Achieving Food Security through Sustainable Irrigation in the Context of Philippine Agricultural Development

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OUTLINE

- Motivation
- Importance of Water in Food Security and Current Challenges
- State of Water and Irrigation Systems in the Philippines
- Policy Analysis: Review of Key Policies
- Conclusions & Recommendations for Policy and Structural Improvements

Motivation

- Global food security is facing unprecedented pressures, driven by climate impacts, price shocks, and supply disruptions

- In the Philippines, these concerns are heightened by recent events like export restrictions on rice and volatile fertilizer costs
  - rising food prices & inflation
  - rice export restrictions
  - volatile fertilizer & fuel costs
  - climate impacts on agriculture

- Irrigation can have a pivotal role in improving and then sustaining agricultural productivity.

- **Fertilizer Costs**
  - Global Average Fertilizer Price Increase: Fertilizer prices have surged by approximately **150%** from 2020 to 2022
    - Nitrogen Fertilizers (e.g., Urea): Prices increased from an average of **$200/ton** in 2020 to over **$800/ton** by mid-2022
    - Phosphate Fertilizers: Increased from around $250/ton in 2020 to around $700/ton in 2022

- **Fuel Costs**
  - Global Crude Oil Prices: Brent crude oil price increased from an average of $42/barrel in 2020 to around $101/barrel by mid-2022, driven by post-pandemic demand recovery and geopolitical tensions, particularly the Russia-Ukraine conflict
  - Diesel Prices (Philippines) rose from PhP 30-35/liter in 2020 to around PhP 80/liter by mid-2022, severely impacting operational costs for agricultural machinery and transport

=> Increase in Production Costs: Rising costs of inputs contributed to an estimated **20-30% increase** in production costs for farmers from 2020 to 2022

Objectives of the Study

- This study aims to review the role of water in food security by examining the water resources needed to sustain agricultural productivity.
- We focus on evaluating water security, addressing policy and governance issues in irrigation, and presenting actionable recommendations that align with the government's food security framework.
- Specifically, this paper discusses the role and importance of water in food security and assess the availability of water resources for sustainable food production; it identifies water policy and governance issues in government irrigation systems and discuss how these impact on food security.
- The study presents actionable recommendations to complement or supplement DA's food security plan and development framework.

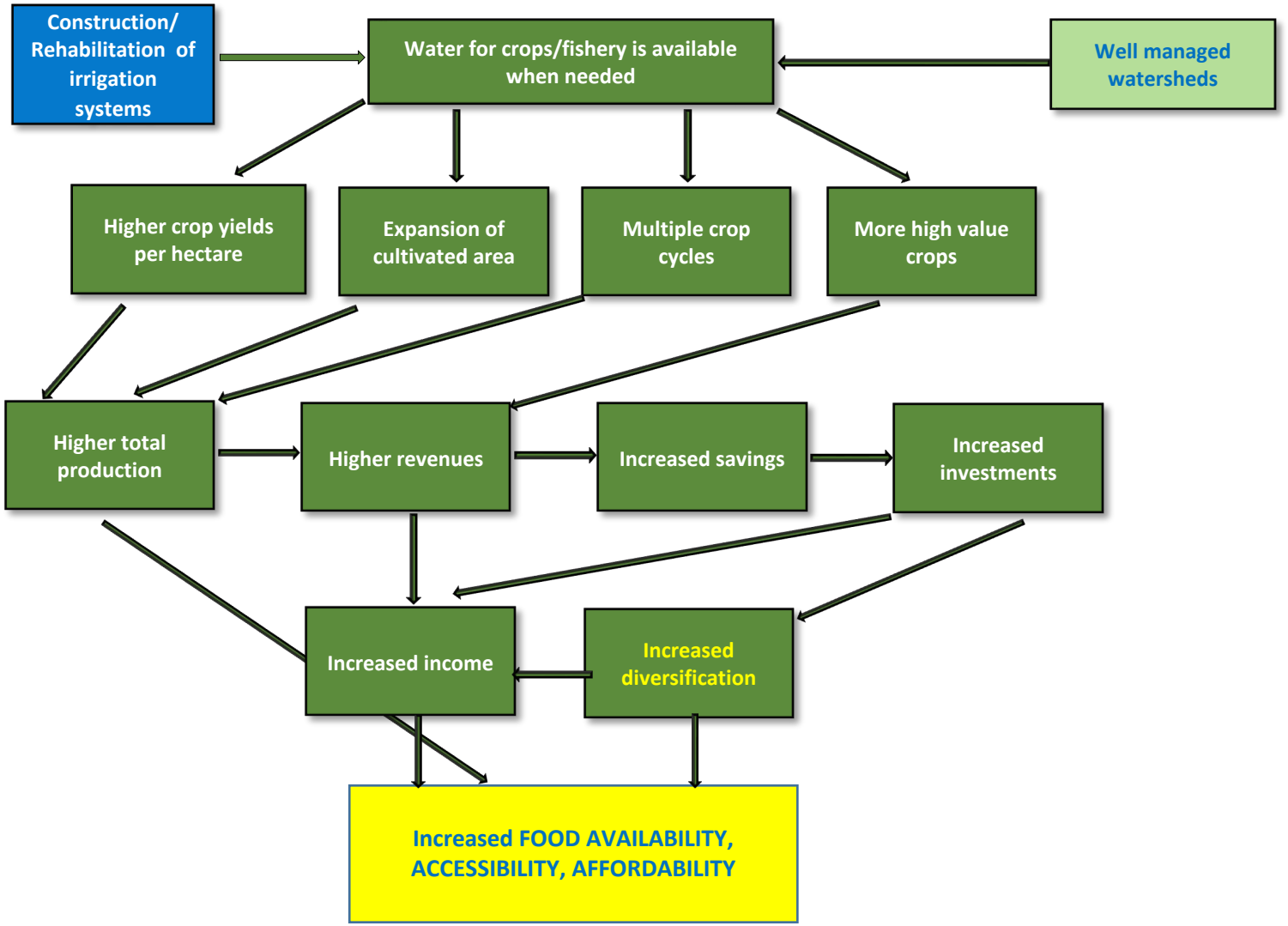
Importance of Water in Food Security & Current Challenges

Global Food Security Index (GFSI): Food Security in the ASEAN, 2022

Country	Affordability	Availability	Quality & Safety	Sustainability & Adaptation	Overall Score	Overall Rank
Singapore	93.2	77.8	69.7	44.3	73.1	28
Malaysia	87.0	59.5	74.7	53.7	69.9	42
Vietnam	84.0	60.7	70.2	52.2	67.9	46
Indonesia	81.4	50.9	56.2	46.3	60.2	63
Thailand	83.7	52.9	45.3	51.6	60.1	64
Philippines	71.5	55.2	65.3	41.8	59.3	67
Myanmar	62.1	53.5	64.4	49.0	57.6	72
Cambodia	74.3	54.5	54.0	33.9	55.7	78
Laos	59.7	51.8	51.7	47.0	53.1	81

Note: The GFSI was designed and constructed by the Economist Intelligence Unit of The Economist and is sponsored by Corteva Agriscience™.
Source: EIU (2024).

Causal Pathways to Food Security Outcomes



Source: Adapted from Andersen, et al. (2015)

Contribution of irrigated agriculture to the economy, 2010-2020

Year	Gross Value Added (in million Php at 2018 prices)			Agri as % of Total
	Agriculture	Industry	Services	
2010	825,535	3,292,770	6,391,291	**7.86**
2011	857,402	3,345,931	6,718,874	**7.85**
2012	882,705	3,603,788	7,214,366	**7.54**
2013	923,081	3,851,632	7,757,820	**7.37**
2014	940,638	4,141,503	8,278,537	**7.04**
2015	963,988	4,413,357	8,889,207	**6.76**
2016	970,057	4,776,266	9,614,325	**6.32**
2017	1,015,106	5,115,225	10,317,619	**6.17**
2018	1,039,590	5,490,598	11,011,976	**5.93**
2019	1,070,092	5,747,425	11,837,233	**5.74**
2020	1,059,647	5,011,992	10,734,698	**6.31**

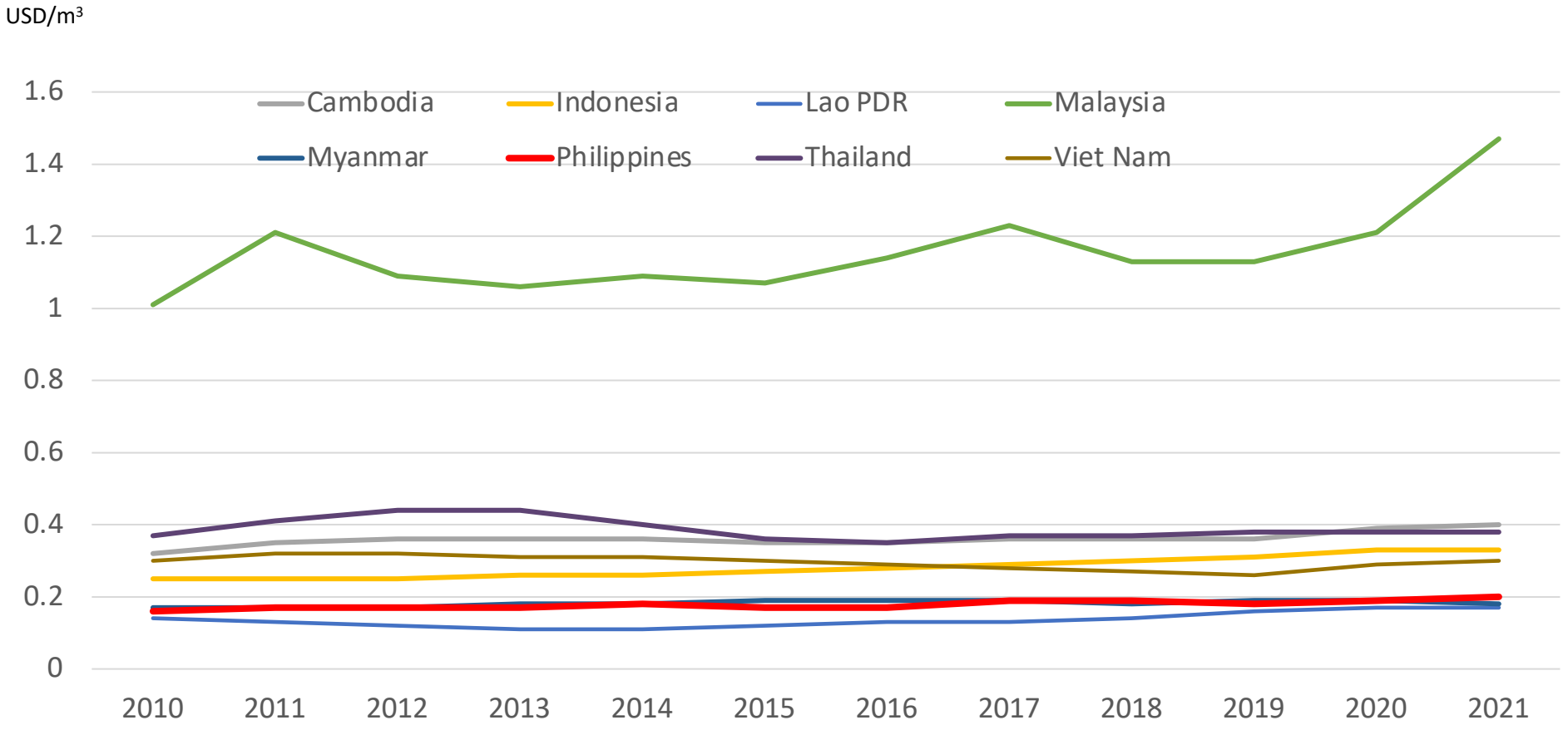
Source: PSA (2024)

Note: GVA for Agriculture includes only irrigated agriculture in alignment with SDG 6.4.1 methodology.

