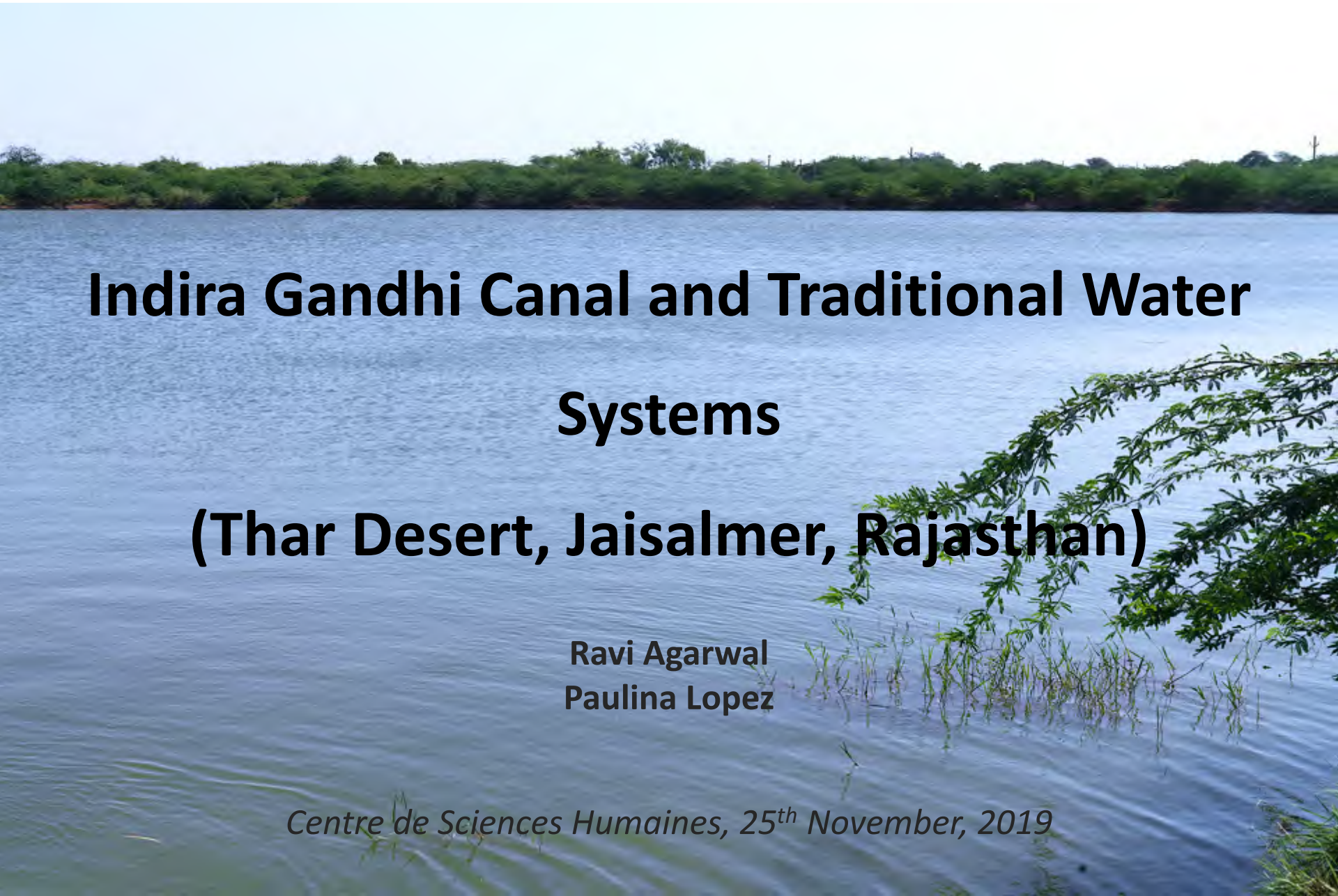


Indira Gandhi Canal and Traditional Water Systems

(Thar Desert, Jaisalmer, Rajasthan)

Ravi Agarwal
Paulina Lopez

Centre de Sciences Humaines, 25th November, 2019

OUTLINE OF THE PRESENTATION

- Introduction: exploring landscapes in the Anthropocene
- The interdisciplinary approach
- Water-related issues in India
- Research question and objectives
- The Indira Gandhi Canal
- Methodological approach
- Preliminary results

EXPLORING LANDSCAPES IN THE ANTHROPOCENE

- Introduction: Exploring landscapes in the Anthropocene framework
- Desert as a terrain
- Evacuations-Migrations-New Inhabitations
- Time scales – Multiple temporalities
- Multi-disiplinary exploration

THE INTERDISCIPLINARY APPROACH

- The interdisciplinary approach

RAVI AGARWAL

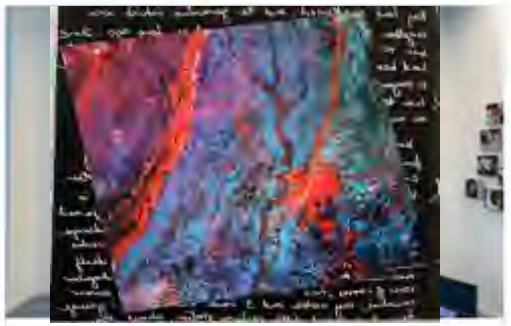
HOME WORKS EXHIBITIONS CURATION CATALOGUES/BOOKS WRITINGS EVENTS PRESS BIO CONTACT

XIII Havana Biennial, 2019

The exhibition, which is staged at the Centro de Arte Contemporáneo Wifredo Lam, is titled "The construction of the possible" and aims to continue its founding principles of equality and justice, "taking into account the conditions of a world in which nuclear and war-mongering threats, xenophobia, racism, forced displacement, fascist tendencies, violence against those who are different, ethnic-cultural conflicts, inequality, terrorism, the systematic use of

Ecologies of Loss, PAV Center Turin, Italy

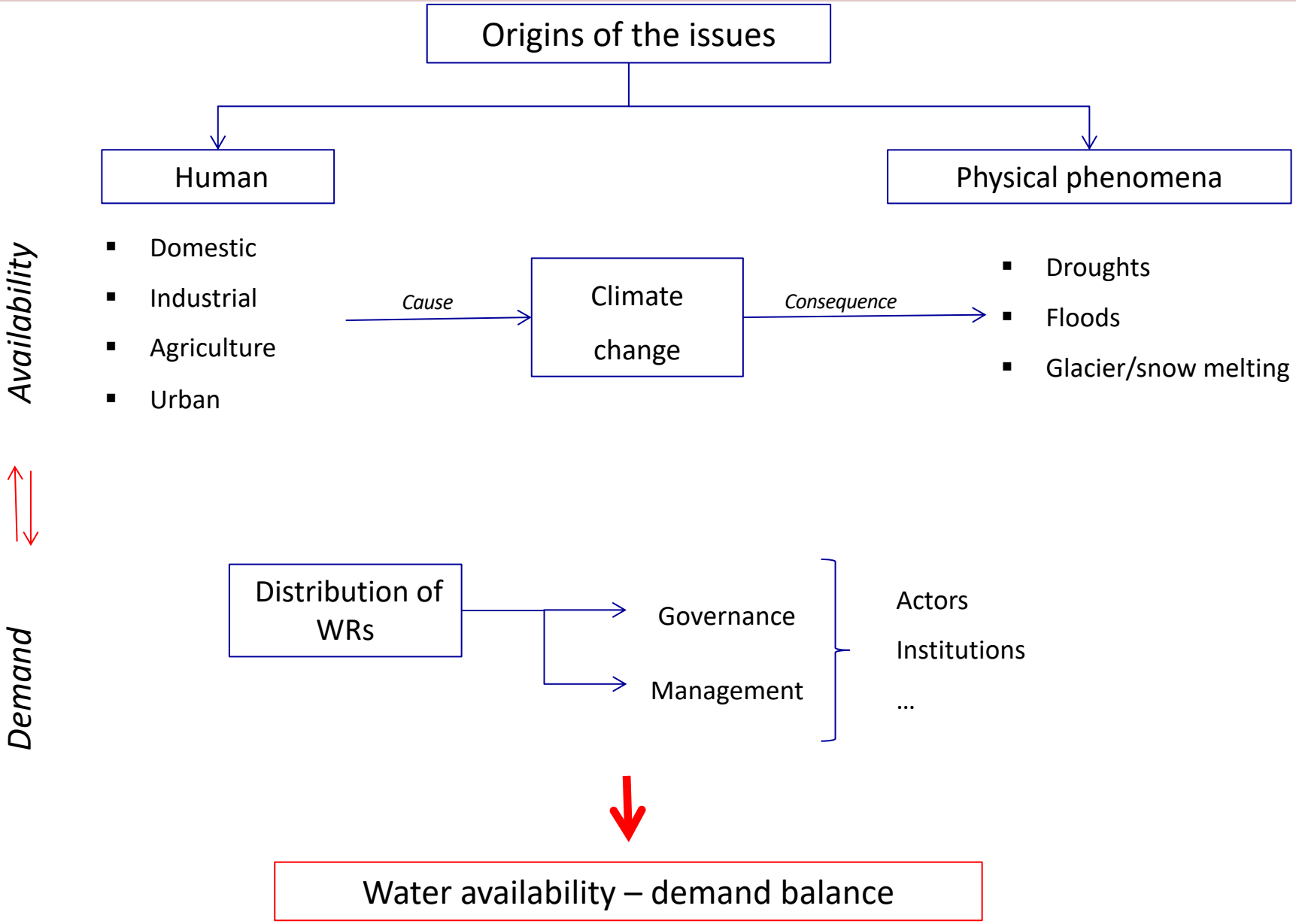
PAV Parco Arte Vivente presents Ecologies of Loss, the first Italian solo exhibition of the Indian artist Ravi Agarwal. Curated by Marco Scotini, this exhibition continues the investigation into the relationship between artistic practices and ecological thought in the Asian context, begun with the solo exhibition of the Chinese artist Zheng Bo. This research wants to take stock of the "centrality of Asia in the climate crisis" as



The Desert of the Anthropocene, India Art Fair Project, Feb 2019

The ongoing project traverses and contrasts a personal memory of a desert homeland in a now abandoned ancestral home with new exploitation of the 'barren' landscape. Pointing towards the loss of the local leading to the breakdown of ecological constructs of identity, food systems, water, and land, the terrain is now increasingly thought of as infertile, leading to it being a ground for nuclear testing,

