“ALASKANIZING” SALMON-SAFE STANDARDS:

A MODEL FOR THE CO-EXISTENCE OF SALMON AND AGRICULTURE

by

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Acknowledgments

First and foremost, this project takes place on the traditional homeland of the Dena’ina and Sugpiaq people where I live and work as a non-native Alaskan resident. Tikahtnu, what is now called Cook Inlet, is a place of extraordinary beauty and abundance, and I am grateful to be here. I am not Indigenous to this place, I am not a farmer, and I am not a fisher. However, I am a supporter of local foods wherever I live and one of my great joys is connecting people.

Many thanks to Robbi Mixon and Sue Mauger of Cook Inletkeeper for trusting me with this project and for their endless support and encouragement as I navigated the complexities of Alaska’s food system. Above all, thank you to the farmers and other participants who attended bi-weekly meetings in the dark days of winter during a pandemic. They sat through every slide deck and awkward pause with good humor and generously shared an abundance of place-based knowledge and experience without which this project would not exist.

Thanks to Prescott College for stretching the bounds of what an MBA can be. I am finishing this program with new skills to serve my community and with a reading list a mile long because the learning continues. On a professional level, this capstone paper is prepared for Cook Inletkeeper to use in stewardship of this watershed, and on a personal level, it is a project of hope for our future food systems.

At home, thank you from the bottom of my heart to my partner David Lefton who has walked with me through every day of graduate school. And to Geo and Leo for reminding me to rest and for being the best cats I’ve ever known.

Executive Summary

This paper presents the case for the community-led development of sustainable agricultural practices for farming on a salmon landscape in Alaska. Pacific salmon habitat spans multiple ecosystems across entire watersheds and shapes the landscape both in and out of the water. Both salmon and agriculture are key components of Alaska’s food system, and both are impacted by climate change. Salmon struggle under increasing thermal stress while agriculture expands with longer growing seasons (US EPA, 2003; Mauger et al., 2017; Hannah et al., 2020; AMAP, 2021; Crozier et al., 2021). Intensifying the development of agriculture in Alaska without addressing its impacts on salmon risks considerable long-term economic, social, and cultural loss (Jones et al., 2020; Lemay et al., 2021; Walker et al., 2021; Price et al., 2022). The goal of this project is to support both local agriculture and salmon and ultimately to build a more resilient and just local food system.

Cook Inletkeeper, a watershed conservation nonprofit organization located in Homer, Alaska, convened a working group of local farmers in the spring of 2022 to discuss the Salmon-Safe Certification Standards for Farms (Salmon-Safe, 2018). These standards were developed by Salmon-Safe with biologists, agronomists, and farmers in the Pacific Northwest as the best practices for farming in watersheds where salmon are found and include protecting in-stream habitat, revegetating riparian areas, minimizing chemical and sediment runoff, careful animal management, increasing on-farm biodiversity, and more (Salmon-Safe, 2018). The Cook Inlet Watershed Farmers Working Group examined these standards, suggested changes, and noted resource and research needs from their perspective as Alaskan farmers within the context of northern agriculture and its associated challenges, such as high costs of shipping supplies, short growing seasons, and small farm size (Meter & Goldenberg, 2014).

The State of Alaska is increasingly aware of food insecurity in the state and supporting agricultural land development, with the Governor’s office signing Administrative Orders 334 and 338 establishing the Alaska Food Security and Independence Task Force and the Office of Food

Security (Dunleavy, 2022a; Dunleavy, 2022b). Telling the story of how and why salmon-safe farming is necessary and developing the best practices for farming in a salmon landscape while salmon populations are still healthy in Alaska is important to avoid compromising valuable sources of local food. Sharing this information involves both raising public awareness as well as responding to some of the barriers to the adoption of these practices. This story is one step of a larger project, informed by the recommendations of the working group and the analysis presented in this paper.

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Introduction

Pacific salmon (*Oncorhynchus* ssp.) habitat spans the western coast of the United States from California to Alaska. The genus includes six salmon species, one of which is only found in Asia, and Pacific trout. Salmon are anadromous, meaning they start their lives in freshwater, migrate to the ocean to grow, and then return to their birthplace to spawn and then die. Genetically distinct populations of salmon return to their historic spawning grounds, even after being denied passage for generations. In 2011, after a dam was removed from the Elwha River in the Olympic National Park of Washington state, access to 70 miles of crucial salmon spawning habitat was restored for the first time in a century, and salmon began returning to these waters within months (US National Park Service, n.d.).

Salmon depend upon habitat quality over a broad geographic area, and salmon populations are vulnerable to habitat fragmentation. As salmon progress through their lifecycle, they pass through numerous ecosystems from stream headwaters to coastal wetlands and estuaries to the open ocean and back (see the image in Appendix A). Preserving and restoring salmon habitat is challenging because it depends upon connectivity across the landscape involving coordination between multiple land use managers including federal, state, borough, municipal, tribal, and private organizations, as well as individual landowners.

Pacific salmon populations in the Pacific Northwest are in an alarming decline. About one-third (29%) of genetically distinct salmon populations have been lost since Euro-American contact, and about one-third of those remaining are threatened or endangered (Gustafson et al., 2007). By another measurement, the stock, or the number of individual salmon making up a population, has decreased dramatically across the region. In the Columbia River basin, runs are reduced to as low as 2% of historic numbers (Robbins, 2019). Where salmon populations and habitats have been dramatically altered, conservation efforts focus strongly on restoration, a slow and expensive process. For example, a decades-long coho salmon and steelhead trout habitat restoration project focused on a mere six miles of Dry Creek in Sonoma County,

California, is halfway completed, and the next 2.5 miles are projected to cost $44.7 million (Beach, 2022).

Industrial agriculture in the lower 48 states is seen as a primary anthropogenic threat to salmon and their habitat with negative impacts including habitat fragmentation, chemical and sediment runoff, blocking or rerouting waterways, and decreasing riparian biodiversity. These problems are notable in Pacific Northwest watersheds where salmon populations are greatly reduced or extinct. California Trout, a conservation nonprofit organization in California, lists agriculture in the top three human-caused threats to anadromous fish along with estuary alteration and major dams (*Threats*, 2011).

Agricultural development is only one aspect, and a small but growing one, of land development in Alaska that impacts salmon habitat. This paper focuses on the impact of agriculture on salmon habitat because both salmon and agriculture are key components of Alaska’s food system. Alaska is in a unique situation with agriculture increasing and intensifying in areas with healthy salmon populations. Research suggests that rapid agricultural development in tropical areas previously considered undesirable for farming portends similarly rapid development in northern latitudes (Unc et al., 2021).

Additionally, there is a lack of models for developing agriculture in a way that also supports salmon in the Pacific Northwest and Alaska. Some inspiration can be drawn from the Indigenous-led agroecology movement in the Northwest Territories (NWT), Canada, where efforts are made to both intensify agriculture and protect traditional foods to increase local food sovereignty (Laforge et al., 2021; Lemay et al., 2021; Price et al., 2022). Increasing cultivation is not addressed separately from natural resource conservation, habitat protection, and species stewardship, but rather all are considered vital parts of a resilient food system. As climate change impacts access to traditional foods, communities are using gardens as an adaptation strategy to increase their food supply. Tribal members in Kakisa, NWT, note increasing the volume of food production and capacity building through skills in food production, preservation,

and composting as high priorities (*Food security and waste,* n.d.). Their garden project also builds relationships between students and elders, among other social benefits (Tucker, 2022).

Given the recent political interest in food security and agriculture as by Governor Dunleavy’s creation of the Alaska Food Security and Independence Task Force and the current Nenana-Totchaket Agricultural Project land auction, now is the time to promote sustainable agriculture in Alaska with a focus on protecting salmon habitat (Dunleavy, 2022; Native Movement, n.d.; State of Alaska, n.d.-b). Fourteen fisheries, mostly salmon, in Alaska were declared federal disasters in January of 2022 (MacArthur, 2022). The 2022 Yukon River salmon fishery is in continued collapse while Bristol Bay is experiencing record-breaking salmon numbers (Bernton, 2022). This unpredictability has far-reaching economic and cultural repercussions (Hughes, 2021-a; Hughes, 2021-b). Salmon need support statewide from many industries, and agriculture is one place to start.

