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Assessing Global drivers of Ghana Water use from Consumption and Income-perspective

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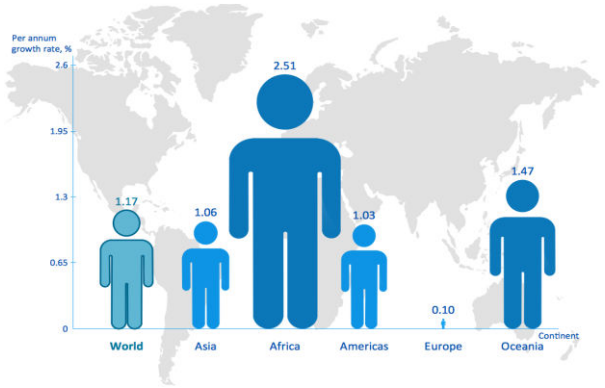
CONTENT

Introduction



- Population growth and increasing demand. (Wahba et al., 2018)
- Global water shortage
- Sustainable development. (Distefano & Kelly, 2017; Hirwa et al., 2022)
- Ghana -West Africa.
- Urgent need to understand the drivers of water uses
- Information for water resources management.

Introduction Cont. (Literature Gap)

Existing approaches to water use analysis (Brindha, 2019; Caro et al., 2021a; Chini et al., 2022; Fang et al., 2023).

- ❖ Three perspectives (production, demand and supply)
- ❖ Two quantification approaches("bottom-up" and "top-down").

Limitations existing studies in Africa

- ○ Production perspective (local scale) (Akoto-Danso et al., 2019; Chouchane et al., 2015).
- ○ Commodity specific (Obeng et al., 2023).
- ○ Sector specific (Boudhar et al., 2017; Wahba et al., 2018).
- ○ Out-dated water use data
- ○ Focus on bottom-up approaches (i.e., Life cycle assessment) (Cansino et al., 2016; Kucukvar & Samadi, 2020).

Innovation and Objective of this research

- ❑ Latest and high resolution water use data
- ❑ Wide sector-wise analysis
- ❑ Top-down approach
- ❑ Demand and supply perspective.
- ❑ Long data frame (2012-2021)

This study analyses two-critical pathways of water use (Demand and supply perspectives) on a global scale from (2012-2021)

Data Sources

GTAP

OECD-ICIO

FIGARO

WIOD

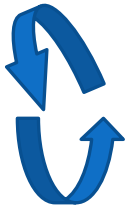
EXIOBASE

OECD-ICIO

GLORIA Database (Lenzen et al., 2022)

Eora

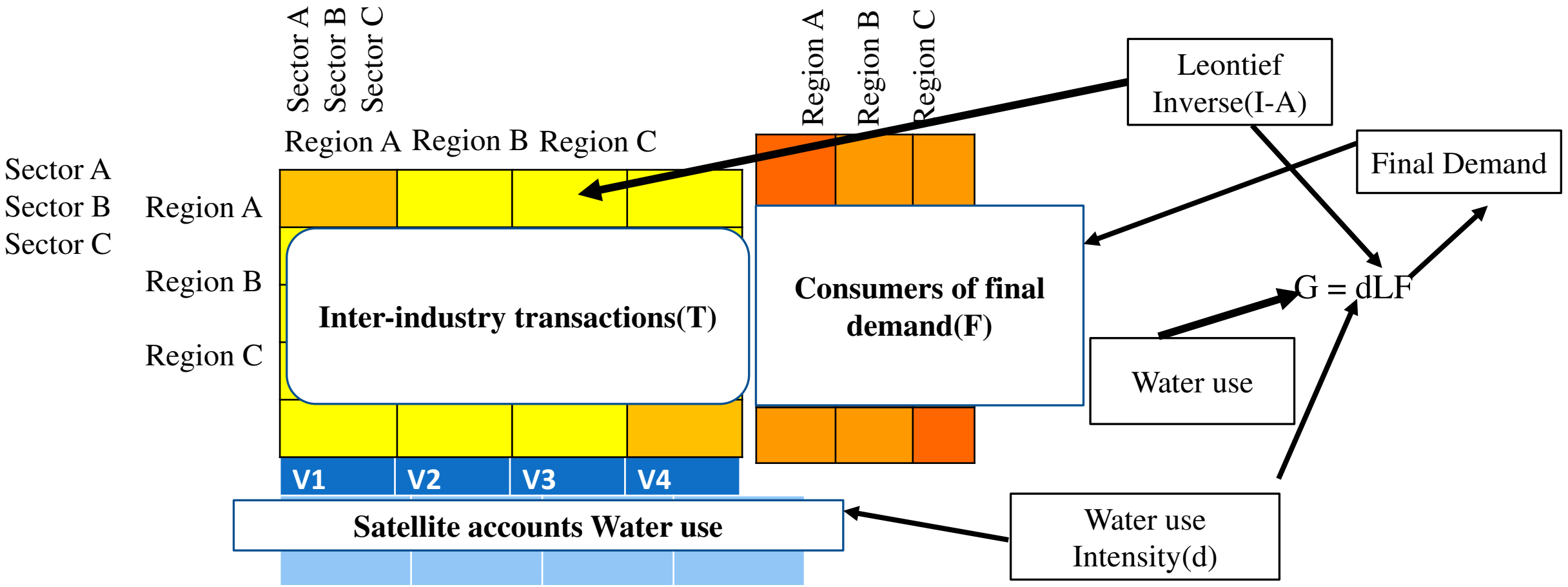
- ❑ 2023 Release (MRIO data)
- ❑ Satellite account of water use
- ❑ 'Root classification' (SUT)



