Agricultural Water Management in Iran

Issues, Challenges, and Opportunities

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Background


ARMENIA
AZERBAIJAN
Tabriz
Orumiyeh
Ashgabat
TURKMENISTAN
Al Mawsil
Mashhad
Tehran
Qom
Kermanshah
Baghdad
IRAQ
Isfahan
AFGHANISTAN
IRAN
Ahvaz
Al Basrah
Kuwait
Shiraz
KUWAIT
SAUDI ARABIA
PAKISTAN
QATAR
OMAN
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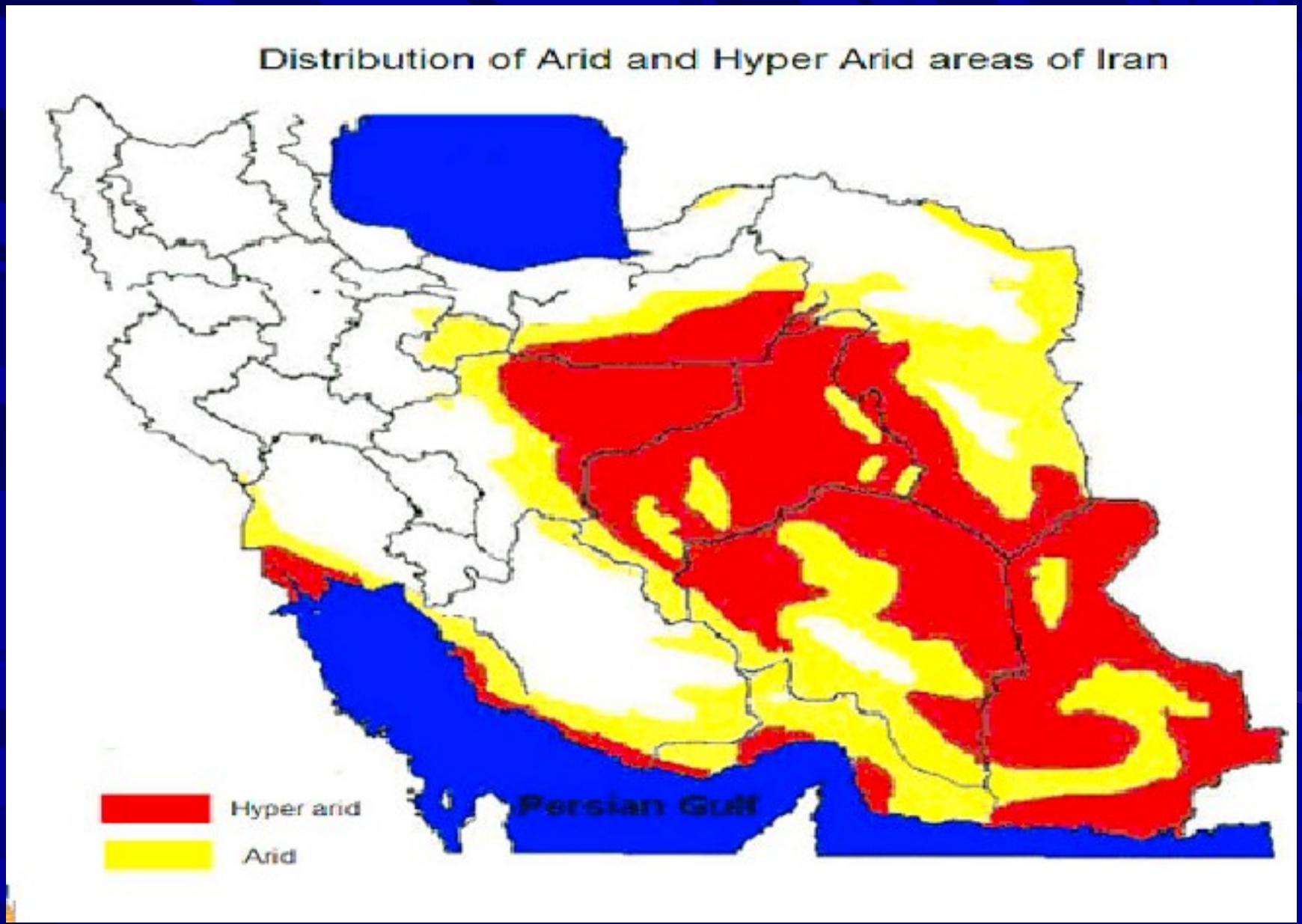
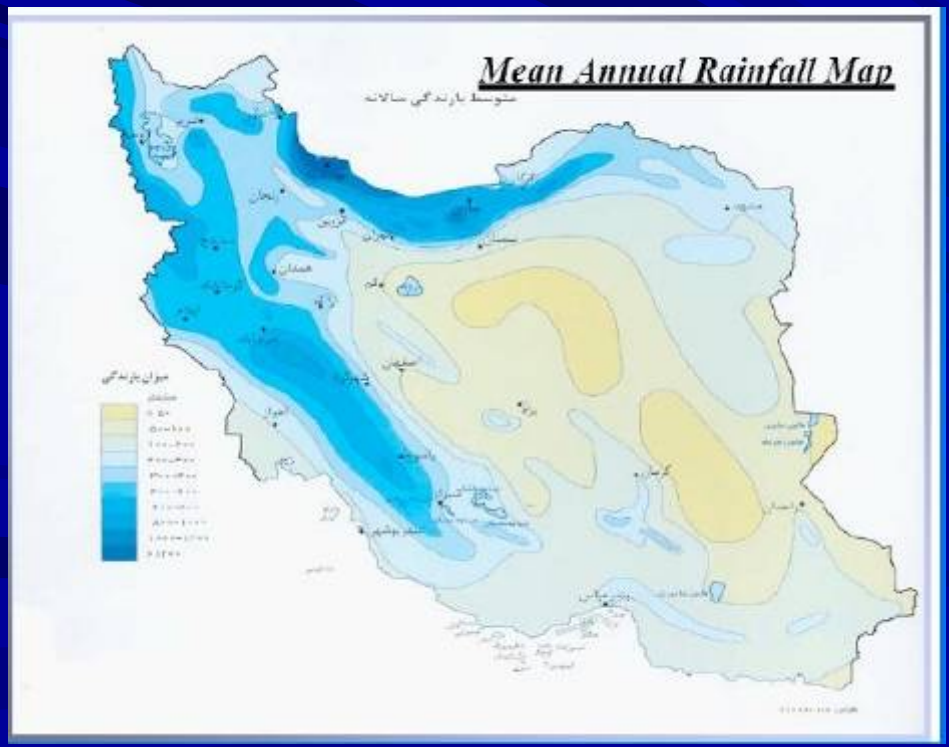
0 108mi
0 175km