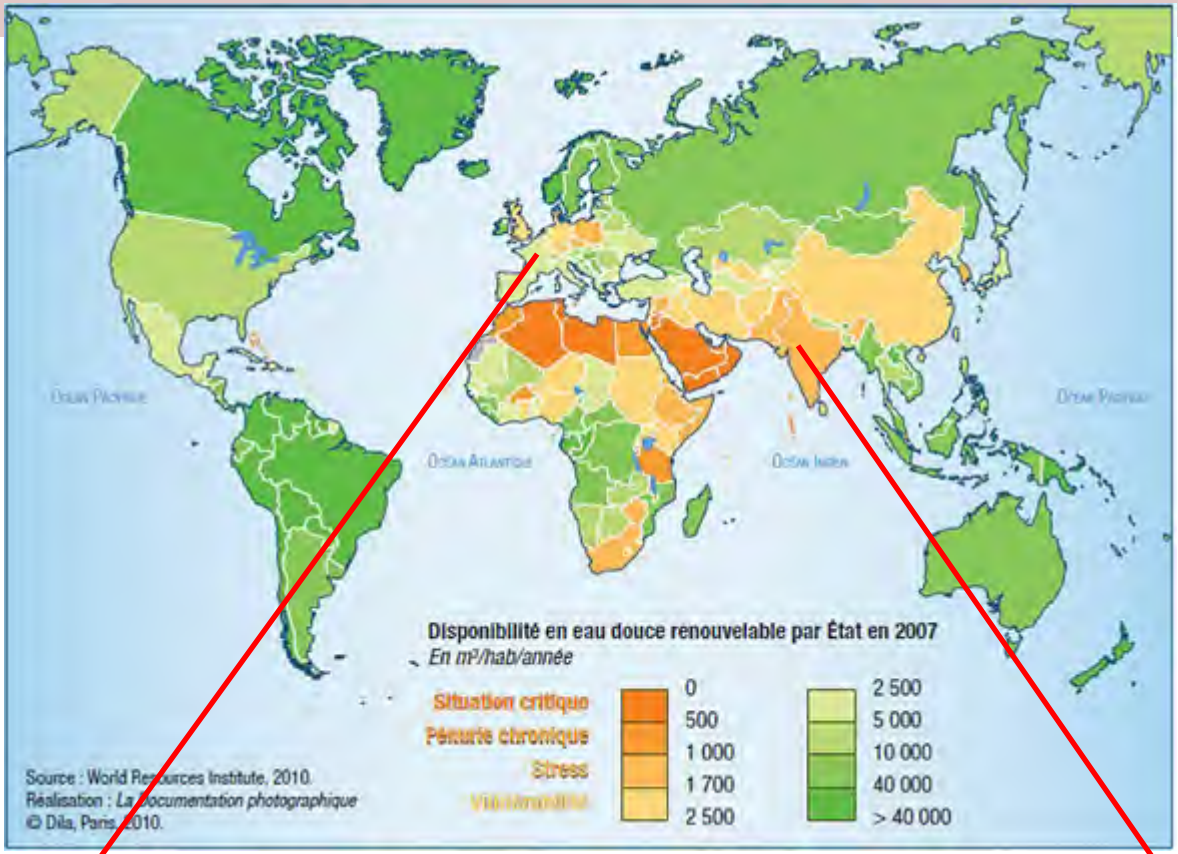
WATER-RELATED ISSUES IN INDIA



Issues related to natural hazards are excluded

WATER-RELATED ISSUES IN INDIA

WATER RESOURCES DISTRIBUTION



© Paulina Lopez (Jardin de Luxembourg, summer 2017)

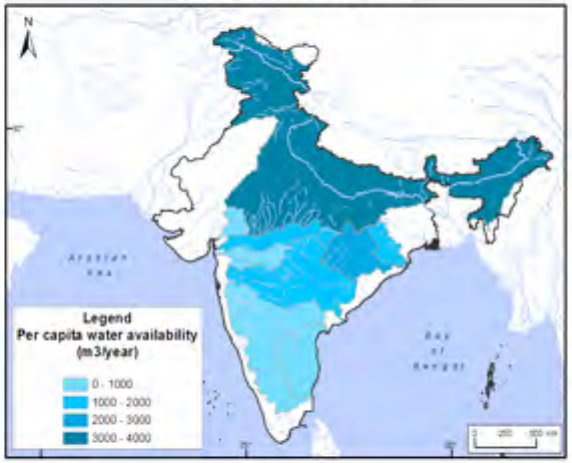
http://www.thehindu.com/opinion/op-ed/Water-will-

WATER-RELATED ISSUES IN INDIA

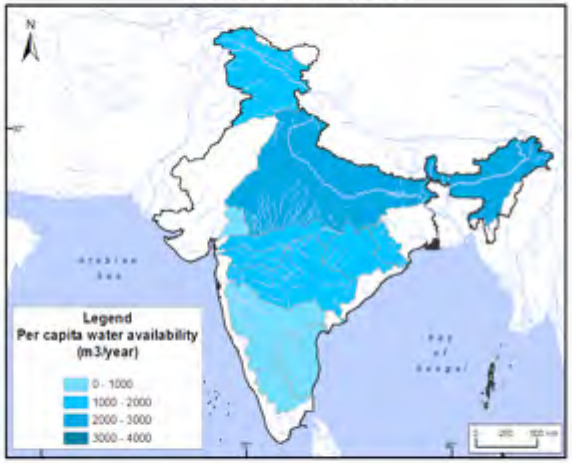
WATER AVAILABILITY IN MAJOR CATCHMENT BASINS OF INDIA

Major catchment basins

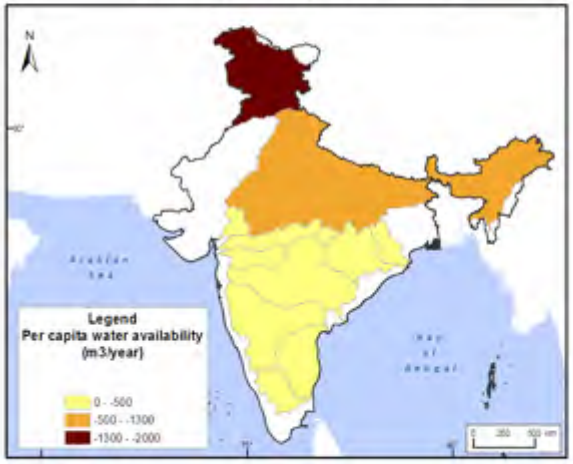
Water availability 1993



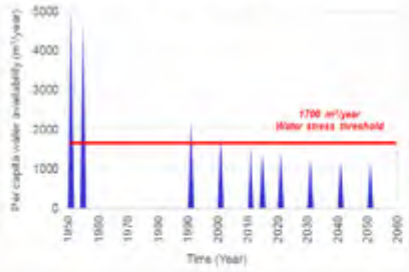
Water availability 2017



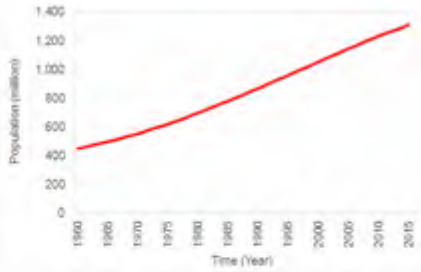
Water availability 1993 - 2015



Per capita water availability in India
1950 - 2060



Population in India
1960 - 2015

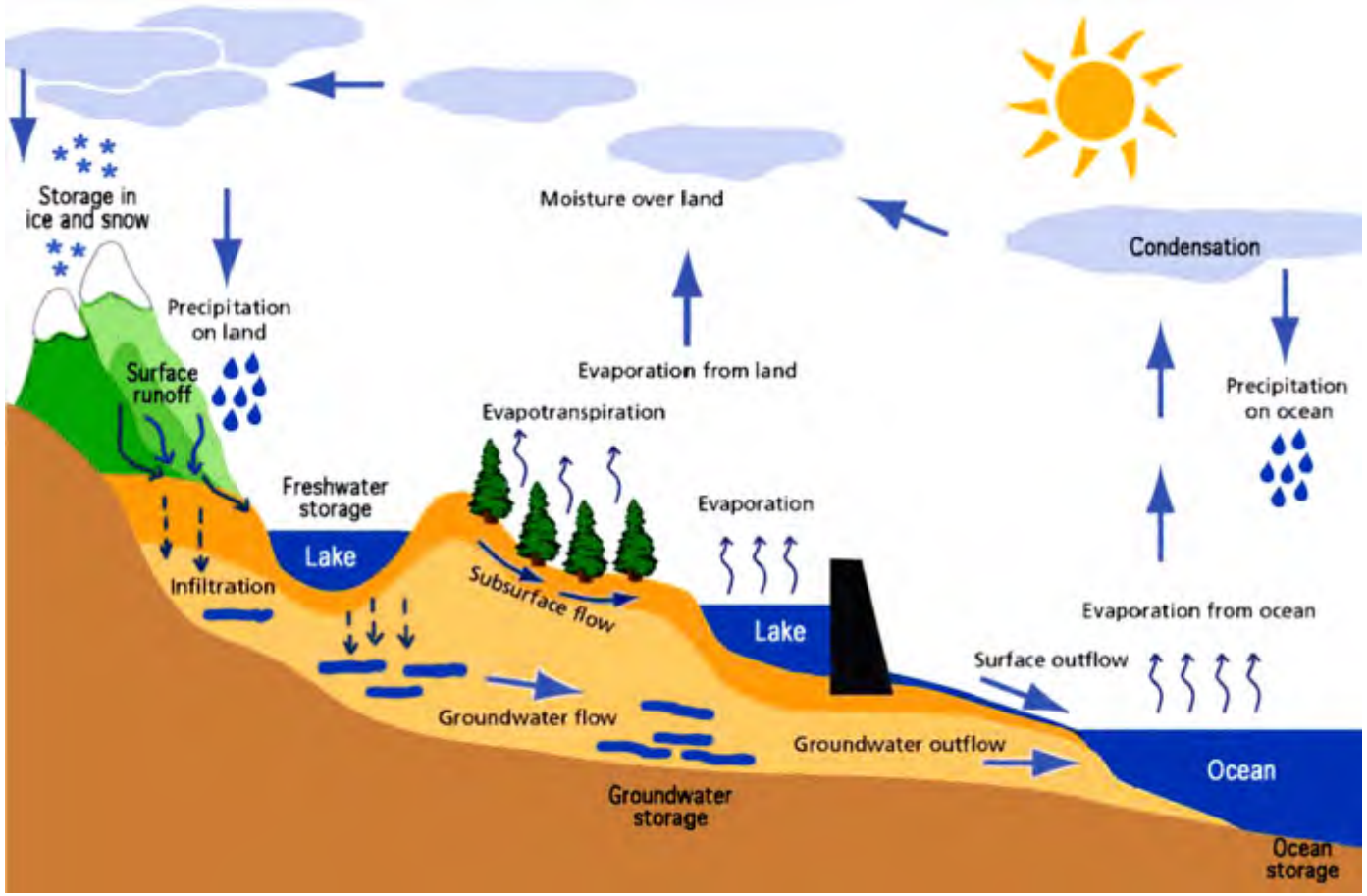


Map design Paulina Lopez

Sources:

(1) Basins: The CEO Water Mandate, http://riverbasins.wateractionhub.org
(2) Water bodies: World Wildlife Fund: (WWF), https://www.worldwildlife.org
(3) Water availability : CWC (2017) Reassessment of water availability in India using space inputs
(4) Population: World Bank (https://data.worldbank.org/)