Cook Inletkeeper is a regional nonprofit organization dedicated to protecting the Cook Inlet watershed and all the life it sustains. It is based in Homer, in Southcentral Alaska on the southern Kenai Peninsula, and is working to support both local agricultural development and healthy salmon populations. Cook Inletkeeper’s “Alaskanizing Salmon Safe Agriculture” project is a proactive effort to develop and promote place-based agricultural principles informed by local farming and Indigenous knowledge which will ensure locally grown foods and wild salmon are abundant for all Alaskans. The project began by examining one existing framework, the Salmon-Safe Farm Certification Standards (Salmon-Safe, 2018). These standards are “based on the latest scientific research and take a holistic approach to land and water management by focusing on salmon as the link between ecosystems and as indicators of overall ecosystem health” (Graham, 2020). Cook Inletkeeper connected with Salmon-Safe for a short-term project to gauge the interest of local farmers in potentially obtaining certification, but Salmon-Safe has not acted as the local partner for implementing certification.

Cook Inletkeeper recognized the need to use local farmers’ and Indigenous growers’ knowledge to inform the Salmon-Safe certification standards if the program were expanded into Alaska. This is referred to as “Alaskanizing” the standards and is one of the objectives of Cook Inletkeeper’s Salmon-Safe Agriculture Project. It has the following four objectives, each with specific action items:

1. Bring together a working group of local farmers and Indigenous growers by leveraging existing local collaborations to create a diverse working group of local farmers and Indigenous growers.
2. Identify sustainable and responsible farming practices on a salmon landscape by ascertaining what farmers are already doing to safeguard salmon habitat and identifying practices that are unique to the Alaskan landscape and climate.
3. “Alaskanize” salmon-safe agricultural principles to protect salmon habitat and water quality by working with Salmon-Safe to modify existing certification standards based on the input from local Alaskan farmers and Indigenous growers.
4. Promote a salmon-safe agricultural ethic through engaging communications and strategic outreach efforts. Create and share engaging outreach products to build a local salmon-safe farming ethic that protects fish, wildlife, lands, and waters while increasing the supply of and access to local food. (Cook Inletkeeper, 2021).

The author was retained by Cook Inletkeeper to facilitate the Cook Inlet Watershed Farmers Working Group. The participants read and discussed the Salmon-Safe Farm Certification standards, and their suggestions and questions are summarized in subsequent sections of this paper. Overall, local farmers were supportive of the goals of the project but expressed concerns with the financial resources and time required to comply with certification, two concerns found to be the main barriers to implementation. This paper presents the findings of the 2022 Cook Inlet Watershed Farmers Working Group as a case study for sustainable agricultural development while protecting and improving salmon habitat in Alaska.

A summary of the six working group sessions is followed by a PESTEL Analysis. PESTEL is a framework used to analyze the macro-environment in which an organization

operates and is typically used by businesses in risk management planning (Corporate Finance Institute, n.d.). Analyzing the categories of PESTEL, the political, economic, social, technical, environmental, and legal factors, will allow Cook Inletkeeper to develop an effective strategy to support and advocate for sustainable, salmon-safe agricultural development in Alaska and will inform upcoming marketing and policy campaigns. The paper concludes with recommendations for next steps.

Setting the Stage for Salmon-Safe in Alaska

Salmon

Figure 1: *Bristol Bay Salmon*

(Ma, 2019)

Alaska is the remaining stronghold for healthy Pacific salmon populations, none of which are currently federally endangered or threatened (*Endangered, Threatened, and Candidate Species in Alaska*, n.d.). The Gulf of Alaska produces about one-third of the world’s wild Pacific salmon (Schoen et al., 2017). By comparison, recent reports from the Pacific Northwest paint a grim picture. In Washington, 14 genetically distinct populations of Pacific salmon and trout are listed as endangered with ten considered in crisis or not progressing toward recovery goals (Washington Governor’s Salmon Recovery Office, 2020). California has four species of salmon that exist as 12 genetically distinct populations. Ten of these are listed as federally endangered, threatened, sensitive, or species of concern (Moyle et al., 2017).

Alaska is home to five species of Pacific salmon, and most of the state is considered salmon habitat. Some Alaskan salmon are raised in hatcheries and released as juveniles to complete their lifecycle without additional human intervention. Finfish farming, which includes salmon, is prohibited in Alaska, so salmon are not raised to adulthood completely in controlled environments. Thus salmon fisheries in Alaska include both wild salmon populations and wild-caught salmon released from hatcheries. Though salmon stream headwaters are often remote, salmon pass through coastal areas where most of Alaska’s population and associated land development are located (Mauger et al., 2021). Salmon habitat is threatened by numerous

human activities such as mining, industrial agriculture, road construction, overfishing, and dams (Moyle, 2017; Crozier et al., 2021; Mauger et al., 2021).

However, salmon and people have shared the same space for millennia, as evidenced in oral histories and archaeological records (Wilson & Black, 2019; Langdon et al., 2019). One example of this relationship is the finding of salmonid scales at a site of human use dated 11,500 years ago on the Tanana River in Interior Alaska (Potter et al., 2017). Cultural keystone species shape the cultural identity of a group and play fundamental roles in their diet, materials, medicine, and spiritual practices (Garibaldi and Turner, 2004). Salmon are cultural keystone species for many Indigenous people in the Pacific Northwest and Alaska. Respect, reciprocity, and stewardship characterize the relationships between salmon and Indigenous people in Alaska and across the Pacific Northwest historically and today (Carothers et al., 2021; Langdon, 2019).

In addition to previously mentioned anthropogenic threats, salmon are sensitive to warming temperatures and thus are vulnerable to the impacts of climate change. The US Environmental Protection Agency (EPA) has set temperature thresholds for different points in the salmon lifecycle above which negative effects are increasingly likely (US EPA, 2003). Areas of warm water can block salmon migration paths even when their habitat is not interrupted by dams and other physical barriers. Even in Alaska, at the northern end of their habitat range, salmon are suffering from thermal stress including die-off events when stream temperatures rose above previous record highs during spawning (Mauger et al., 2017; Martin, 2019).

Salmon are documented as hopscotching along areas of cooler water temperatures, called cold-water refugia (CWR), to reach their spawning grounds. In the Columbia River, the EPA reports that these areas are generally where tributaries flow into the main river and that CRW use appears to be a behavioral adaptation to increasingly warm summer water temperatures, reducing time exposed to stressful temperatures by up to 50% in some cases (US EPA, 2021).

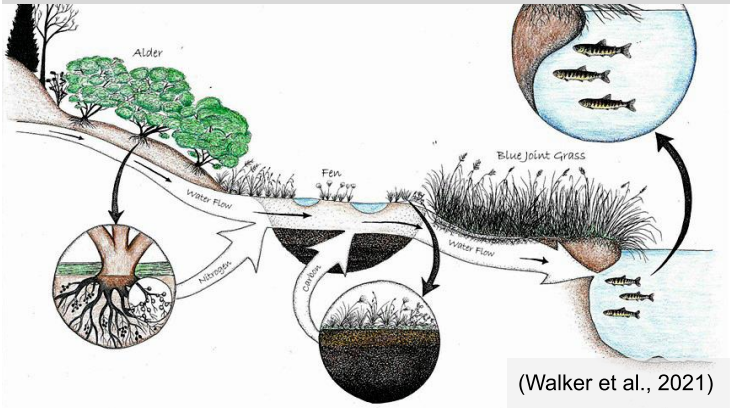
Researchers have used global climate models to project warming temperatures through the end of the century and found rising sea surface temperatures to be the most impactful variable on salmon populations leading to high marine mortality rates (Crozier et al., 2021). Efforts to protect and improve freshwater habitat, such as maintaining vegetated riparian buffers that shade streams and reduce water temperature can build resilience in salmon populations because greater numbers of healthier, larger juvenile salmon enter the marine ecosystem and have higher rates of survival (Crozier et al., 2021; Tillotson & Quinn, 2016). Smaller populations dropped below the extinction threshold more quickly as they lack the genetic and ecological diversity to adapt to environmental change. Crozier et al. (2021) suggest a focus on conserving key areas such as healthy, accessible estuarine and upstream habitat. Additionally, the authors recommend developing management actions that both improve salmon habitat and maintain other benefits for people, using the example of reconnecting floodplains with rivers, thus expanding salmon habitat as well as recharging aquifers and mitigating floods (Crozier et al., 2021).