Increasing agriculture water productivity, 2010-2020

Year	Water used (in MCM)	Water use efficiency (WUE) (PHP/m³)	Change in WUE (%)
2010	67,883	12.16	
2011	67,886	12.63	3.85
2012	67,897	13.00	2.94
2013	67,898	13.60	4.57
2014	67,921	13.85	1.87
2015	67,924	14.19	2.48
2016	67,933	14.28	0.62
2017	67,962	14.94	4.60
2018	67,968	15.30	2.40
2019	67,831	15.78	3.14
2020	67,876	15.61	-1.04

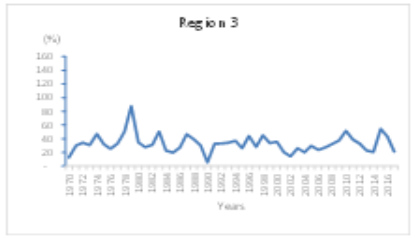
Water Productivity (WUE), USD per m^3, 2010-2021

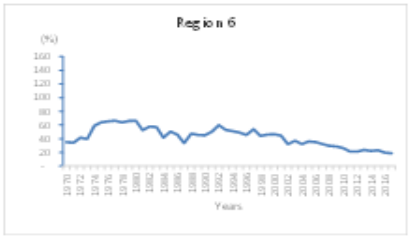


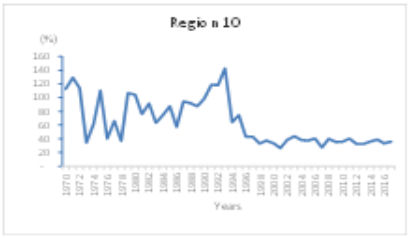
Ratios to Total of Irrigated Palay Production and Area Harvested, Philippines and By Region, 1970-2017

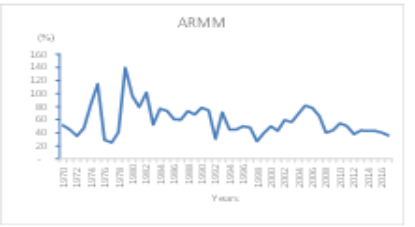
Source: PSA (2018)

Yield Advantage of Irrigated over Rainfed Palay (%), Philippines and by Region, 1970-2017

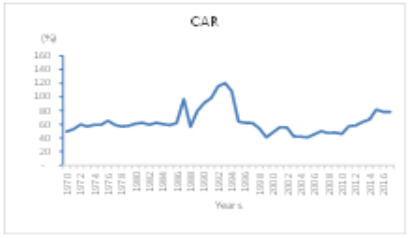


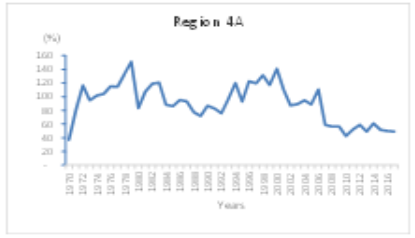


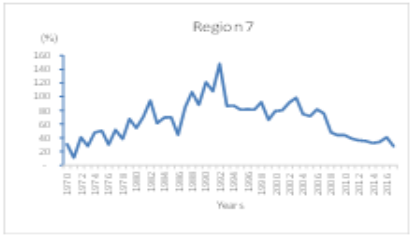


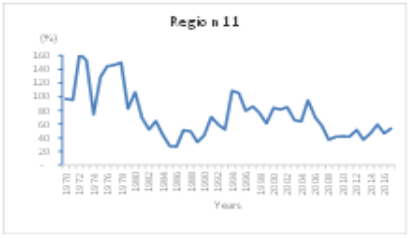


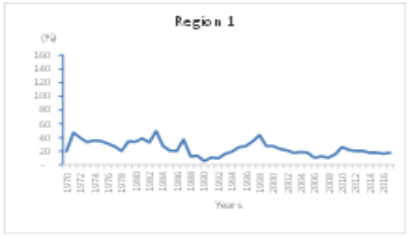
Source: *PSA (2018)*

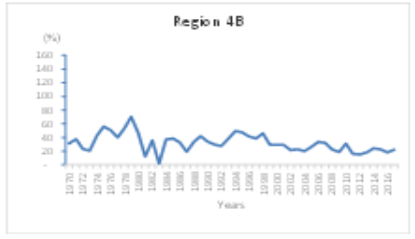


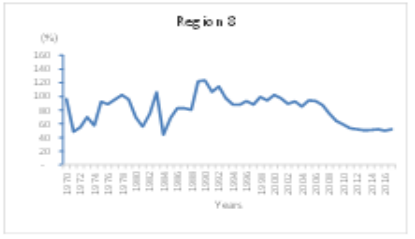


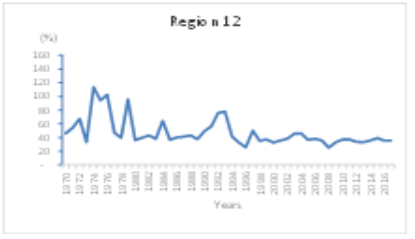


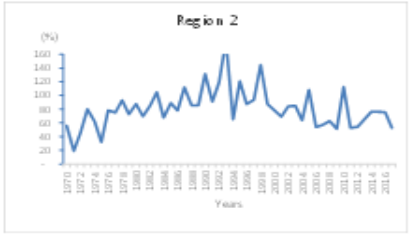


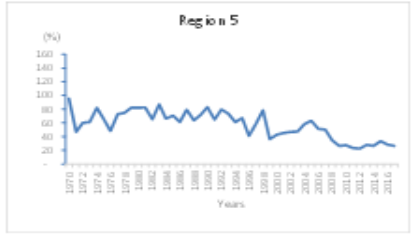












State of Water and Irrigation Systems in the Philippines

Irrigation Water Demand and Estimated Available Water Supply (without Effective Rainfall)

Region	Total Irrigated Area (Ha)	Irrigation Water Demand for Existing Systems (MCM)				Irrigation Water Demand for Existing Systems including SPIS (MCM)				Mean Estimated Available Water Supply (MCM)[3]
	Based on FUSA, Newly-generated with Non-Operational[1] and SPIS Area[2]	2020	2025	2030	2036	2020	2025	2030	2036	
CAR	95,321	2,196	2,211.36	2,226	2,244	2,198	2,213	2,2288	2,246	37,400
I	180,674	4,232	4,245	4,257	4,273	4,234	4,247	4,259	4,274	1,829
II	281,569	6,613	6,650	6,686	6,731	6,614	6,651	6,688	6,732	7,960
III	306,370	9,708	9,818	9,927	10,059	9,711	9,821	9,930	10,062	3,968
IV-A	50,740	1,169	1,174	1,179	1,186	1,170	1,175	1,181	1,187	5,106
IV-B	90,577	2,187	2,196	2,206	2,217	2,188	2,198	2,207	2,218	9,223
V	120,034	2,854	2,869	2,884	2,903	2,856	2,871	2,886	2,904	44,090
VI	112,721	2,695	2,707	2,719	2,733	2,697	2,709	2,721	2,736	10,339
VII	45,938	1,053	1,057	1,062	1,067	1,054	1,059	1,063	1,068	3,199
VIII	74,013	1,714	1,722	1,731	1,741	1,715	1,723	1,732	1,742	11,462
IX	45,796	1,149	1,154	1,159	1,164	1,150	1,155	1,160	1,166	8,491
X	63,698	1,343	1,349	1,356	1,365	1,343	1,350	1,357	1,366	8,934
XI	69,762	1,861	1,867	1,874	1,882	1,863	1,869	1,876	1,884	11,054
XII	116,954	2,719	2,736	2,753	2,773	2,721	2,738	2,754	2,774	12,122
CARAGA	64,691	1,486	1,534	1,583	1,641	1,487	1,535	1,584	1,642	22,659
ARMM	48,223	-	-	-	-	-	-	-	-	4,749
TOTAL	1,767,081	42,978	43,290	43,602	43,977	43,001	43,313	43,625	44,000	202,586

Source: NIMP 2020-2030

BUT there are vulnerabilities affecting irrigated agriculture …

- **Climate change** and climate variability and increasing occurrences of extreme weather events
- Annual damage from **disasters** affecting crops, livestock & poultry, fisheries production
- Inadequate and uncoordinated **watershed** and aquifer protection leading to systematic degradation

Sources: DA (2021), NIMP (2021)

Climate Variability and Change

Mindanao NIA Regions; N=4

- Reduced water flows in the dry season
- Flooding and erosion in the wet season
- Damages to irrigation facilities

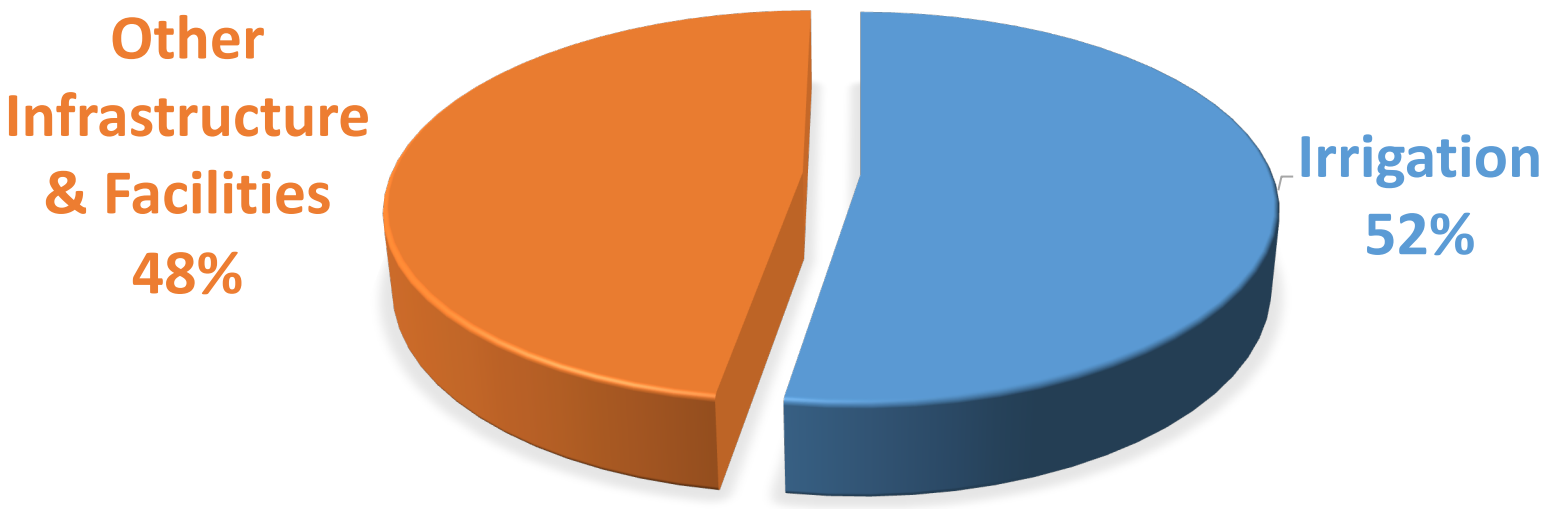
Visayas NIA Regions; N=4

- Crop damages because of abnormal dry and wet seasons

Luzon NIA Regions; N=12

- Flashfloods cause canal siltation
- Damages to irrigation infrastructures and facilities
- Reduced water storage in dams' reservoirs
- Reduced irrigated areas

Distribution of Damage to Agricultural Infrastructure & Facilities due to Natural Calamities, 2011-2020



	Irrigation	Other Infra & Facilities	Total
Annual average (P Mn)	697	631	1,328
Total (P Mn)	6,972	6,308	13,280

Note: Natural calamities consist of typhoons, droughts & floods.
Data Source: FPOPD, DA (2021)

Annual Damage to Agriculture Infrastructure & Facilities due to Natural Calamities , 2011 to 2020

Year	Irrigation Damage (P Mn)	Other Infrastructure & Facilities Damage (P Mn)	Irrigation Investment (P Mn)	Irrigation Damage as % to Irrigation Investment
2011	2,144	131	12,791	17%
2012	1,736	83	24,454	7%
2013	2,181	3,508	27,156	8%
2014	162	436	21,183	1%
2015	82	285	28,750	0.3%
2016	-	475	32,743	0.0%
2017	21	227	38,376	0.1%
2018	421	448	41,669	1%
2019	162	106	36,046	0.4%
2020	62	610	36,277	0.2%
Total	**6,910**	**5,698**	**267,167**	**2.3%**

Note: Natural calamities consist of typhoons, droughts & floods.
Data Sources: FPOPD, DA (2021), NIA (2021)

Watersheds to be managed

- 2,224 river watersheds (ridge-to-reef) within the Philippines (26.13 M ha)
- 18 Major River Basins -11M ha
- 131 Priority Critical Watershed supporting National Irrigation System (14 M ha)
- 113 Proclaimed Watershed Forest Reservations (2.4 M ha)

Source: A. Castillo (2021)

Policy Analysis: Review of Key Policies

2020-2030 National Irrigation Masterplan (NIMP)

- *2020-2030 NIMP* establishes a comprehensive framework for advancing irrigation in the Philippines, aimed at achieving food security and poverty reduction through intensified, climate-resilient irrigation systems
- Central to the NIMP is a target of a 2.5% annual increase in irrigated area, equating to about 47,272 hectares per year; is accompanied by strategic goals such as enhancing irrigation efficiency, increasing farmer productivity, and improving asset management
- Recent initiatives under the NIMP have focused on regional adaptation; e.g., NIA Region III has updated its regional & provincial irrigation plans; NIA Region IV-A conducted consultations to refine its *Regional Irrigation Master Plan* (RIMP) for 2023-2030; these RIMPs, tailored to regional priorities, guide annual budget formulation and project proposals, ensuring alignment with NIMP goals

2023-2028 Phil Devt Plan (PDP)