Background


Distribution of Arid and Hyper Arid areas of Iran
Hyper arid
Arid
Persian Gulf

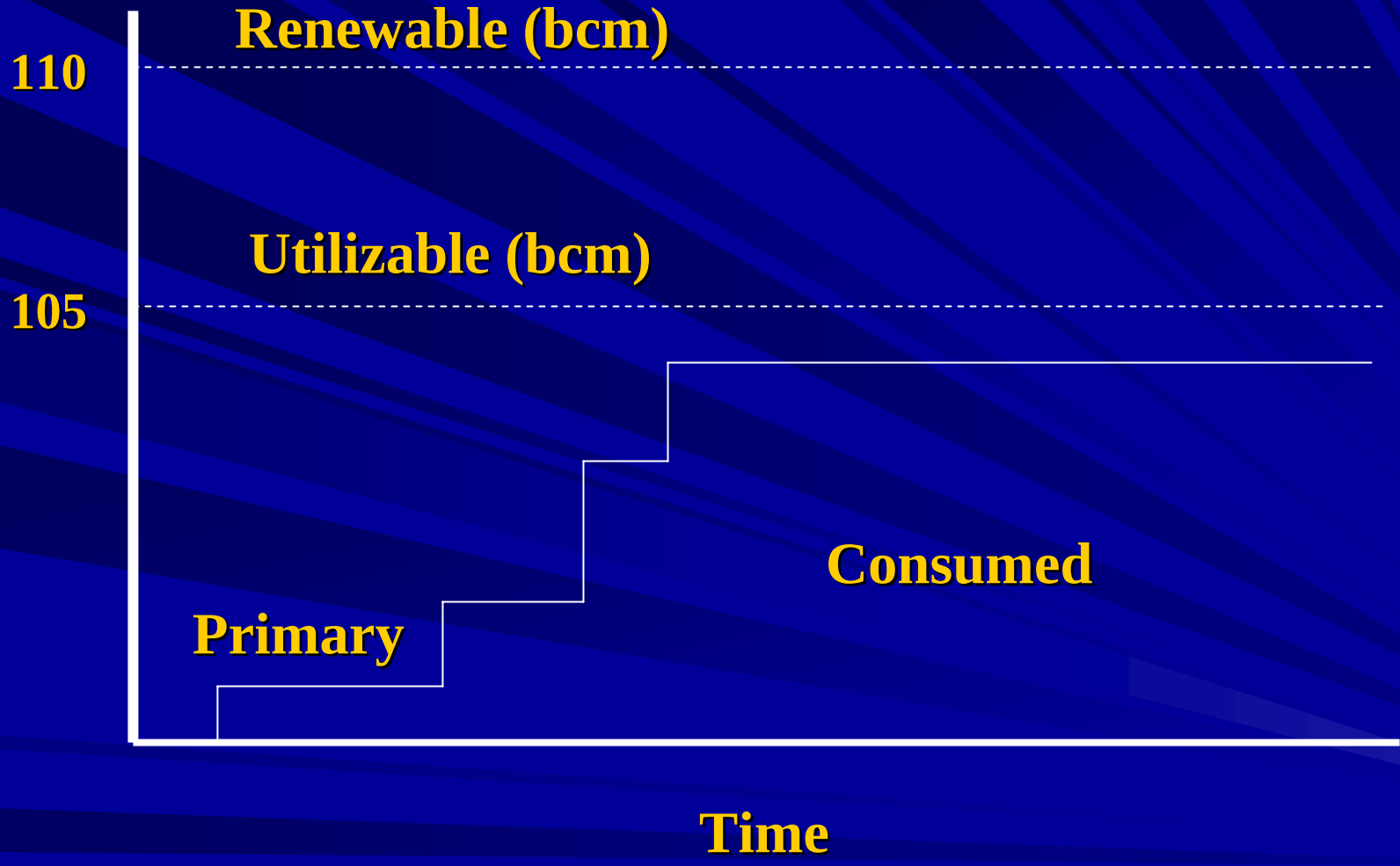
Background

- 80% of rains in Iran fall over 20% of area
- 80% of rains fall in non-irrigation season
- Rainfall varies from 2000 mm/year down to almost zero
- 70% of precipitations are in the form of rain and 30% snow



Water Resources in Iran

- Precipitation = 410 BCM
- Evaporation = 300 BCM
- Borders incoming water = 13 BCM
- Borders outgoing water = 12 BCM
- Left as renewable water = 110 BCM/year
- Accessible water = 105 BCM/year