In Alaska, Pacific salmon populations are still healthy, though they are under increasing pressure from threats of climate change and habitat fragmentation. Jones et al. (2020) conducted the “first analysis of the effects of regional and watershed-specific climate drivers on the productivity of a diverse group of Alaskan Chinook salmon populations” (p. 4920). The authors studied how 16 populations of Chinook salmon in the Cook Inlet basin were impacted by a variety of local conditions. The Cook Inlet basin salmon population suffered record-low returns in 2012, and the authors recognize that continued declines will impact jobs, food security, cultural well-being, and even the persistence of salmon-dependent communities in the region. Jones et al. concluded that “no single driver or life stage has been identified that can fully explain these declines, suggesting that multiple drivers are involved, individual populations are responding differently, or both” (p. 4933). Rather than being discouraged or led to inaction

by the uncertainty, these findings present numerous points in the salmon lifecycle where management efforts could be impactful.

Walker et al. (2021) focus their research specifically on links between landscapes and salmon-bearing streams, specifically four watersheds of the southern Kenai Lowlands, in the Cook Inlet basin. The authors situate salmon in a complex food web and nutrient cycle. Returning salmon bring marine-derived nutrients to headwaters, and salmon carcasses removed by birds, bears, and humans deliver nutrients to riparian areas, as well as nourish those that consume them. Then the authors explain the value of stream headwaters where spawning occurs, and juvenile salmonids grow. Three major landscape considerations in the headwaters are alders, peatlands, and groundwater flows. Alders, a nitrogen-fixing tree, provide shade, salmon habitat within the stream from tree debris, and nutrients for macroinvertebrates, food for juvenile salmonids. Peatland adds dissolved carbon to the stream, an important nutrient for the ecosystem. Groundwater discharge provides a cold water refuge in warming streams, and it does not freeze in the winter, providing crucial habitat for growing juvenile salmonids.

Figure 2: *Connection between landscape and salmon stream*



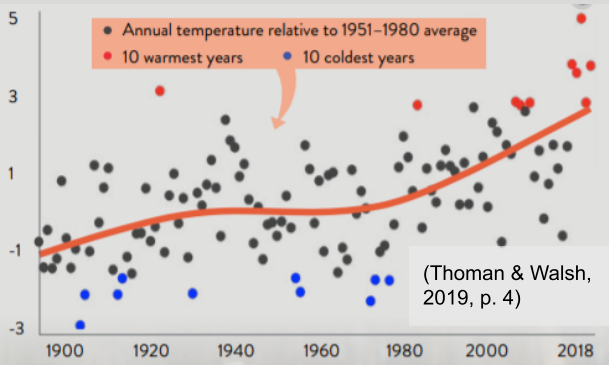
(Walker et al., 2021)

Together, these three landscape components form important habitat hotspots that can be mapped and monitored. These hotspots may exist on private property while the landowner remains unaware, and salmon streams pass through the influence of multiple stakeholders. Walker et al. (2021) note that “although most people in the Kenai Lowlands value and feel strongly about salmon, these feelings do not necessarily translate into salmon-friendly land-use strategies in landscapes consisting of a complex web of public and private land ownership” (p. 2).

Climate Change and Agriculture

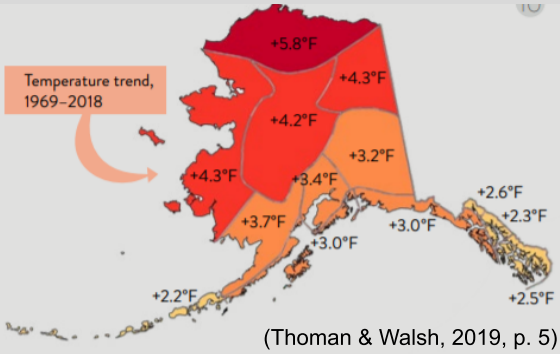
Researching the impact of warming temperatures on salmon is especially relevant in Alaska because the Arctic is warming two to four times faster than in the rest of the country (USGCRP, 2018; AMAP, 2021; Rantanen et al. 2022). The Arctic Monitoring and Assessment Programme (AMAP) reported in 2021 that the increase in annual mean temperatures between 1971 and 2019 in the Arctic was 3.1 degrees Celsius, three times the global average (AMAP, 2021). The following charts show temperature trends from Alaska.

Figure 3: *Average temperatures in Alaska*



(Thoman & Walsh, 2019, p. 4)

Figure 4: *Temperature trends in Alaska*



(Thoman & Walsh, 2019, p. 5)

Climate change brings unpredictable weather and increased risks like storms and wildfires. Climate change is also extending the growing season in the state. Agriculture in Alaska is increasing, and, due to the increase in new farmers, much of the land being developed is raw land. According to the 2017 USDA Census of Agriculture, between 2012 and 2017, the number of farms in Alaska increased by 30% compared to a national decrease of over 3% (USDA, 2017b). The number of small farms in Alaska grew by 67% from 2002 to 2012 and direct sales from farmers to local consumers are growing at a rate 13 times the national average (Langlois, 2017). The number of farmers markets in

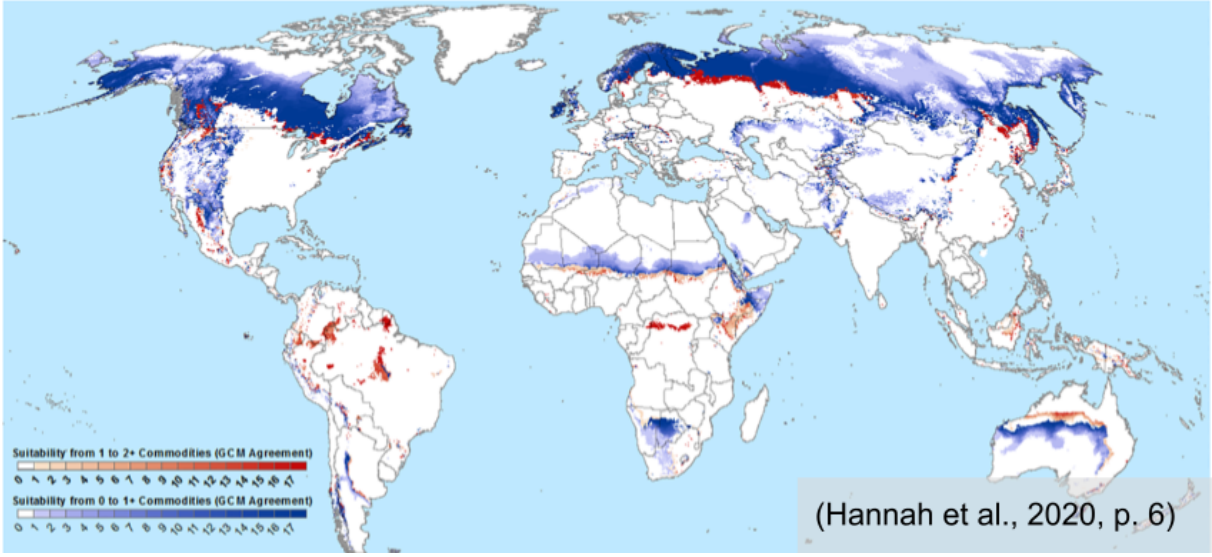
Figure 5: *Homer, Alaska, Farmers Market*

(*Homer Farmers Market*, n.d.)

Alaska grew from 13 in 2006 to 41 in 2017, and this growth continued with 56 farmers markets counted statewide in 2021 and more being planned (Mixon, 2021).