- ❑ Suitable MRIO Table
- ❑ 120 SECTORS
164 COUNTRIES

Methods and Data Cont.

Estimating water-use embodied in Ghana's Global Trade.



Methods and Data

❖ **Modelling water use from demand perspective**

$$\mathbf{G} = \mathbf{d}(\boldsymbol{I} - \mathbf{A})^{-1}\hat{\boldsymbol{f}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.(1)$$

- ❑ Water use intensity (G)
- ❑ Water use intensity of each nations sector (d)
- ❑ Identity matrix (I)
- ❑ A (direct input coefficient matrix)
- ❑ $(\mathrm{I} - \mathrm{A})^{-1}$ (Leontief inverse matrix)
- ❑ f (final demand of each nation)
- ❑ $\hat{f}$(diagonal matrix of f).

⇒

$$\mathbf{d} = \mathbf{p}\left(\hat{\boldsymbol{x}}\right)^{-1} \quad \ldots\ldots\ldots..(2)$$

Methods and Data Cont.

⇨

❖ **Modelling water use from Primary input supply perspective**

$$\mathbf{n} = \hat{q}(I - \mathbf{B})^{-1}\ \acute{d} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

- ❑ Ghana's water use intensity enabled by primary inputs **(n)**
- ❑ Row vector of primary inputs supply **(q)**
- ❑ Corresponding diagonal matrix $(\hat{q})$
- ❑ Ghosh Inverse matrix $(I - \mathbf{B})^{-1}$

Results and Discussions

Trend of water use driven by Domestic and Foreign Final demand and primary input supply