Renewable (bcm)
110
Utilizable (bcm)
105
Consumed
Primary
Time

Oil and Gas Resources of Iran

- 10% of oil world's reservoirs
- 16% of world reserves of natural gas

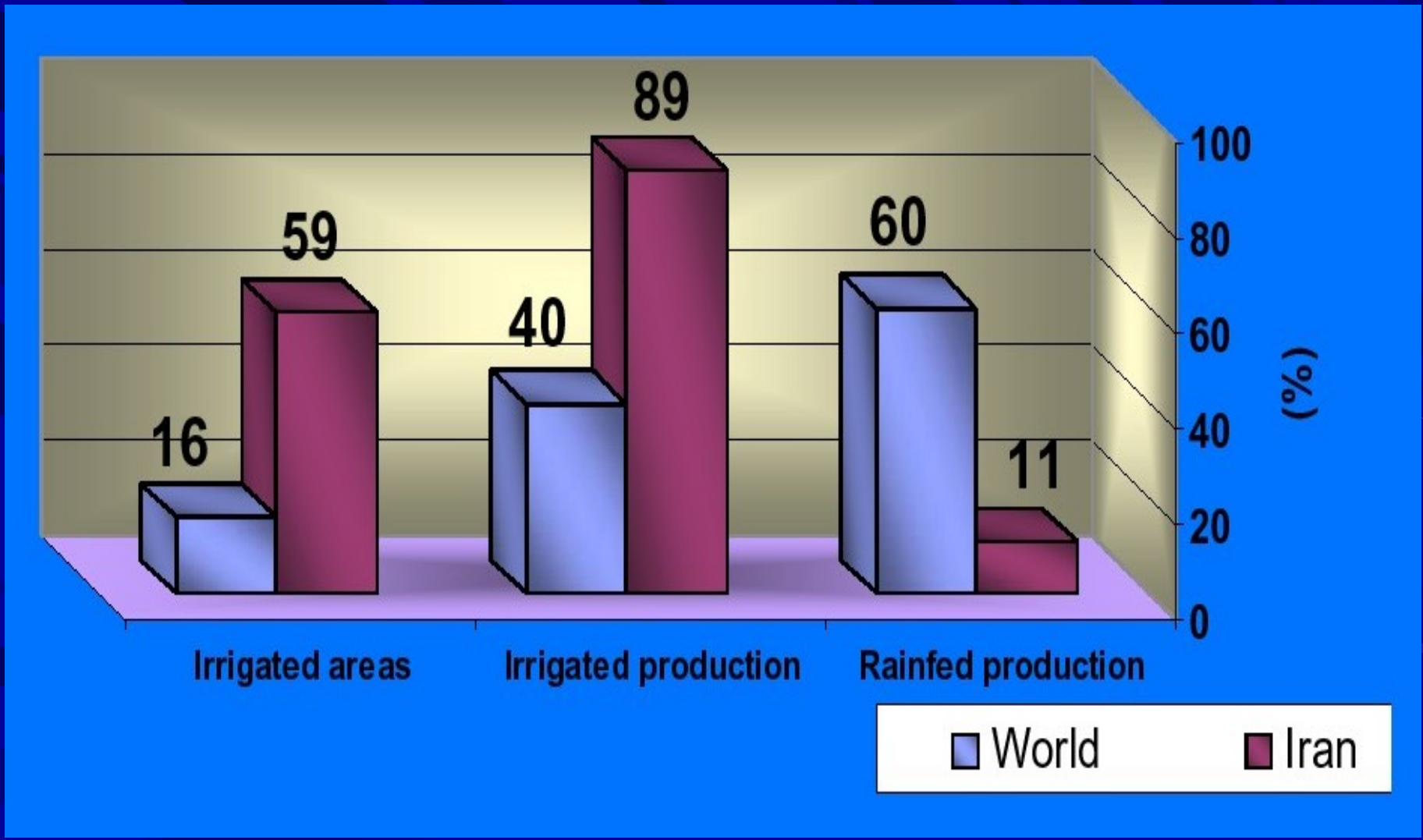
Background

- Agriculture plays a key role in the economy of Iran
  - ✓ It accounts for 18% of the Gross Domestic Product (GDP)
  - ✓ one-fourth of employment
  - ✓ more than 85% of food requirements
  - ✓ 25% of non-oil exports
  - ✓ 90% of raw materials for industries
- The agriculture an average growth rate of 5.1% over the National Development Plans

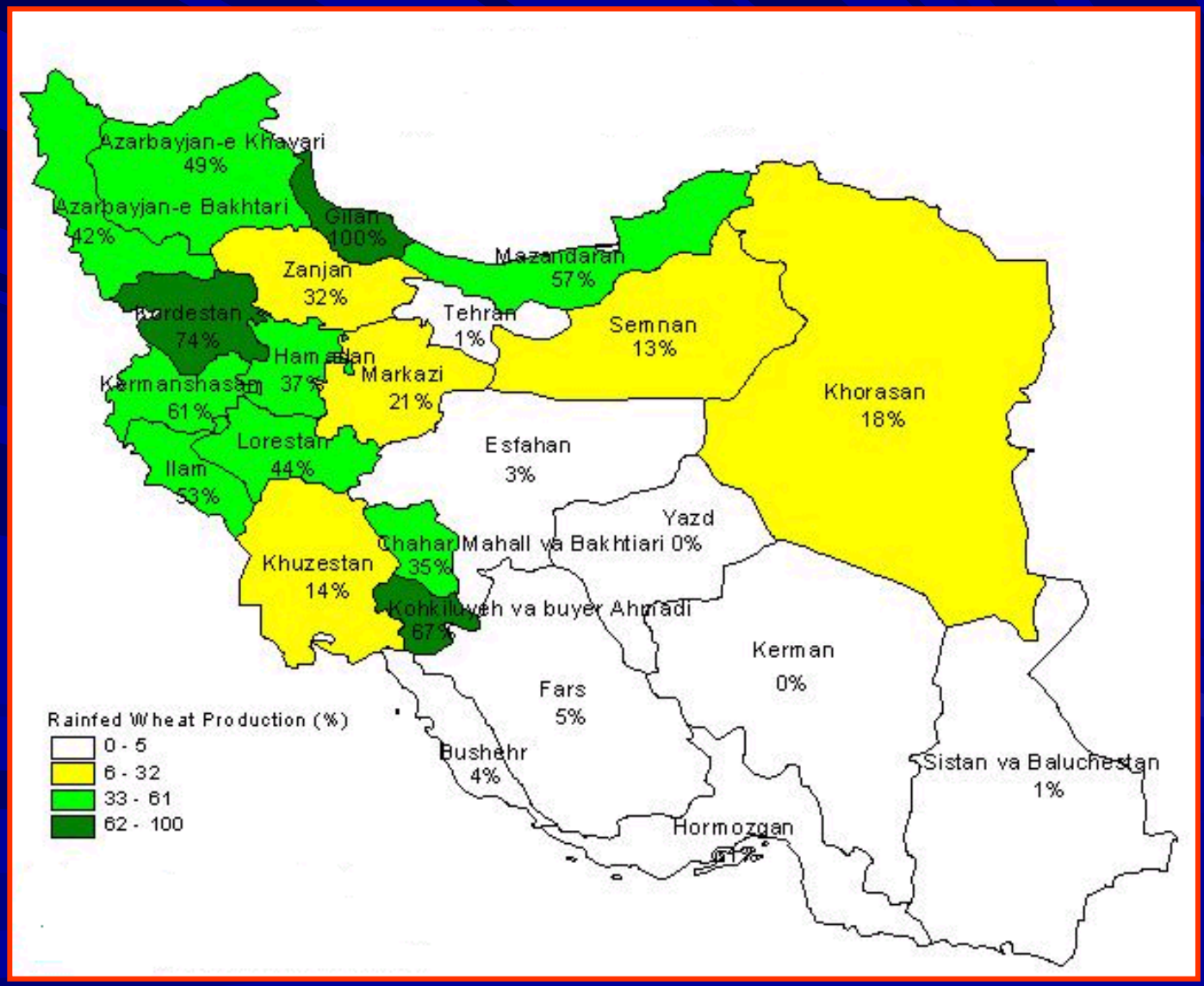
Estimated Consumption of Water by Different Sectors in Iran