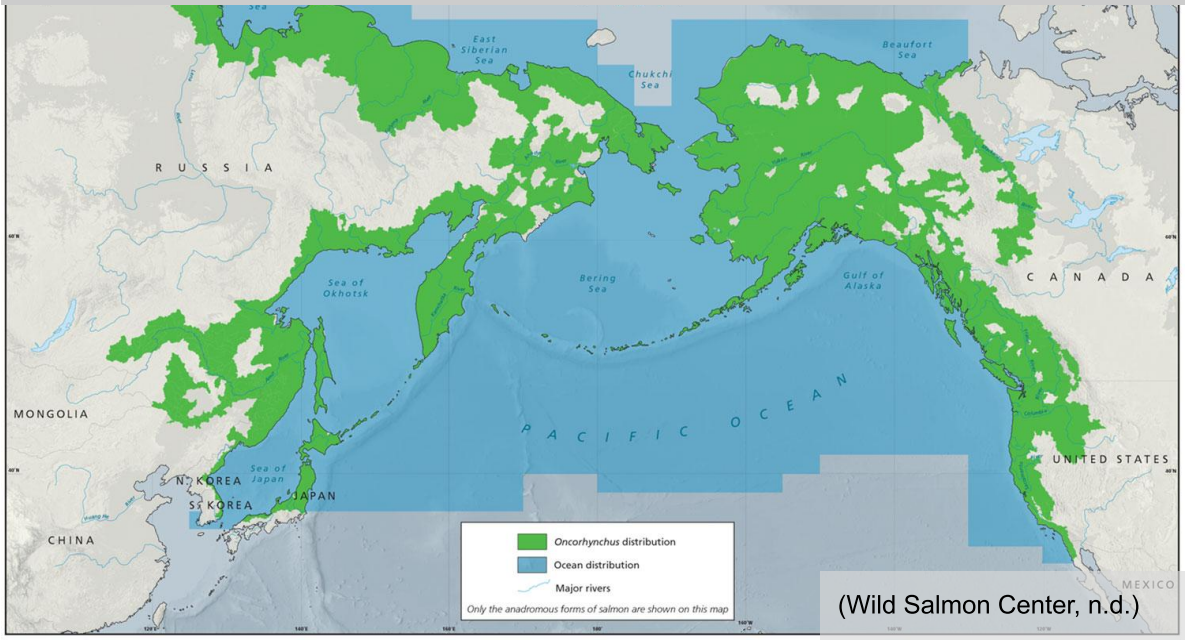
As shown in Figure 6 below, on a global scale, agriculture is expanding along “climate-driven agricultural frontiers” into northern latitudes and higher altitudes that span an area totaling approximately one-third the size of current agricultural land on the planet and impact watersheds where over 1.8 billion people live (Hannah et al., 2020). The authors note that many of these frontiers are the ancestral homelands of Indigenous people and stress that Indigenous communities must be included in development plans and “must be the primary beneficiaries” of development (Hannah et al., 2020, p. 11). Figures 6 and 7 highlight the potential impact of expanding agriculture on salmon populations due to overlap with salmon habitat.

Figure 6: Climate-driven Agricultural Frontiers covering most of Alaska



(Hannah et al., 2020, p. 6)

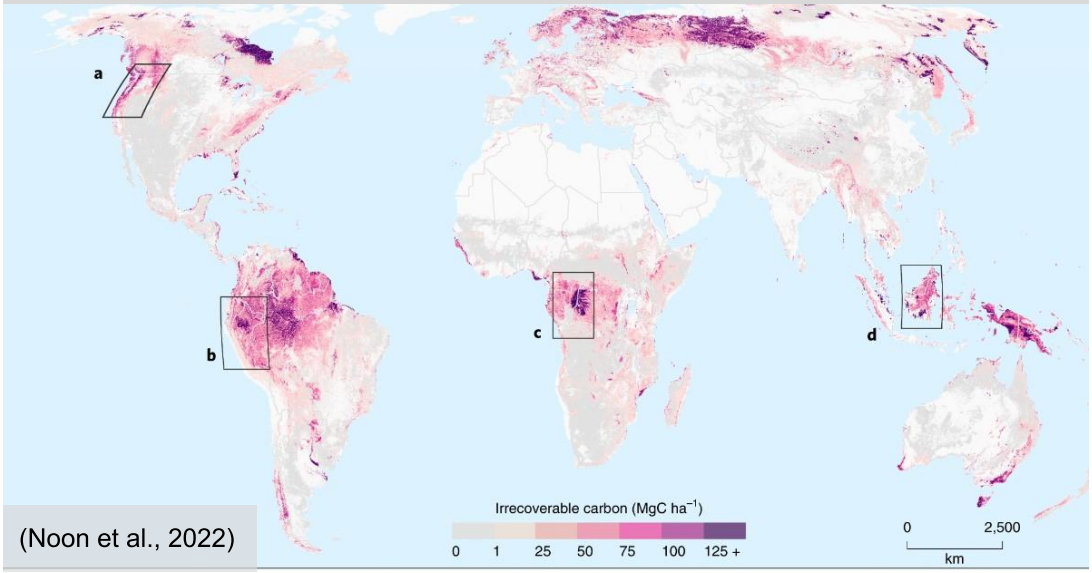
Figure 7: *Pacific salmon habitat distribution*



(Wild Salmon Center, n.d.)

According to Hannah et al. (2020), the biggest environmental impacts of expanding agricultural frontiers are on biodiversity, water quality, and carbon storage. For example, the total value of carbon in the top one meter of soil under the projected agricultural frontiers “is equivalent to 47-116% of all carbon currently in the Earth’s atmosphere” (p. 6). Carbon is released during agricultural land conversion through tilling of previously untilled soils. In addition, many frontier areas, especially in northern regions, contain peat soils that degrade when disturbed leading to the release of more and deeper carbon. The magnitude of this carbon release has the potential to add feedback to environmental problems, meaning that cultivation in the northern frontier potentially leads to increased carbon release and even faster rates of climate change. The ecosystem services provided by these frontier areas need to be recognized and protected as agricultural expansion occurs. The authors hope to “inform policies that balance optimized food production with the importance of biodiversity and ecosystem services” (p. 2).

Figure 8: *Areas of irrecoverable carbon, PNW outlined as hotspot, Alaska also impacted, compare to salmon habitat map above*



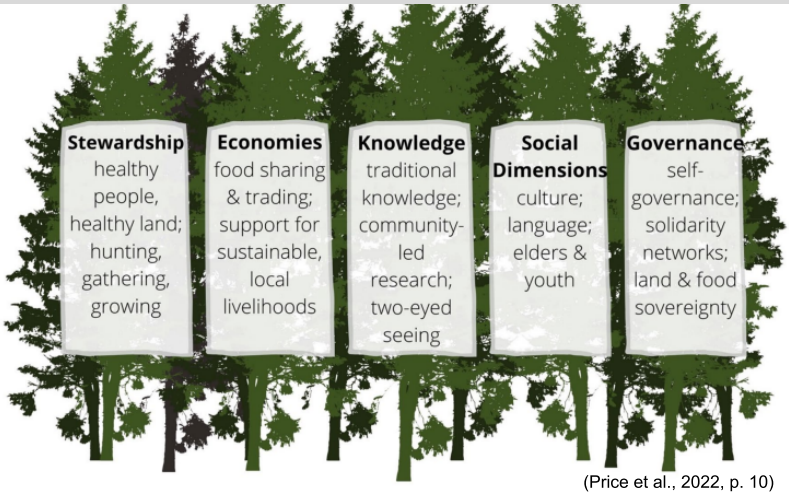
(Noon et al., 2022)

Projections of agricultural possibilities in the Arctic point to dramatic changes. By the year 2099, 76% of the boreal region could support agriculture, compared to the current 32%, with variable precipitation and poor soil being the main limiting factors (King et al., 2018). The maps below compare the frontier areas of agricultural expansion and intensification with the historic habitat range of Pacific salmon. In addition, Figure 8, above, shows areas of “irrecoverable carbon”, carbon that is vulnerable to release and is unlikely to be recovered by 2050, the date chosen to align with Paris Agreement emission reductions (Goldstein et al., 2020; Noon et al., 2021). Agriculture, deforestation, and wildfires were listed as the main causes of carbon release, and the authors stress that management by local communities and Indigenous groups is crucial to protecting these areas. These maps of agricultural expansion, projected carbon loss, and salmon habitat illustrate the potential changes to these areas over the next century and the necessity of proactive policy decisions.

Agriculture in Southern Canada is largely industrial, and recent research has emerged from that climate-driven agricultural frontier. Price et al. (2022) list numerous concerns with the northward expansion of this system of agriculture including the destruction of fragile Arctic

ecosystems and a continuation of the country’s history of forced land dispossession and assimilation of First Nations communities. The authors propose an expanded version of agroecology as an alternative to this frontier agriculture. Agroecology, as a science, practice, and social movement, is a sustainable farming system that focuses on the health of the whole ecosystem that started in Indigenous and peasant communities in Latin America. By expanding the definition of agroecology to include land and resource stewardship practiced by First Nations in Canada, Price et al. (2022) provide a framework of agroecology for communities in northern Canada to expand both agriculture and traditional foods shown in Figure 9. It is the result of participatory research with the Ka’a’gee Tu and Sambaa K’e First Nations and is meant to guide both Indigenous and non-Indigenous farmers, producers, and growers in their agricultural activities.

