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Small-Scale Irrigation – Income and economic growth opportunities

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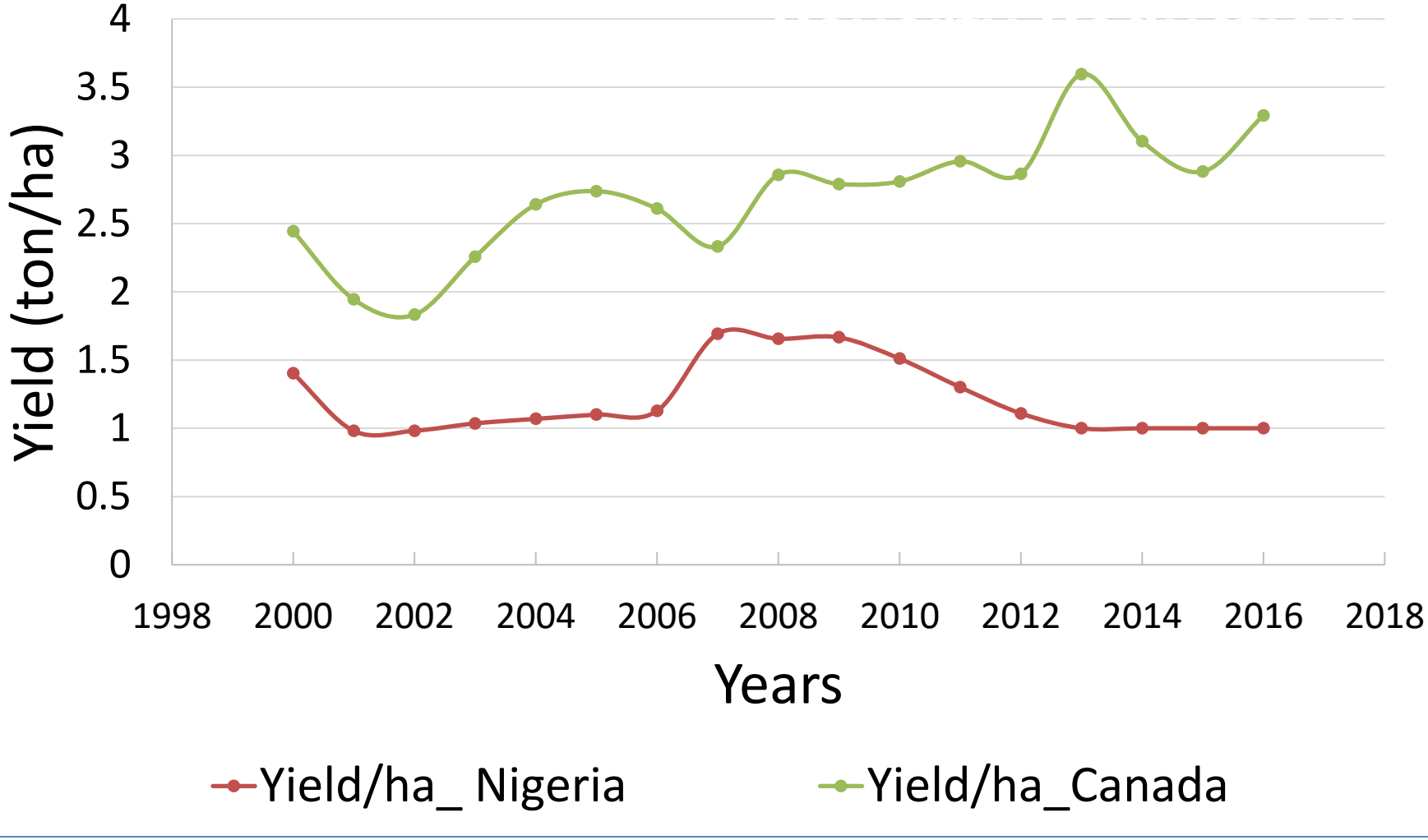
Key Characteristics