Sector	Consumption in BCM	Domestic Allocation (%)	Global Allocation (%)
Agriculture	82.5	93.22	60
Urban	5.6	6.32	14
Industry	0.03	0.03	26
Misc.	0.37	0.43	-
Total	88.5	100	100

Irrigated Areas and Production in Iran



Shares of wheat production from rainfed lands in different provinces of Iran (last 10 year average)



Irrigated Crops Play a Key Role in The Economy of Iran

Water for Irrigation

- Ground water supply = 63 (BCM) = %70
- Surface water supply = 20 (BCM) = 30%

Ground water Use in Iran

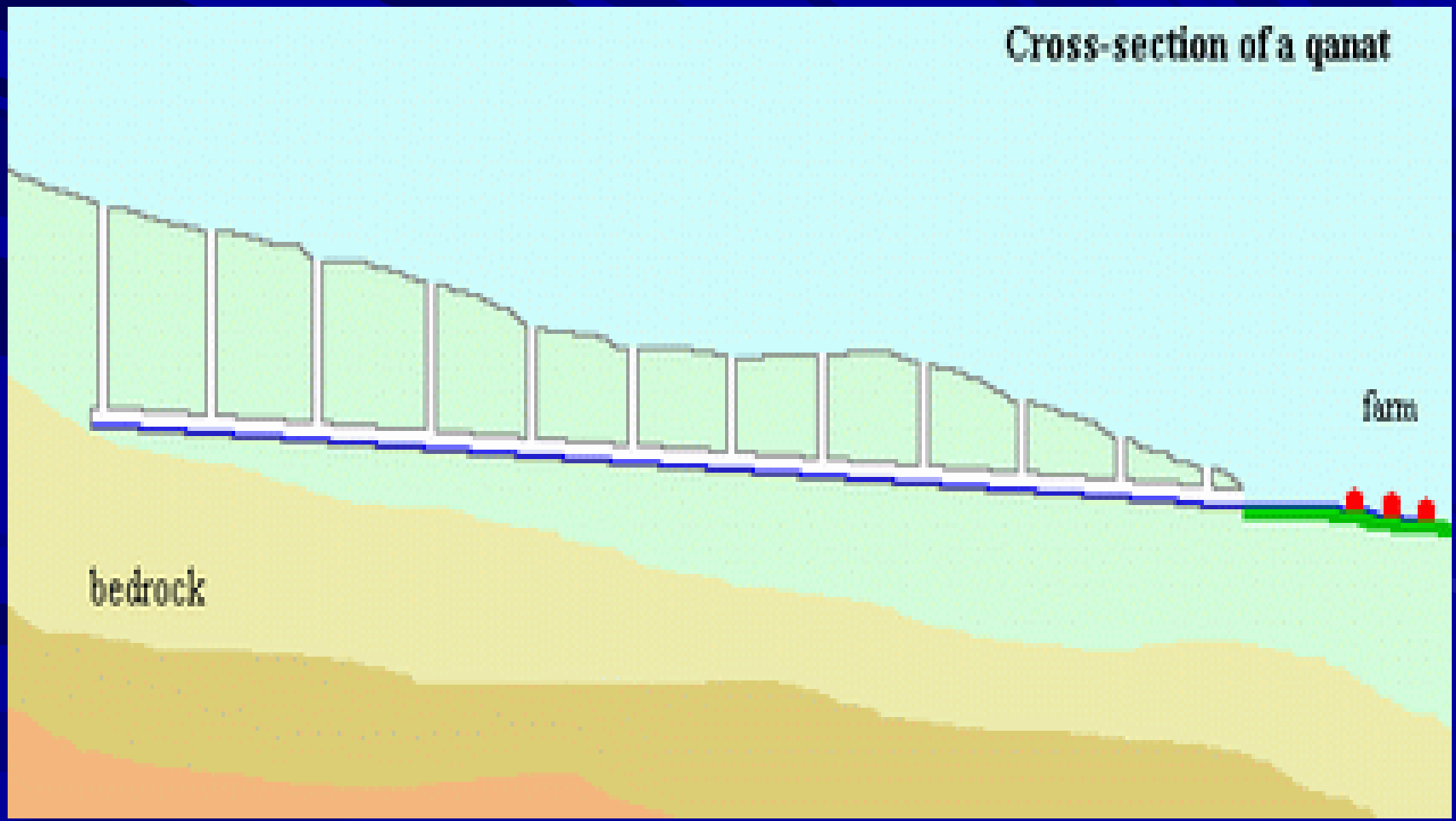
- Total ground water use per year = 62 BCM
  - By wells = 53 BCM
  - By Qanats and springs = 9
  - Percent use by wells = 80
- Total recharge per year = 55 BCM/year
- Ground water reservoirs deficit = 7 BCM/year