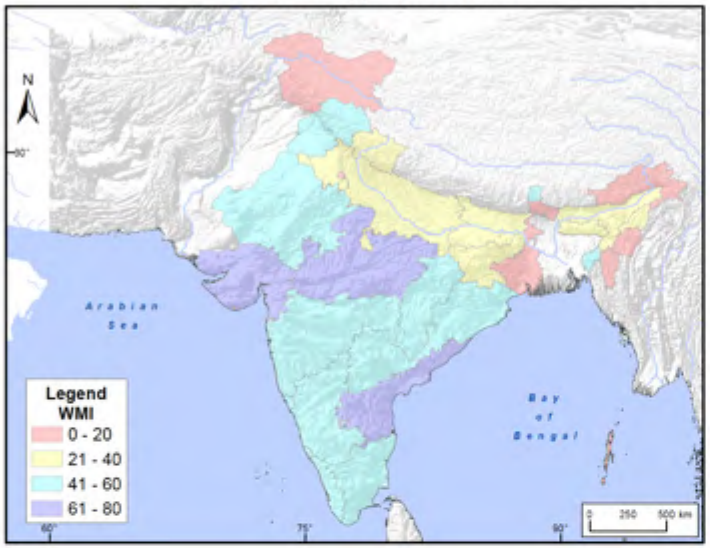
WATER-RELATED ISSUES IN INDIA



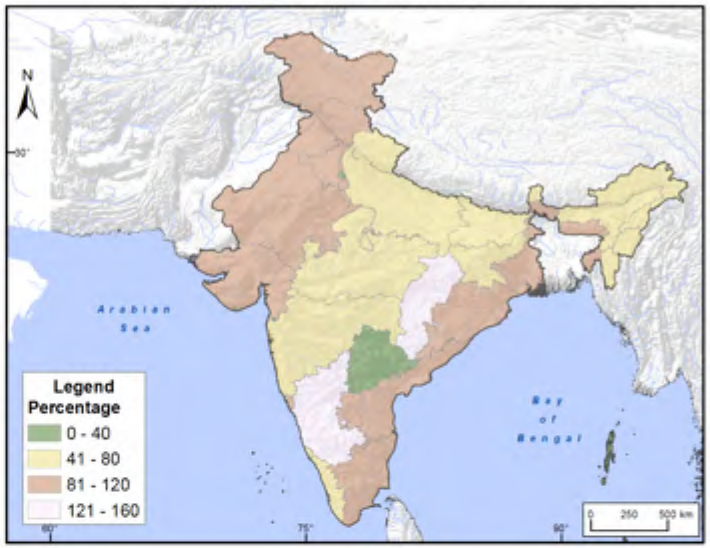
https://civilsolution.wordpress.com/

WATER-RELATED ISSUES IN INDIA

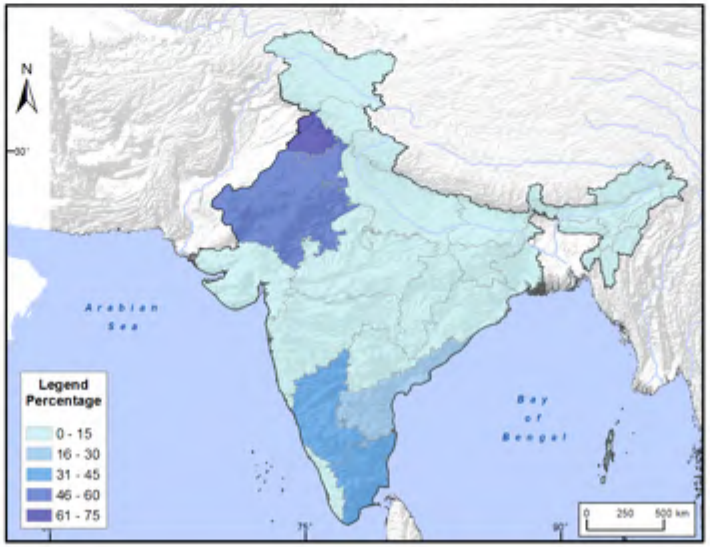
Water management Index



Total Irrigation Potential Utilised



Groundwater overexploited

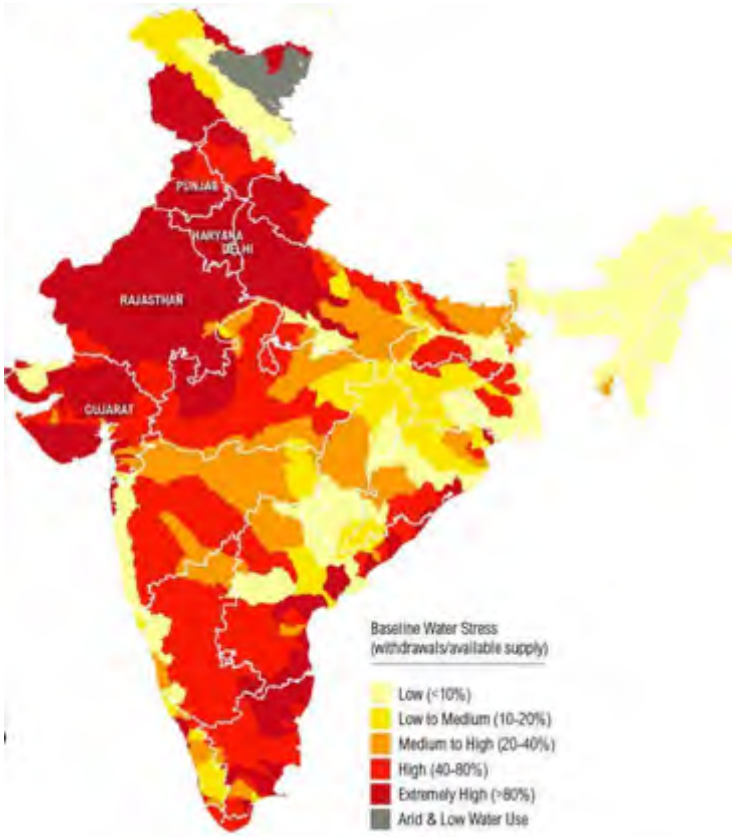


WATER-RELATED ISSUES IN INDIA

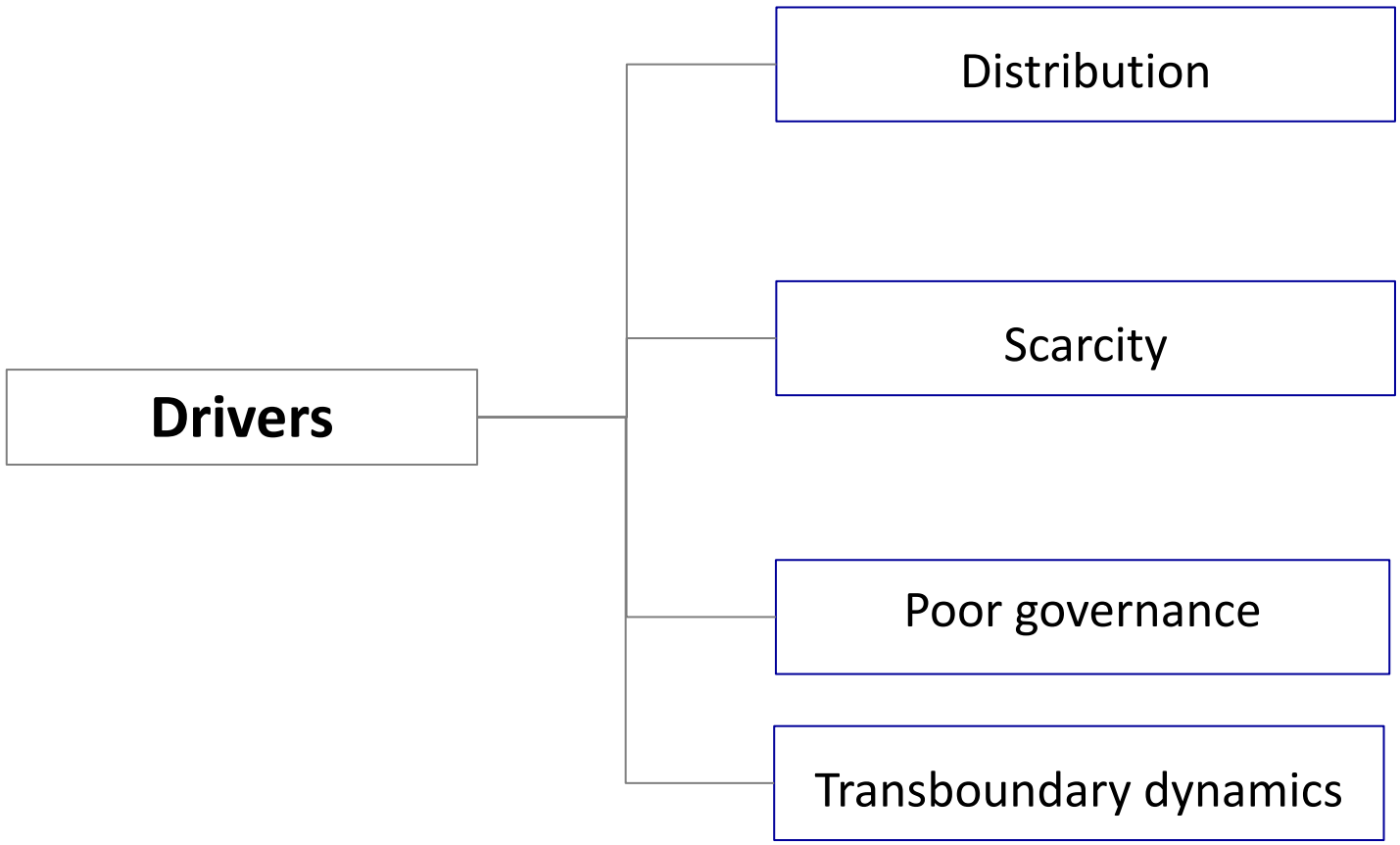
- Water crisis in India
- Climate change will exacerbate existing problems
- To ensure sustainability of the water sector
- Balance water availability - demand
- Demands and availability of water resources in India are spatially uneven distributed: State level

WATER-RELATED ISSUES IN INDIA

- 54% in extreme water stress
- Agriculture consumes 78% of WRs
- Intersectoral competition will increase
- Suboptimal use of water: led by policies
- Susidised pricing of water and power, overuse
- Misalignement in the cropping patterns and WRs
- Relevance of policies, water governance and management



WATER-RELATED ISSUES IN INDIA



Adapted from UNEP, 2009

RESEARCH QUESTION AND OBJECTIVES

- **Research question:**

  What are the benefits, deficiencies and limits of the use of technology in the management of water resources?