- *Rain-fed agriculture dominates (over 95% rain-fed)*
- *Low irrigated production (only <4% irrigated production).*
- *Low use of agric. inputs/technologies (2kg/ha SSA vs.146/ha World averg. vs.~400kg/ha China)*
- *Low agric. productivity (prod. most staples < 50% global average)*
- *Land fragmentation/population pressure*
- *Low income/high incidence poverty (~40% below poverty line)*
- *Food insecurity & malnutrition (35% children < 5 stunted: Nigeria)*
- *Climatic risks/shocks*

Agric. Productivity



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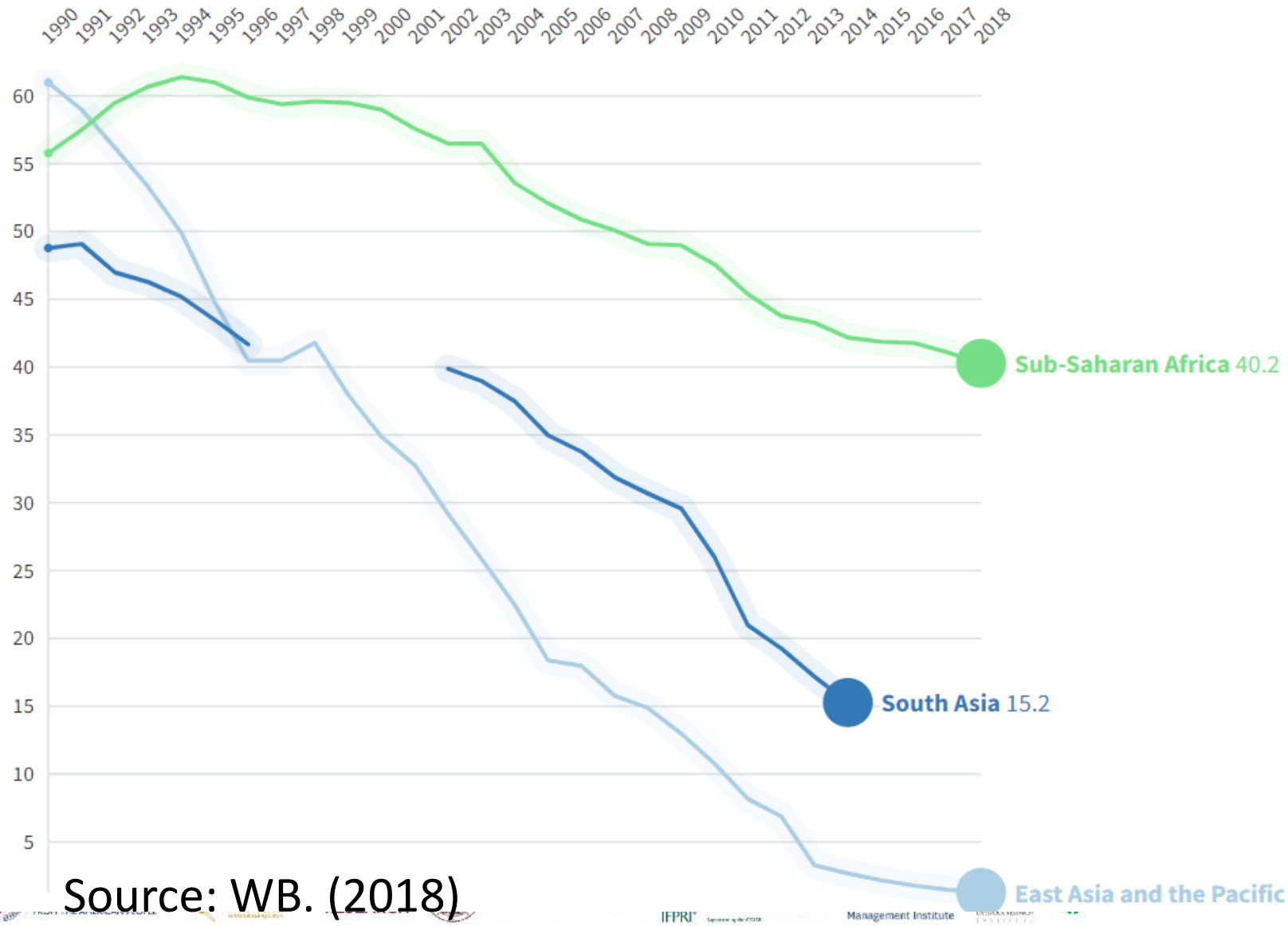
Poverty