Means of Ground Water Extraction in Iran

- Qanats
- Wells

Iran's Qanats (chain wells)

- Number of Qanats in 1950 = 70,000



Trend of Ground Water Withdrawal in Mashhad Valley During 1962-69

Pumped by Wells (mcm)	Discharged by Qanats (mcm)	Year
80	250	1962
135	215	1963
185	200	1964
310	170	1965
485	130	1966
640	100	1967
655	97	1968
700	90	1969


نیروگاه
همدان
Power plant

Number of wells in Iran

Type of Well	Number
Deep Electrical Wells	29,000
Semi-deep Electrical Wells	75,000
Deep Diesel Wells	96,000
Semi-deep Diesel Wells	252,000
Total	452,000

Groundwater Withdrawal Needs Energy

- **New Agriculture:**
  - Managing an ecosystem for food production by using direct and indirect energy sources.
- **25% of all energy in Iran is used for food supply**
- **From all energy used for food supply, 30% of that is directly used in the field.**

Percentage of the Energy used for Supplying Water and Irrigation to the Total Energy used for Crop Production

Crops	Share Of Water And Irrigation (%)
Wheat	37
Sugar Beet	32
Alfalfa	60
Cotton	38
Potato	42
Average	41.5

Power Need for Each Liter per Second of Water Extracting by Wells

Type Of Well	Required Power (Hp)
Semi-deep (Electrical)	1.06
Deep (Electrical)	2.60
Semi-deep (Diesel)	1.76
Deep (Diesel)	4.24

Energy Consumption by Irrigation Wells per Hectare per Hour

Type of Well	Electricity (Kw) Gas Oil (L)
Semi-deep (Electrical)	8 Kw
Deep Wells (Electrical)	38 Kw
Semi-deep (Diesel)	4.5 L
Deep Wells (Diesel)	21.1 L

Water Use of Field Crops

Vegetables = 17,000 m^3/ha

Sugar Beet = 14,000 m^3/ha

Cotton = 13,000 m^3/ha

Rice = 20,000 m^3/ha

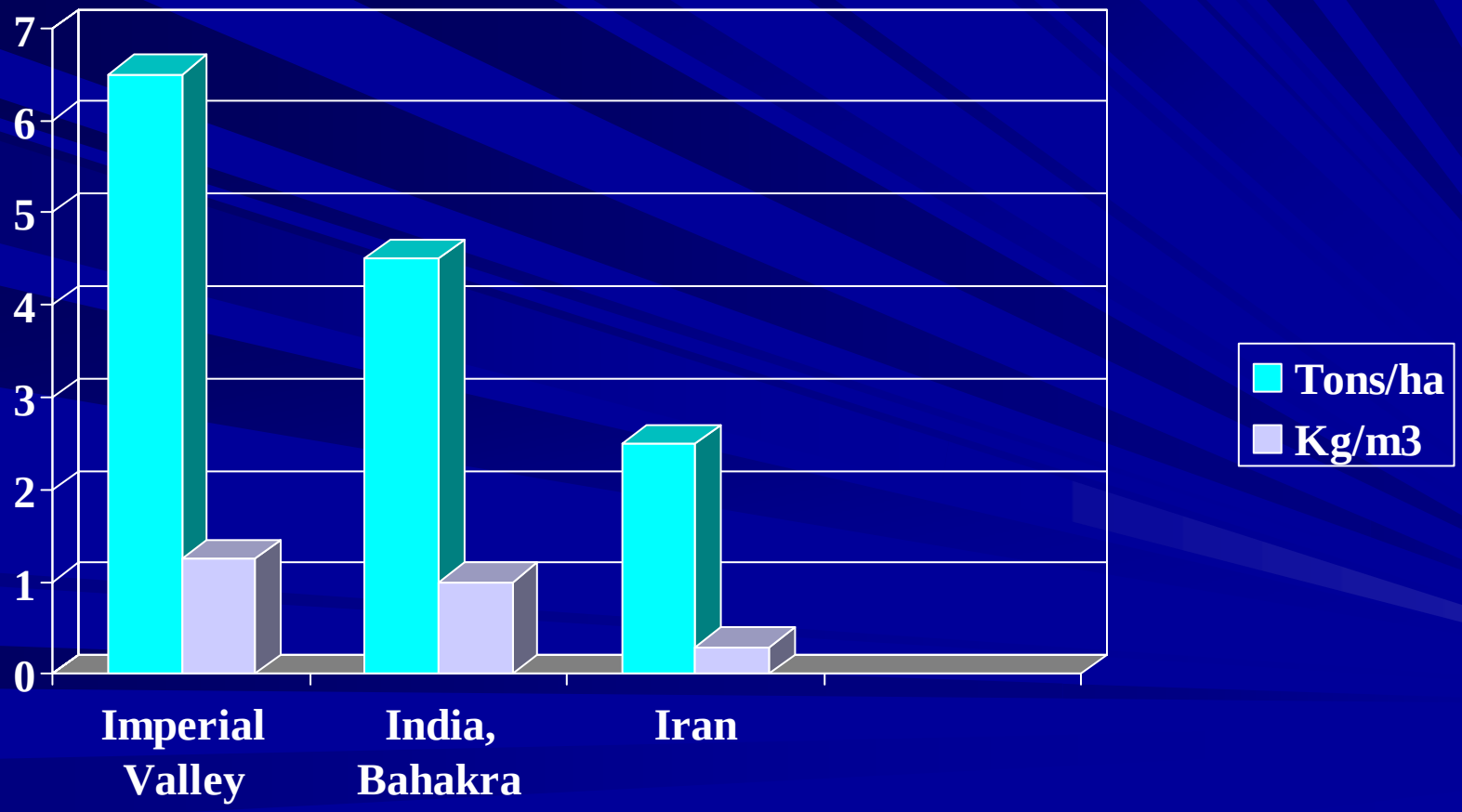
Sugar Cane = 30,000 m^3/ha

Direct and Indirect Energy Consumption per Hectare of Cultivated Crops in Khorasan (Kw/hr)