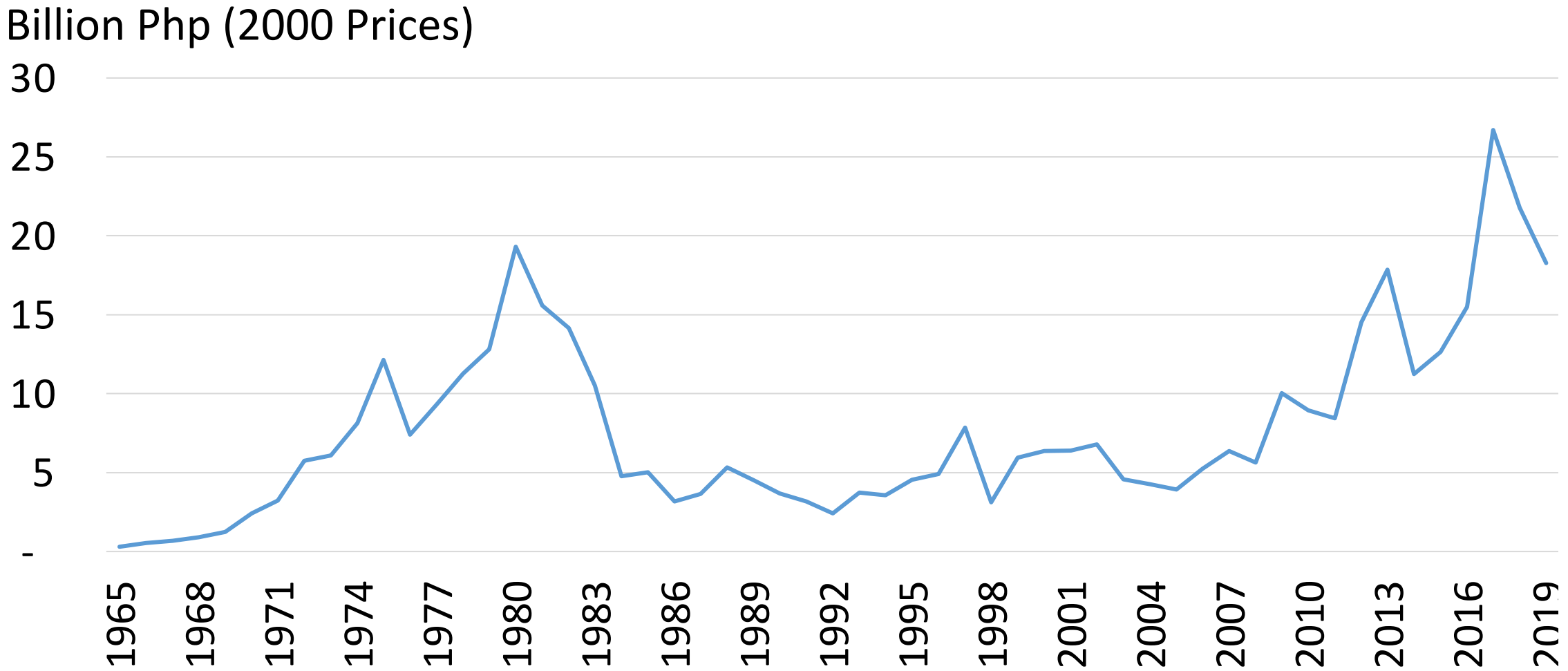
- *PDP 2023-2028* embeds the priorities proposed in NIMP, as a key driver of agricultural modernization and climate adaptation; It aligns with the NIMP's objectives by prioritizing infrastructure development, particularly irrigation & water management systems, under the government's infrastructure flagship program; In response to escalating climate challenges, including El Niño effects on rice farms, the PDP emphasizes irrigation expansion, upgrading, and disaster-resilient technologies
- To support these ambitions, the national budget for NIA was increased to PHP 41.7 billion in 2024; reflecting a commitment to bolstering irrigation as part of an integrated response to El Niño and climate change impacts; this funding will support not only new construction but also the rehabilitation and maintenance of existing irrigation systems
- The convergence of the NIMP and PDP is supposed to signal a strategic shift toward resilient agriculture in the Philippines, addressing immediate challenges like El Niño while promoting long-term growth in the agricultural sector; this alignment underscores a unified national approach to sustainable water resource management, climate resilience, and rural economic empowerment

Budget allocation for irrigation & DA system (Php Mn, current prices)

Year	NIA	DA-BSWM	Total Irrigation Allocation	Total DA System* Budget	Share of irrigation in DA System Allocation (%)	Share of NIA in total Irrigation Allocation (%)
2011	12,791	510	13,301	34,758	38.3	96.2
2012	24,454	618	25,072	52,931	47.4	97.5
2013	27,156	1,282	28,438	64,504	44.1	95.5
2014	21,183	1,143	22,326	68,553	32.6	94.9
2015	28,750	1,338	30,088	67,807	44.4	95.6
2016	32,743	1,198	33,941	91,206	37.2	96.5
2017	38,376	3,292	41,668	95,014	43.9	92.1
2018	41,669	2,686	44,355	110,148	40.3	93.9
2019	36,046	2,000	38,046	100,179	38.0	94.7
2020	36,277	1,186	37,463	116,021	32.3	96.8
2021	31,659	1,021	32,680	121,715	26.8	96.9

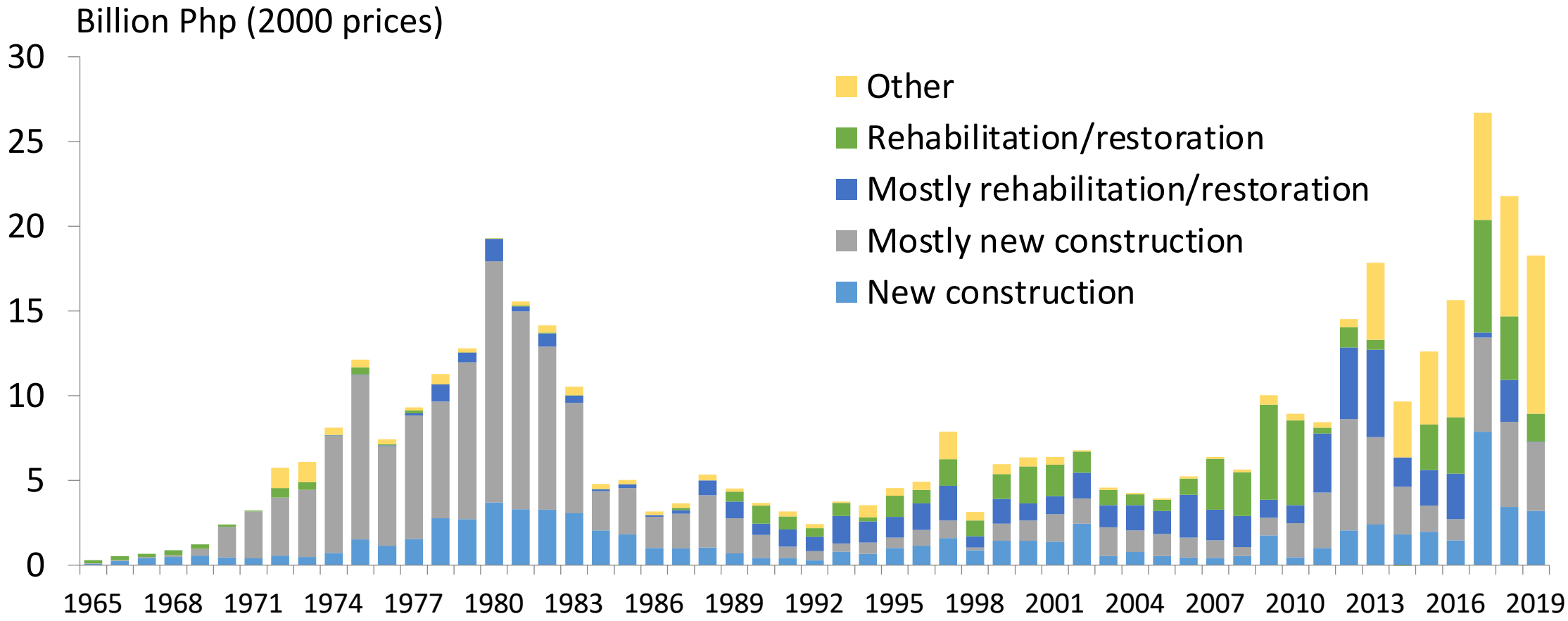
Sources: General Appropriations Act (various years).

Public Investments in Irrigation (NIA), 1965-2019



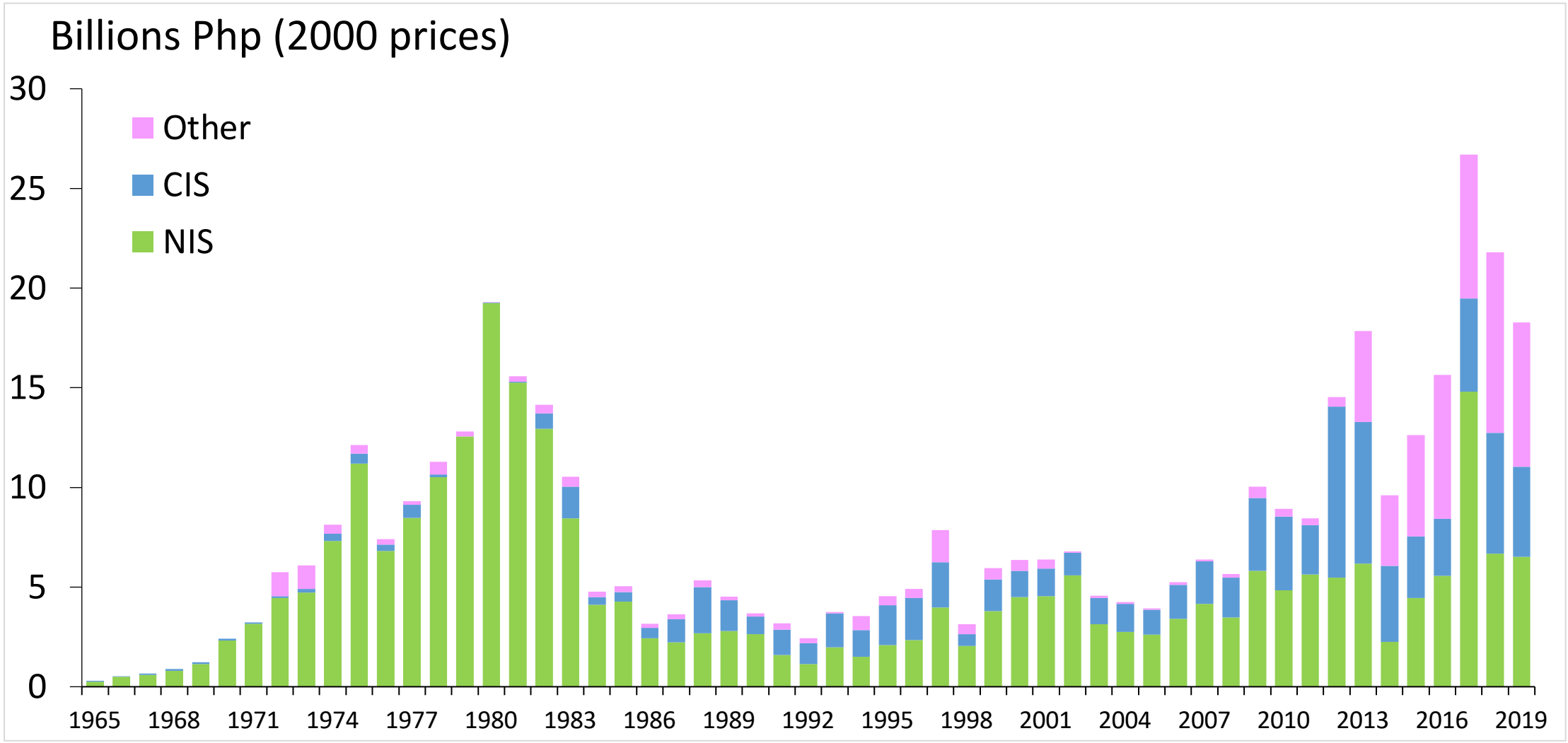
Sources: NIA Year-End Report (various years).

Irrigation Investments by Type of Project, 1965-2019



Sources: NIA Year-End Report (various years).

Irrigation Investments by type of System, 1965-2019



Notes: "Other" includes private irrigation systems and other government agency funded. The 2016 values were preliminary results from NIA annual report.
CIS = communal irrigation systems; NIS = national irrigation systems; PHP = Philippine Peso
Sources: NIA Year-end and annual reports (various years).

