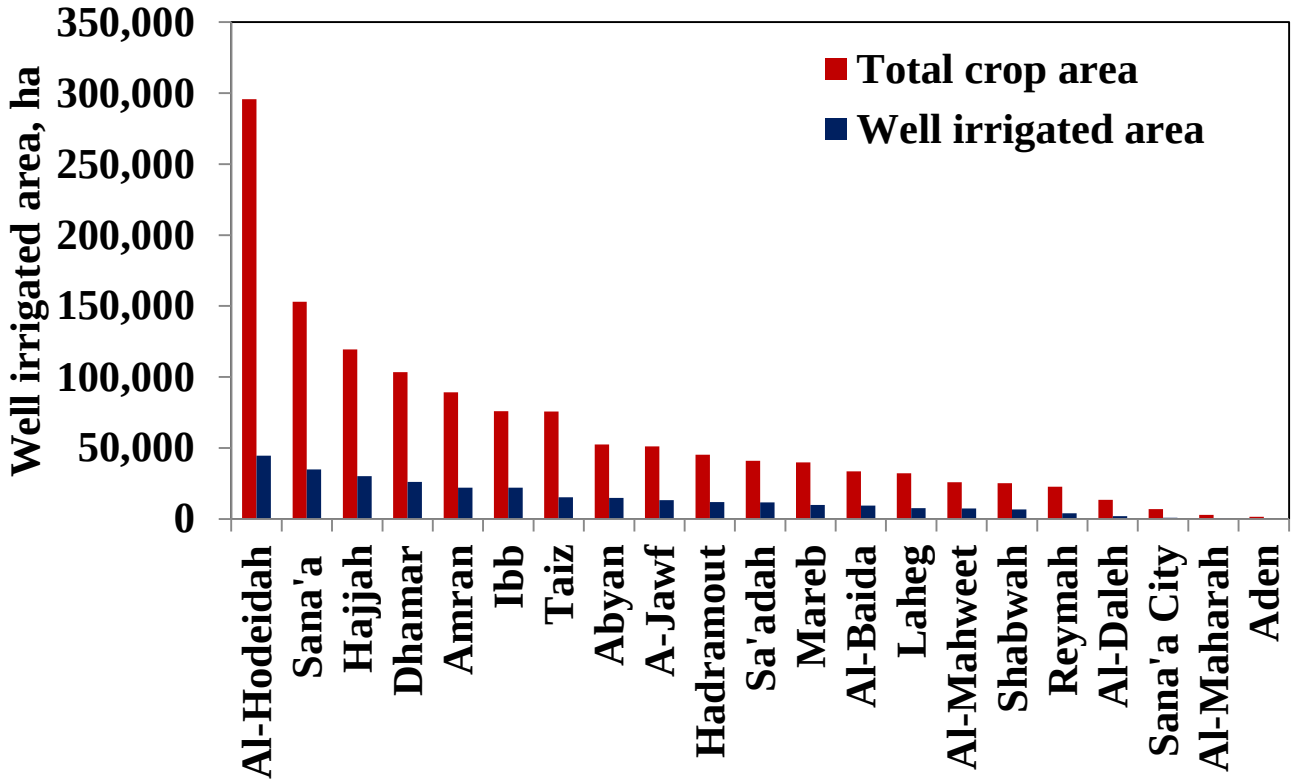
Data Source: General Division of Agriculture Statistics, MAI

Groundwater, Diesel and Politics Nexus in Yemen

- The irrigated lands depending upon groundwater pumping in Yemen science 1960. its areas doubled from 1970 to nowadays.
- Over 40% of cultivated lands depending on groundwater pumping.
- In 1990 the irrigated agriculture alone was consuming 130% of renewable water resources, this reached 150% by 2005, and would reach 200% by 2025.
- As consequence the crop pattern had been changed, and more cash crops of high irrigation water requirement has been adopted causing excessive depletion in ground water level

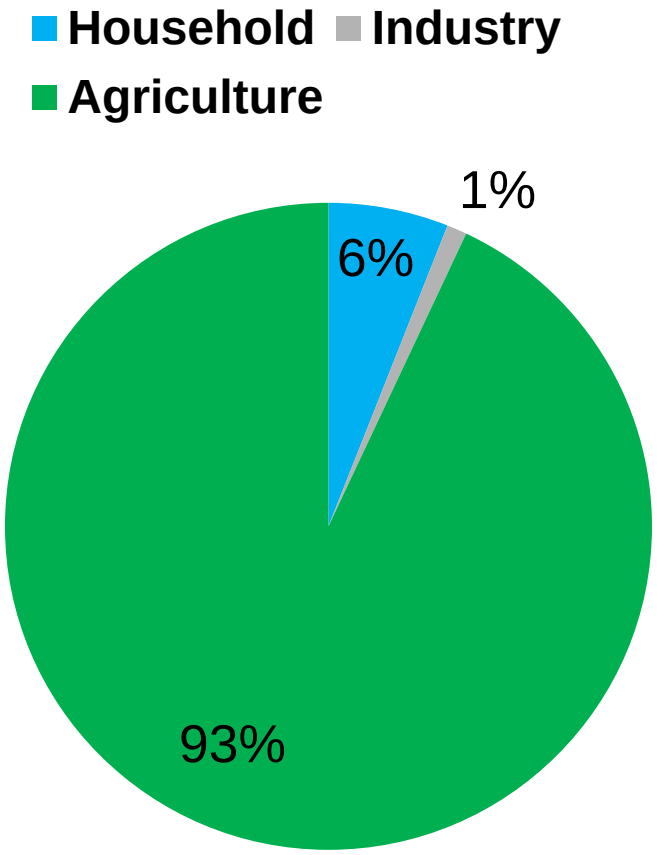
Groundwater, Diesel and Politics Nexus in Yemen