- **Objective:**

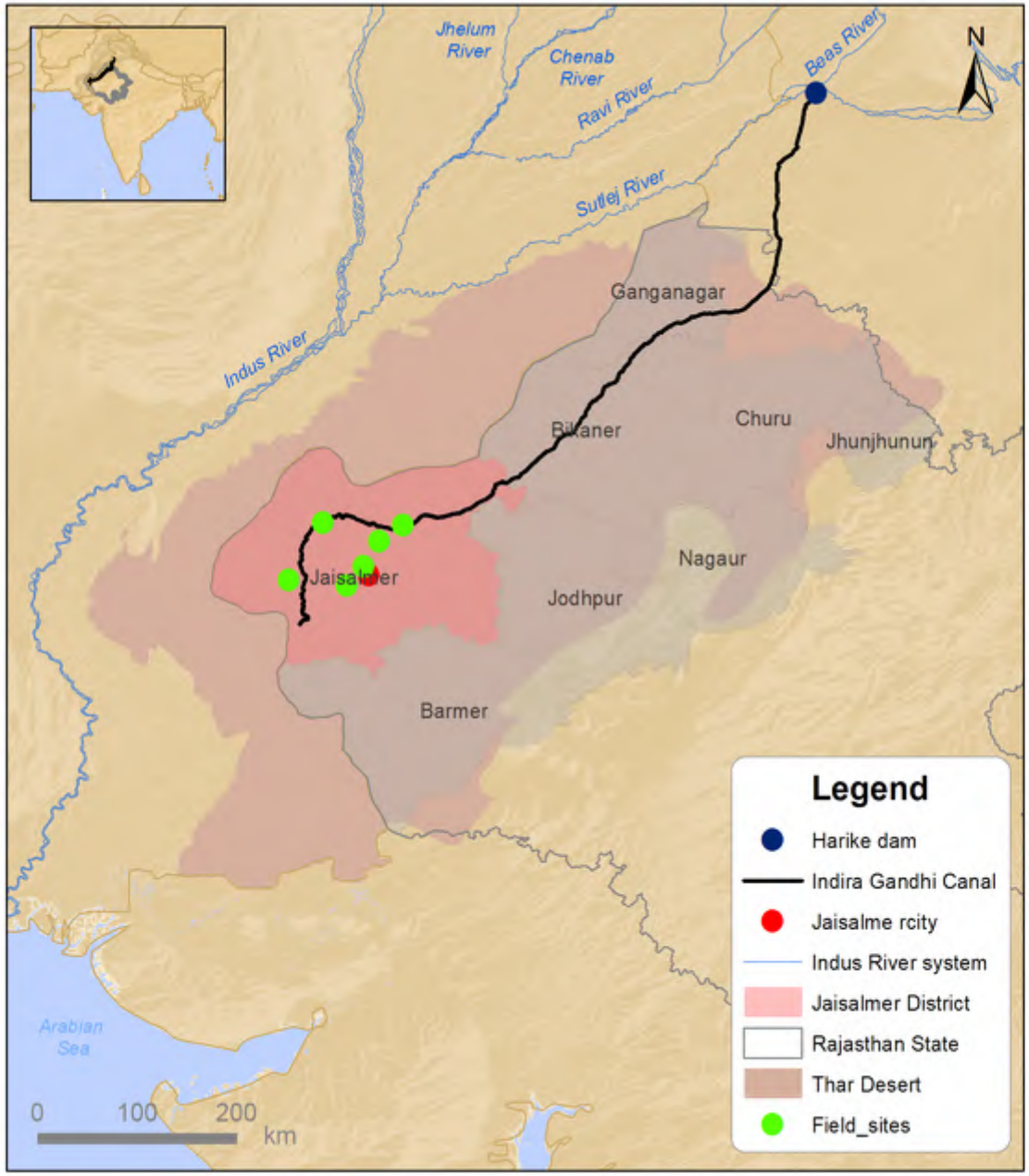
  To identify and analyze the impact of technological solutions to problems of water supply through the Indira Gandhi Canal in the District of Jaisalmer (Rajasthan)

Thar Desert

- Great Indian Desert – *Marusthal*
- 200,000 sq Km/ Rajasthan / Pakistan
- Most populated desert of the world
- Climate: arid
- Characteristic feature development of sand dunes, cover 50% of the Thar Desert
- Low rainfall; erratic distribution; extremes of diurnal and annul rainfall: low humidity: high wind levels
- Moisture deficient zone
- Evaporation higher than precipitation
- Draught is a frequent feature

Indira Gandhi Canal

- Earlier called Rajasthan Canal, started 1958
- To carry out intensive cultivation
- Biggest canal project in India: Conceived in 1948: From Harike Barrage at Sultanpur below confluence of Sutlej and Beas: 650 km
- Ends a Ramgargh near Jaisalmer
- The IGC is a symbol and tribute to India's engineering skills (Rao 1992)
- 2 phases of construction
- Before the arrival of IGC the region was dominated by sand dunes and occasional patches of wild bush
- New towns, changes to life style of the inhabitants, changes in settlement patterns
- 1956-57 – increase of new sown area 39%
- Agriculture has taken momentum but without consideration of climatic and edaphic constraints


Jhelum River
Chenab River
Ravi River
Beas River
Sutlej River
Indus River
N
Ganganagar
Bikaner
Churu
Jhunjhunun
Nagaur
Jaisalmer
Jodhpur
Barmer
Arabian Sea
0
100
200
km
Legend
Harike dam
Indira Gandhi Canal
Jaisalme rcity
Indus River system
Jaisalmer District
Rajasthan State
Thar Desert
Field_sites

S. No.	Item	Description
1.	Origin point of the Project	Harike Barrage situated in Punjab at 3.0 Km downstream of confluence of Sutlej and Beas Rivers.
2.	Water Allocation	7.59MAF
3.	Length of Indira Gandhi Feeder Canal	204 Km (170 Km in Punjab & Haryana, and 34 Km in Rajathan)
4.	Capacity of IGFC at Harike Head	18500 Cusec (523.86 Cumec)
5.	Origin point of the Indira Gandhi Main Canal	Tail Point of Indira Gandhi Feeder Canal
6.	Length of Indira Gandhi Main Canal	445 Km
7.	Capacity of IGMC at Head	17266 Cusec (488.92 Cumec)
8.	Entry point of canal in Rajasthan	In Hanumangarh District
9.	Stage-I of the project	Area under IGFC & IGMC up to 189 Km (RD 620, Pungal Bikaner) except area under Sahwa lift system (Originating from 33 Km of IGMC)
	a) Culturable Command Area (CCA)	Flow -4.84* lakh hectare Lift- 0.62 lakh hectare Total- 5.46 lakh hectare *(According to restricted CCA)
	b) Intensity of Irrigation	Flow – 110% (Rabi 63%, Kharif 47%) Lift – 100% (Rabi 55%, Kharif 45%)
10.	Stage-II of the project	Area from 189 Km of IGMC(RD 620, Pungal Bikaner) to 445 km of IGMC(RD 620, Pungal Bikaner)i.e. tail end of main canal and Area under Sahwa lift system (Originating from 33 Km of IGMC)
	a) Capacity of IGMC at Head of Stage-II	9955 Cusec (281.89 Cumec)
	b) Capacity of IGMC at Tail of Stage-II	4810 Cusec (136.20 Cumec)
	c) Culturable Command Area (CCA) in lakh hectare	Flow 7.24 Lift 3.47 Total 10.71
	d) (i) Length of IGMC	256 Km
	(ii) Distribution - System	Flow -3354.50 Km Lift- 1495.45 Km Total- 4849.95 Km)
	e) Intensity of Irrigation	Flow – 80% (Rabi 46%, Kharif 34%) Lift – 60% (Rabi 35%, Kharif 25%)
11.	Construction of Water Courses (in lakh hectare)	Stage-I: 5.29; Stage-II: 7.03; Total: 12.32
12.	Reservation of Water in IGNP for Drinking, Energy- Projects, Army, Industries & Other Uses	0.87MAF (1200 Cusec)
13.	Proposed Beneficiary Districts	Sriganganar,Hanumangarh,Bikaner,Jaisalmer, Jodhpur, Churu, Jhunjhunu*, Sikar*, Nagore*, and Barmer* *(Only for Drinking Water)

Indira Gandhi Nahar Information

Thar Desert

- Covers Bikaner, Jaisalmer, Churu, Western Nagaur and Barmer Distt.
- Characteristic feature development of sand dunes, cover 50% of the Thar Desert
- Most populated desert of the world
- Climate: arid
- Low rainfall; erratic distribution; extremes of diurnal and annul rainfall: low humidity: high wind levels
- 200,000 sq Km
- Rajasthan / Pakistan
- Great Indian Desert – *Marusthal*
- Rainfall:
- January coldest month
- Moisture deficient zone
- Evaporation higher than precipitation even during rainy months with perpetual water deficit in all the months
- One of the most in-hospitable arid zones in the world
- Major part of the hot arid region (90%) covering 29 m ha in NW India *(Joshi 2014)*
- Draught is a recent feature varying from year to year
- *Graphs from Joshi*

Jaisalmer

Rainfall:

- Average less than 200 mm. 100m in NE of Jaisalmer was lowest in Rajasthan
- Max daily to 40 deg C to 45 deg C: occasionally rises to 49 deg C
- Annual EPT highest of Rajasthan State

Population

- 11% of the area of Rajasthan
- 0.97% of the population of Rajasthan
- Lowest density (7 persons / sq. km)
- Highest growth rate of population

Irrigated area:

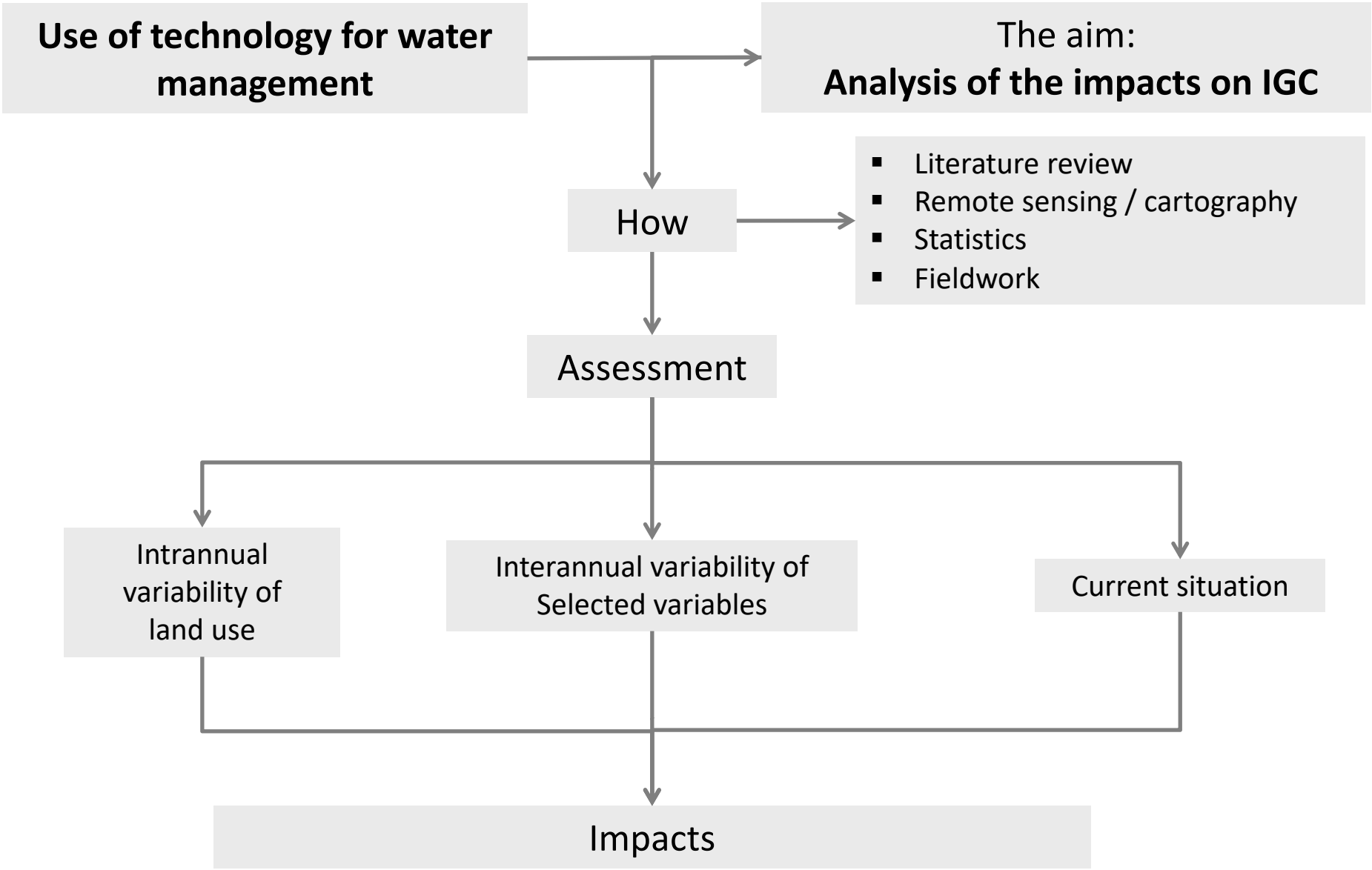
Before Indira Gandhi Canal it was a district with negligible irrigated farming but this changed after IGC