Figure 9: *Framework for agroecology in the North that incorporates Indigenous values*



(Price et al., 2022, p. 10)

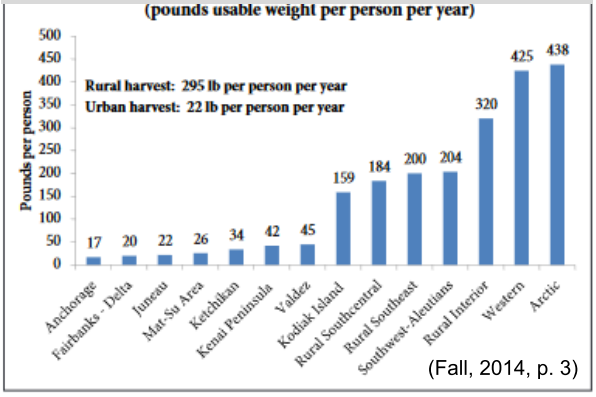
The Ka’a’gee Tu First Nation in Northwest Territories, Canada, led a project called Northern Agriculture Frontiers (NAF) that used focus group discussions to determine how the growing agri-food industry (agriculture plus associated sectors such as processing and distribution) fits within the local food system (Lemay et al., 2021). One point of consensus among stakeholders was “the inherent and essential role of the natural environment in the lives of the people of the NWT and its food system. Any future agri-food industry would be expected to respect and strengthen this relationship” (p. 7). The lack of current policy and regulation is seen as an opportunity to begin with “progressive, sustainable, climate-smart agricultural practices that protect the traditional food system for future generations” (p. 14).

Food System of Alaska

In Alaska, an oft-repeated statistic is that 95% of food is imported, totaling $1.9 billion of the $2 billion that Alaskans spend annually on food, but this only accounts for purchased goods (Meter & Goldenberg, 2014). Wild foods are frequently harvested, foraged, gifted, and traded, and, although they are not counted in that statistic, their economic impact on Alaska residents is significant. In fact, the main source of local food in Alaska is combined subsistence and personal use gathering, worth about $900 million per year (Meter & Goldenberg, 2014).

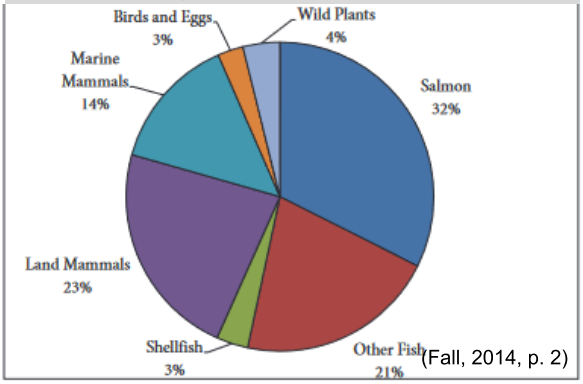
Figures 10 and 11 show the volume and composition of wild food harvests with salmon comprising about a third of the total. Figure 12 shows that less than two percent of salmon harvested in Alaska is consumed by local residents with most going to commercial fishing harvests.

Figure 10: *Wild food harvests in Alaska by area, 2012*



(Fall, 2014, p. 3)

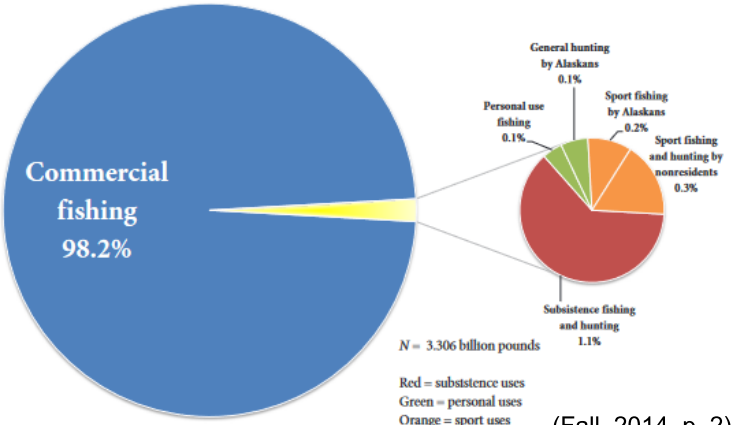
Figure 11: *Composition of wild food harvest by rural Alaska residents, 2012*



(Fall, 2014, p. 2)

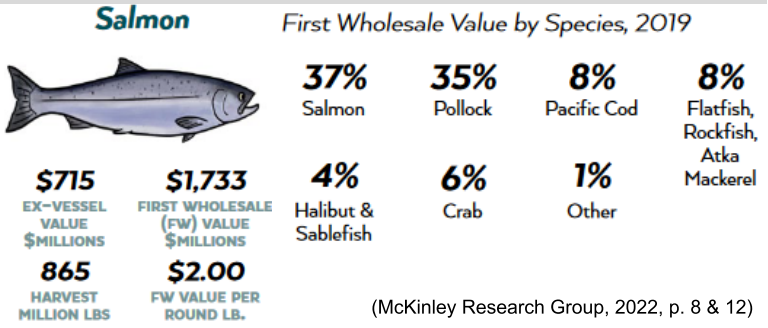
In addition to being a crucial part of the food system, salmon fisheries are an economic driver in the state. The seafood industry in Alaska contributed $5.7 billion in economic output to the state’s economy in 2021 (McKinley Research Group, 2022, p. 4).

Figure 12: *Resource harvests by use in Alaska*



(Fall, 2014, p. 2)

Figure 13: *Commercial salmon harvest, 2019 numbers*



(McKinley Research Group, 2022, p. 8 & 12)

Salmon is the second most harvested species by volume, and it is the top species by value. Alaska provides 11% of the global supply of salmon. However, regarding food security, most of this is exported and does not increase the food supply for Alaskans. (McKinley Research Group, 2022)

The food system in Alaska is vulnerable to both disruption of supply of, and access to, wild foods, including fish, wildlife, and wild plant resources (Fall & Kostick, 2018). Food available in grocery stores travels long distances by barge, truck, and plane, often in subzero temperatures or delayed by inclement weather. There is a need for more food storage and processing facilities. Even urban areas of Alaska have only about five days of food in grocery stores, and ninety percent of the imported food passes through the Port of Anchorage (Alaska Food Policy Council, 2012; AFPC Advocacy Committee, 2021). These limitations on imported food make increasing locally-grown foods and access to wild foods even more important.

Access to wild foods requires a number of resources, including but not limited to time away from work that aligns with hunting and fishing seasons and fuel for vehicles and boats, to hunt, fish, and gather on the land. This issue of access disproportionately impacts Alaska Native populations. American Indians and Alaska Natives are twice as likely to be food insecure when compared with white populations (Jernigan et al., 2017).

Access also depends upon adequate amounts of wild foods being available to harvest. For example, 2022 marks the second year in a row of record low salmon counts on the Yukon River, causing a cascade of cultural, social, and economic hardship, and “people are running out of food” (Ebertz, 2022). In 2021, the State of Alaska Department of Fish and Game mobilized salmon donations totaling 90,000 pounds of frozen fish in boxes, purchased by state

funds from areas of the state with more abundant salmon runs and distributed by small plane across the lower Yukon River delta (Hughes, 2021a, Hughes, 2021b).

Figure 14: *Boxes of frozen salmon as food aid delivered along Yukon River*

(Hughes, 2021b)

Although this service provided locals with food, it did not address the cultural loss for communities that are unable to gather and share salmon according to their traditions. Further, it does not prevent the economic impacts from both the loss of commercial fishing income in communities and residents forced to purchase replacement foods. For example, if families struggle to pay utility bills that make up a portion of municipal revenues, the ability of villages to provide services to residents is impacted. Food security is impacted twice, first with the inability to provision in traditional ways and second with reduced purchasing power for commercial groceries (Hughes, 2021b).