Comparison of well irrigated area by Governorates

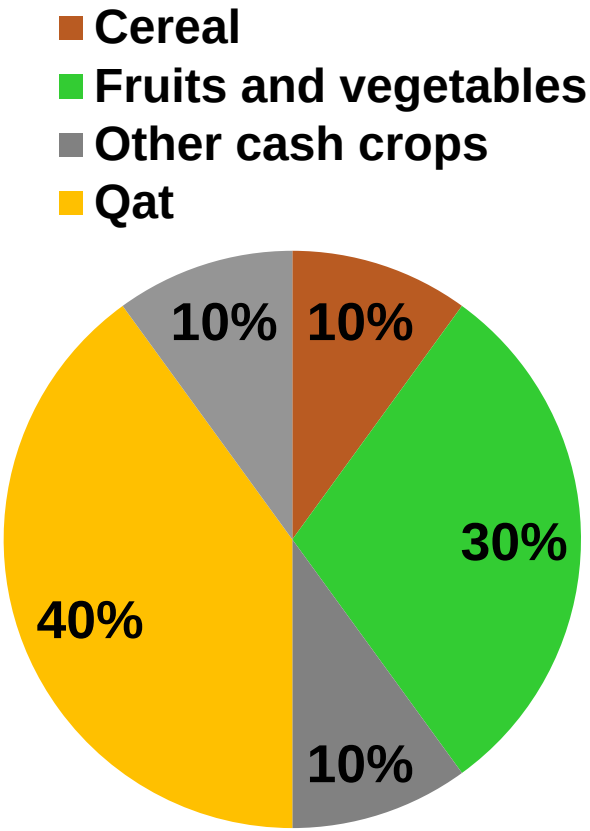


Groundwater, Diesel and Politics Nexus in Yemen

Water use by sector and agricultural subsector



Water consumption by sector

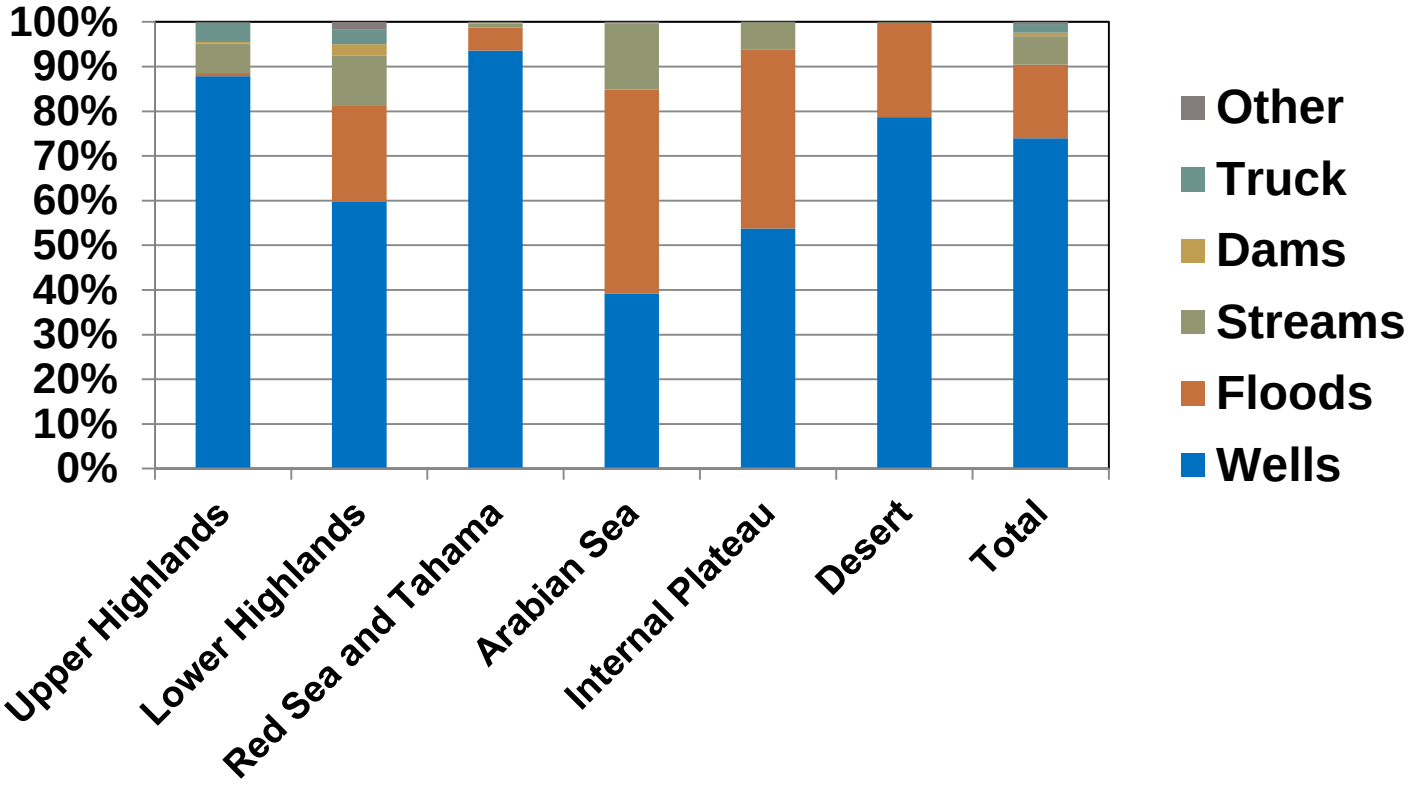


Water consumption within agriculture

Source: MOPIC, 2010, National Food Security Strategy Paper (NFSSP)- PART II, Policies, Investments, and Program Options for Achieving Yemen's Food Security Goals

Groundwater, Diesel and Politics Nexus in Yemen

Sources of irrigation by agro-ecological zones



Source: MOPIC, 2010, National Food Security Strategy Paper (NFSSP)- PART II, Policies, Investments, and Program Options for Achieving Yemen's Food Security Goals

Groundwater, Diesel and Politics Nexus in Yemen

Diesel as energy source for water pumping

- **More abstraction of groundwater for irrigation more depending on diesel as an energy source for pumping. Other elements help increasing in groundwater pumping exploitation:**
  - **Cheap diesel price, much less than import price, 69% of fuel subsidies goes to diesel,**
  - **Absence of pumping equipment duties,**
  - **Import ban on competing cash crops,**
  - **Absence of any regulatory framework.**

Reports indicates that 22.1Million Liters of Diesel were consumed monthly for irrigation water pumping of what 30% goes to qat trees.

Groundwater, Diesel and Politics Nexus in Yemen

Diesel consumption for water pumping

Basic equation for energy, in MJ, required to lift a given quantity of water:

$$E = \frac{9.81(1000)Qh}{\eta_p \eta_e} 10^{-6}$$

$E =$	**Energy required for pumping of water**
$h =$	**Hydraulic head, m**
$Q =$	**Volume of water pumped, m^3**
$\eta_p =$	**Efficiency of the pump**
$\eta_e =$	**Efficiency of the diesel engine**

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Diesel consumption for water pumping