Devolution of communal irrigation systems (CIS) to LGUs

- 1991 Local Government Code (RA7160) devolved the communal irrigation systems (CIS) **management & development responsibilities** to LGUs faced significant obstacle; CIS construction and maintenance were devolved to LGUs, with funds for these services reallocated to LGUs' internal revenue allotments (IRA) starting in 1992

- The mandate to fully devolve CIS responsibilities has seen minimal progress; as of 2024 only about 188 of over 10,000 CISs nationwide have been devolved to LGUs, indicating the challenges that LGUs face in assuming these functions

- The Executive Order No. 138 (Mandanas-Garcia Ruling) - outlines an institutional development program to support LGUs in managing devolved functions, highlights the need for capacity-building initiatives; but limited technical training and a general lack of interest from some LGUs have slowed the devolution process; **in practice, LGUs still rely on NIA and foreign assistance, e.g., projects linked to agrarian reform communities through the DAR and other development funds**

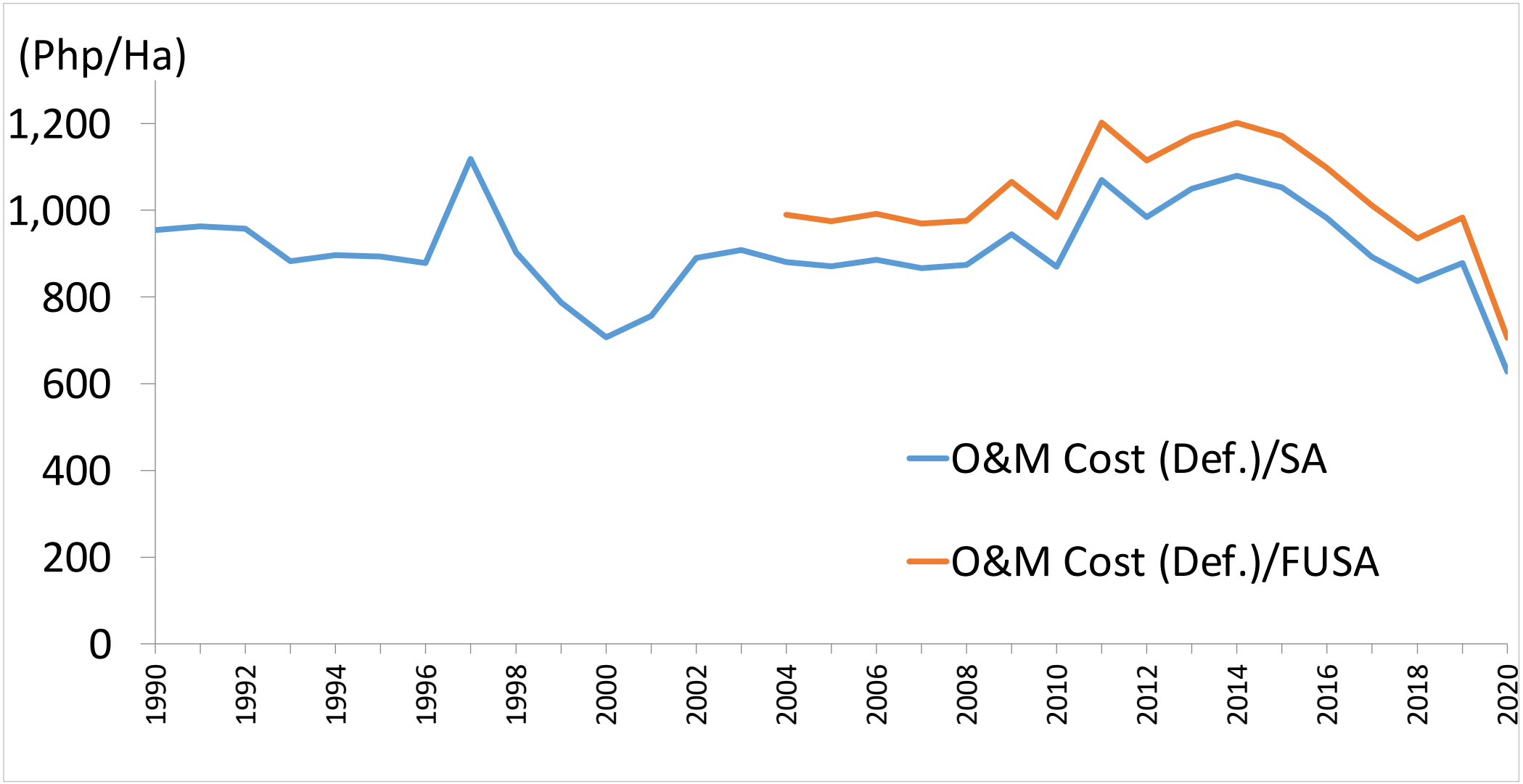
Free Irrigation Service Act (2018)

- The country's irrigation systems have had a long history of recovering maintenance cost from farmers; the Free Irrigation Service Act of 2018 was a radical departure from this policy

- PIDS assessment finds that the main benefit to farmers from free irrigation is the savings from paying the ISF in the case of NIS; the subsidy for O&M in the case of CIS

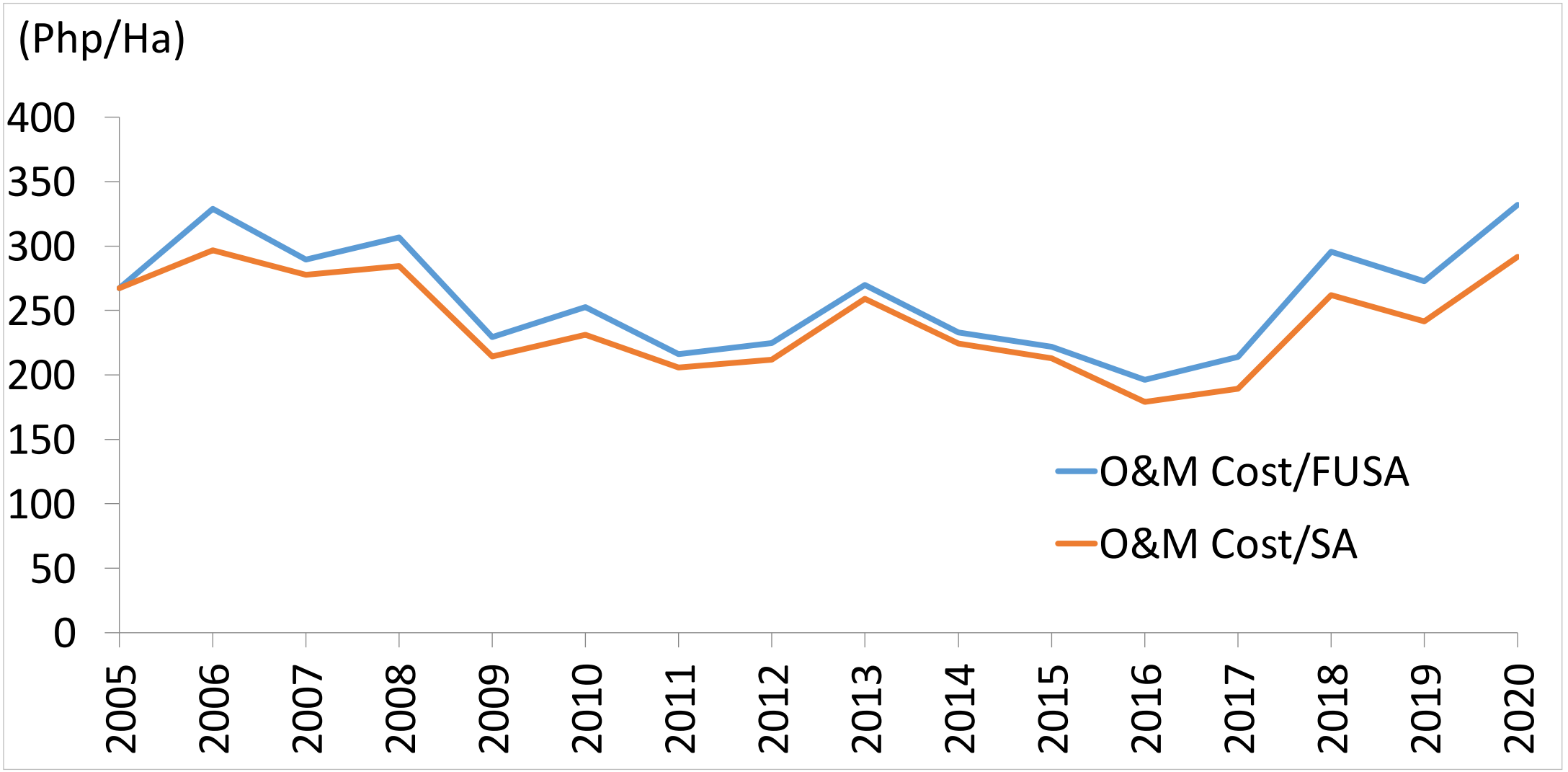
- Overall level of O&M may have increased despite the likely decline in O&M subsidy for NIS; while beneficiaries of free irrigation are poorer than average, a large majority of beneficiaries are non-poor; to achieve equity objectives

Real NIS O&M per ha. (2000 prices), 1990-2020



Sources: NIA-SMD NISPER & CISPER data, various years)

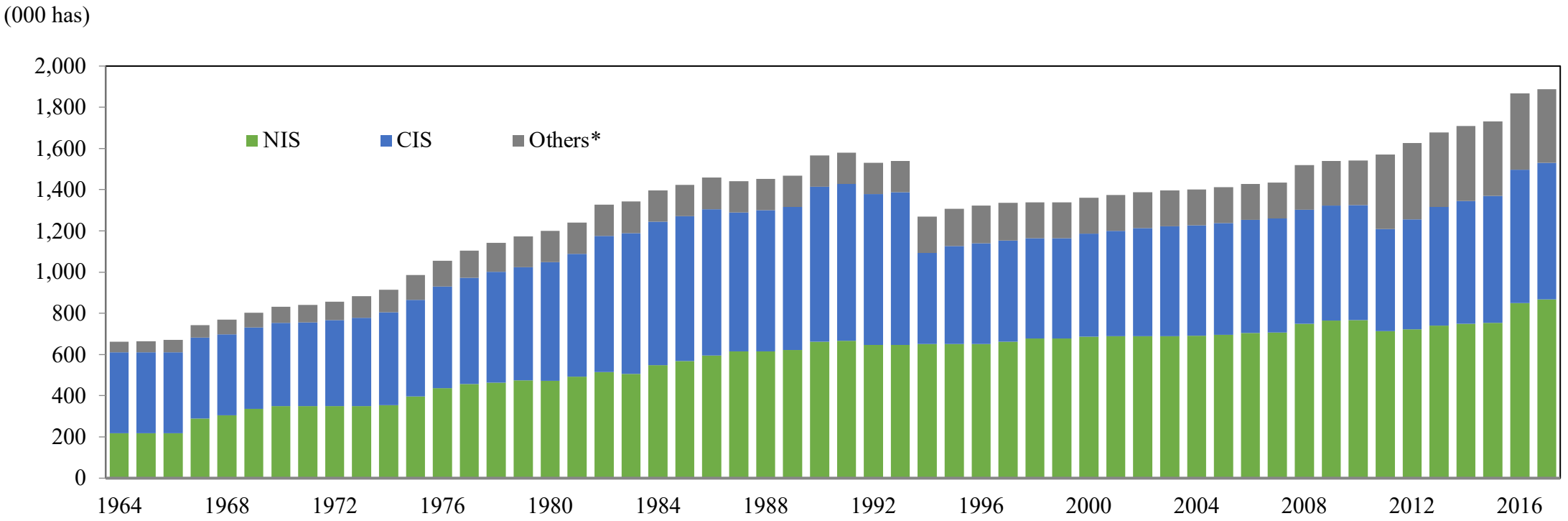
Real CIS O&M per ha. (2000 prices), 2005-2020



Sources: NIA-SMD NISPER & CISPER data, various years)

