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COMMENTARY

# Evaluating the Non-Market Value of Pacific Salmon: Why Current Water Withdrawals in the Salmon River Are Economically Unsustainable

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## Introduction

Pacific salmon are foundational to the ecological, cultural, and economic fabric of British Columbia, yet their value is profoundly understated in resource management decisions. The Salmon River, located in the southern interior of the Thompson-Okanagan Region, B.C (B.C Ministry of Environment, 2007), supports populations of sockeye, chinook, coho, chum and pink salmon (British Columbia, 2025). This watershed is highly vulnerable to drought, a stressor that has intensified under climate change (IPPC, 2023).

In addition to being highly sensitive to environmental factors, agricultural production relies heavily on water extraction to maintain annual yields. The majority of withdrawals occur during the summer, when incoming hydrologic inputs are limited, thereby heavily reducing streamflow, increasing temperature, and reducing dissolved oxygen availability. These changes restrict salmon's ability to return to natal streams and spawn (British Columbia Ministry of Environment & Climate Change Strategy, 2022). Despite this conflict, water allocation decisions

typically prioritize the market value of irrigation while excluding non-market ecosystem services such as stream health, nutrient cycling, cultural value, and long-term fisheries productivity. This commentary argues that if the non-market value of Pacific Salmon were incorporated into agricultural water management decisions, current withdrawal levels would be recognized as economically unsustainable.

# Seasonal Flow Patterns and Impacts of Agricultural Withdrawal in the Salmon River

The Salmon River experiences extreme seasonal variability in discharge, with flows peaking during spring freshet and dropping to critically low levels in late summer and early fall (Water Survey of Canada, 2025). These low-flow periods coincide with peak agricultural irrigation demand, when crop water needs are the highest. Recent water-budget analysis of the Salmon River valley aquifers upstream of Falkland identifies irrigation-related surface-water and groundwater withdrawals as major components of annual outflows, directly reducing baseflow contributions to the river during late-summer low-flow periods (Beebe et al., 2024).

From August through November, adult salmon migrating into the Salmon River require cool, well-oxygenated water, adequate depth, and sufficient flow velocity to move upstream (Levy and Slaney, 1993). Department of Fisheries and Oceans (DFO) guidelines note that most salmon species experience increased physiological stress and pre-spawning mortality when temperatures exceed 15–20°C, with mortality increasing sharply above 20°C (Levy and Slaney, 1993).

During the summer of 2025, water temperatures in the Salmon River peaked at 23.7°C and fluctuated above 20°C well into October (Water Survey of Canada, 2025), conditions exceeding tolerance thresholds for migrating salmon. Because these thermal conditions occur during the same period when irrigation withdrawals are highest, agricultural extraction directly accelerates the rate at which the river warms and prolongs the duration of harmful temperatures. By reducing discharge during the period when salmon require the most favorable hydrologic conditions, irrigation practices intensify biological bottlenecks and contribute to long-term declines in salmon productivity.

# Economic Value of Pacific Salmon

Understanding the economic value of Pacific Salmon is essential for recognizing why current levels of agricultural withdrawals are unsustainable. It is important to acknowledge that irrigation in the Salmon River valley supports regional agriculture and contributes to food production and economic stability. However, when irrigation withdrawals are substantial and poorly regulated, the resulting reductions in streamflow directly undermine salmon survival, leading to long-term economic losses that may exceed short-term agricultural benefits gained from unrestricted extraction (Table 1).

Recreational and cultural benefits associated with salmon are also economically significant, with travel-cost valuation demonstrating substantial consumer surplus for visitors attending salmon runs (Androkovich, 2015).

Below, we assess the benefits and costs of reallocating 10,000 $m^3$ of water from agricultural to salmon habitat protection. In agricultural terms, 10,000 $m^3$ of water is roughly the amount needed to irrigate one hectare of farmland over a growing season in the B.C. Interior.

There are private benefits associated with water usage for agriculture. Expressed in constant 2024 Canadian dollars, agricultural water is valued at approximately $1.64–$3.28 CAD per $m^3$, based on U.S. western irrigated agriculture estimates reported by Janmaat (2019). Hence, reallocating 10,000 $m^3$ from agriculture to enhance salmon habitat implies foregone private sector benefits of approximately $16,000–$33,000 per year.

However, enhancing salmon habitat generates not only private benefits but also broader societal benefits. Habitat protection from improved instream conditions is estimated at roughly $2,470–$13,100 per kilometer of salmon-bearing stream and $1.74–$4.92 per hectare of affected watershed area (Knowler et al., 2003). These conservative estimates suggest that if the same 10,000 $m^3$ of instream flow improves 0.5 km of salmon habitat and several hectares of watershed, the resulting habitat value would be approximately $1,300–$6,600 per year, which falls short of the water usage losses and the foregone irrigation benefits.

However, beyond these physical habitat benefits, non-market public willingness to pay for recovering threatened coho populations is substantial. Lewis et al. (2019) estimate societal benefits on the order of $830 million per year for an additional 100,000 salmon (approximately $8,300 per additional salmon per year), with an additional $444 million CAD per year placed on achieving these gains sooner rather than later, for a total of $1.27 billion annually in 2024 CAD.

Hence, reallocating 10,000 $m^3$ of water from irrigation results in private losses of approximately $16,000–$33,000 annually; however, even a very small biological response from the reallocation, on the order of ten additional returning salmon per year, would generate roughly $83,000–$127,000 in annual public benefits, more than offsetting private losses in the agricultural sector.