Taking

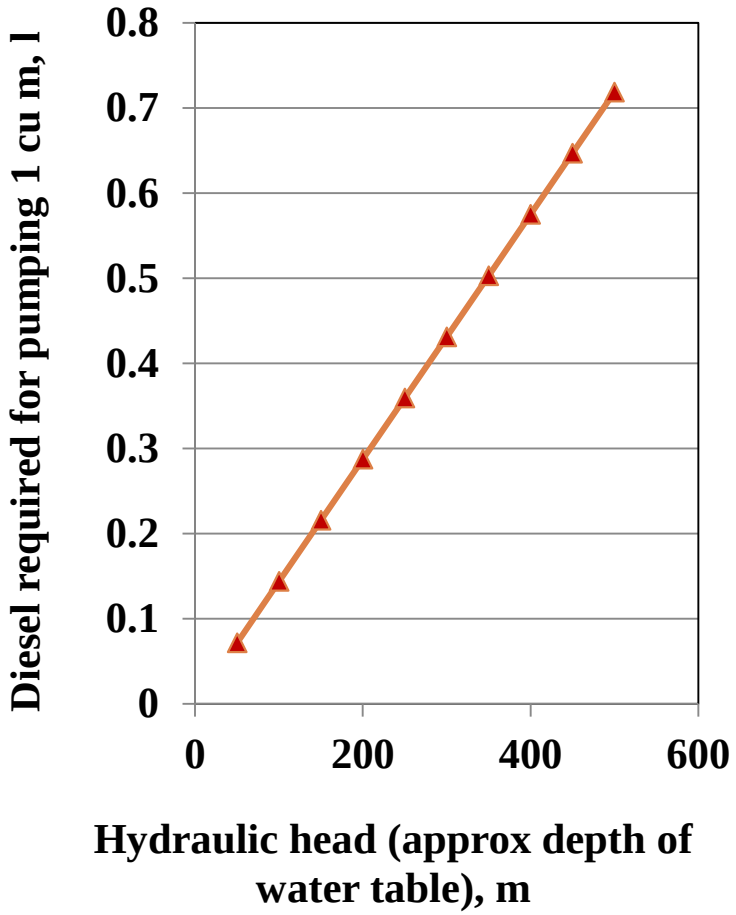
Specific energy content of diesel = $E_{sd} = 36.4$ **MJ/l**

Average diesel engine efficiency: 25%

Average pump efficiency: 75%

Quantity of diesel, l /cu m, require for pumping will be:

$$q = \frac{E}{E_{sd}}$$

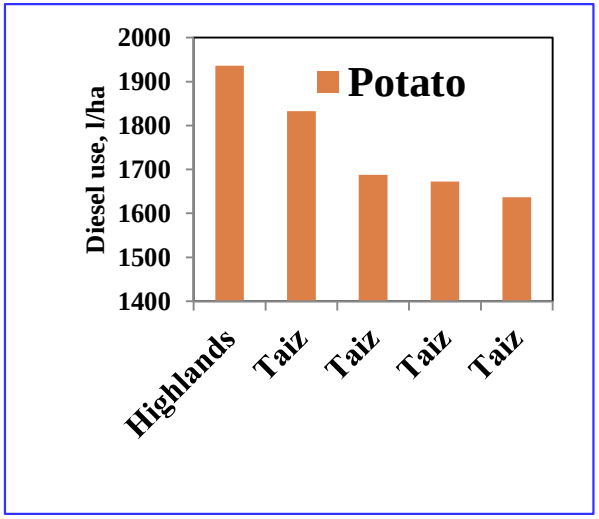


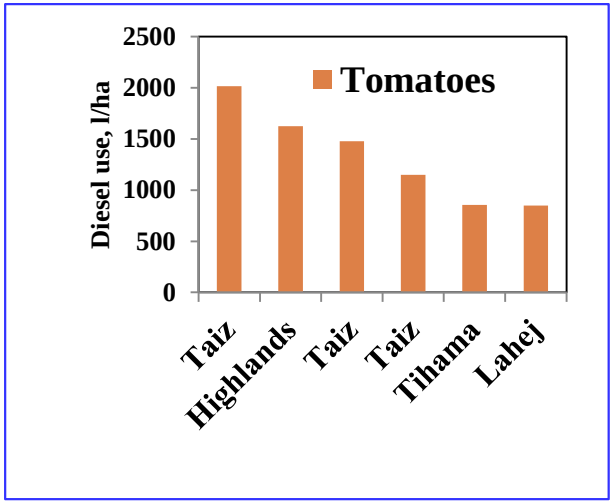
Diesel use for pumping water in some basins calculated on the basis of total abstractions and average well depth

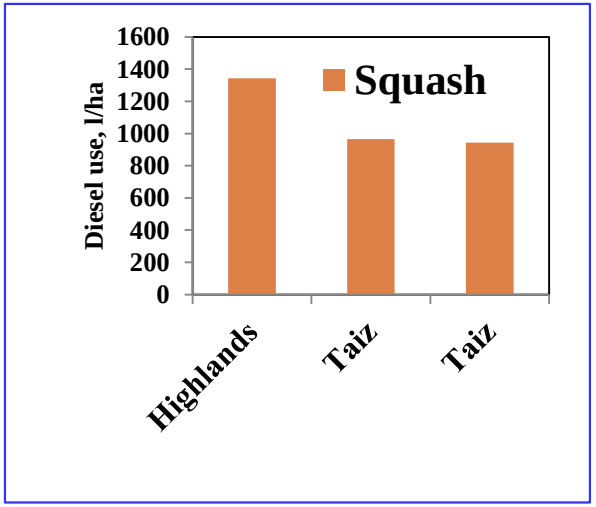
Basin	Total abstraction, MCM	Average Depth, m	Diesel use for pumping, Ml
Sana’a	270	250	97.022
Taiz	62	150	13.367
Hadramout	400	100	57.495
Sa'adah	105	180	27.166

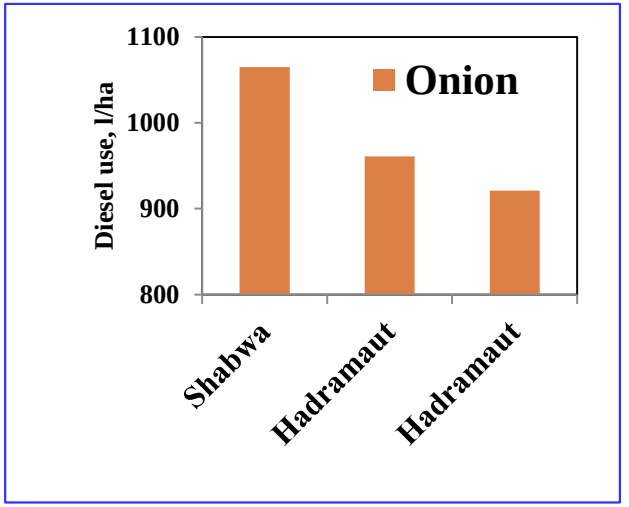
Groundwater, Diesel and Politics Nexus in Yemen