Crop growing period less than 45 years

IG Canal

- Head at Mohangarh
- Feeder canal till Ramgarh
- Farming 3 km west of canal – gravity flow as per natural gradient
- Canal network exists beyond that but is silted/ broken/ unusable
- Drinking water pumped east to Jaisalmer using pipelines
- Network
  - Main canal capacity 1200 cusecs
  - Axial C@D canal – 420 cusecs
  - Minor canals – 120 cusecs to 30 cusecs

METHODOLOGICAL APPROACH

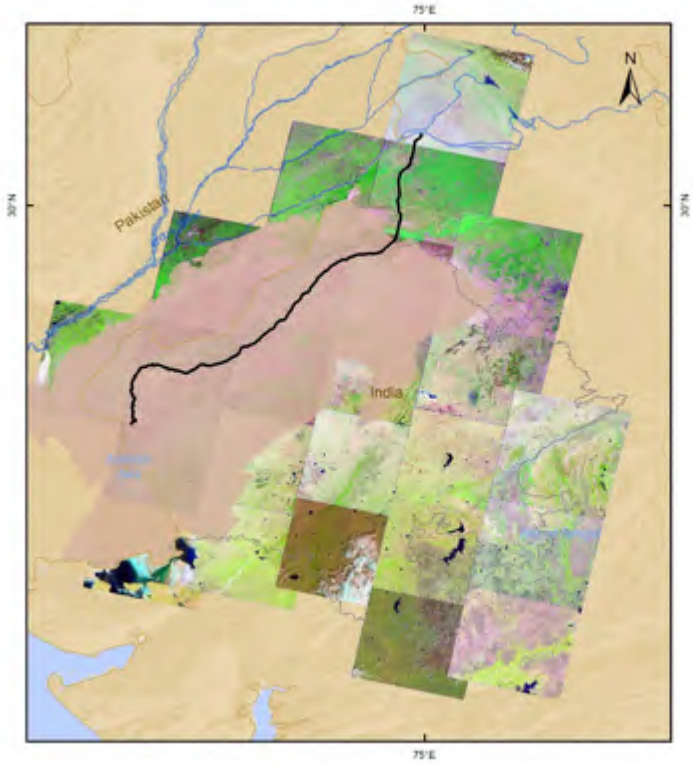


LAND USE INTRA ANNUAL VARIABILITY

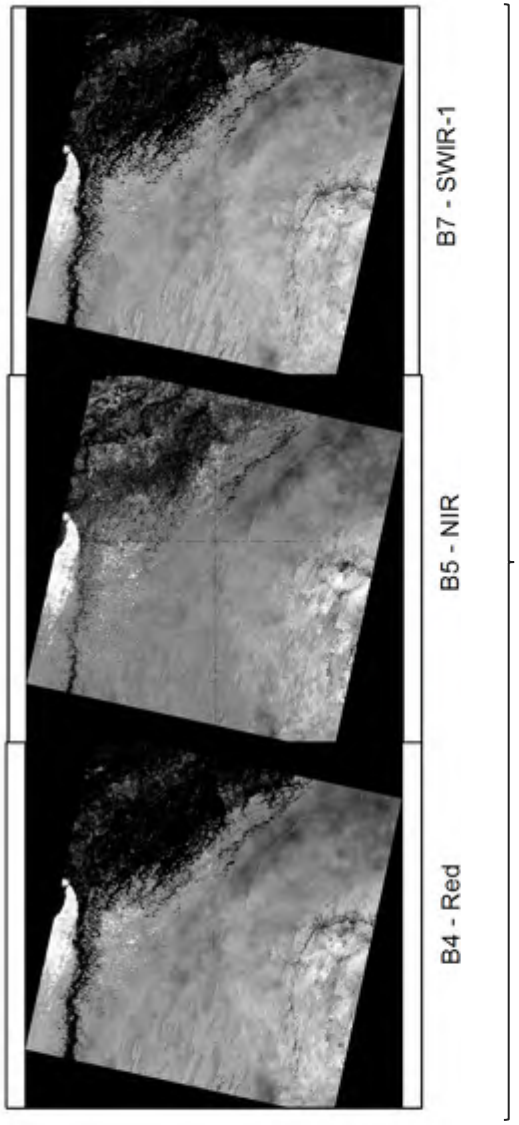
OLI satellite images

(Operational Land Imager)

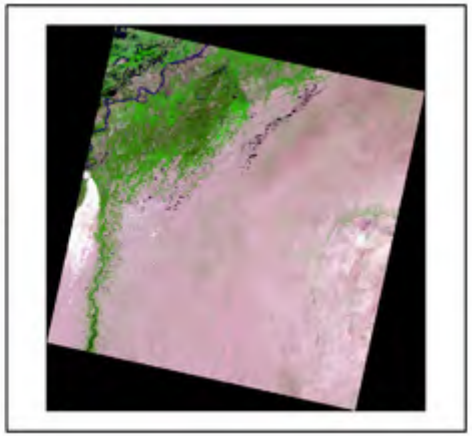
- Instrument onboard LANDSAT 8 Earth-observation sat.
- (Earth Resources Technology Satellite)
- Visible, near infrared, and short wave infrared bands
- Spatial resolution: 15-meter panchromatic and 30-meter multi-spectral spatial resolutions
- 185 km (115 miles) wide swath
- 16 days near-polar orbit.

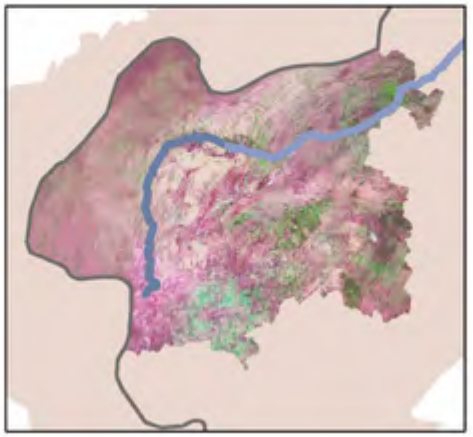


LAND USE INTRA ANNUAL VARIABILITY

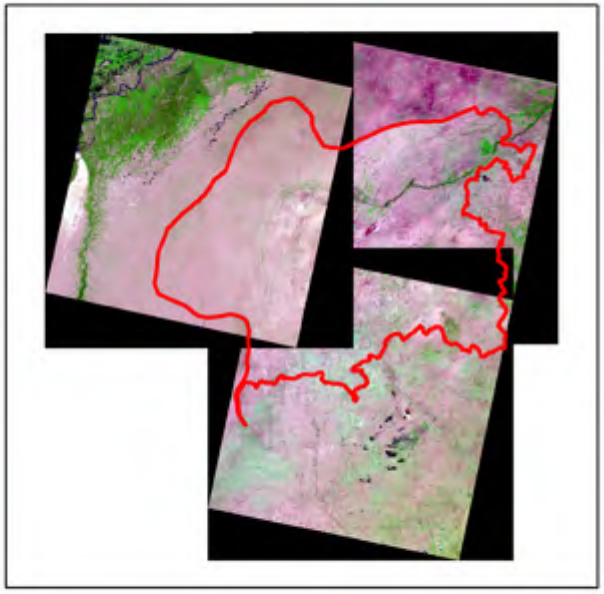


NCC (7,5,3)