Source: WB. (2018)

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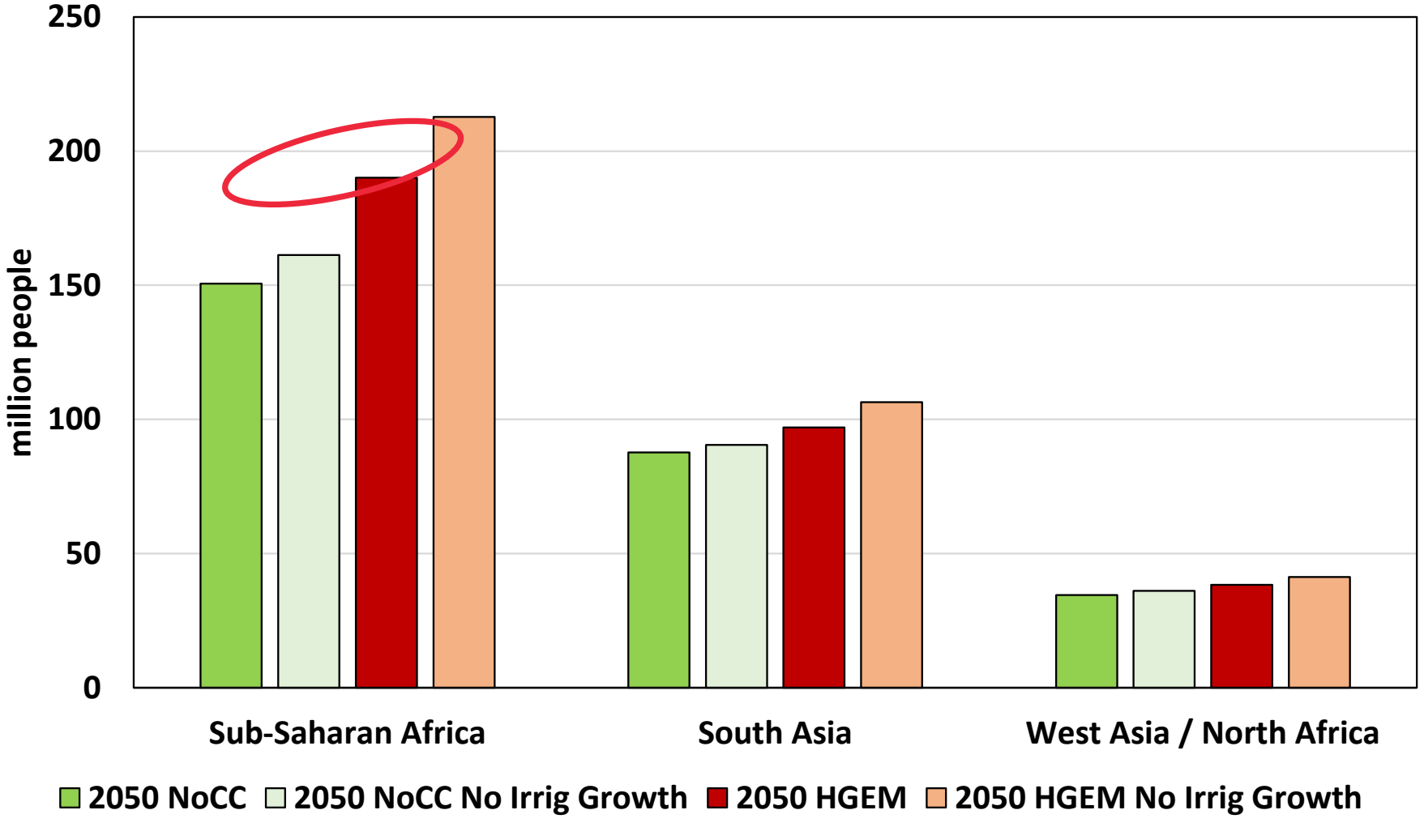
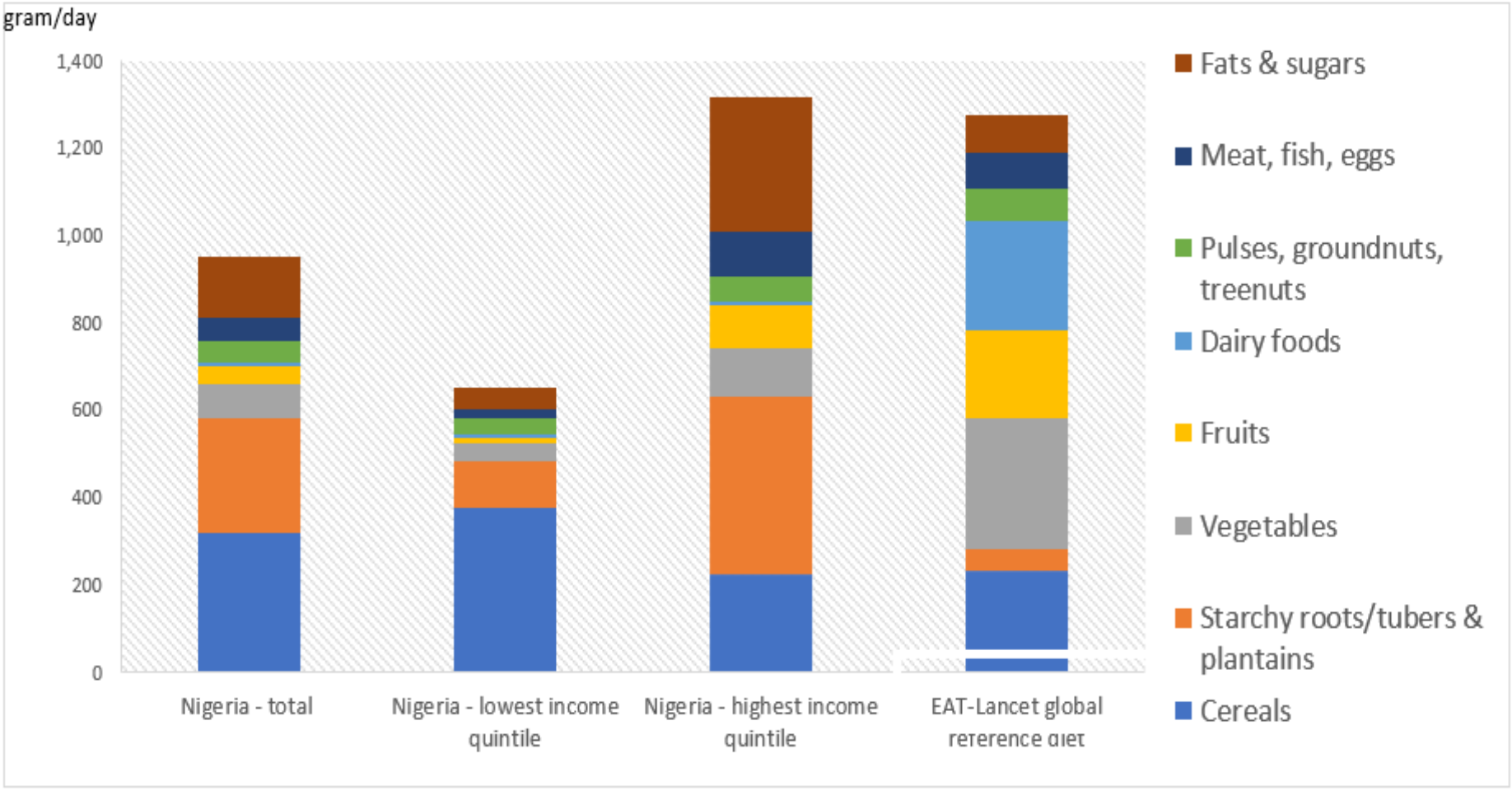
Irrigation development is essential to reduce the number of people at risk of hunger: 46 million fewer people at risk of hunger with irrigation development