Diesel consumption for some crops under surface irrigation





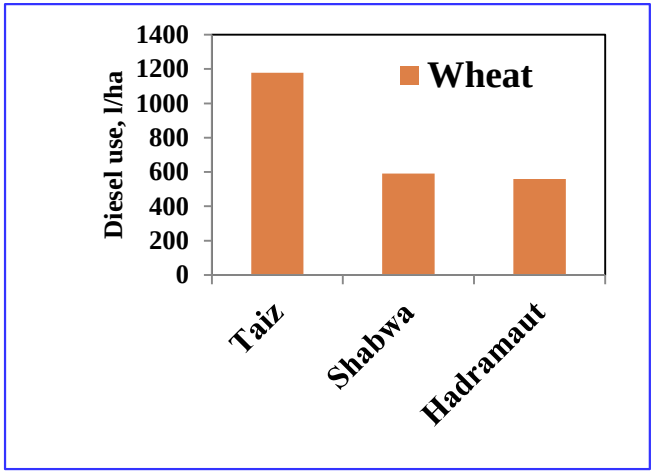


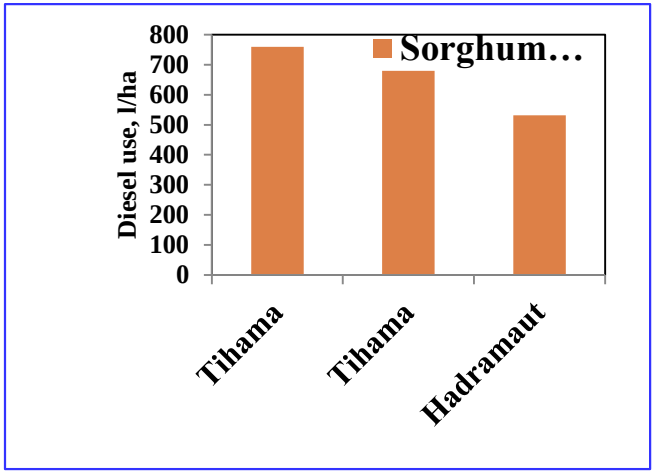


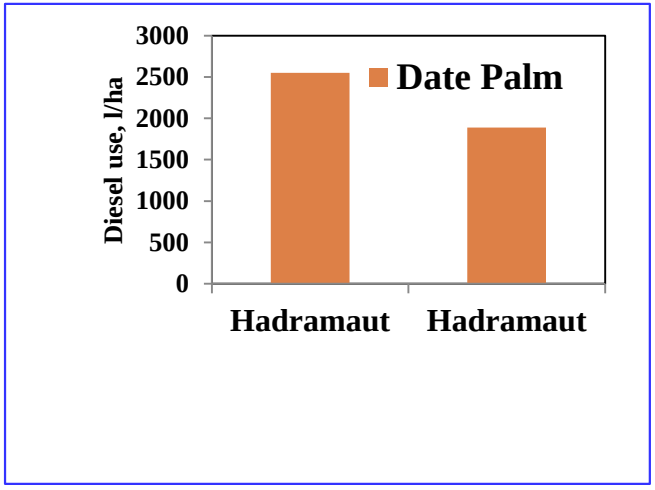
Data Source: GSCP, 2011

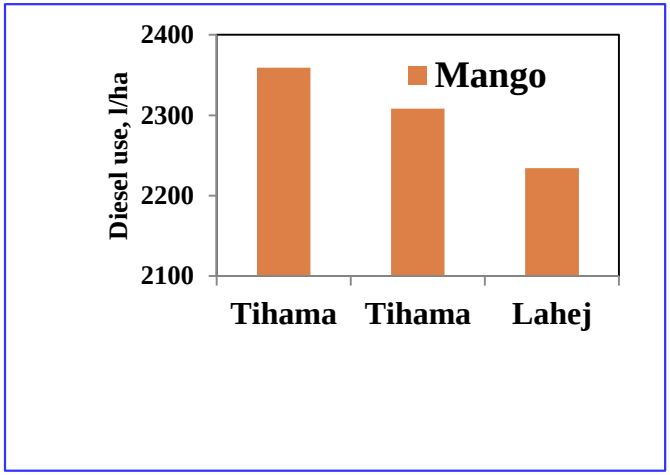
Groundwater, Diesel and Politics Nexus in Yemen