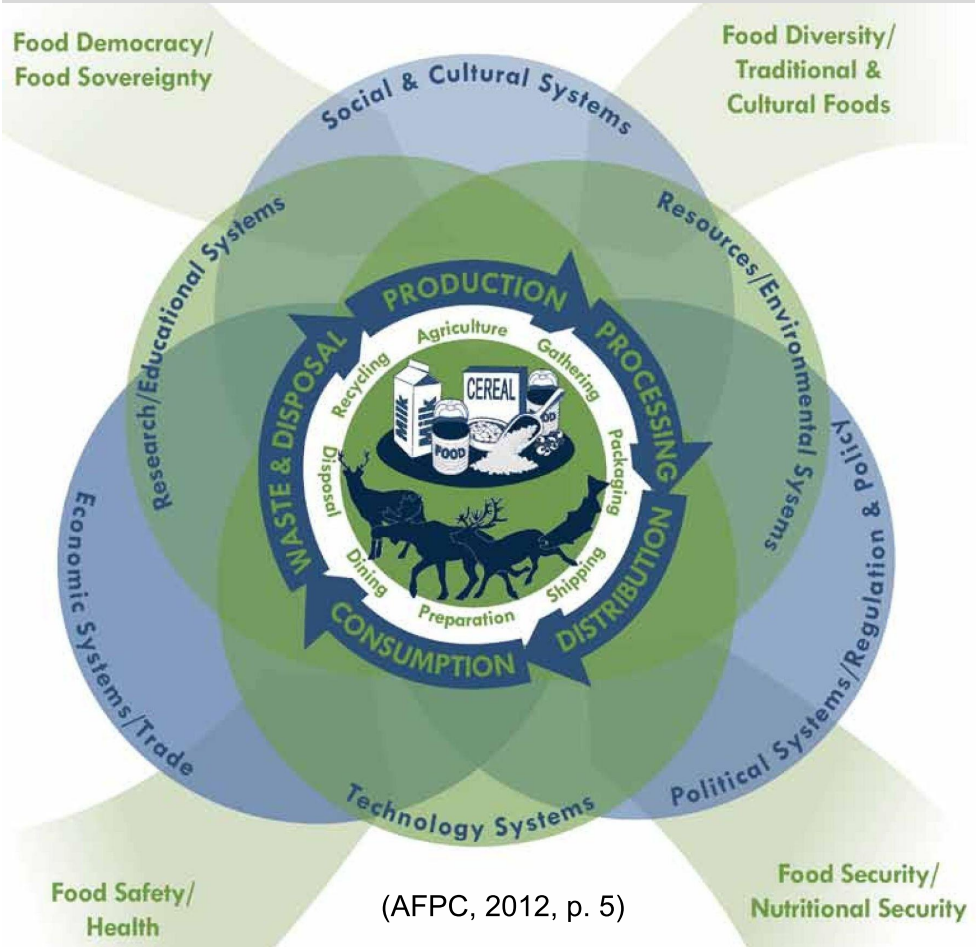
A Systems Perspective

As illustrated by Figure 15, Alaska’s food system is composed of numerous parts that all interact with each other. The Alaska Food Policy Council defines the food system as “a complex of food-related interactions between people, plants, and animals, with other human and natural systems” (2012, p. 5). This web of connections looks different for each region, community, household, and individual, but complexity remains.

In a complex system, the consequences of changes are not always clear and predictable. Each element of the system both reacts and impacts other elements. Even the very resilience of a system can add to this unpredictability. Resilience is a system’s ability to persist and survive within a variable environment, and salmon have shown themselves to be incredibly

resilient (Meadows, 2008). Salmon’s resilience may mask feedback or make warning signals difficult to connect to a specific cause, leading to habitat degradation and population reductions seen elsewhere in the Pacific Northwest. Focusing on increasing local food production through agricultural land development can threaten salmon habitat, and the results to other elements of the food system, like salmon, may not be obvious at first.

Figure 15: *Alaska Food Systems & Food Cycle*



(AFPC, 2012, p. 5)

Rather than focusing on the negative impacts to the system, which in this case are the consequences of industrial farming in the Pacific Northwest, it is also possible to leverage actions with multiple positive impacts. Certain practices, such as improving soil health, benefit all elements of the system. Improved soil health allows farmers to use fewer inputs, which saves the farmer money, and reduces chemical runoff, which benefits salmon. Increasing biodiversity

in riparian areas stabilizes eroding stream banks which reduces soil loss for farmers and runoff for salmon, slows down the flow of and lowers the temperature in streams for salmon, and attracts pollinators which benefits farmers (Salmon-Safe, 2018). Prioritizing high-leverage practices that could benefit both salmon and agriculture would put two potentially conflicting sources of local food into a relationship where they support each other.

Case Study: “Alaskanizing Salmon Safe” Working Group

Introduction to Salmon-Safe

Figure 16

(*About,* n.d.)

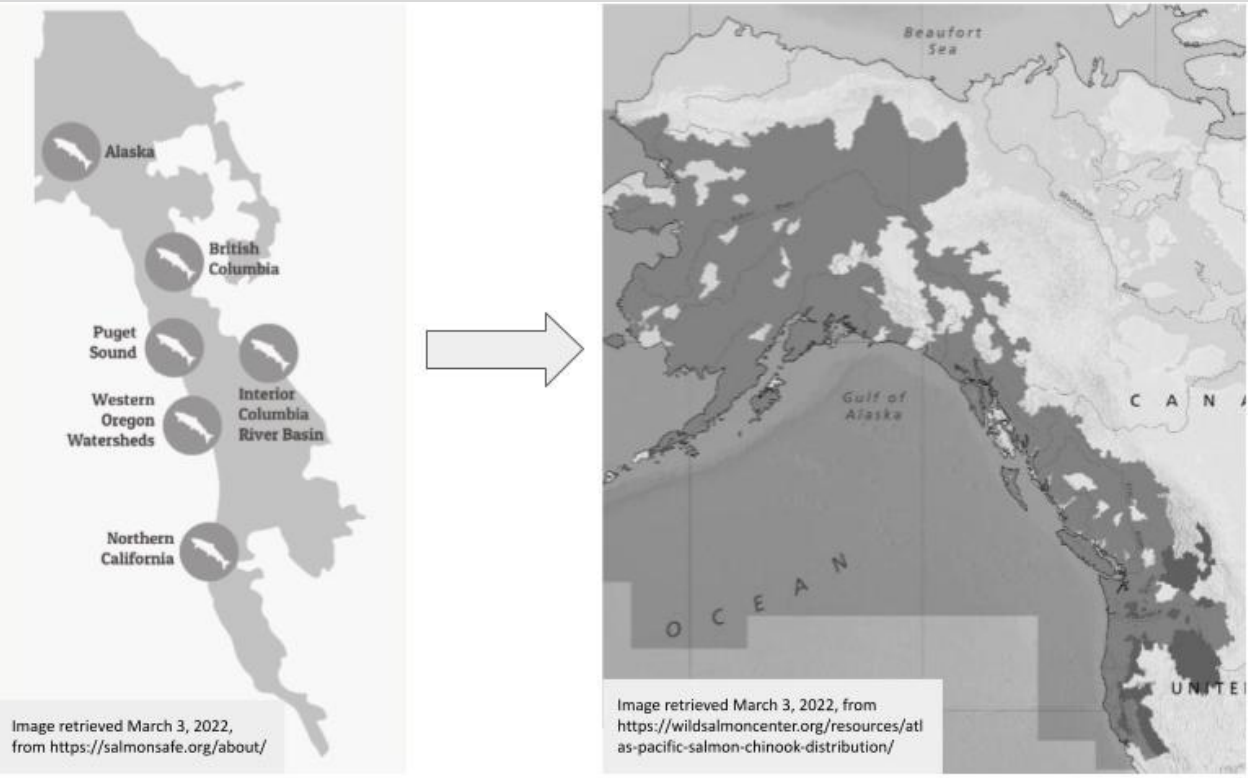
Salmon-Safe is a nonprofit organization based in Portland, Oregon that created an ecolabel and land-use certification of the same name. Salmon-Safe’s mission is to “transform land management practices so Pacific salmon can thrive in West Coast watersheds” (*About,* n.d.). Salmon-Safe has created certification standards for urban development, vineyards, farms, corporate and university campuses, infrastructure, parks, and golf courses. Over 500 farms and 350 vineyards are Salmon-Safe certified. Salmon-Safe also developed accreditation for construction management, developers, and design professionals. Landowners rally around a shared goal of salmon protection, focusing on watershed health. Consumers can buy over 70 Salmon-Safe certified products including wine, beer, and food in over 300 grocery stores. Regional programs across the Pacific Northwest include Trout Safe Idaho, Salmon-Safe Puget Sound, Salmon-Safe British Columbia, and Green Bridges for Salmon. (*About*, n.d.).