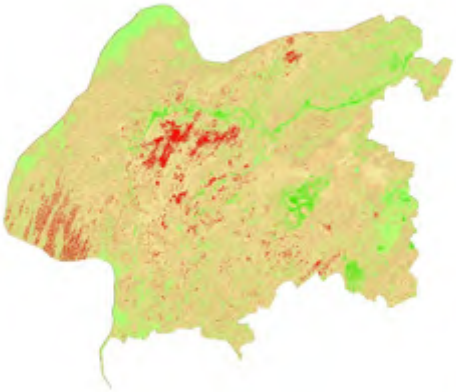




Mosaicking



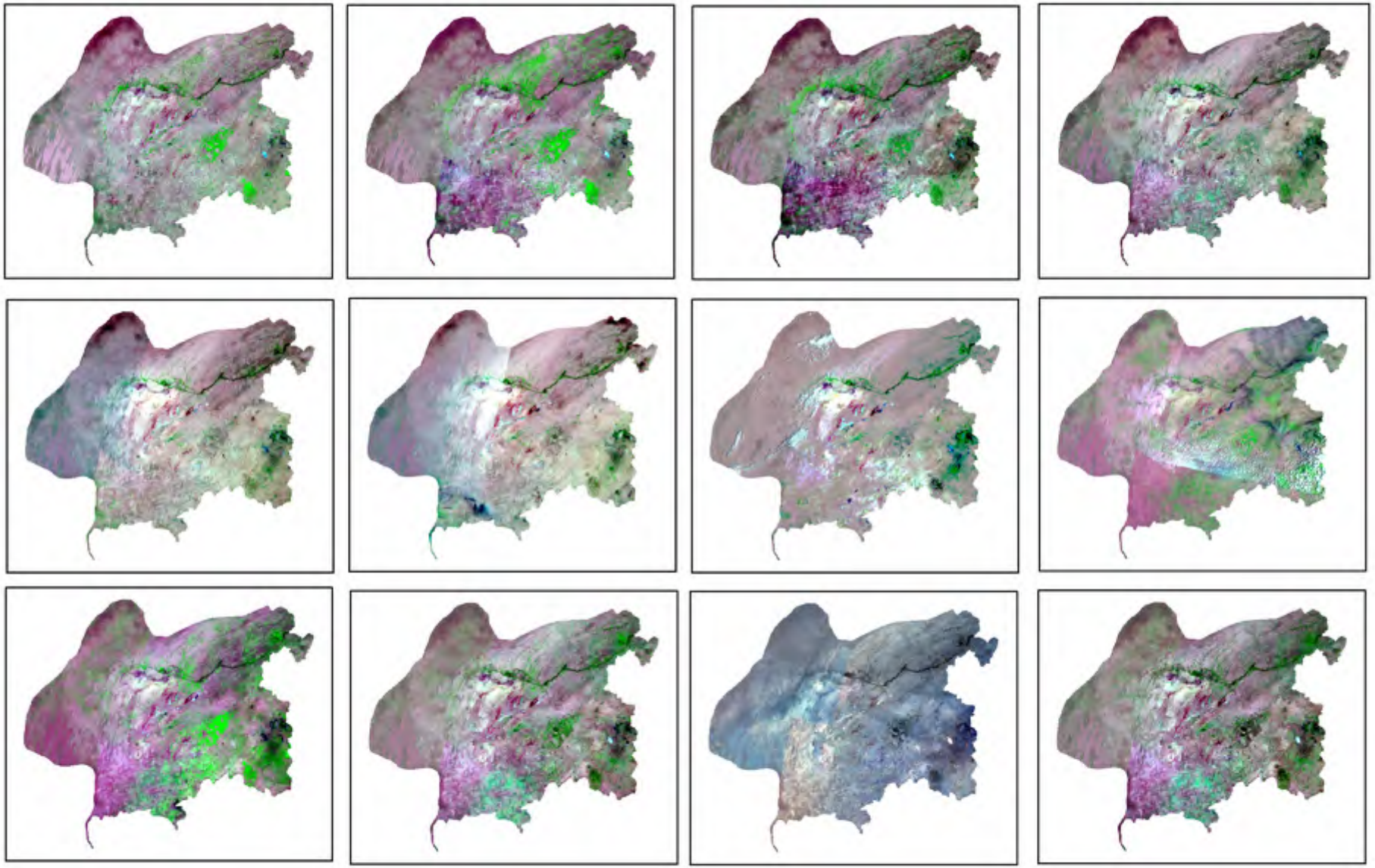
Spectral classification



- 36 images processed
- Monthly time scale 2018

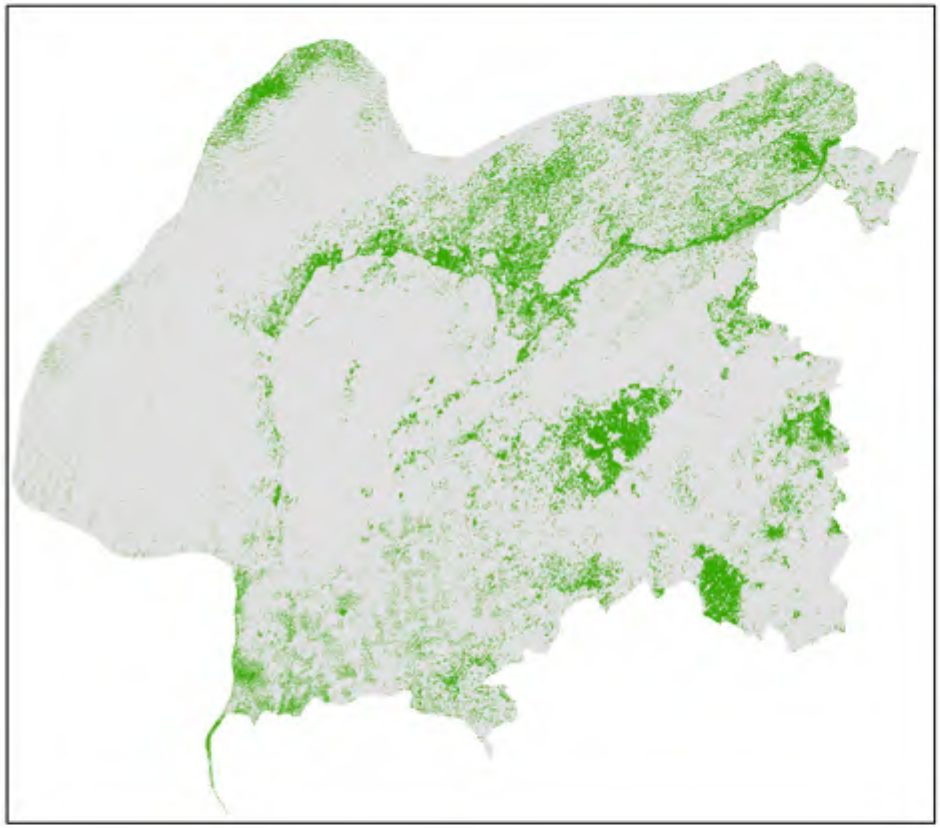
LU INTRA ANNUAL VARIABILITY 2018

January

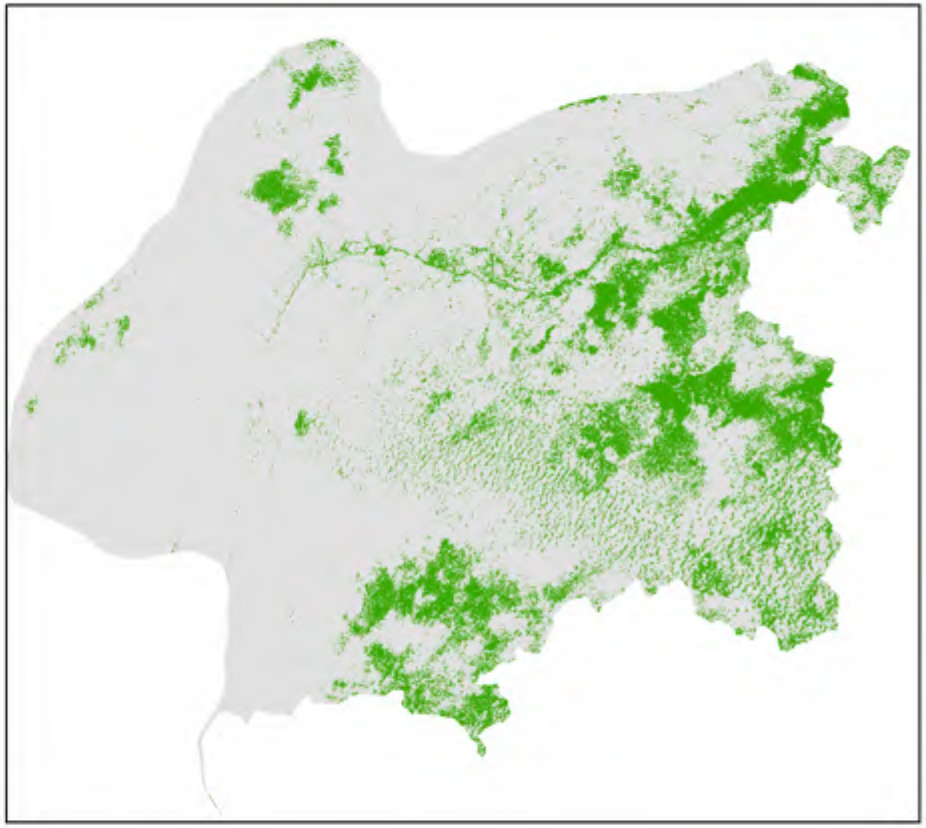


December

LAND USE INTRA ANNUAL VARIABILITY



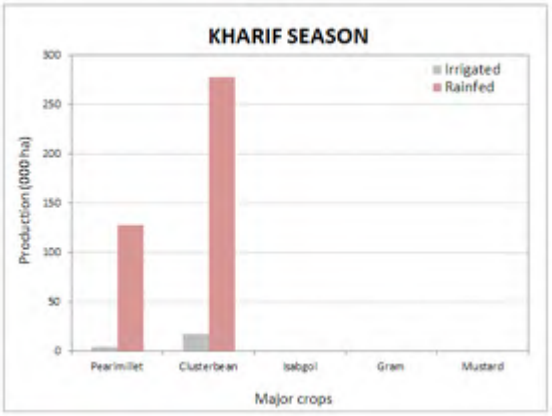
February ~350000 ha



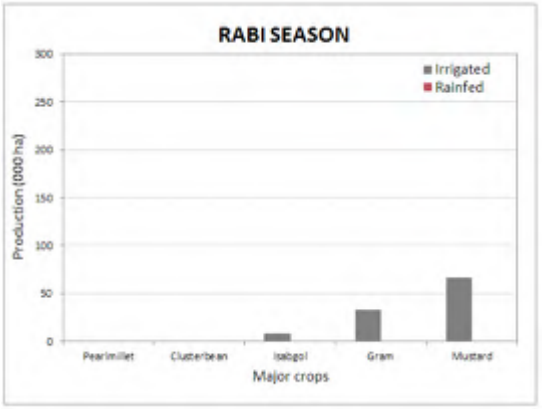
February ~ 630000 ha

Crop Seasons

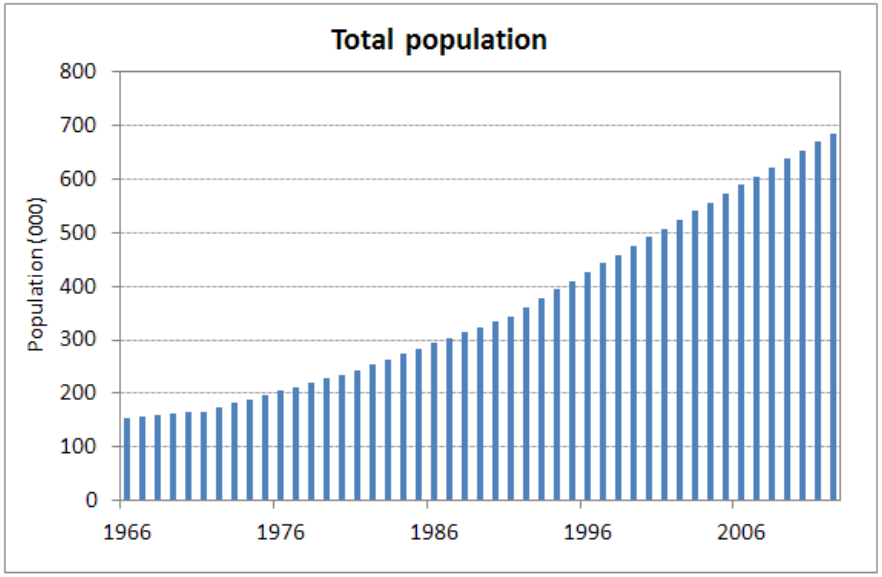
Kharif : Summer Crop.
Sowing in June end/ July
Harvesting in September/ October
Principal crops: Bajra, pulses, jowar, groundnut

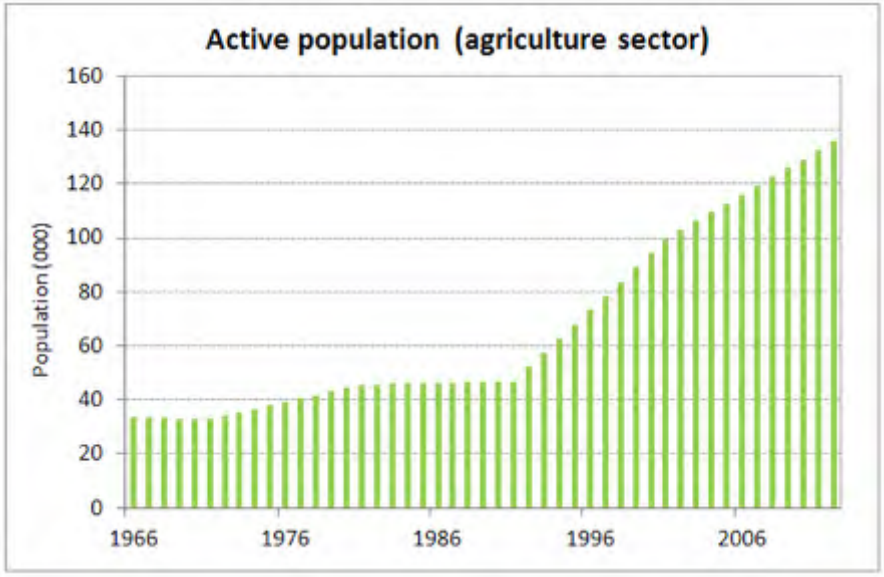


Rabi: Winter Crop
Sowing in October/ November
Harvesting in April/March
Principal crops: Barley, wheat, gram, pulses, Oil seeds.