Diesel consumption for some crops under surface irrigation





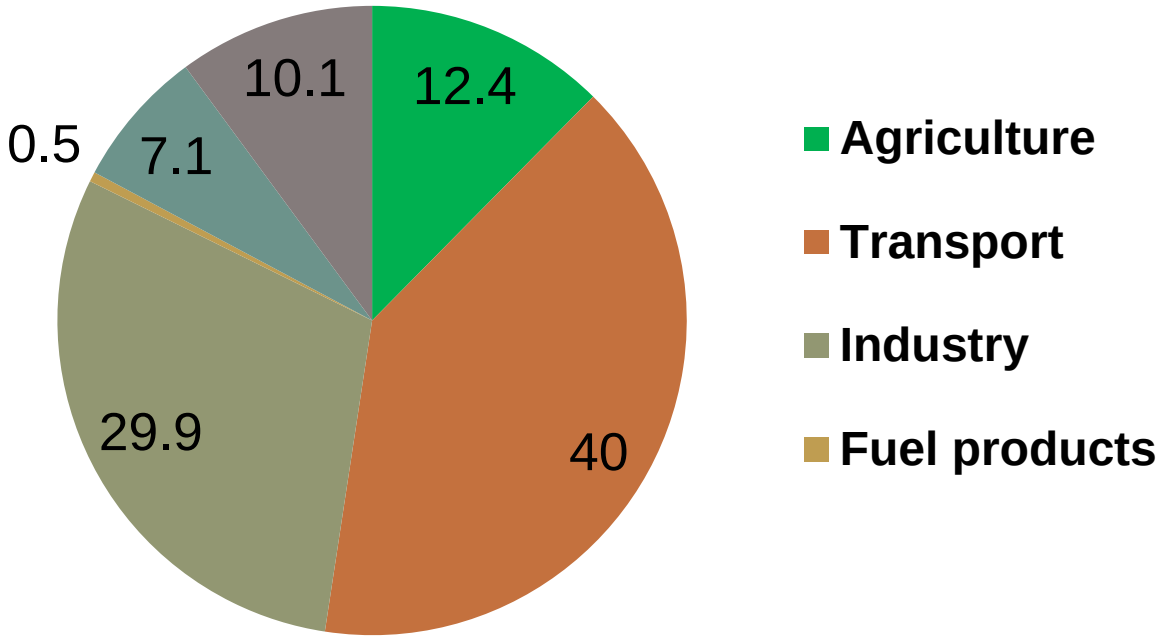




Data Source: GSCP, 2011

Groundwater, Diesel and Politics Nexus in Yemen

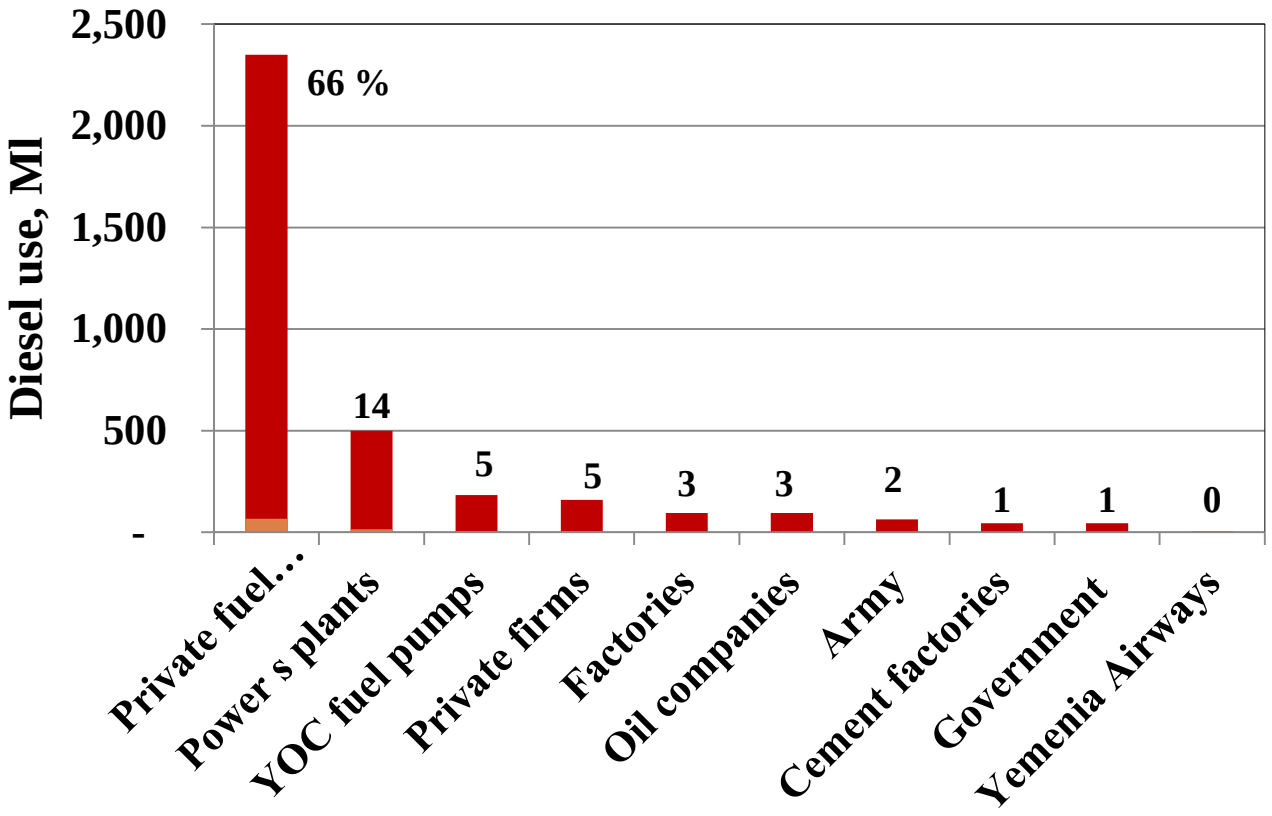
Distribution of fuel consumption amongst economy sectors



Data Source: Breisinger et al., 2011

Groundwater, Diesel and Politics Nexus in Yemen

Diesel distribution per outlets



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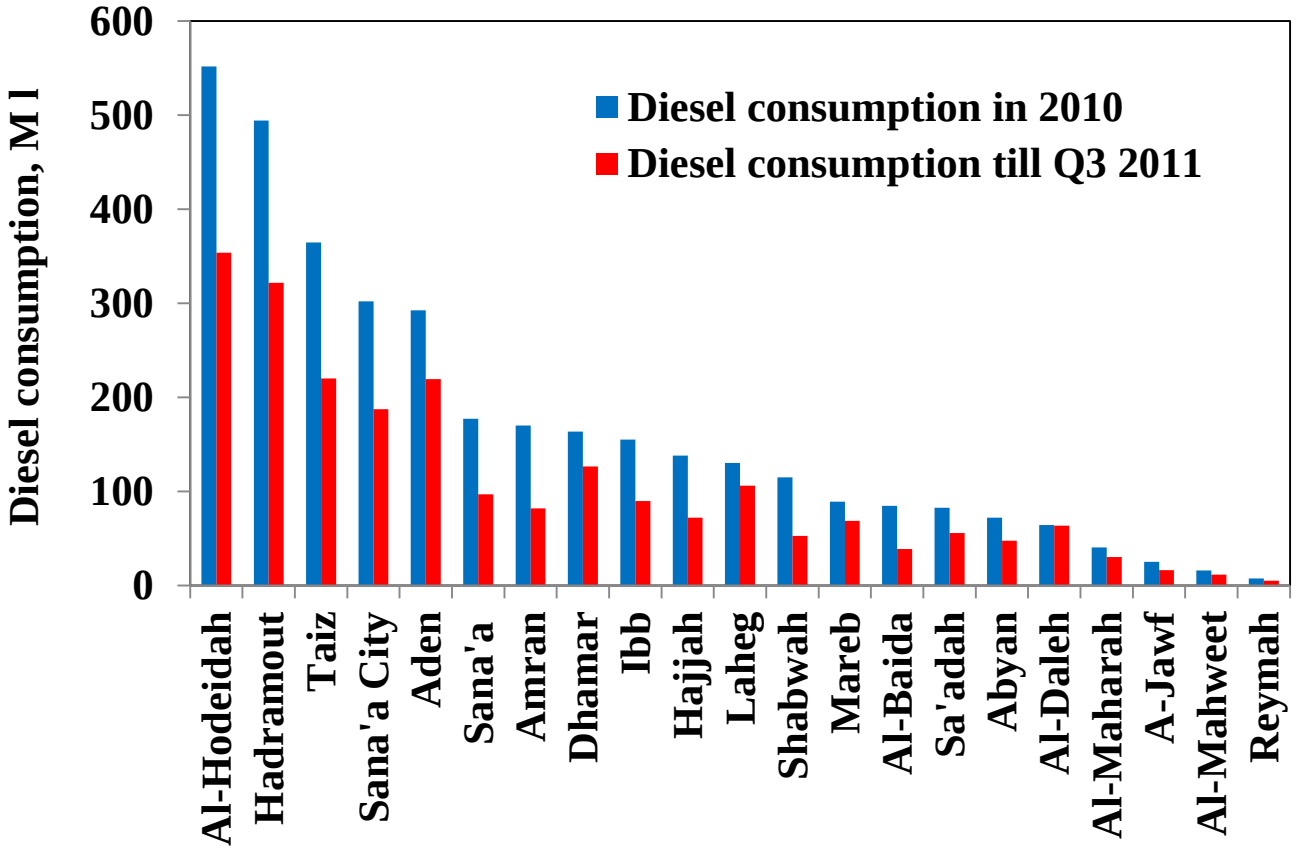
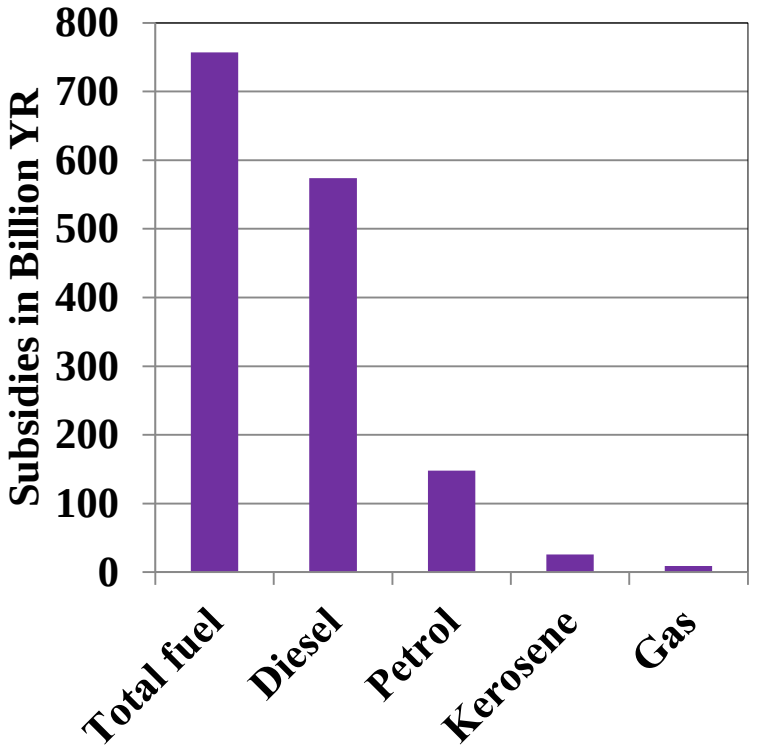
Comparison of diesel consumption by Governorates for 2010 and until third quarter of 2011