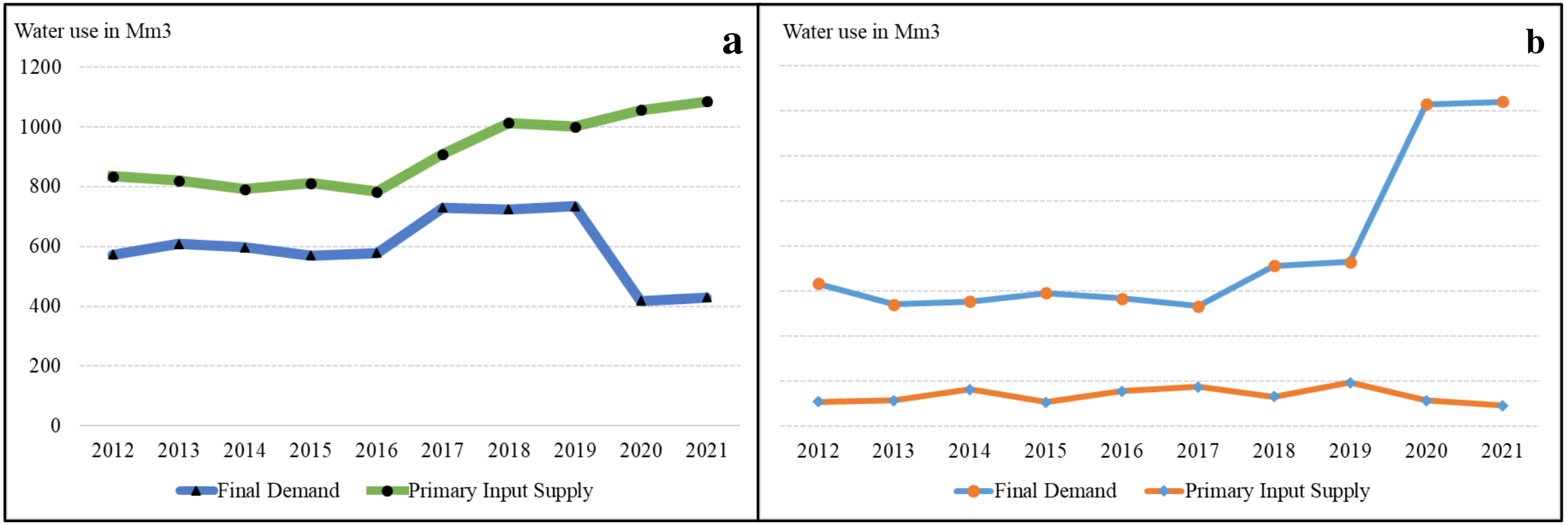


Fig 1(**a** and **b**). Domestic and Foreign Final demand and primary input supply driving Ghana's water use(2012-2021)