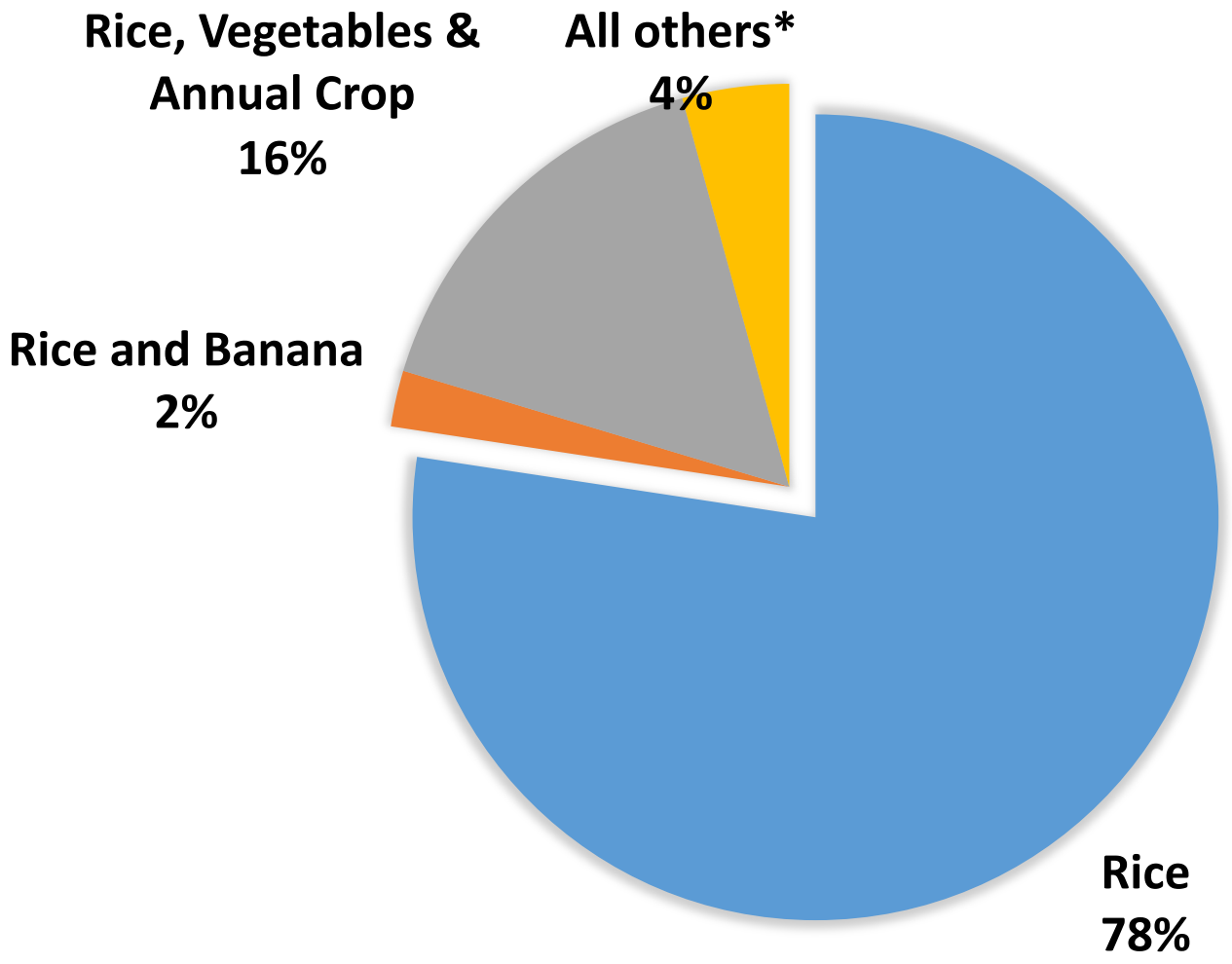
Profiles of Irrigation Systems

Trends in Area Irrigated by Type of Systems, 1964-2017



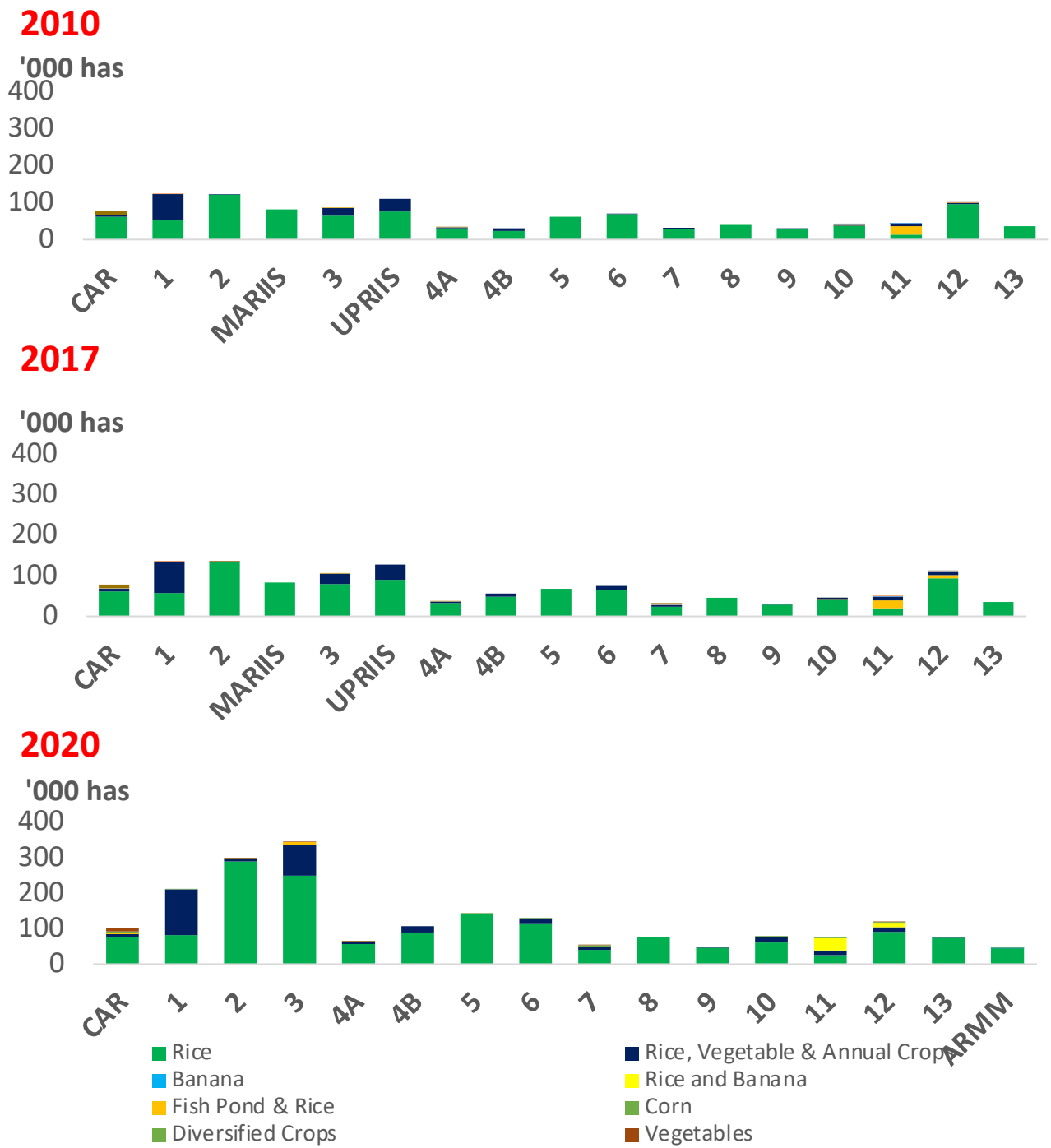
Annual growth rates	1995-00	2000-05	2005-10	2010-15	2015-17
NIS	0.9	0.24	1.6	-0.3	4.8
CIS	0.9	1.34	0.5	1.6	2.5
Others	-0.6	0.00	3.8	8.8	-0.4
TOTAL	0.7	0.62	1.5	1.9	2.9

Distribution of Irrigated Area by Crop (%), 2020

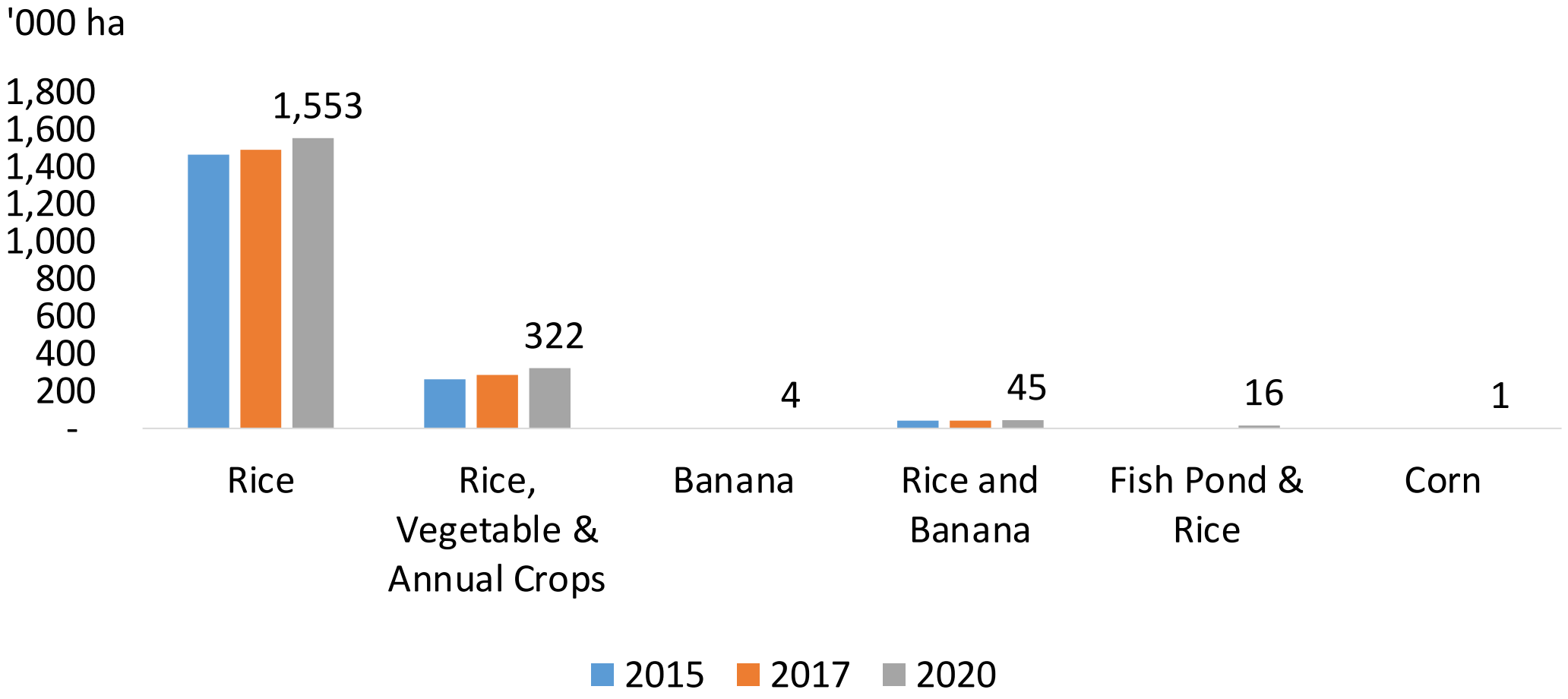


Note: “All others” include vegetables, diversified crops, banana, fishpond and rice, corn, and unclassified.
Source: NIA (2021)