Groundwater, Diesel and Politics Nexus in Yemen

Diesel subsidies

	Yemeni Riyal (YR)	US Dollar (US$)	Share
	(in billion)	(in billion)	%
Petrol	148	0.8	19.6
Diesel	**574**	**2.8**	**75.8**
Kerosene	26	0.1	3.4
Gas	8.9	0	1.2
Total fuel	**757**	**4**	**100**



About one-third of the Government's budget (US $3.8 billion or $172 per capita) is spent on fuel subsidies

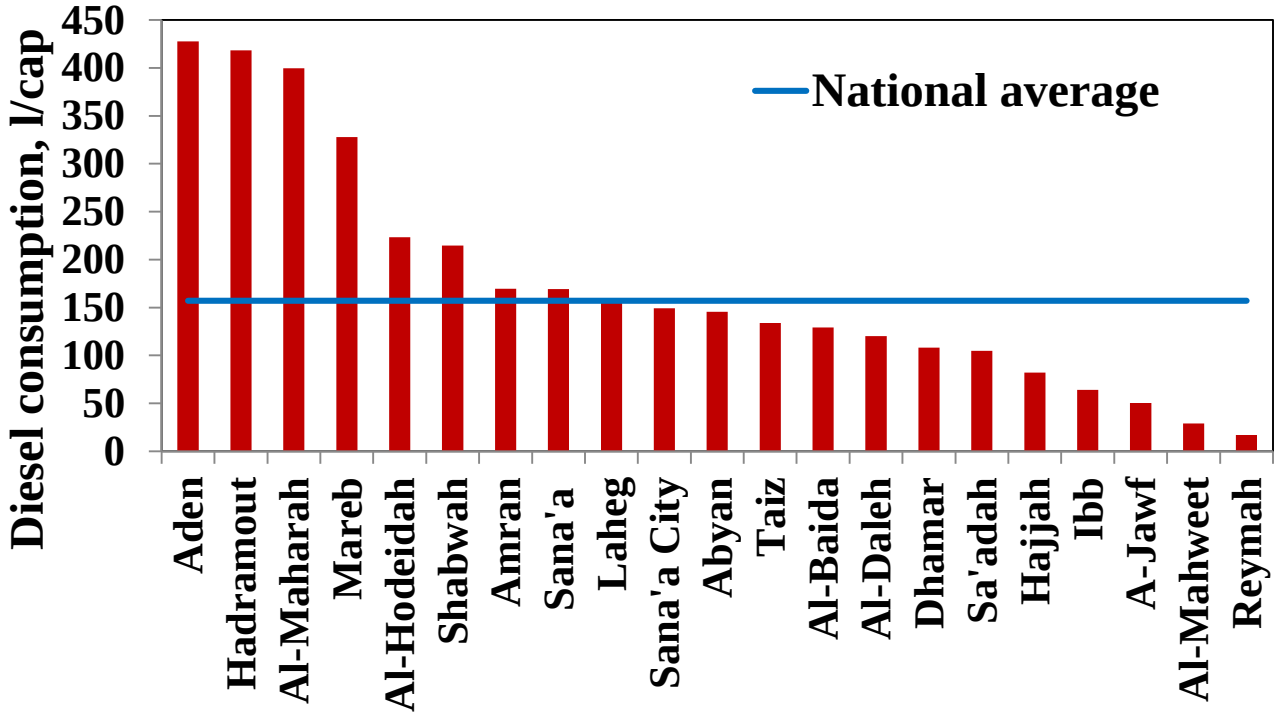
Source: Breisinger et al., 2011

Groundwater, Diesel and Politics Nexus in Yemen

Money = Power : Who is benefiting from Diesel subsidies?

Case I: Diesel smugglers

Diesel smuggling hypothesis: very high per capita use in Aden, Alhodeidah and Eastern Governorates which are open to sea indicates large scale smuggling