Crop	Indirect Energy	Direct Energy	Total
Wheat	4,998	6,464	11,462
Potato	8,573	13,709	22,283
Sugar Beet	21,413	13,747	35,161
Cropping Pattern	8,000	9,000	17,000


Water use efficiency for wheat
Average value=1.13 kg/m3
Caspian Sea
1.60
Ardabil
East Azerbaijan
West Azerbaijan
Zanjan
Gilan
Ghazvin
Mazandaran
2.32
Golestan
Sanandaj
Tehran
Semnan
0.80
Khorasan
Hamedan
Kermanshah
Markazi
Lorestan
Ilam
Isfahan
0.87
1.07
Khozestan
Chahar-Mahal Bkhtyari
Yazd
0.70
Kohkiluyeh Boirahmad
Kerman
0.56
Fars
Boushehr
Sistan & Baluchestan
Hormozgan
Persian Gulf
Oman Sea

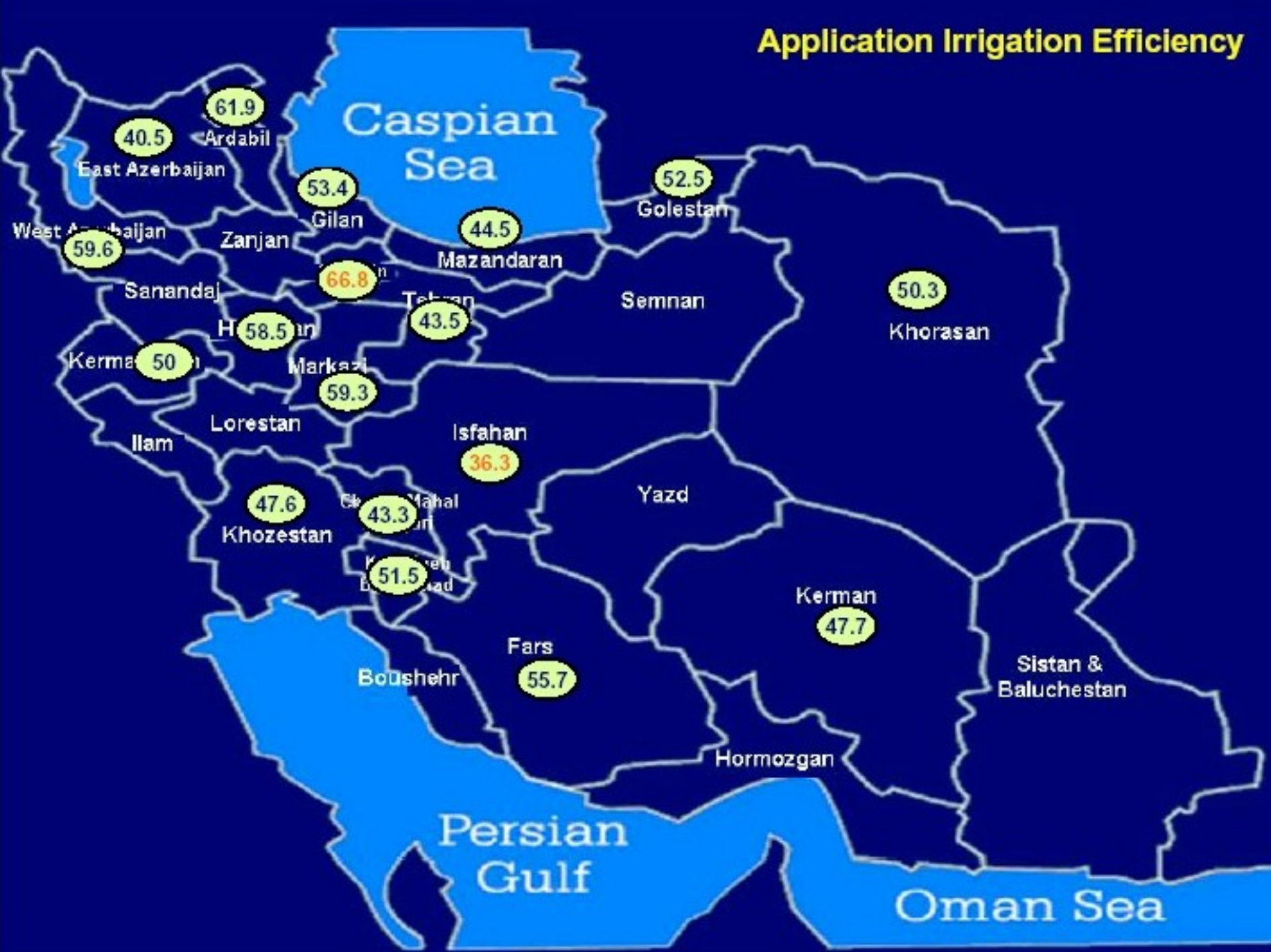
Yield and Water Productivity of Wheat in kg/m^3




Water use efficiency for sugar beet
Average 4.14 kg/m3
Caspian Sea
4.78
Ardabil
East Azerbaijan
West Azerbaijan
Zanjan
Gilan
Ghazvin
Mazandaran
Golestan
Sanandaj
Tehran
Semnan
3.58
Khorasan
Hamedan
Kermanshah
Markazi
Lorestan
Ilam
Isfahan
3.36
10.56
Khozestan
Chahar-Mahal Bkhtyari
Yazd
3.31
Kohkiluyeh Boirahmad
Kerman
2.25
Fars
Boushehr
Sistan & Baluchestan
Hormozgan
Persian Gulf
Oman Sea