Distribution of irrigated crops by Region

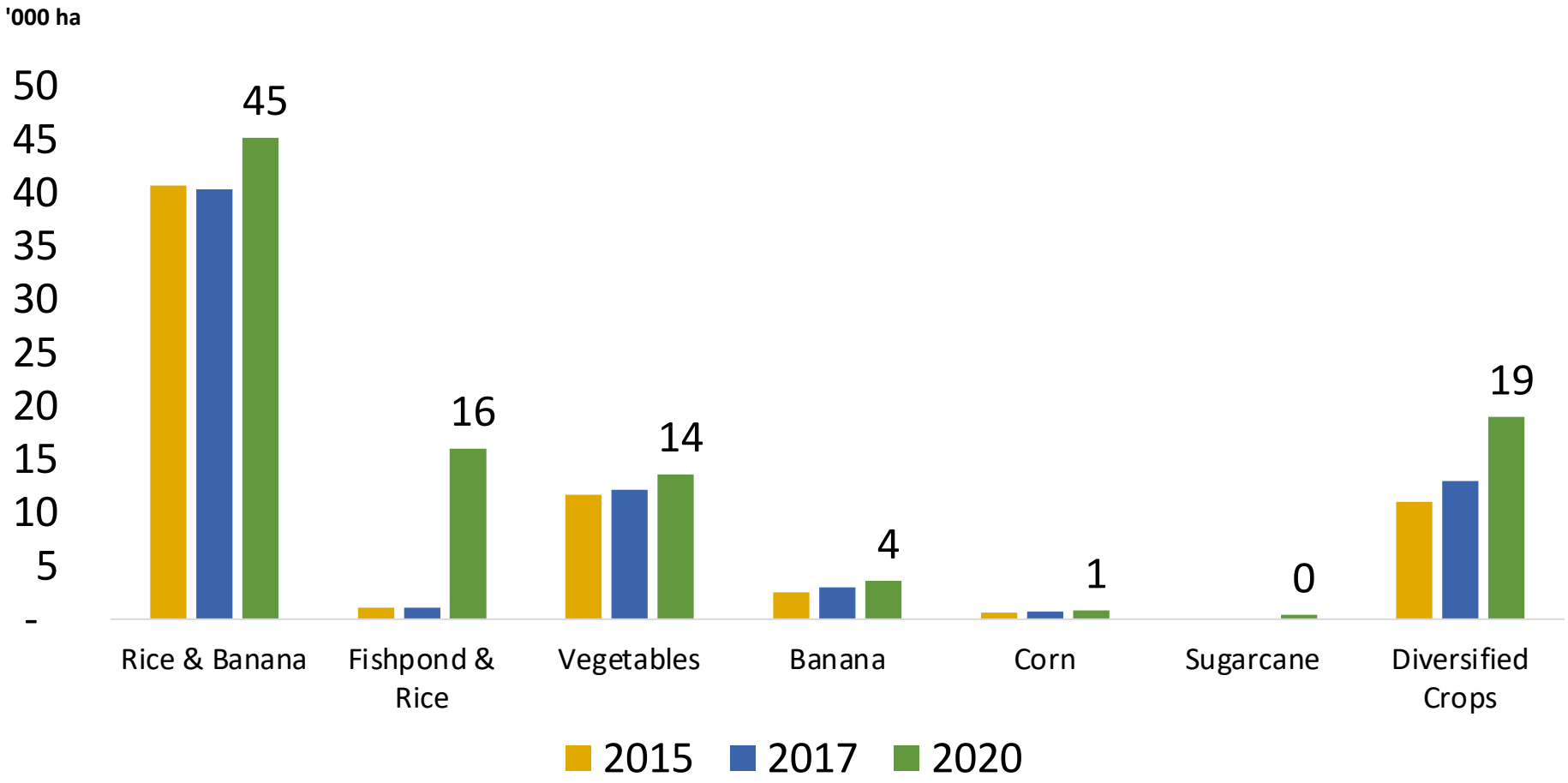


Trends in Irrigated Commodities by Type, 2015-2020



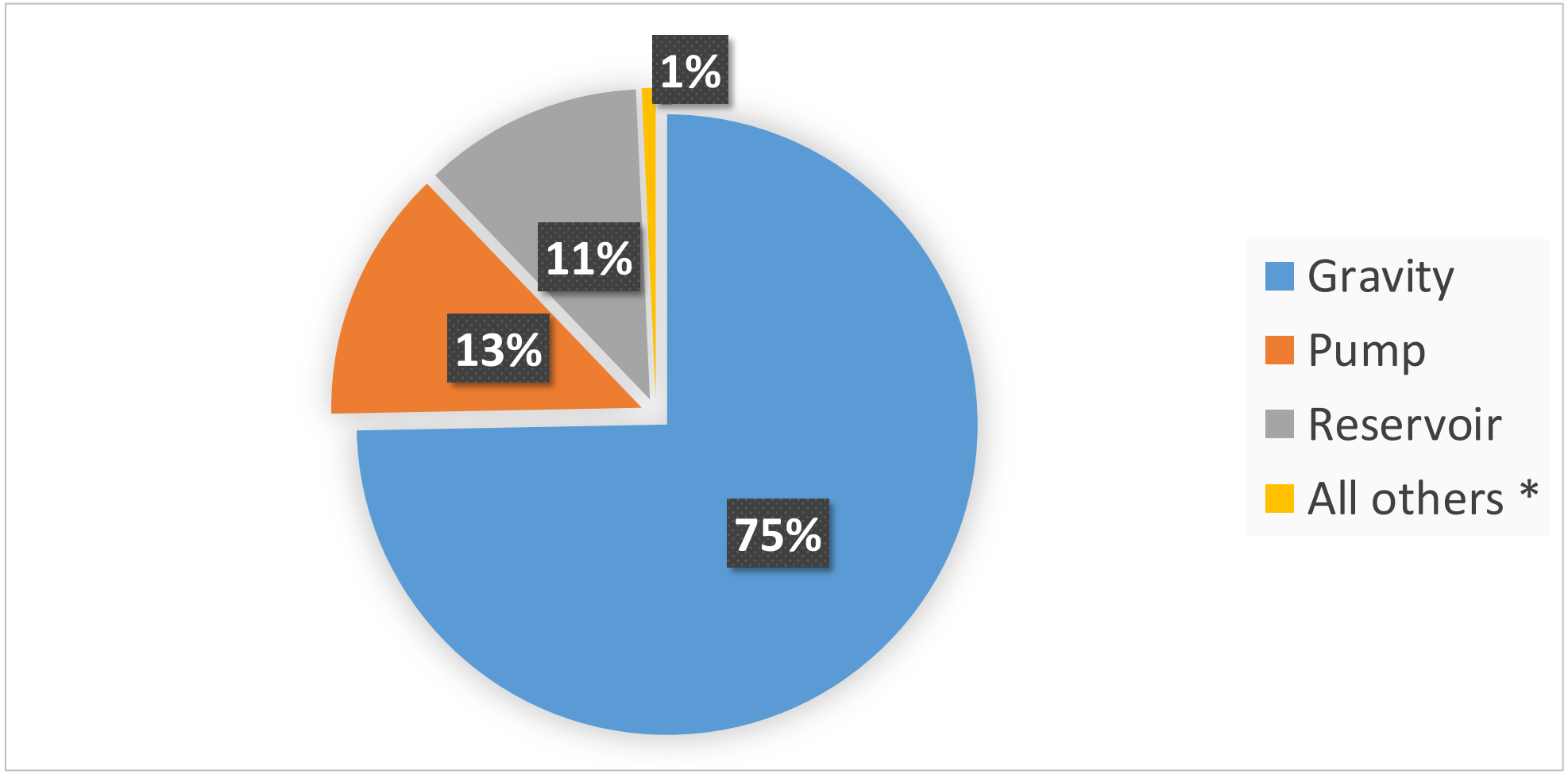
Sources: NIA (2021)

Trend in Other Crops, 2015-2020



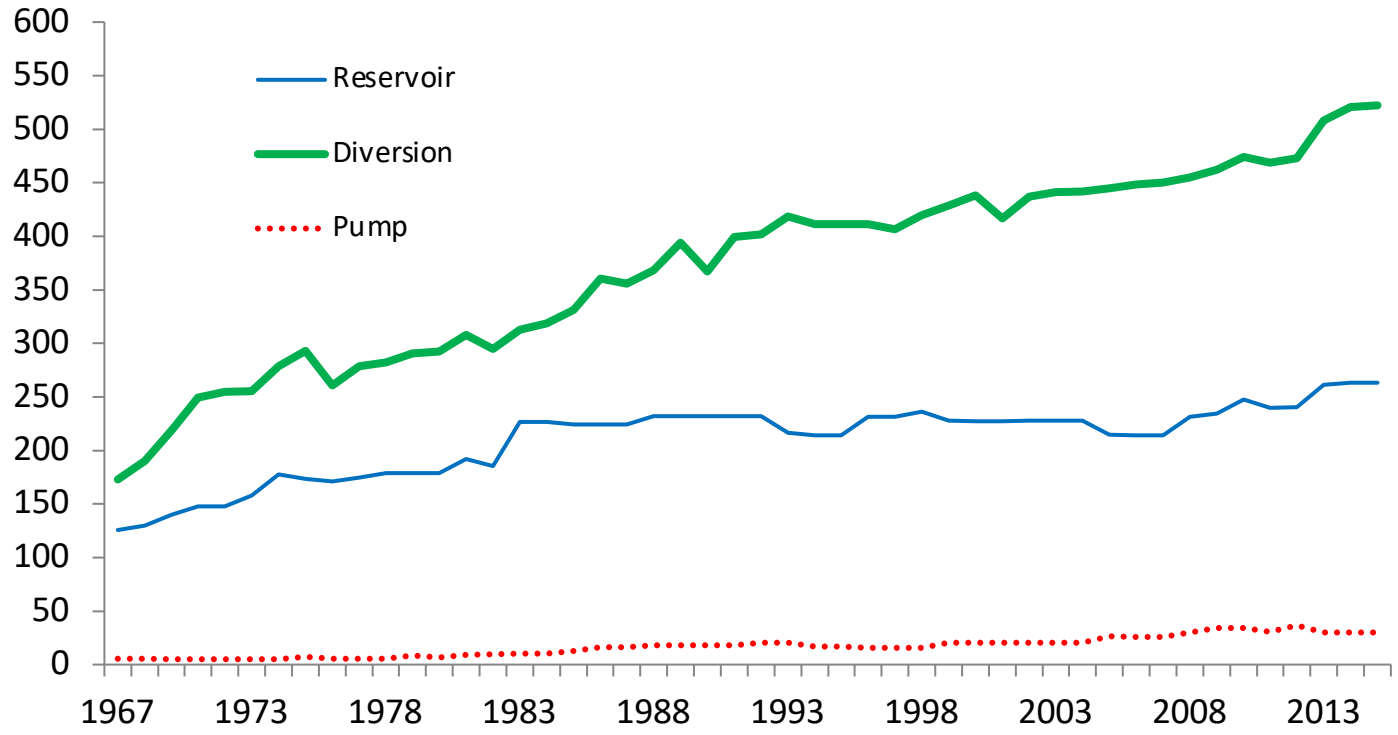
Sources: NIA (2021)

Average Distribution of Irrigated Area by Technology (%), 2020

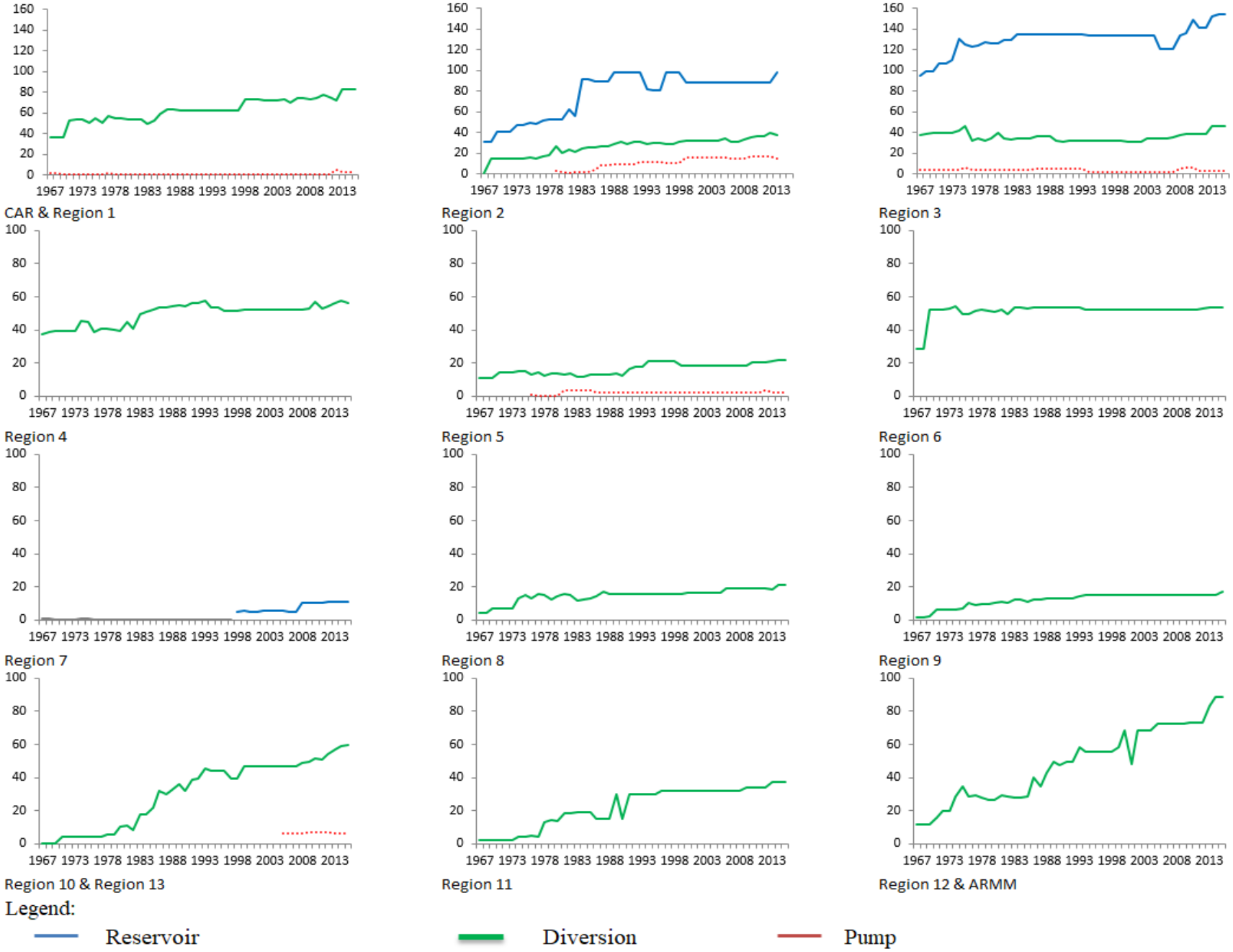


Note: “All others” include small farm reservoir and small water impounding system, among others.
Sources: NIA (2021)

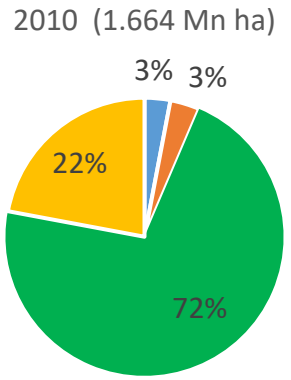
Trend in NIS irrigated area by Type of Technology ('000 has)