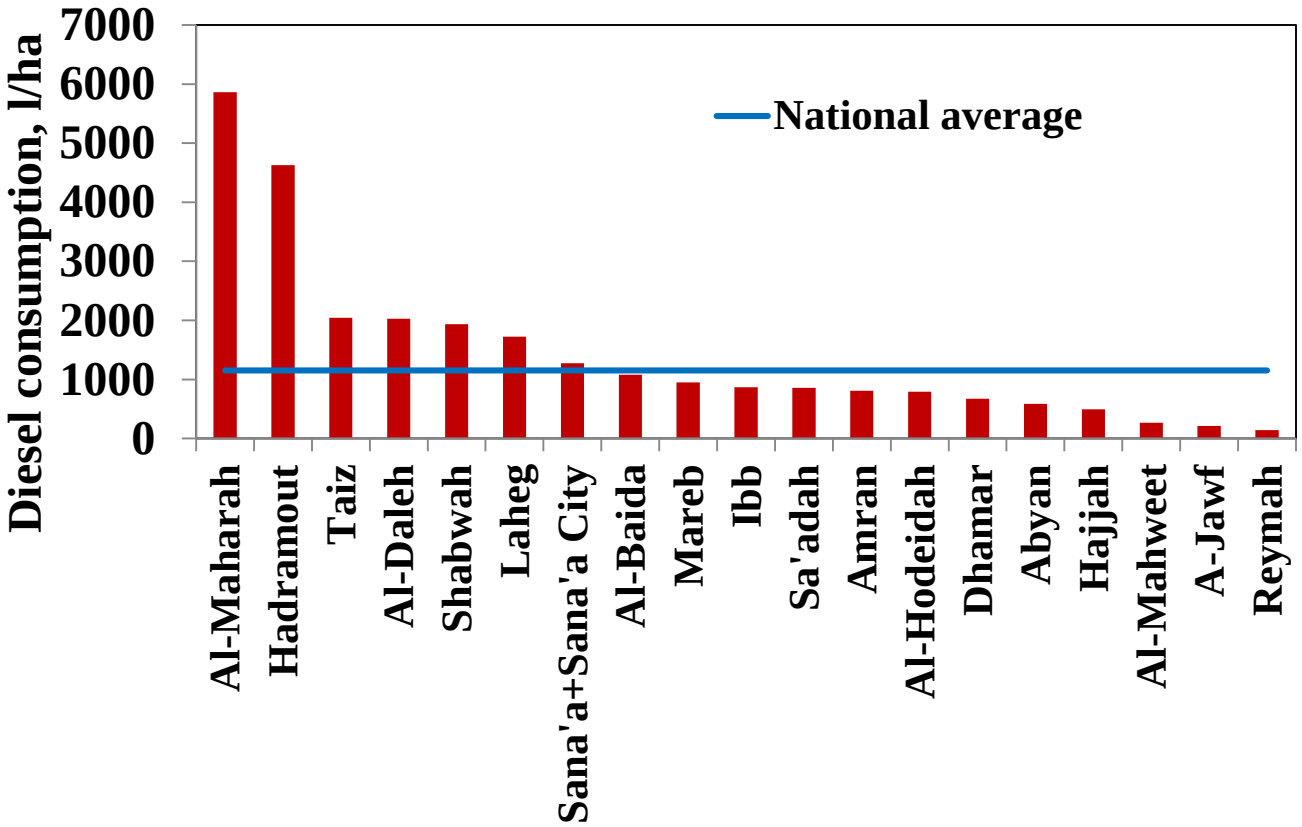
Diesel use per capita by Governorates for 2010

Groundwater, Diesel and Politics Nexus in Yemen

Money = Power : Who is benefiting from Diesel subsidies?

Case I: Diesel smugglers

Diesel smuggling hypothesis: very high per ha use in Aden and Eastern Governorates which are open to sea indicates large scale smuggling

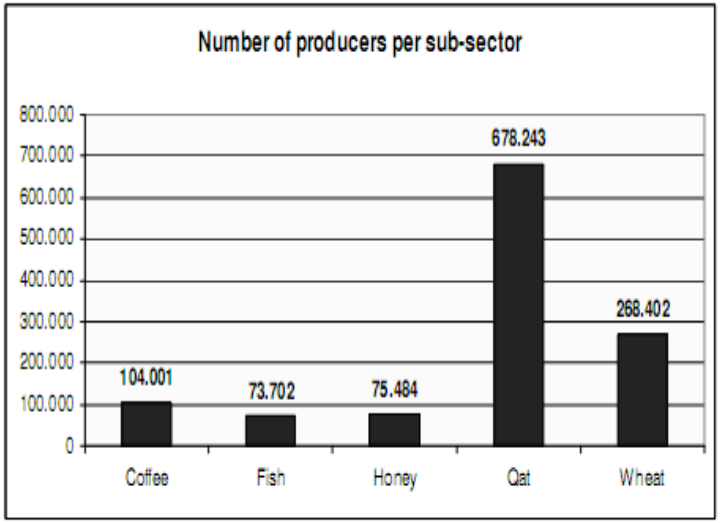


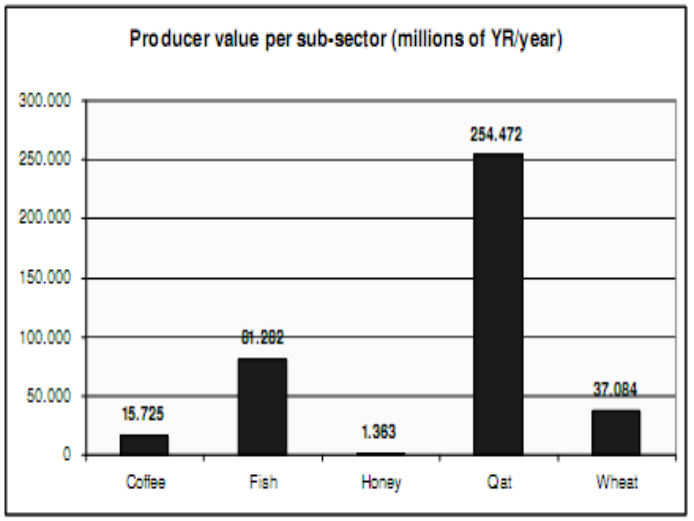
Diesel use per irrigated area (ha) by Governorates for 2010 (assuming diesel use in agriculture @ 12.4 of total

Groundwater, Diesel and Politics Nexus in Yemen

Money = Power : Who is benefiting from Diesel subsidies?

Case II: Qat big farmers





Some statistics:

Qat annual turnover: 254.472 Billion YR (10% GDP, one third of agricultural GDP)

Average yearly income of qat farmer: 375,000 YR (more than twice per capita income)

Qat profitability: 5 times as profitable as grapes and 20 times as profitable as potatoes

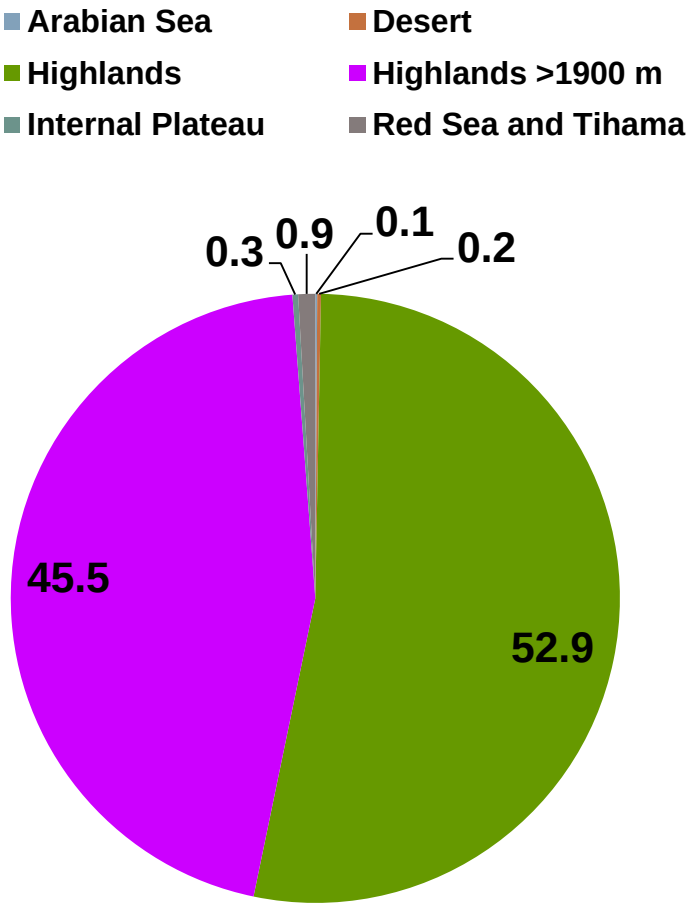
Source: World Bank, 2009, Analysis of 5 value chains – Yemen (Fish, Honey, Coffee, Wheat and Qat)