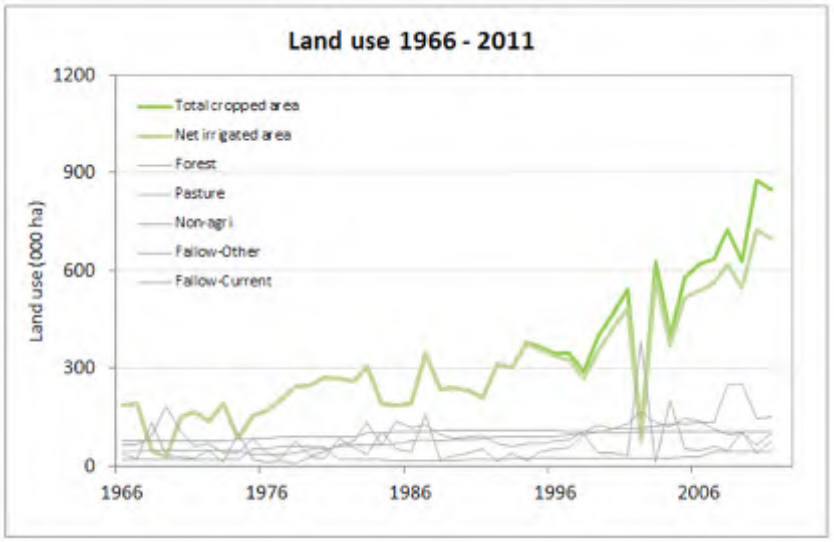
SOCIO-ECONOMIC CHANGES

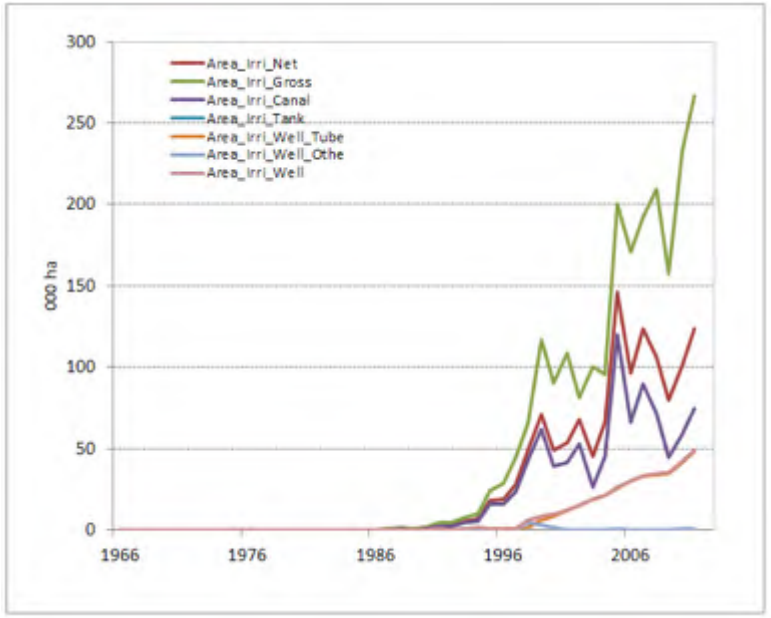


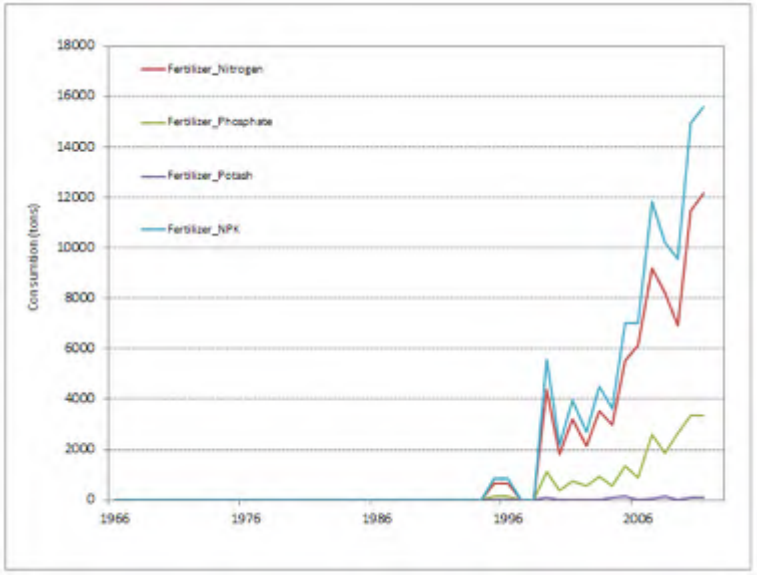


Source: Dorin, 2019 – Agribiom India

SOCIO-ECONOMIC CHANGES





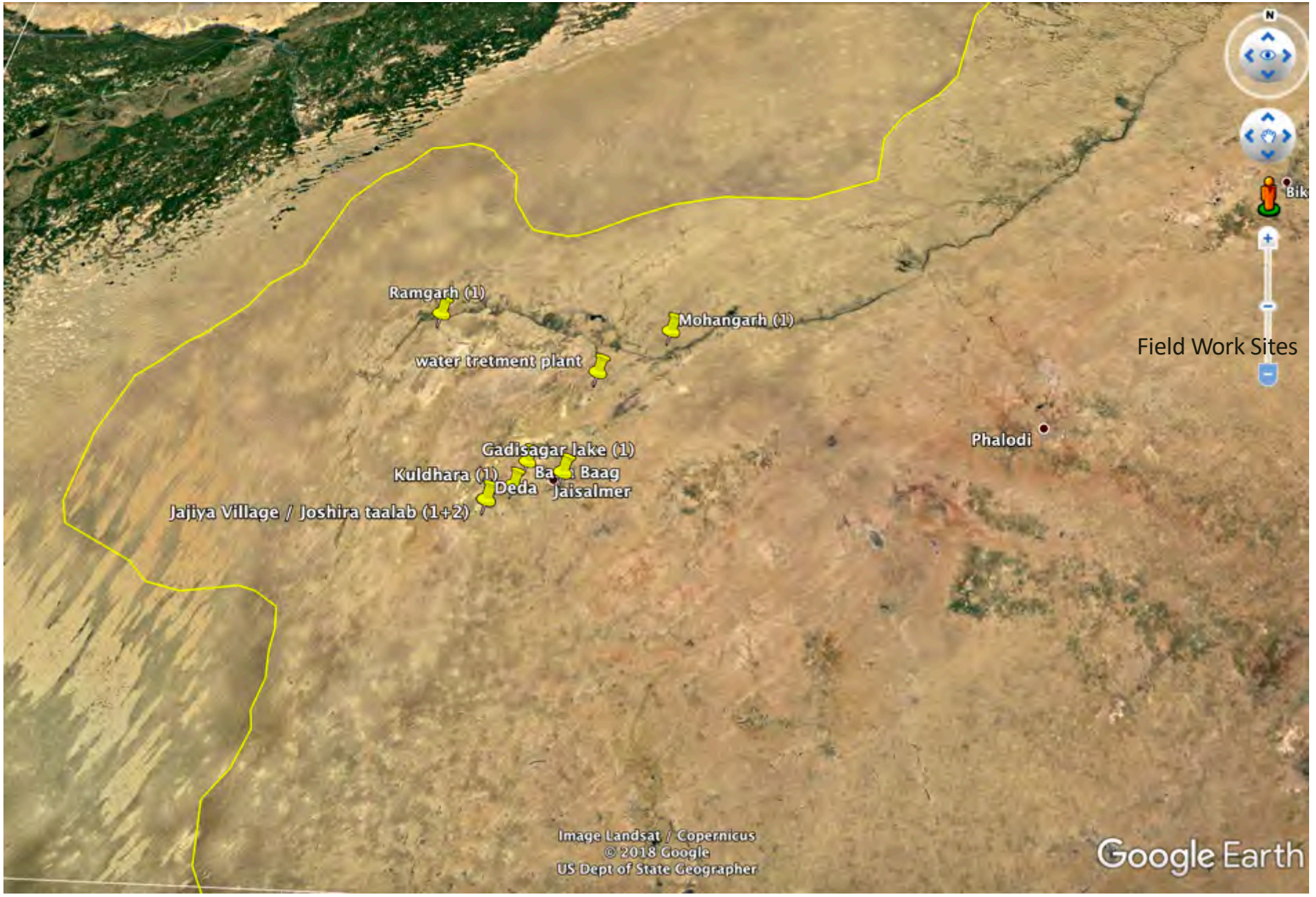


Source: Dorin, 2019 – Agribiom India

- Gross cultivated area
  - 6.3%: growing only of rainy crops in Kharif season that too associated
  - with high risk. Leads to dependence of community on livestock

Field Visits

- First in July 12-16, 2019
- Second in August 17 – 21, 2019
- Different sites visited
- Access issues
- Unstructured interviews with local farmers


Ramgarh (1)
Mohangarh (1)
water tretment plant
Gadisagar lake (1)
Kuldhara (1)
Deda
Jaisalmer
Jajiya Village / Joshira taalab (1+2)
Phalodi
Field Work Sites
Image Landsat / Copernicus
© 2018 Google
US Dept of State Geographer
Google Earth

Field Work

- Places visited
  - Ramgarh- Canal
  - Mohan nagar – Canal Head / Water Treatment Facility (Debhua)
  - Jaisalmer city and around
    - Villages: Kuldhara/Dedha/Sam/Jhajia/Amars-sagar/Pithla/
    - Baghs: Barra Bagh/Amarsagar bagh
    - Tallab: Joshira/ Gadhisar/Dashina
    - Khadins: Nani/Masoodi/Bap – behind Jajia/Khatari
    - Nadi: Pipal/ Kak
    - Baoris

Khadins

- Several
  - Designed by Palival Brahmins (15th c) *'Mishra 2001*
  - Rainwater harvesting for farming
  - Remains moist for several months
  - Improve soil nutrients and stability
  - Shared water – individual fields
  - Often have a religious structure at the head
  - Masoodi fed by Kak nadi (app 30 km long river)/ Nani – 2.5 km long/Bap/Khatari
  - Water is shared and left over drained for adjacent fields outside
  - Upto 2 crops annually if it rains
  - Some are slowly going into disuse