Food/nutrition

Nigerian household dietary composition – (by income quintile)



Source: Ecker, Brown, and Andam (2021)

Return to Investment (1)

Returns to investment in irrigated crop production - Ghana

Small-scale irrigation technology/scheme	Returns on investment (GH¢) (by crops and irrigation technology)[a]								
	NPV			IRR (%)			BCR		
	Onion	Tomato	Mixed[b]	Onion	tomato	Mixed	Onion	Tomato	Mixed
Small reservoirs	799,059	8,197,693	10,974,035	49%	194%	248%	1.65	6.31	7.36
Fuel-powered motorized pumps	7,257,011	6,257,011	6,648,213	302%	256%	279%	8.48	7.20	7.95
Electricity-powered large pumps	36,305,654	28,495,246	32,598,465	122%	103%	113%	3.58	3.03	3.35

Notes: [a]US$1 = 4.40 GH¢ during the time of field survey (2017); Ghana cedis, the official currency of Ghana.
[b]In a mixed cropping scenario, 50% onion and 50% tomato were assumed.
NPV, net present value; IRR, internal rate of return; BCR, benefit–cost ratio.

Balana & Akudugu (2023). *Water Inter. 48(1):40-62*

Return to Investment (2)

Table 3. Results of sensitivity analysis for various scenarios and the associated changes in returns or investment indicators[a].

Small-scale irrigation technology/scheme	NPV			IRR (%)			BCR		
	Onion	Tomato	Mixed[b]	Onion	tomato	Mixed	Onion	Tomato	Mixed
Scenario 1: 25% reduction in output prices (changes in returns on investment)									
Small reservoirs	173,331	6,237,627	7,598,788	36%	156%	182%	1.10	4.56	5.40
Fuel-powered small, motorized pumps	4,369.232	4,073,890	4,234,604	195%	184%	190%	5.50	5.20	5.43
Electricity-powered large pumps	18,959,873	16,845,773	18,100,839	80%	75%	77%	2.35	2.20	2.32
Scenario 2: 50% capacity utilization (changes in returns on investment)									
Small reservoirs	30,859	3,774,319	4,624,067	34%	108%	124%	1.02	3.16	3.68
Fuel-powered small, motorized pumps	7,257,011	6,013,330	3,248,482	302%	256%	279%	6.64	5.64	7.95
Electricity-powered large pumps	11,122,031	7,216,827	13,033,605	61%	51%	56%	1.79	1.51	1.68
Scenario 3: 30% cost overruns (changes in returns on investment)									
Small reservoirs	627,240	8,791.840	10,466,683	43%	166%	191%	1.28	4.89	5.66
Fuel-powered small, motorized pumps	6,988,590	5,744,909	2,980,061	232%	179%	215%	6.64	5.64	6.21
Electricity-powered large pumps	32,230,589	24,420,181	8,958,540	94%	79%	87%	2.78	2.35	2.58
Scenario 4: 25% reduction crop yields (changes in returns on investment)									
Small reservoirs	173,331	6,237,627	7,598,788	36%	156%	182%	1.10	4.56	5.40
Fuel-powered small, motorized pumps	4,369,232	4,073,890	4,234,604	195%	184%	190%	5.50	5.20	5.43
Electricity-powered large pumps	18,959,873	16,845,773	18,100,839	80%	75%	77%	2.35	2.20	2.31

Notes: [a]US$1 = 4.40 GH¢ during the time of field survey in 2017; Ghana cedis, the official currency of Ghana.
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NPV, net present value; IRR, internal rate of return; BCR, benefit–cost ratio.