**Table 1:** *Estimated Economic Impacts of Reallocating 10,000 $m^3$ of Water*

| Category | Value Category | Unit Value (2024 CAD) | Impact of 10,000 $m^3$ Reallocation | Source |
|---|---|---|---|---|
| Private Market | Agricultural value (per $m^3$) | $1.64–$3.28 | Private loss: $16,400-$32,800 | Janmaat (2019) |
| Ecological Service | Salmon habitat protection (per km) | $2,470–$13,100 per km | Assumes 0.5 km improved → $1,240–$6,560/year | Knowler et al. (2003) |
| Ecological Service | Salmon habitat protection (per ha) | $1.74–$4.92 per ha | Assumes 5 ha improved → $9–$25/year | Knowler et al. (2003) |
| Non-Market Public | Additional salmon abundance | 830 million/year = $8,300 per salmon | Public WTP per additional returning salmon | Lewis et al. (2019) |
| Non-Market Public | Timing premium (achieving gains sooner) | 444 million/year = $12,700 per salmon | Includes abundance + timing premium | Lewis et al. (2019) |

***Note.*** All values are expressed in constant 2024 Canadian dollars using Statistics Canada CPI (Table 18-10-0005-01). Agricultural values are based on Janmaat (2019), citing 2013 U.S. irrigated agriculture data converted to 2024 CAD. Habitat values are from Knowler et al. (2003) and adjusted from 1994 CAD. Non-market willingness-to-pay estimates are from Lewis et al. (2019), converted from 2017 USD to 2024 CAD. Hydrologic assumptions (e.g., 10,000 $m^3$ improving 0.5 km of habitat) are stylized but consistent with IFIM/PHABSIM methods.

# Conclusion

The cumulative evidence demonstrates that the current pattern of agricultural withdrawals in the Salmon River valley is hydrologically and environmentally unsustainable. Reduced salmon populations decrease resource availability for local First Nations, reduce recreational and commercial harvest opportunities, and diminish ecological function. Salmon habitat provides substantial long-term societal and economic benefits that are overlooked in existing water allocation practices.

Incorporating the non-market value of salmon and their habitat into water management frameworks would reveal that current extraction levels impose disproportionate ecological and economic costs. A more balanced approach would better sustain both food production and the long-term viability of Pacific salmon in the Salmon River.

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# References

Androkovich, R. A. (2014, November 07). Recreational visits to the Adam's River during the annual sockeye run: A travel cost analysis. *Marine Resource Economics. 30*(1), 1–20. https://doi.org/10.1086/679462

Beebe, C. R., Goetz, J., Spittlehouse, D. L. (2024). *Updated water budget for Salmon River Valley aquifers upstream of Falkland*. Water Science Series No. 2024-07. Province of British Columbia. https://a100.gov.bc.ca/pub/acat/documents/r63066/WestwoldWBStudy,June2024_1721325054471_E54B8CD382.pdf

B.C. Ministry of Environment. (2007). *Salmon River watershed overview.* Government of British Columbia.

B.C. Ministry of Environment & Climate Change Strategy. (2022). *Salmon River water quality assessment summary*. Government of British Columbia.

British Columbia. (2025). *Salmon species distribution in B.C.* Government of British Columbia.

Intergovernmental Panel on Climate Change (IPCC). (2023). *Climate change 2023: Synthesis report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [H. Lee & J. Romero (Eds.)]. IPCC. https://doi.org/10.59327/IPCC/AR6-9789291691647.

Janmaat, J. (2019). *What is the economic impact of irrigation in the Okanagan?* [Internet]. University of British Columbia, I.K. Barber School of Arts and Sciences. https://blogs.ubc.ca/ubcowatershed/files/2019/11/BCIA_Workshop_201911.pdf

Knowler, D., MacGregor, B., Bradford, M., Peterman, R. M. (2003). Valuing freshwater salmon habitat on the west coast of Canada. *Journal of Environmental Management, 69*(3), 261–273.

Levy, D. A, Slaney, T. L. (1993). *A review of habitat capacity for salmon spawning and rearing.* Prepared for the B.C. Resources Inventory Committee (RIC), Habitat Management Division, Department of Fisheries and Oceans. Levy Research Services Ltd.

Lewis, D. J., Dundas, S. J., Kling, D. M., Lew, D. K., Moore, J. R. (2019). The non-market benefits of recovering and protecting threatened and endangered salmon. *PLoS One, 14*(7), e0219713.

Statistics Canada. (2025, January 19). *Table 18-10-0005-01: Consumer Price Index, annual average, not seasonally adjusted.* https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1810000501

Water Survey of Canada. (2025). *Real-time hydrometric data for Salmon River at Falkland* (08LE020). Government of Canada. https://wateroffice.ec.gc.ca/report/real_time_e.html?stn=08LE020

Water Survey of Canada. (2025). *Real-time hydrometric data for Salmon River near Salmon Arm* (08LE021). Government of Canada. https://wateroffice.ec.gc.ca/report/real_time_e.html?stn=08LE021

# Author

**Micah Lowen** is an undergraduate student in Natural Resource Science at Thompson Rivers University in Kamloops, British Columbia. She is particularly passionate about Pacific salmon and the protection of cold-water habitats that support fish and amphibian species across British Columbia. Micah has contributed to projects focused on fisheries monitoring and has collaborated with federal partners on salmon-related initiatives, gaining experience in applied conservation and watershed stewardship. She has also participated in amphibian salvage work, helping locate and relocate individuals to suitable habitats during periods of environmental disturbance.

Her interests center on understanding how water management, habitat change, and climate pressures affect aquatic species and the ecosystem they depend on. Micah is motivated by a desire to support conservation that protects vulnerable populations and maintains healthy freshwater systems.