Baoris

- Hand dug wells
- Some have pumps installed
- Upto 200-300 ft deep
- Some have separate troughs for animals
- Ground water falling sharply over 20 years owing to borewells
- Exist all over the field sites – near villages
- Potable water

Taalabs (lakes)

- Man made (said to be around 15th century)
- Well thought Have water harvesting systems to guide rain-water
- Retain some water around the year - perennial
- Can be very large and several meters deep
- Water used only for drinking not for irrigation
- Used for livestock drinking as well
- Marked by ”shilpas” for travelers
- Visited Jashira/ Josher/ Gadhisar/Dashina

Lake Jashira

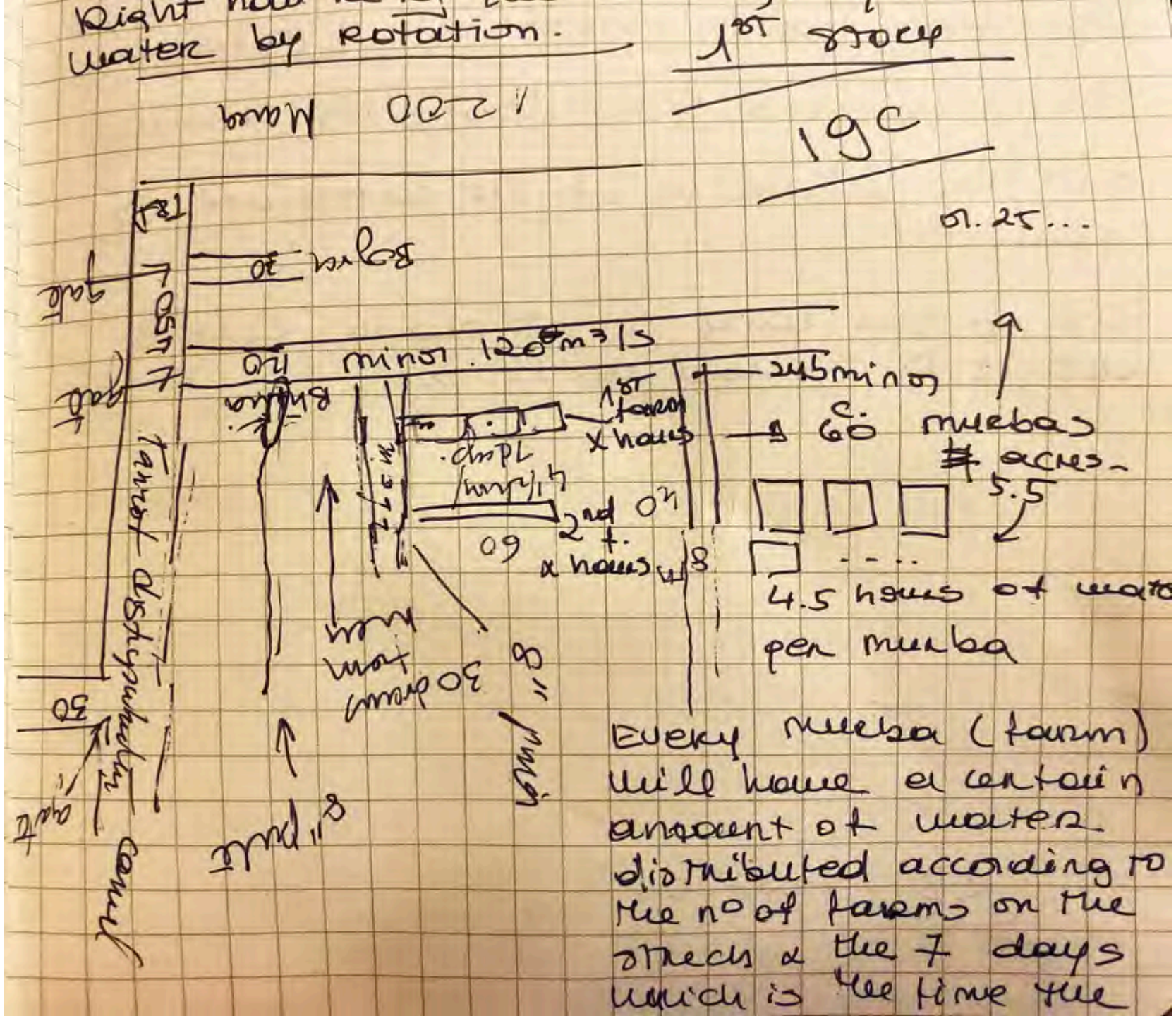
- 1 km lengths when completely filled
- Perennial lake
- 13-15 century by Paliwal Brahmins
- Gravity flow
- 8 villages consume water from it
- Private tankers (500 litres) carry water to local home storages
- When there is a water overflow, a canal stores the water and feeds it back to the lake in a circular manner

Canal Farming

- Land allotted in 1999
- All land still not allotted – also land disputes
- Farms divided into block and land allocation of about 4.5 acre each (approx. 11 acres)
- Holdings vary – one farmer owned 75 biga
- Water is released every 15 days for 7 days for a cluster of plots
- Each plot received 4.5 hours of water every fortnight
- 2 crops – Rabi and Kharif (June/July – Aug/Sept and Oct/Nov– March/April
  - Mustard, moong, moth, gowar, millet: Wheat groundnut, channa…

Canal Farmers

- Local plus migrated in from Haryana and Punjab
- Increased to over 30 % of population
- All farmers also keep livestock
- Price of land varies with harvest bounty
- Illegal farming exists
- Some farmers store water from seepage as emergency water
- Water supplied barely enough – no surplus



Canal network

Borewell Farming

- Visited near Dedha – 100 bighas
- 600 ft borewell – water is at 400 ft , pump driven
- Jawhar, gawar, bajra, til, peanut, brinjal, red pepper, etc.
- Sharecropper – 1:3 revenue sharing with owner
- Family labour
- Adjoining farmers buy water

Dabhua Lake – water treatment plant

- Near Mohangarh – supply to Jaisalmer drinking water
- 20 km canal from main canal
- Artificial lake
- 2 filtration plants
- Poorly maintained tanks – water hyacinth

Processes – Issues (Water) *Goyal and Arora, 2003*

(negative impacts)

Introduction of the IGC

Waterlogging and Salinity

Irrigation with the canals

- Accumulation of water causes rise of groundwater
    - Absence of sufficient withdrawal
    - Rise of groundwater table
    - When water table upto root zone of the crops – causes waterlogging
    - Land unsuitable for agricultural use
    - Increases salt in soil and soil in groundwater is transported to top soil and raises salinity
- Water logging and salinity – major land degradation processes and impact

Difficulties with IGC

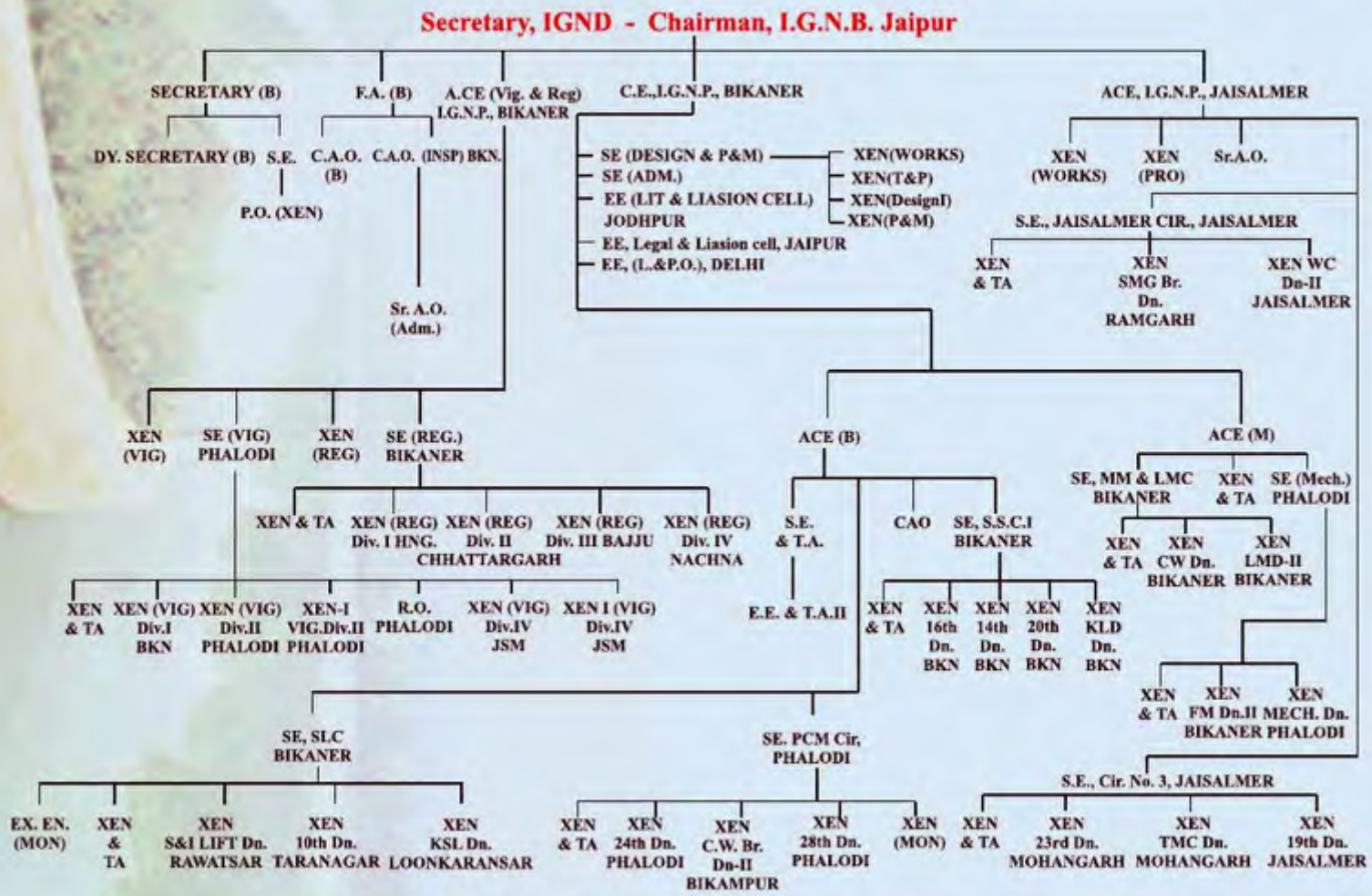
- Technical Issues
  - Water logging
  - Seepage
  - Siltation
  - Salinity

- Environment
  - Evaporation
  - Windspeed
  - Sand Transportation
  - Climate Change
  - Undulating topography

- Governance and Management Issues

ORGANISATIONAL SET-UP OF IGND

परिशिष्ट-1



Note :- A.C.E. Vigilance and Regulation is under Administrative Control of Water Resource Department, Jaipur

Indira Gandhi Nahar Organizational setup

Thank you!