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SSI: Income & growth Potential in SSA

Koo et al. (2019). **PARI Policy Brief No. 12**

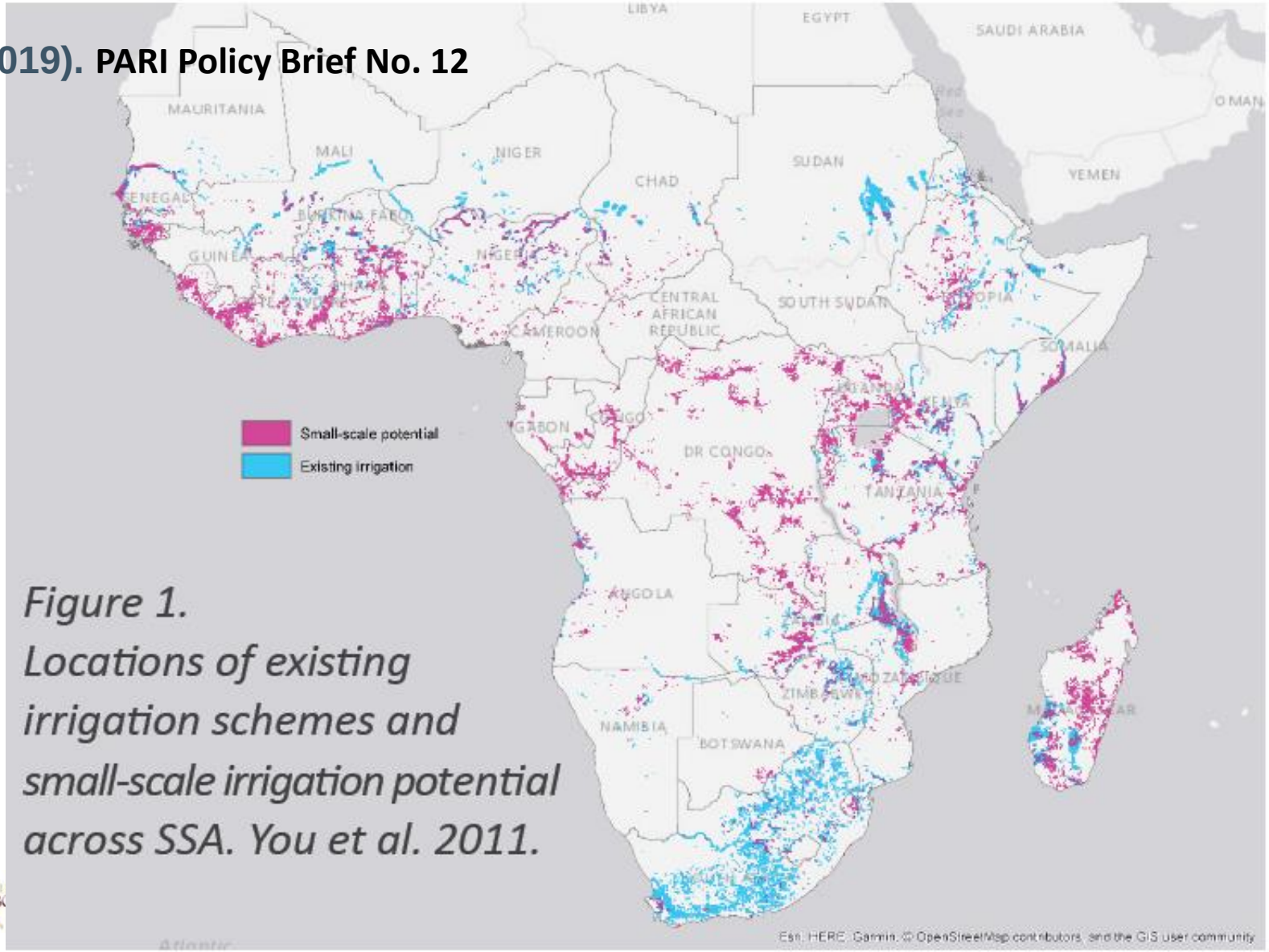

Figure 1. Locations of existing irrigation schemes and small-scale irrigation potential across SSA. You et al. 2011.

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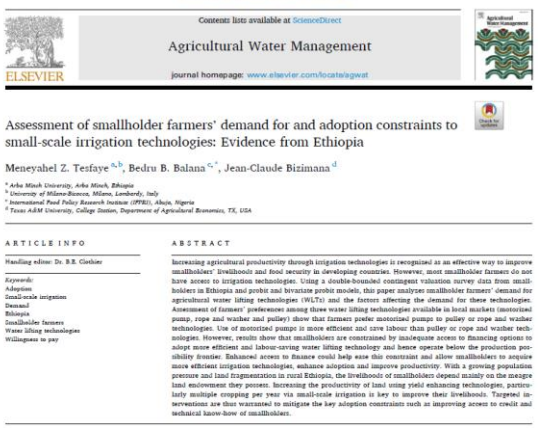
Challenges/Constraints



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Assessment of smallholder farmers' demand for and adoption constraints to small-scale irrigation technologies: Evidence from Ethiopia

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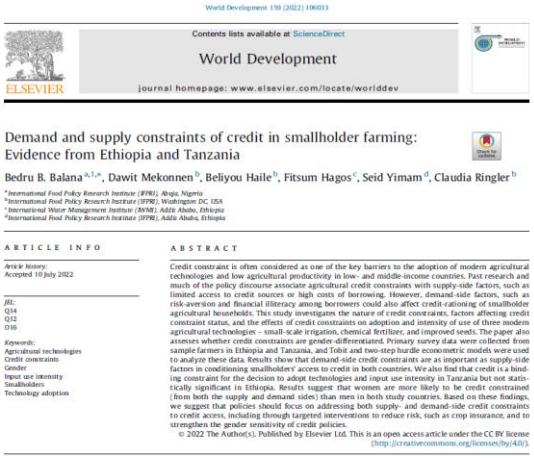
ABSTRACT

Increasing agricultural productivity through irrigation technologies is recognized as an effective way to improve smallholders' livelihoods and food security in developing countries. However, most smallholder farmers do not have access to irrigation technologies. Using a double-bounded contingent valuation survey data from smallholders in Ethiopia and probit and bivariate probit models, this paper analyzes smallholder farmers' demand for agricultural water lifting technologies (WLTs) and the factors affecting the demand for these technologies. Assessment of farmers' preferences among three water lifting technologies available in local markets (motorized pump, rope and washer and pulley) show that farmers prefer motorized pumps to pulley or rope and washer technologies. Use of motorized pumps is more efficient and save labour than pulley or rope and washer technologies. However, results show that smallholders are constrained by inadequate access to financing options to adopt more efficient and labour-saving water lifting technology and hence operate below the production possibility frontier. Enhanced access to finance could help ease this constraint and allow smallholders to acquire more efficient irrigation technologies, enhance adoption and improve productivity. With a growing population pressure and land fragmentation in rural Ethiopia, the livelihoods of smallholders depend mainly on the meagre land endowment they possess. Increasing the productivity of land using yield enhancing technologies, particularly multiple cropping per year via small-scale irrigation is key to improve their livelihoods. Targeted interventions are thus warranted to mitigate the key adoption constraints such as improving access to credit and technical know-how of smallholders.