Water use efficiency for potato
Average value=4.15 kg/m3
Caspian Sea
5.27
Ardabil
East Azerbaijan
West Azerbaijan
Gilan
Zanjan
Ghazvin
Mazandaran
6.63
Golestan
Sanandaj
Tehran
Semnan
3.18
Khorasan
Hamedan
Kermanshah
2.31
Markazi
Lorestan
Ilam
Isfahan
3.83
7.06
Khozestan
Chahar-Mahal Bkhtyari
Yazd
2.54
Kohkiluyeh Boirahmad
Kerman
2.35
Fars
Boushehr
Sistan & Baluchestan
Hormozgan
Overall WUE
in the country about 0.85 kg/m3
total production 70 mton
Total water consumed 82 BCM
Persian Gulf
Oman Sea


Water use efficiency for alfalfa
Average value=0.96 kg/m3
Caspian Sea
0.52
Ardabil
East Azerbaijan
West Azerbaijan
Gilan
Zanjan
Ghazvin
Mazandaran
1.62
Golestan
Sanandaj
Tehran
Semnan
0.81
Khorasan
Hamedan
Kermanshah
Markazi
Lorestan
Ilam
Isfahan
0.95
0.72
Khozestan
Chahar-Mahal Bkhtyari
Yazd
1.16
Kohkilueh Boirahmad
Kerman
0.93
Fars
Boushehr
Sistan & Baluchestan
Hormozgan
Persian Gulf
Oman Sea


Application Irrigation Efficiency
Caspian Sea
61.9
Ardabil
40.5
East Azerbaijan
53.4
Gilan
52.5
Golestan
44.5
Mazandaran
59.6
Zanjan
66.8
Sanandaj
43.5
Semnan
50.3
Khorasan
58.5
50
59.3
Markazi
Lorestan
Ilam
Isfahan
36.3
Yazd
47.6
Khozestan
43.3
51.5
Kerman
47.7
Fars
55.7
Boushehr
Sistan & Baluchestan
Hormozgan
Persian Gulf
Oman Sea


Total Irrigation Efficiency
Caspian Sea
52.6
Ardabil
34
East Azerbaijan
45.4
West Azerbaijan
50.6
Zanjan
44.8
37.9
Semnan
42.8
Khorasan
Sanandaj
56.8
Tehran
36.9
49.7
42.5
50.5
Markazi
Lorestan
Ilam
Isfahan
30.8
Yazd
40.5
Khozestan
36.8
43.8
Kerman
40.5
Fars
47.3
Boushehr
Sistan & Baluchestan
Hormozgan
assuming 85% for network irrigation efficiency
Persian Gulf
Oman Sea

Water and Energy Consumption per Kilogram of Wheat

Surface Irrigation

- 1.8 m^3 water
- 1 kw/hr energy

Sprinkler Irrigation

- 1.5 m^3 water
- 1.5 kw/hr energy

Water and Energy Consumption per Kilogram of Sugar

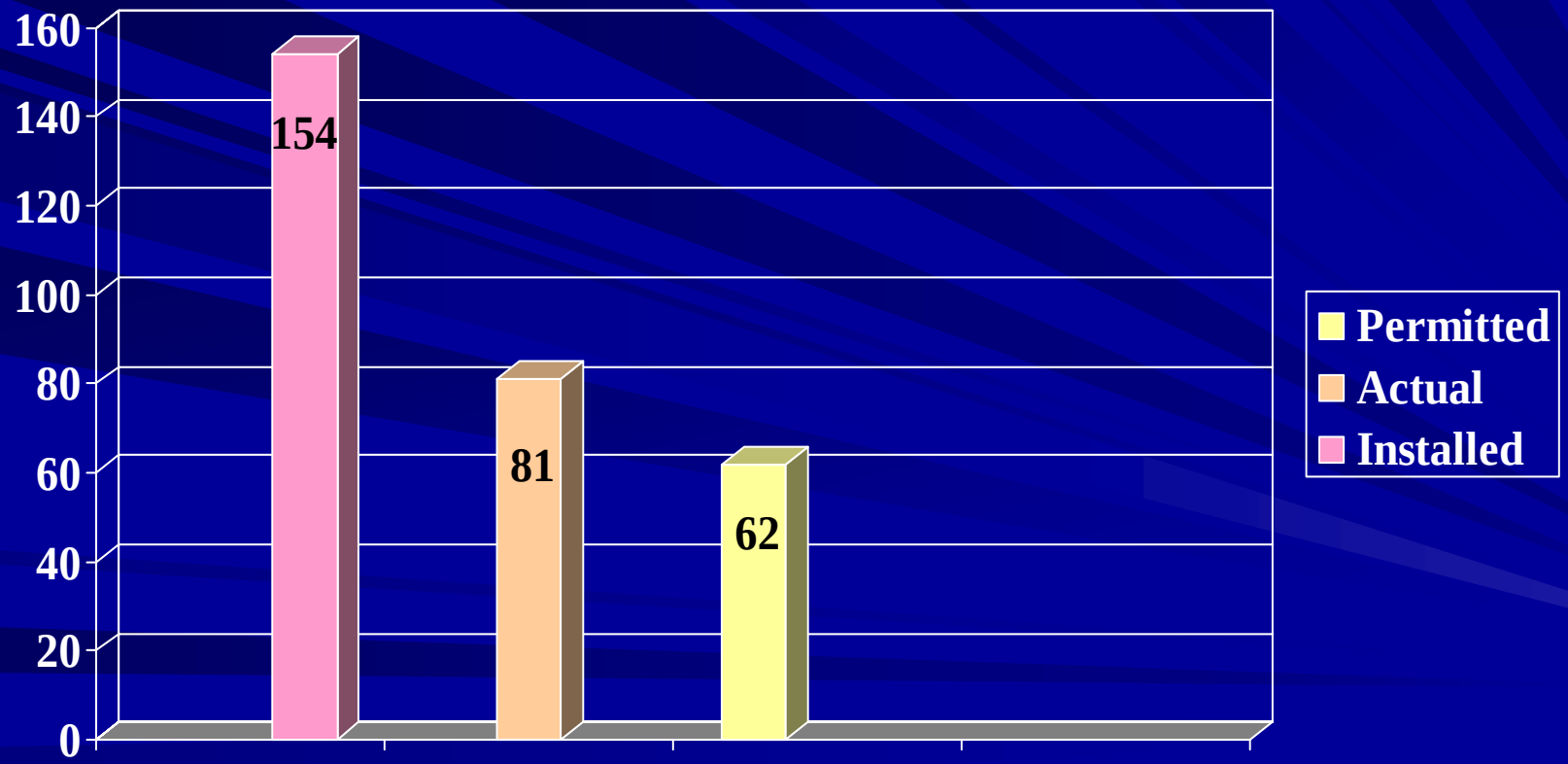
Surface Irrigation

- 2.5 m^3 water
- 4.5 kw/hr energy (total)
- 2.0 kw/hr energy (direct)