Salmon-Safe’s ecolabel requires agricultural practices that support the organization’s goals to protect water quality, maintain watershed health, and restore habitat. Salmon-Safe certification standards are created in a transparent peer-reviewed process informed by regional scientists and land use experts. The organization uses independent third-party auditors to grant

certification. Salmon-Safe has certified over 95,000 acres of farm and urban lands in Oregon, Washington, California, and British Columbia. The organization grows by expanding into adjacent geographical regions through connections with partner organizations. The partners do the ground-level work of raising awareness and certifying landowners while Salmon-Safe provides the ecolabel logo and marketing support. (*About,* n.d.; *Farms,* n.d.)

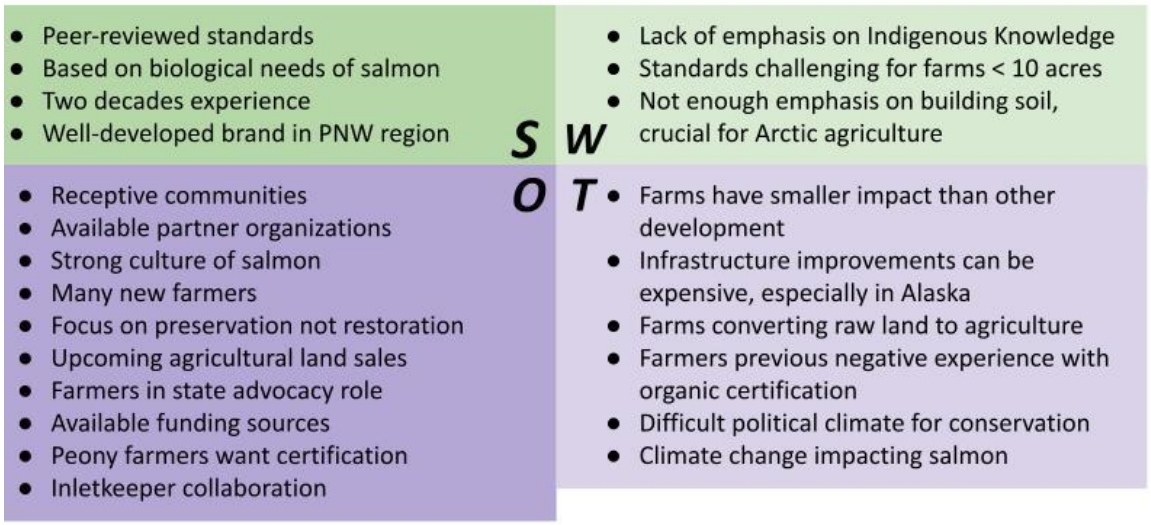
Alaska is geographically significant to salmon habitat protection efforts like Salmon-Safe’s. However, salmon in Alaska face looming threats, such as climate change and land development, and neglecting this region could have long-term negative impacts on Salmon-Safe’s ability to meet its goals. Figure 17 shows the current extent of watersheds where Salmon-Safe operates on the left. The map on the right is the habitat range of Pacific Chinook salmon, one of the five salmon species in Alaska. Comparing the two clearly illustrates the potential for Salmon-Safe’s work in Alaska.

Figure 17: *Current Salmon-Safe activities compared to full extent of Chinook salmon populations*



An analysis of the strengths, weaknesses, opportunities, and threats (SWOT) facing Salmon-Safe is shown in Figure 18. A SWOT analysis is a tool used to assess the internal and external factors facing an organization (Peterdy, 2022). If Salmon-Safe were to expand its certification into Alaska, organizational strengths such as the peer-reviewed standards based on the biological needs of salmon and twenty years of experience certifying farms and vineyards may ease the process. However, Salmon-Safe’s experience with certifying mostly larger farms may be a weakness in Alaska where the majority of farms are under 50 acres. Expansion, which is an important step in Salmon-Safe’s mission to protect salmon habitat, comes with significant macroenvironmental opportunities and threats to the organization and certification as it is currently offered. Ideally, Salmon-Safe’s organizational strengths would combine with local knowledge to support Salmon-Safe’s weaknesses.

Figure 18: *SWOT Analysis for Salmon-Safe in Alaska*
(prepared by author)



Salmon-Safe is currently interested in expanding agricultural certification into Alaska. Certification is awarded on a three-year cycle, a process that begins with a site visit by a local independent auditor. The auditor, a role that has not yet been created in Alaska, has experience with local farmers and the local ecosystem. They prepare an assessment for Salmon-Safe, recommending full or conditional certification. Conditional certification is an agreement between

Salmon-Safe and the farm manager that certain improvements will be accomplished along a designated timeline. The farmers pay for the initial assessment, between $300-$500, and any improvements agreed upon during conditional certification. Salmon-Safe is also interested in piloting group certification, potentially in Alaska, where only 20% of growers in a group would go through the assessment process each year, and the costs would be shared across the entire group (K. Scribner, personal communication, March 23, 2022).

Cook Inlet Watershed Farmers Working Background

Eight local farmers committed to attending six working group sessions from January to April 2022 to consider if Salmon-Safe certification were desirable and beneficial as well as potential adjustments to the certification standards based on local needs. Farmers were compensated with a $500 stipend based on attendance and feedback during the session. In addition, participants from the following organizations attended some of the sessions:

Figure 19:

(Inletkeeper, n.d.)

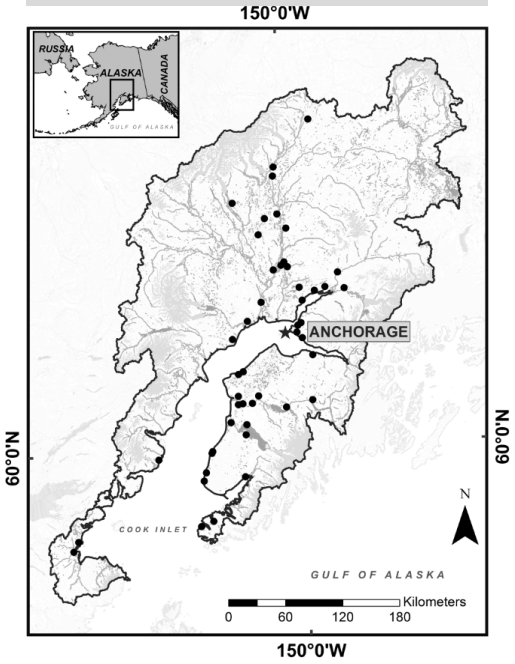
- USDA Natural Resources Conservation Service (NRCS)
- Homer Soil and Water Conservation District
- Intertribal Agriculture Council (IAC)
- Alaska Village Initiatives (AVI)
- Cook Inletkeeper
- Salmon-Safe (first and last sessions only)

These organizational participants provided information about local laws and regulations and shared resources related to technical and financial support. IAC and AVI both work to support Indigenous agriculture in Alaska. Due to the COVID-19 pandemic and the diverse locations of participants, all sessions were attended using Zoom. Cook Inletkeeper recorded all of the sessions which were stored as Youtube videos for reference within the organization. Each session lasted two hours, and participants discussed a pre-assigned portion of the most recent

Salmon-Safe Certification Standards for Farms, Version 2.7 (Salmon-Safe, 2018). Despite the robust schedule, the sessions were well-attended, and the discussion grew lively as participants became more comfortable with the process.

Geographic Scope

Figure 20: *Cook Inlet Basin*
(Mauger et al., 2017, p. 704)



Although much of Alaska is salmon habitat, and Salmon-Safe farming is relevant across the state, this project is geographically limited. Cook Inletkeeper recruited participants for the group who were located in the Cook Inlet basin, an area of southcentral Alaska that drains into the Gulf of Alaska. The Cook Inlet basin contains 12,000 kilometers of documented salmon streams and populations of five Pacific salmon species (Jones & Coleman, 2014). The Cook Inlet basin includes the Kenai Peninsula, the city of Anchorage, and the Matanuska-Susitna Valley. This is an area where farmland and salmon habitat are increasingly likely to interact and potentially conflict. The map in Figure 19 shows the Cook Inlet basin relative to the rest of Alaska. The Kenai Peninsula, directly south of Anchorage, is where most participating farmers were located.