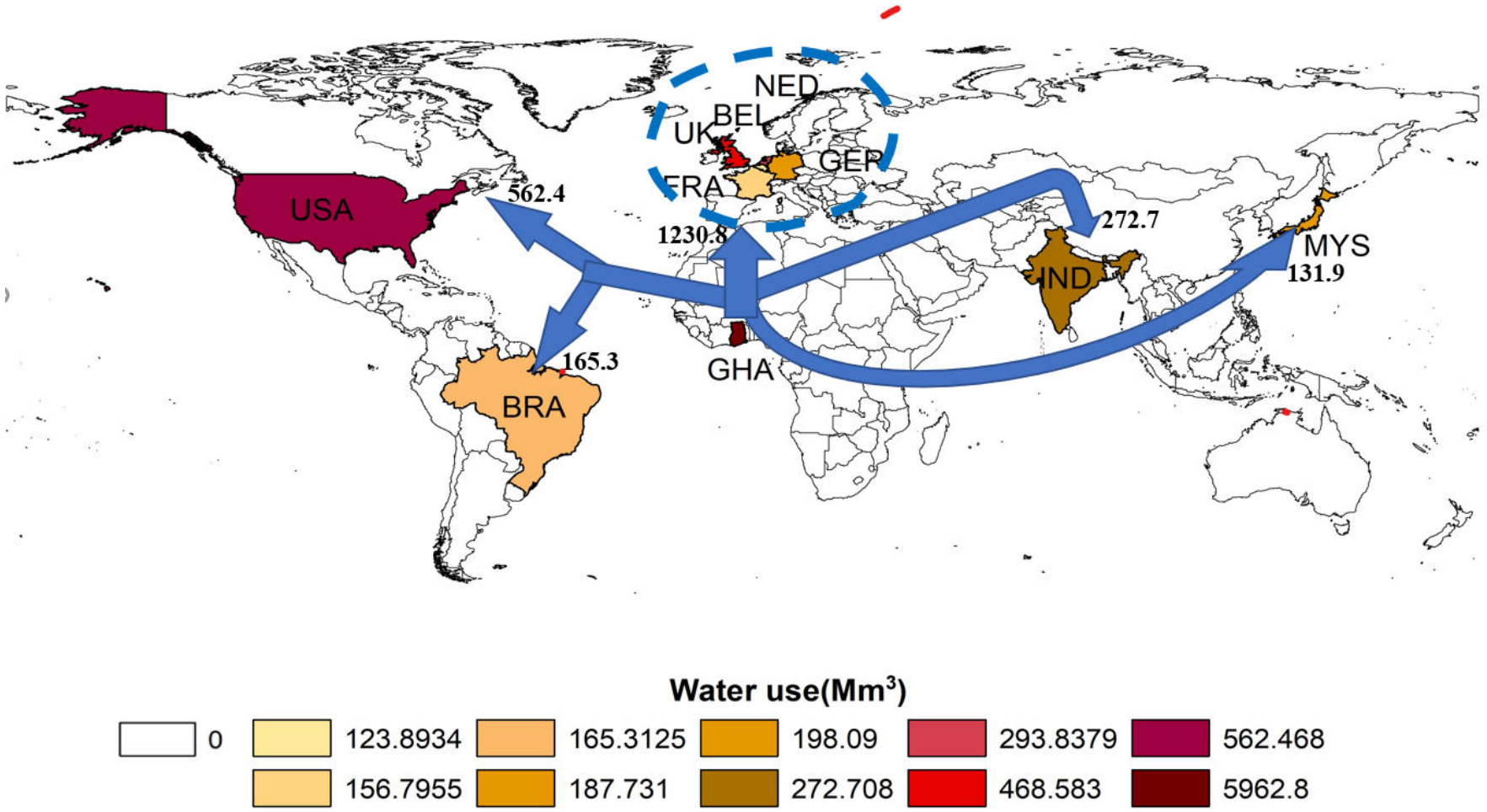
Results and Discussions

Table 1: Contribution of critical nations driving Ghana's water use

Consumption				**Income**		
Rank	Nation	Induced water use (Mm^3)	Contribution (%)	Nation	Induced water use (Mm^3)	Contribution (%)
A	Ghana	5962.8	60.67	Ghana	9110.1	93.1
B	USA	562.468	5.72	China	88.5	0.9
C	UK	468.583	4.77	Cote d'Ivoire	59.03	0.6
D	Netherlands	293.8379	2.99	USA	54.2	0.6
E	India	272.708	2.77	U A E	35.4	0.4
F	Germany	198.09	2.02	Nigeria	29.7	0.3
G	Japan	187.731	1.91	India	27.8	0.3
H	Brazil	165.3125	1.68	Russian	21.1	0.2
I	France	156.7955	1.60	Netherlands	21.0	0.2
J	Malaysia	131.9748	1.34	UK	20.3	0.2

Note: A-J denotes ranking from highest to the lowest contributor to Ghana's water use