Groundwater, Diesel and Politics Nexus in Yemen

Money = Power : Who is benefiting from Diesel subsidies?

Case II: Qat big farmers

Land allocation for qat production



85% of qat production comes from five governorates only: Sana'a, Amran, Dhamar, Ibb, and Hajah

Source: MOPIC, 2010, National Food Security Strategy Paper (NFSSP)- PART II, Policies, Investments, and Program Options for Achieving Yemen's Food Security Goals

Groundwater, Diesel and Politics Nexus in Yemen

Diesel crisis of 2011 on water pumping and agricultural activities

- **The fuel crisis of 2011 touch all fuel types, and affected all sectors and public, its impact has affected every aspect of Yemeni lives:**
  - **Diesel, gas and other fuel types shortages,**
  - **Roads Blockage and poor access to public services,**
  - **Seizing gas and diesel trucks**
  - **Electricity cut of[illegible] electrical towers.**

Groundwater, Diesel and Politics Nexus in Yemen

Diesel crisis of 2011 on water pumping and agricultural activities

Groundwater, Diesel and Politics Nexus in Yemen

Diesel crisis of 2011 on water pumping and agricultural activities

- **Information were collected through several assessments dedicated to:**
  - **Farmers**
  - **Agriculture products whole sell**
  - **Fuel stations owners**
  - **Diesel black market vendors**

Assessment was conducted in six different regions:

1)Dhamar and Radda'a **2)Sana'a Basin**

3)Northern Tehama **4)Wadi Hadramout**

5)Southern Tehama **6)Sa'adah**

Groundwater, Diesel and Politics Nexus in Yemen

Diesel crisis of 2011 on water pumping and agricultural activities

- **Impact of Diesel Crisis on Water Pumping:**
  - **Pimping operation times and duration hours**

Reduction in operating hours in Wadi Hadramout vary from 20% during winter to 45% during summer, with a mean percentage of 30% for all four seasons of year 2011.

Groundwater, Diesel and Politics Nexus in Yemen

Diesel crisis of 2011 on water pumping and agricultural activities

- **Impact of Diesel Crisis on Water Pumping**
  - **The impacts on operation times and hours vary from area to area**

For example, while the reduction percentage in operating Hours was 30% as mean value in Hadramout it reached 48% in Zabid. Meanwhile, reduction percentage in operating times recorded 24% for Hadramout and 38% in Zabid

Groundwater, Diesel and Politics Nexus in Yemen

Diesel crisis of 2011 on water pumping and agricultural activities

- **Impact of Diesel Crisis on Diesel Consumption**
  - **Reductions in quantity of diesel consumption were recorded in all areas under study.**

A mean value for all seasons recorded 68% in Hadramout and 77% in Zabid

An important notice: addition irrigation water pumping were used to be done by substituted fuel type (by mixing 200 liters burned oil with 20 liters kerosene)

Groundwater, Diesel and Politics Nexus in Yemen

Diesel crisis of 2011 on water pumping and agricultural activities

- **Impact of Diesel Crisis on Agricultural Productivity**

- **Productivity negatively affected by the abandonment of significant irrigated land areas, In Dhamar, the area of irrigated land in farms decreased in range between 30-50%**

Groundwater, Diesel and Politics Nexus in Yemen

Diesel crisis of 2011 on water pumping and agricultural activities

- **Impact of Diesel Crisis on Agricultural Productivity**
- **In Sa'adah a decreasing in vegetables yields by 40% and decrease in sell price by 80%. Also a reduction of 40% in qat yield occurred without any change in sell price.**
- **A decrease in vegetables and fruits productivity of 40-60% had been recorded in Qa'a Jahran which is the largest plain in Dhamar.**

Groundwater, Diesel and Politics Nexus in Yemen

Diesel crisis of 2011 on water pumping and agricultural activities

- **Impact of Diesel Crisis on Agricultural Productivity**
- **In general, Yemen lost about 10% of its total agricultural productivity as declared in 22 December 2011, with a reduction in total return from 1.95 to 1.21 trillion Yemeni Ryals comparing with the precedent year 2010.**

Groundwater, Diesel and Politics Nexus in Yemen

Diesel crisis of 2011 on water pumping and agricultural activities

- **Impact of Diesel Crisis on Groundwater level**
- **Diesel crisis affected positively groundwater level in some areas as Qa'a Jahran and Radaa where results indicate that the decline rate of groundwater level decreased compared with 2010 rate from 0.3 - 2.31 m/year (2010) at Qa'a Jahran to 0.57 - 1.85 m/year (2011)**

Groundwater, Diesel and Politics Nexus in Yemen

Diesel crisis of 2011 on water pumping and agricultural activities

- Impact of Diesel Crisis on products market chain
- Intergovernorate trade in products declined sharply because of halt of transport.
- Price of local products decreases because of absence of demand:
- Price of crops which were produced outside the governorate increased
- In Wadi Hadramaut tomato price increased by 265%, while the price of onion decreased by 88%
- In Dhamar the price of tomato decreased by 65%, while the price of onion increased almost three folds

Data Source: GSCP, 2011

Groundwater, Diesel and Politics Nexus in Yemen

Diesel crisis of 2011 on water pumping and agricultural activities

- **Could diesel and other fuel types form a political pressure point by a side against the other one?**

- **WHO IS RESSPONSIBLE?**

The power, tribes, political part, opposition or black-market vendors …?

Groundwater, Diesel and Politics Nexus in Yemen

Diesel crisis of 2011 on water pumping and agricultural activities

Groundwater, Diesel and Politics Nexus in Yemen

Diesel crisis of 2011 on water pumping and agricultural activities

- From discussions conducted during survey a probable scenario say that 2011 diesel crisis came in the wake of dire political unrest and continue by black-market increasing.
- During crisis so many changed their professional towards vendors of diesel in black-market
- Price of diesel liter increased from 50Ry to 500Ry in black-market