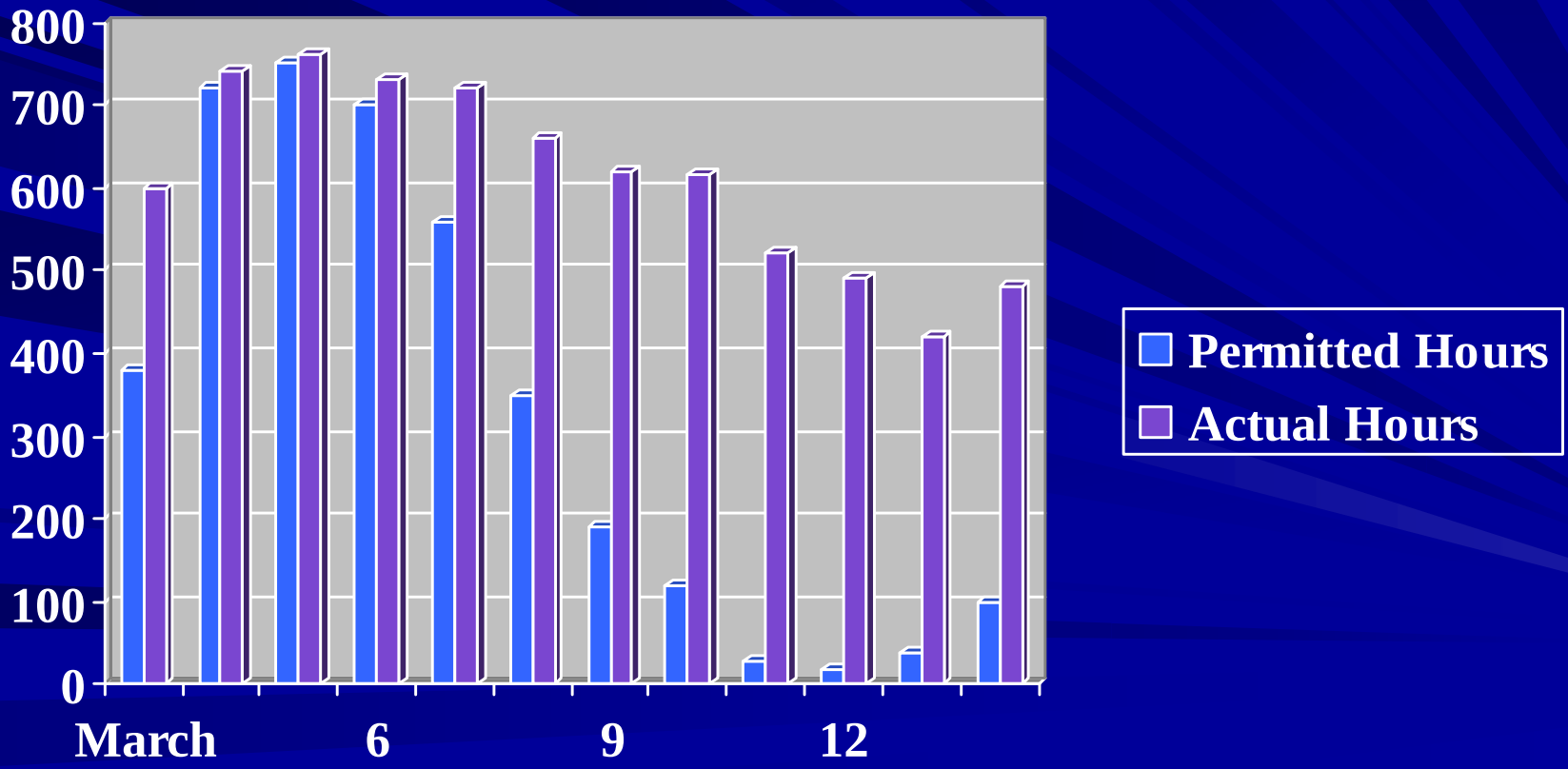
Sprinkler Irrigation

- 1.5 m^3 water
- 5.2 kw/hr energy (total)
- 2.5 kw/hr energy (direct)

Permissible and Installed Powers in Pumping Plants (Kw)



Permitted Hours (4000) versus Actual Hours (7000) of Operation in Pumping Wells (Hrs/Year)



Ratio of Output:Input Energy in Irrigated Fields of Khorasan

Crop	Output / input
Cotton (Kashmar)	0.25
Potato (Mashhad)	0.75
Sugar beet (Mashhad)	0.85
Barely (Mashhad)	1.02
Melon (Sarakhs)	1.50
Wheat (Mashhad(	1.30
Legumes (Bodjnoord)	1.20
Alfalfa (Mashhad)	4.50

Conclusion

Menu of Options

- Technical practices
- Institutional implementations
- Agronomic practices
- Management

Recommendations

- Water pumping must be accordance with the crop water requirement
- Energy subsidies should be regulated
- Equipping, consolidating, and renovation of lands
- Regulated allocation of water
- Water pricing and charges
- Public participation
- Proper water policy
- Establishing an Independent water resources department
- Supreme water council

Challenges

- Agriculture in Iran is mostly for survival
- Problems arising from weak implementation of policies
- Improper allocation of available water
- Slow adaptation of introduced and available technologies
- Frequent droughts and decreasing water supply for agriculture

Thanks for Your Attention