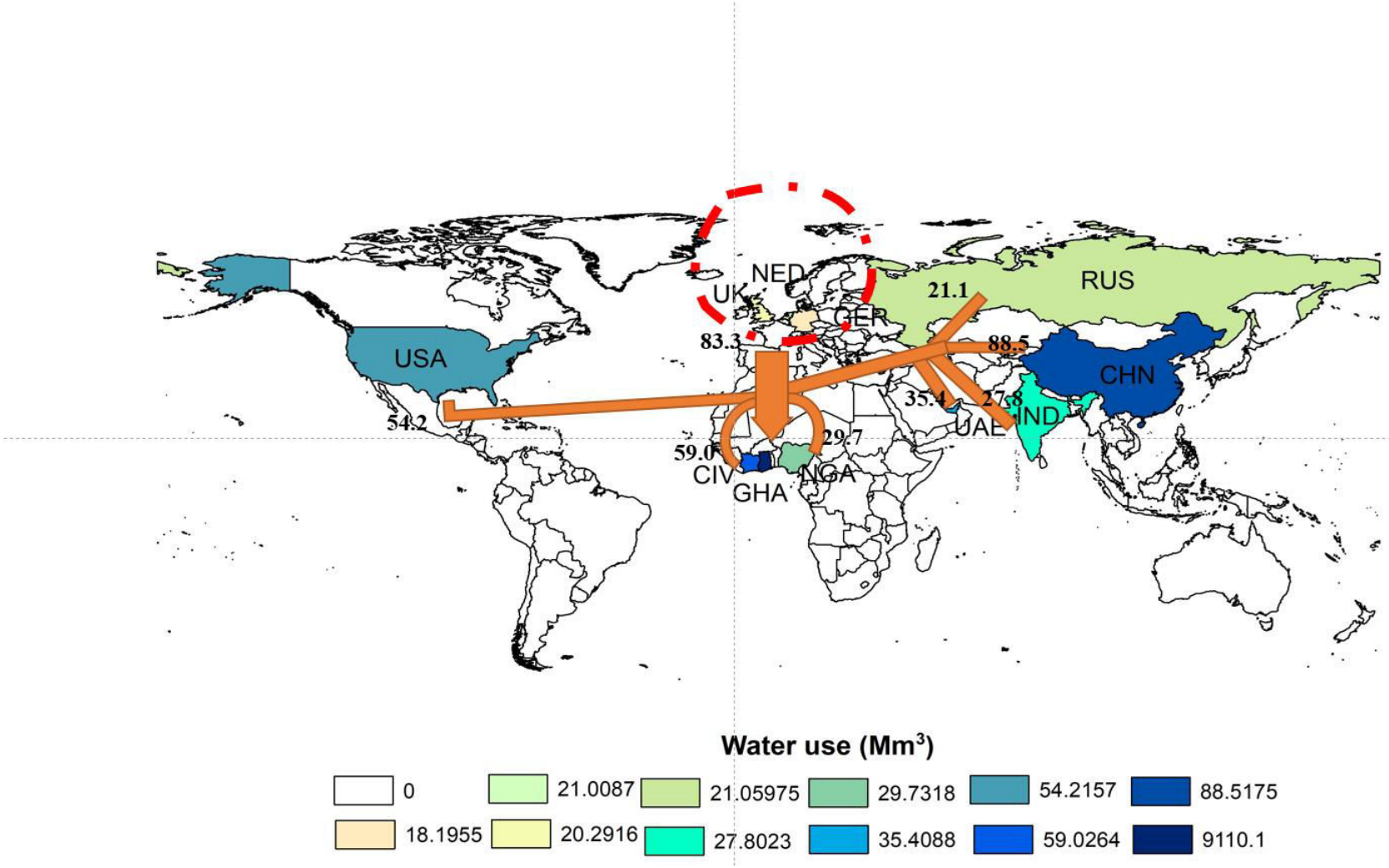
Results and Discussions



- ✓ **Europe, USA and India drives substantial water-use (Consumption)**
- ✓ **Brazil and Malaysia play significant role in Ghana's water use**

Fig 2. Ghana's **water use** induced by **final demand** of key nations

Results and Discussions



- ✓ **China, Europe and USA drive substantial water use(Indirect)**
- ✓ **Cote d'Ivoire and Nigeria play significant role in Ghana's water use**
- ✓ **India Russia are import supply side drivers**

Fig 3: Ghana's water use induced by primary input supply from Key nations

Results and Discussion

Table 2: Consumption and Income perspective of Ghana's water use by sectors

Sectors driving Ghana's water use	Consumption		Income	
	Internal	External	Internal	External
Agriculture	**5063.6**	**2460.6**	**6475.3**	**72.4**
Fishing	0.99	1.08	0.16	1.6
Mining and Quarrying	24.7	1.44	**90.9**	**81.1**
Manufacturing	**698.6**	**1179.1**	**367.3**	**309.6**
Electricity, gas, steam and air conditioning supply	1.74	2.74	24.7	11.3
Water supply; sewerage, waste management and remediation activities	2.13	1.7	2.6	7.2
Construction	14.23	43.3	10.0	3.4
Wholesale and retail trade; repair of motor vehicles	1.08	12.0	**1632.8**	**68.2**
Transportation and storage	0.74	6.23	**260.8**	30.7
Accommodation and food service activities	**70.3**	**54.9**	10.7	3.2

Note: *Value above 50 are given bold

Results and discussion Cont.

Table 2 Cont.: Consumption and Income perspective of Ghana's water use by sectors

Sectors driving Ghana's water use	Consumption		Income	
	Internal	External	Internal	External
Information and communication	11.7	6.1	18.6	18.8
Financial and insurance activities	0.7	2.5	**88.9**	20.0
Real estate activities	3.3	4.1	43.1	8.4
Professional, scientific and technical activities	0.2	2.3	39.1	22.9
Administrative and support services	0.7	2.2	17.6	13.6
Public administration and defense; compulsory social security	20.2	19.2	6.5	2.6
Education	28.3	8.5	0.6	1.2
Human health and social work activities	9.5	51.1	1.9	0.7
Arts, entertainment and recreation	3.4	4.7	1.03	1.2
Other service activities	5.7	3.2	17.2	2.1

Note: *Value above 50 are given bold

Conclusion

➢ DOMESTIC DRIVERS OF GHANA'S WATER USE

- ❑ About 60% of water use is virtually consumed within the boundaries of Ghana (Internal) via final demand for goods and services.
- ❑ Local primary inputs supply accounts for about 90% of Ghana's water use.
- ❑ The agriculture and manufacturing sectors play significant role in definition water use in Ghana.

➢ FOREIGN DRIVERS OF WATER USE INGHANA

- ❑ USA and China are critical drivers of Ghana's water use from final demand and income perspective respectively.
- ❑ Two West African nations impact Ghana's water use via primary input supply
- ❑ Foreign final demand and primary input supply exhibit great potential in driving Ghana's water use
- ❑ 5 European nations contributes significantly to indirect water use in Ghana(Final demand) whilst 3 induce water use through primary input supply

Policy Recommendation

Fair allocation water management responsibilities

Improving Agricultural production efficiency

Implementing strategies targeting primary input supply.

R&D investments and improvement in water Data access at Local & sectorial level

Harnessing existing trade agreements to balance virtual water gains

Water decade (2018-2028)

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THANK YOU!