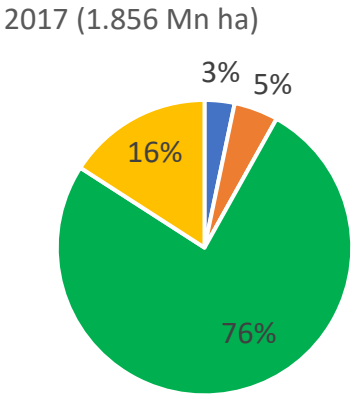


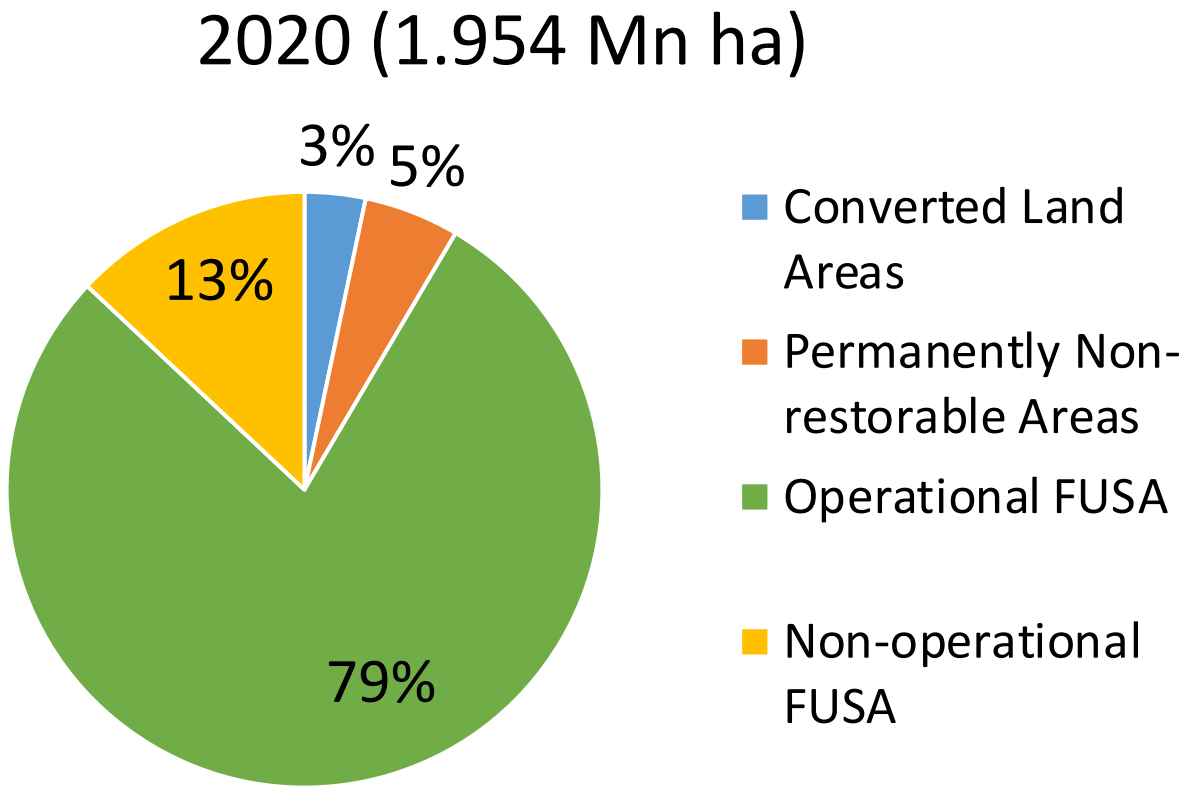
Type of Irrigation Systems (NIS):
-gravity
-reservoir
-pump



Status of Irrigated Areas (%), 2010, 2017, 2020



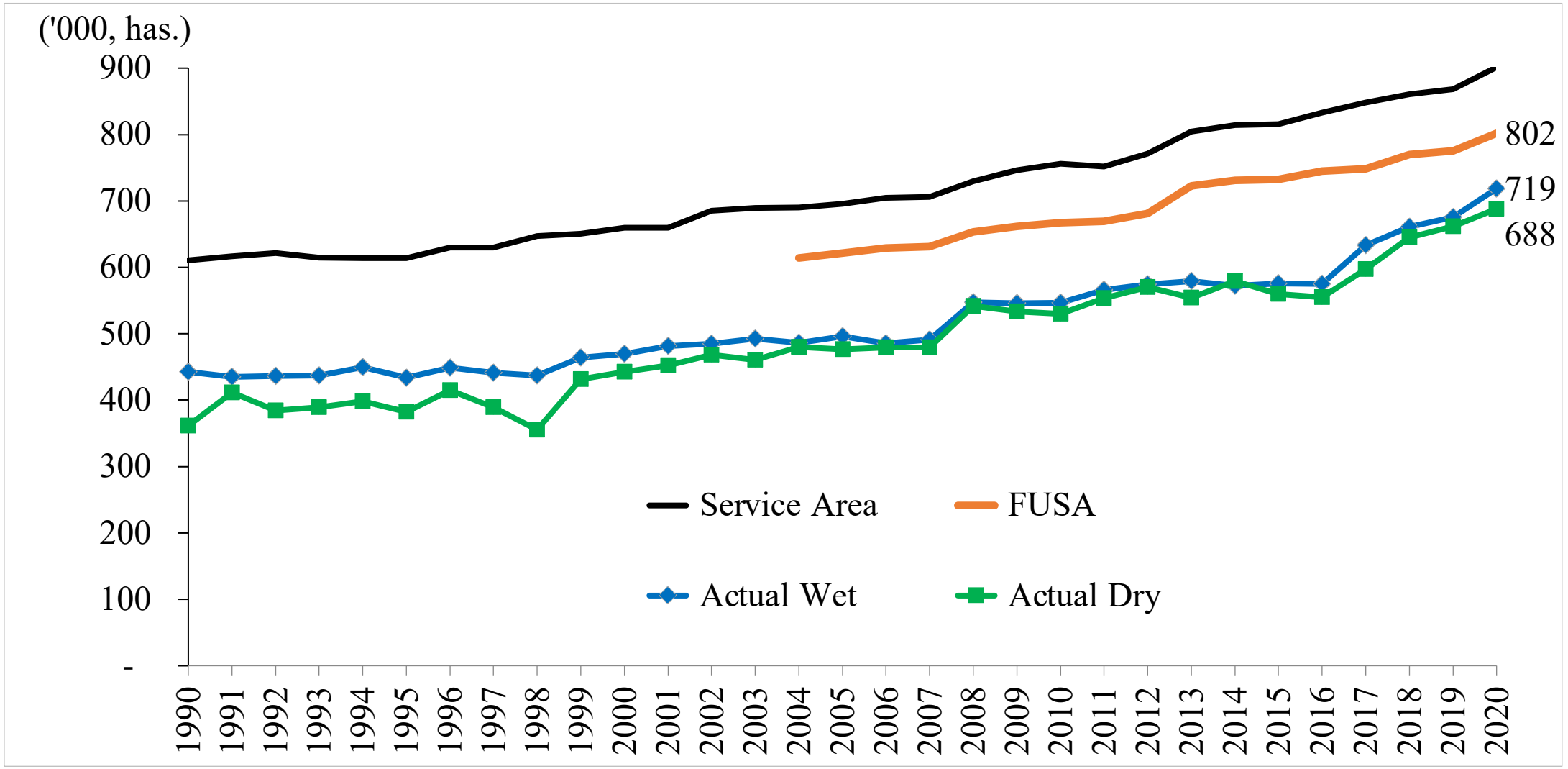




Note: Mn = million; ha = hectares; FUSA – firmed-up service area
Sources: NIA (2021)

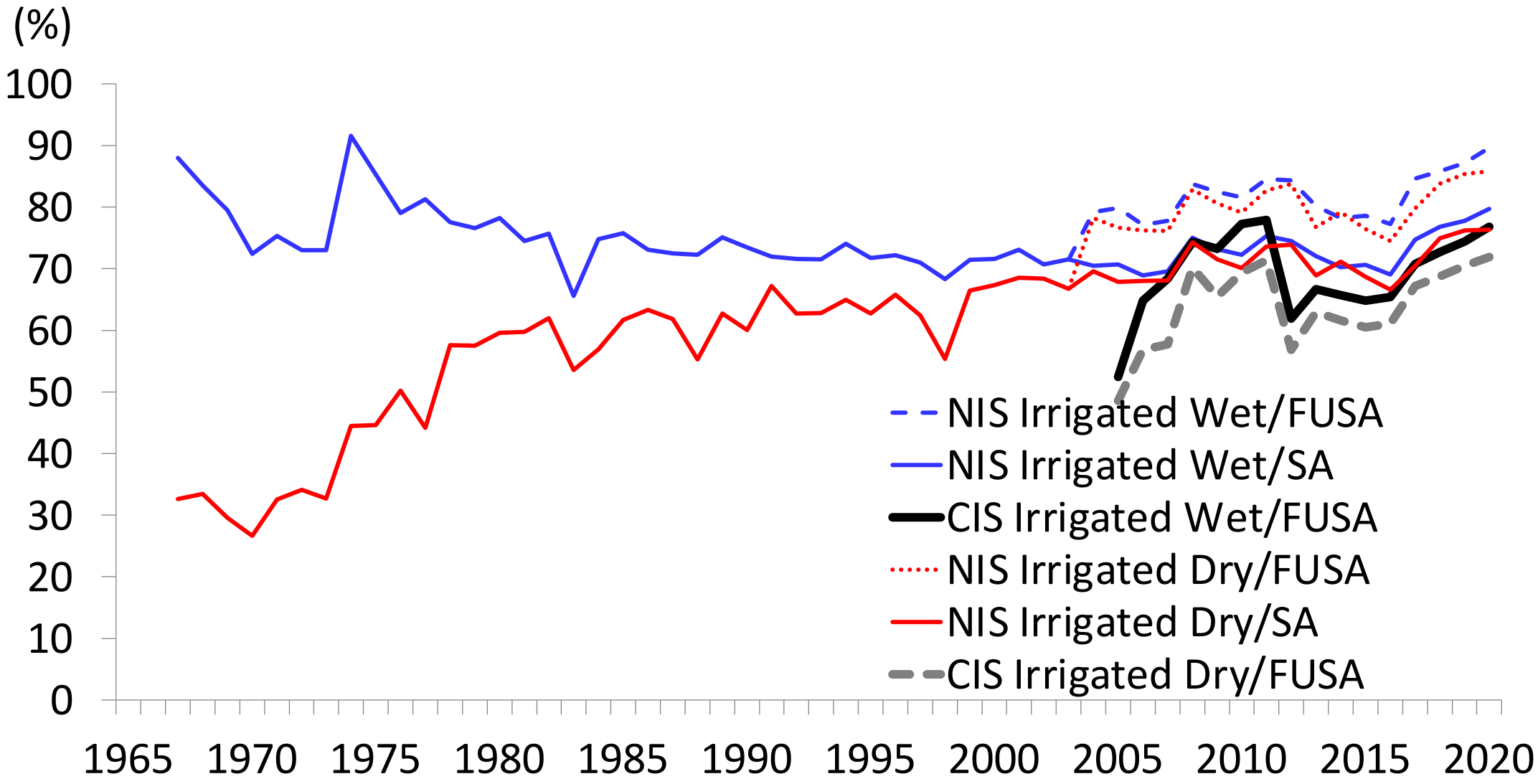
Performance of Irrigated Area

NIS SA, FUSA, Actual Wet & Dry Performance, 1990-2020



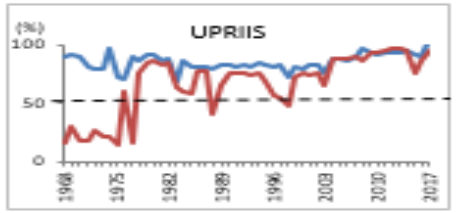
Sources: NIA-SMD NISPER & CISPER data, various years)

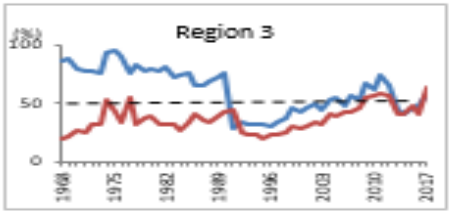
Trends in Irrigation Intensities, 1965-2020

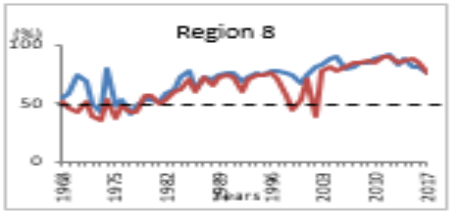


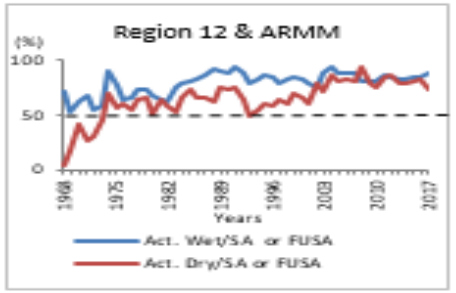
Sources: NIA-SMD NISPER & CISPER data, various years)