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Demand and supply constraints of credit in smallholder farming: Evidence from Ethiopia and Tanzania

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ABSTRACT

Credit constraint is often considered as one of the key barriers to the adoption of modern agricultural technologies and low agricultural productivity in low- and middle-income countries. Past research and much of the policy discourse associate agricultural credit constraints with supply-side factors, such as limited access to credit sources or high costs of borrowing. However, demand-side factors, such as risk-aversion and financial illiteracy among borrowers could also affect credit-rationing of smallholder agricultural households. This study investigates the nature of credit constraints, factors affecting credit constraint status, and the effects of credit constraints on adoption and intensity of use of three modern agricultural technologies – small-scale irrigation, chemical fertilizer, and improved seeds. The paper also assesses whether credit constraints are gender-differentiated. Primary survey data were collected from sample farmers in Ethiopia and Tanzania, and Tobit and two-step hurdle econometric models were used to analyze these data. Results show that demand-side credit constraints are as important as supply-side factors in conditioning smallholders' access to credit in both countries. We also find that credit is a binding constraint for the decision to adopt technologies and input use intensity in Tanzania but not statistically significant in Ethiopia. Results suggest that women are more likely to be credit constrained (from both the supply and demand sides) than men in both study countries. Based on these findings, we suggest that policies should focus on addressing both supply- and demand-side credit constraints to credit access, including through targeted interventions to reduce risk, such as crop insurance, and to strengthen the gender sensitivity of credit policies.

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Agricultural credit constraints in smallholder farming in developing countries: Evidence from Nigeria

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ABSTRACT

The agricultural sector in developing countries like Nigeria is characterized by low productivity, driven partly by low use of modern agricultural technologies. Poor access to credit is seen as a key barrier to adoption of these technologies. Policy discourses and literature often associate credit constraints by smallholders with supply-side factors such as inadequate access to sources of rural finance or high costs of borrowing. However, demand-side factors, such as smallholders' risk-averse behavior, high transaction costs and information asymmetry predominate in rural areas of developing countries equally play important roles in the functioning of rural credit market. Using a nationally representative LSMS-ISA data from 5000 smallholders in Nigeria and seemingly unrelated econometric models, we examine the nature of rural credit, the factors affecting rural credits, and the effects of credit constraints on adoption of four agricultural technologies – inorganic fertilizer, improved seed, agrochemicals, and mechanization. Contrary to policy discourses focusing on supply-side factors of rural credit, we found that demand-side factors are equally important for improving access and utilization of rural credit. On the supply side, inadequate collateral is the key constraint; hence supply-side policies should focus on enhancing smallholders' capacity to possess bankable collateral, such as land title or assets. On the demand-side, interventions such as crop insurance, information access and extension services are needed to increase credit access, technology adoption, and smallholder's agricultural productivity.

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RESEARCH ARTICLE

Economic analysis of public investment in alternative agricultural water management schemes: a case study from northern Ghana

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ABSTRACT

This study assesses the institutions and economics of public investments in three agricultural water management infrastructure and technologies: rehabilitation of small reservoirs, fuel-powered motorized small pumps and electricity-powered large pumps. We find that all three technologies yield positive returns on investment, but their applicability varies spatially and across community due to differences in capital costs and environmental feasibilities or conditions. Sensitivity analyses indicate the base decision parameters – net present value, benefit–cost ratio and internal rate of return – remain stable despite potential changes in the flow of future benefits or costs. This provides further evidence about the worthiness of investment in irrigation infrastructure and technologies. However, significant under-utilized infrastructural capacities exist that warrant complementary investment in human and institutional capacities. Based on the findings policy recommendations are provided.

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- Credit/finance
  - Supply side
  - Demand side
- Institutional/policy (e.g., land tenure & water rights)
- Capacity/knowledge/information
- Gender inequality
- Complementary inputs
- Market imperfection (input & output)
- No/limited value addition
- Infrastructure (e.g. roads)
- Technical (dis-adoption)

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