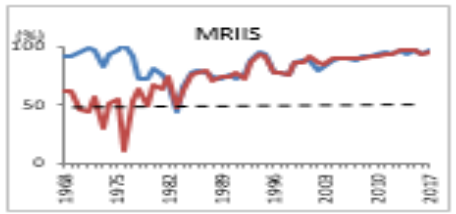
Trends in Irrigation Intensities in NIS by Region, 1968-2017

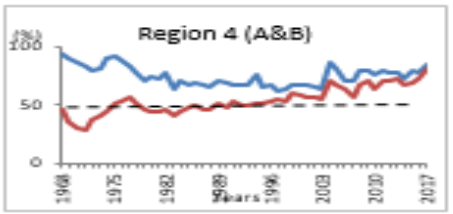


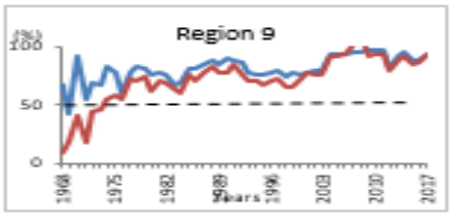


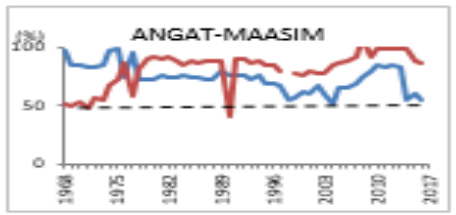


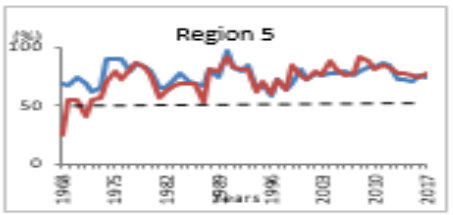


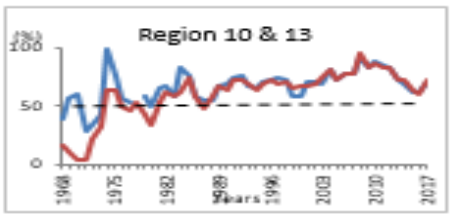


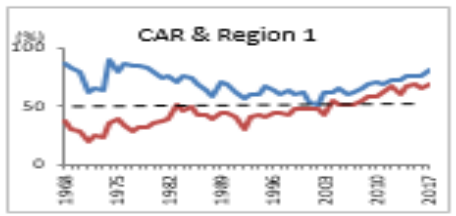


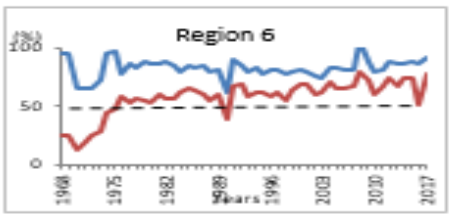


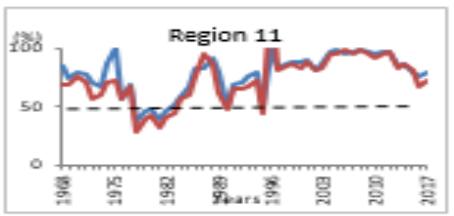


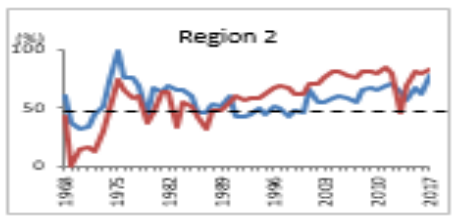


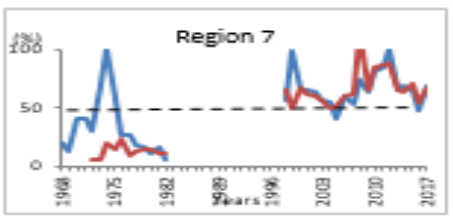






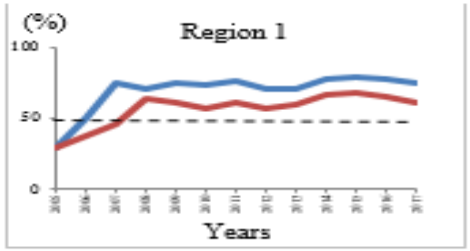


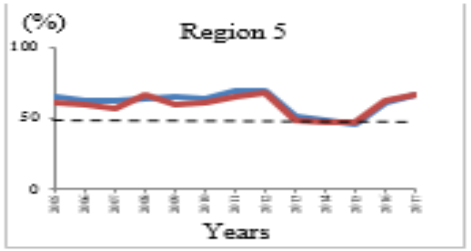


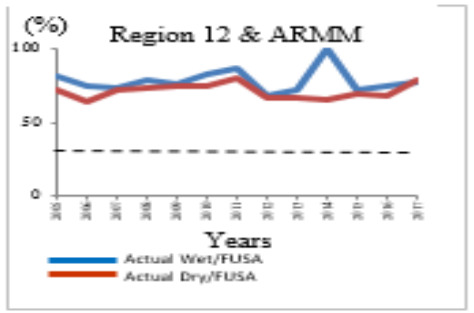


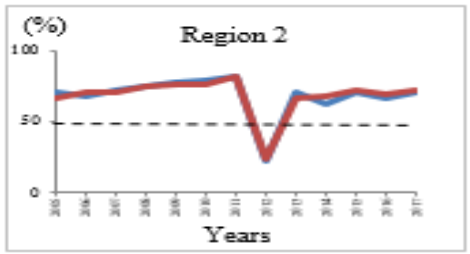
Sources: NIA NISPER Various Years

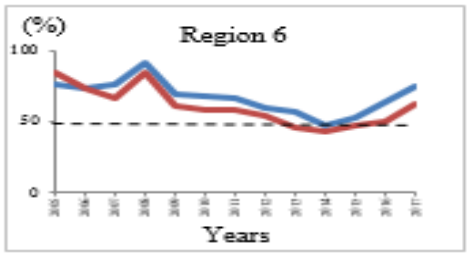
Trends in Irrigation Intensities of CIS by Region, 2005-2017

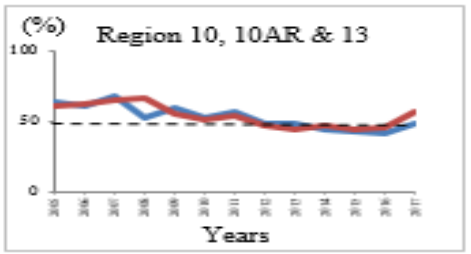




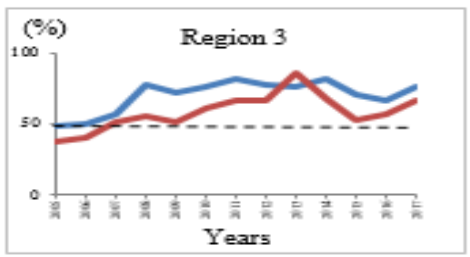


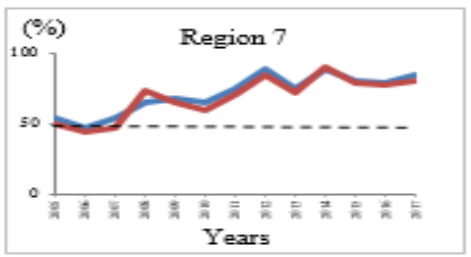


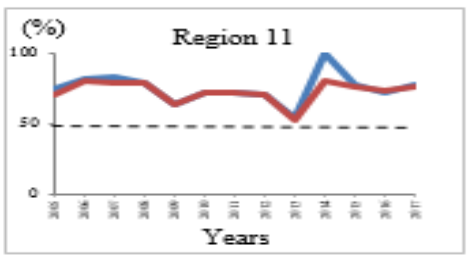


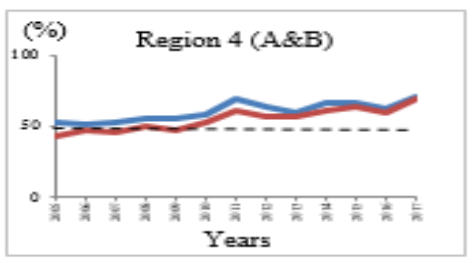


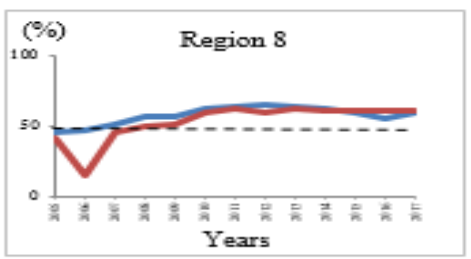
Sources: NIA CISPER Various Years











Conclusions & Recommendations

Conclusions

- **Need to align policies with objectives**
  - Food self-sufficiency at all cost will not mean achievement of food security; Targeting for 91-92% self sufficiency is shown not to translate to higher food security

- **Role of water in food security**
  - Water contributes to food security through expansions in production areas, increases in revenues and incomes, which in turn contribute to food availability and accessibility, and affordability
  - Achieving food security in the Philippines hinges on a reliable, sustainable water supply

❑ DA budget heavy on irrigation

- NIA gets the bulk of the water for food allocation; all other programs/infra projects share the balance
- NIA allocation for irrigation still heavy bias on rice; very slow and limited diversification; **big implications on incomes & food security**
- Nominal allocation & slow interventions for watershed management both in NIA & DENR

❑ Water Availability and Water security & Sustainability of systems

- Irrigation systems must support not only productivity but resilience to climate impacts because of vulnerabilities brought about by: climate change requiring resilience of structures/processes; significant annual damage from natural disasters; most NIS watersheds in critical states

- Need to address **declining real O&M expenditures for NIS given sustained damage; time to review the FISA**

Recommendations

- Full implementation of the National Irrigation Masterplan - facilitate the completion of RIMP using the NIMP as guide

- Devolution of CIS & the 2022 Mandanas-Garcia Ruling - significantly increases LGUs' IRA & presents an opportunity to transform CIS management & expand agriculture-focused productivity enhancing & income increasing programs or interventions => To achieve this potential, govt needs to build LGU capacity for irrigation management & facilitate sustainable, locally driven agricultural productivity improvements

- Free Irrigation Service Act - review the law and its implementation with the goal of rationalizing O&M support and subsidies and tie up with performance of IAs; explore linking the support to IAs with adoption of water-saving and productivity enhancing crops & practices; conduct a study to compare FISA with other social assistance and social protection schemes in achieving equity objectives

Irrigated agriculture should aim for higher productivity, water use efficiency, revenues and incomes

- Diversification should be a food security strategy and the DA's food security agenda and strategy must guide NIA's irrigation development program.

- Following the NIMP 2020-2036 recommendations, the national masterplan should be translated into regional and provincial masterplans so that more appropriate irrigation support and crop diversification strategies can be formulated. Suitable crops and cropping patterns should be identified.

- Irrigation support for crop diversification can include increased use of shallow tube well, small water impounding systems or small farm reservoirs; where financially & economically viable solar powered irrigation systems; pipe delivery systems; or hybrids of open channel and pipe distribution system and water management schemes, if shown to be economically viable.

- Government can provide support services related to institutional strengthening of cooperatives or agro-enterprises; solicitation of sources for technical and capital assistance on the management and operation of the facilities; and research and development on post-harvest processing technologies; designing farm tools for labor-intensive non-rice crops.

Irrigation investments need to address sustainability issues such as climate change risks, highly degraded watersheds for most NIS, and significant disaster damage

- Water supply estimates need to be improved by conducting assessments of groundwater potential, especially in regions projected to experience water deficits (NIA 2021b)
- In order to sustain impacts in line with NIMP recommendations, climate proofing irrigation systems & infrastructures must become the **norm** from planning and design to construction, operation and maintenance, and rehabilitation.
- Flood and drought forecasting systems, and early warning systems for floods, landslides, and mudflow must be considered in risk-prone areas; The government has to allocate significant resources for climate-resilient structures and processes.
- The protection and proper management of watersheds and aquifer systems needs to be sustained; Collaboration between NIA & DENR should be strengthened, institutionalized, and adequately funded.
- Implementing integrated watershed management planning to address poor governance, prioritization of watershed projects, & budgetary constraints require the collaborative effort of multiple government agencies & private sector players; the creation of a Watershed Council may be explored, piloted, and institutionalized, if there is potential for success.

More systems should be restored and rehabilitated to improve efficiency and performance

- To increase water use efficiency (WUE), irrigation spending for restoration and rehabilitation must be increased; this investment will sustain the reduction in non-operational service areas; Provision or allocation of “adequate” operations and maintenance budget may help arrest the systematic deterioration of system performance.

- With FISA potentially affecting O&M spending and system operation and maintenance, its review and evaluation may be warranted.

- A program for diversification and promotion of higher value crops should be accompanied by the needed technical support and facilitation of market linkage.

Thank You