Many people on the Kenai Peninsula share a culture of salmon, which is expressed as a range from general understanding to a deep sense of identity associated with the cultural, economic, and/or environmental benefits surrounding healthy salmon populations. First, the region is the homeland of the Dena’ina and Sugpiaq people who have a long relationship with salmon, one that continues to develop today. For example, the Kenaitze Indian Tribe operates a fishery at the mouth of the Kenai River that is used to feed the community and to bring Elders

and youth together through summer fish camps. The practice goes beyond food to identity: “The net gives us more than food. It preserves the culture and traditions established by the early Dena'ina. It brings us together, with our children and Elders, creating a sense of unity. It represents the resiliency of our people.” (*Educational Fishery*, n.d.).

Figure 21: *Salmon harvest brings youth and elders together*

(Educational fisheries, n.d.)

Both Alaska Natives and non-native Alaska residents value salmon as a food source, an economic driver through fishing and tourism industries, and a vital part of the ecosystem. In a 2019 ecosystem services assessment of Kachemak Bay, located on the lower Kenai Peninsula, the authors performed semi-structured interviews with 31 residents and three focus groups to determine what they value about the region (Flaherty et al., 2019). The results are shown in Figure 22, with fish topping the list and agriculture near the bottom.

Figure 22: *Ecosystem services assessment of Kachemak Bay, Alaska*

What is Valued	% of Interviews
Fish (salmon, halibut)	93
Wildlife	99
Recreation	87
Aesthetics	87
Ecological Processes	71
Research and Education	61
Agriculture	42
Forests	26

(Flaherty, 2019, p. 14)

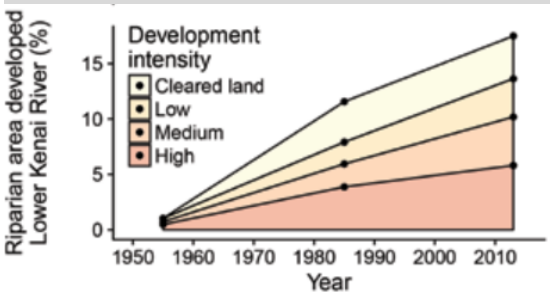
A foundation for protecting salmon and their habitat is already in place on the Kenai Peninsula. However, translating personal beliefs into policy measures is not straightforward, and, as referenced previously, Walker et al. (2021) propose that strong feelings about salmon “do not necessarily translate into salmon-friendly land-use strategies in landscapes consisting of a complex web of public and private land ownership” (p. 2).

The complex lifecycle of salmon and their habitat range passes through land under many different uses and management strategies. If agricultural land is not next to a salmon

stream, the farmer may not be aware that their farm can still impact salmon habitat. To address this, Salmon-Safe emphasizes landscape-level conservation and a whole-farm approach to certification (Salmon-Safe, 2018).

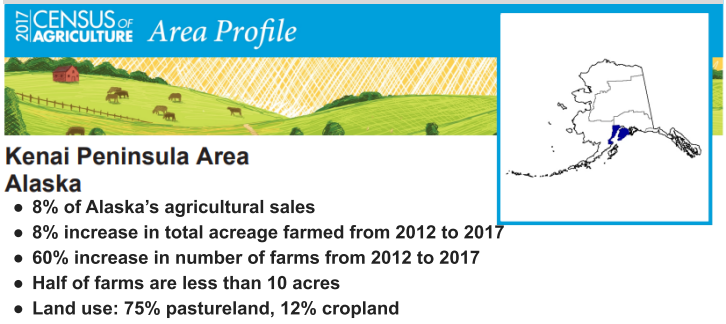
The Kenai Peninsula is an ideal location for this project because Cook Inletkeeper could leverage existing relationships for participants and support. In addition, the Kenai Peninsula, with its abundant salmon habitat, is experiencing increasing land development and supports a growing agriculture industry, as shown in Figures 23 and 24.

Figure 23: *Land development on the Kenai*



(Schoen et al., 2017, p. 546)

Figure 24: *2017 Kenai Ag Statistics (USDA, 2017a)*



Cook Inlet Watershed Farmer Working Group Feedback Summary

The Salmon-Safe Certification Standards for Farms, Version 2.7, has two main sections. Part A covers the general certification for farms, verifying that the farm operation does not violate any environmental laws, that water rights are legal, and that all pesticide use is documented. If these conditions are met, then the farmer can begin the certification process which includes preparing additional information (maps, irrigation information, waste management, pest management information), meeting relevant management practices listed in Part B, and the whole-farm assessment (Salmon-Safe, 2018). Cook Inletkeeper’s farmer working group carefully reviewed Part B of the document, which includes the specific details of what farmers seeking certification should expect. The full text of the document is found on Salmon-Safe’s website: https://salmonsafe.org/certification/farms/.

Salmon-Safe’s “Part B: Core Certification Standards” lists management practices for seven categories, and the group discussion around each is summarized below. A detailed analysis of each session is included in Appendix B.

Figure 25: *“Alaskanizing Salmon Safe” Focus Group Schedule*

1. *In-stream Habitat Protection and Restoration*

Participant Comments:

- Not all farmers have active salmon streams on or bordering property.
- Alaska Department of Fish & Game’s list of anadromous streams catalog is updated annually but is still incomplete, representing “a fraction of the streams, rivers, and lakes actually used by anadromous species” (Overview, n.d.).

Recommendations for “Alaskanization”:

- Presume any persistent stream to be salmon habitat.

Needs:

- Time, training, and materials to check streams for juvenile salmonids and report to state catalog at https://www.adfg.alaska.gov/sf/SARR/AWC/.
- Assistance to offset costs of installing or upgrading salmon-friendly culverts.

2. Riparian and Wetland Vegetation Protection and Restoration

Participant Comments:

- Vague language can be misleading, such as the phrases “impacts are minimized” which could allow for negative impacts to salmon and “adequately vegetated” without parameters or plant recommendations.

Needs:

- Baseline studies of agriculture’s impact on soil and water temperatures.
- Lists of appropriate plants for riparian vegetation.

3. Water Use Management

Participant Comments:

- Standards do not scale down to small farms easily.
- Since water withdrawals from a cataloged salmon stream are not permitted in Alaska, the standards referring to using fish screens and diversions are not relevant.

Recommendations for “Alaskanization”:

- Focus on water conservation.
- Healthy soils prevent water loss but only 2 of 9 standards mention soil. This could be further developed.

Needs:

- List of local irrigation practices ranked by impact on salmon or “salmon friendliness” so that farmers can choose the best practice for their situation or learn about other options.
- Technical support and financial resources for the implementation of low-cost, gravity-fed, efficient irrigation systems.

4. Erosion Prevention and Sediment Control

Participant Comments:

- The standards suggest using deep-rooted native plants, but Alaska has few examples of these.
- The biggest source of runoff and unstabilized soil observed by participants comes from farm roads but the only associated standard reads that “to the greatest extent operationally feasible, farm roads are stabilized” (p. 19). This

recommendation would be improved with instructions and examples of how and where to build farm roads not simply requiring existing roads to be stabilized.

Recommendations for “Alaskanization”:

- Clarification of categories of plants (native, non-native, noxious weeds, invasive species).

Needs:

- Specific lists of recommended plants for erosion control, especially those that would benefit farmers and promote biodiversity.
- Additional guidelines for developing farm roads, especially on raw land.

5. Integrated Pest Management (IPM) and Water Quality Protection

Participant Comments:

- Particularly relevant to Alaska’s peony farmers who use a fungicide on the High Hazard List.
- Soil and plant tissue testing can be expensive for farmers especially when required repeatedly.
- Systems with minimal or no tillage that use composting and biological amendments do not have the same issues of overfertilization and may rely less on testing.
- Climate change is increasing pressure from different pests.
- Requirements apply more to conventional agriculture common in the lower 48 states than current farming practices in Alaska. However, it is still relevant because agriculture is increasing and conventional practices may become more common.

Recommendations for “Alaskanization”:

- Scale back requirements for soil testing especially for small farms and farms that don’t use chemical fertilizers.
- Continue to stress building soil fertility as a strategy in this category as well.
- Include and highlight the use of salmon as fertilizer, particularly fish waste from salmon fisheries.

Needs:

- Additional research for copper-free fungicide effective against botrytis, especially for peony farmers.
- Cheaper methods of field testing plant tissues.

- Access to affordable soil testing.
- Centralized location for information about local pest and weed management strategies.

6. Animal Management

Participant Comments:

- Only a few farmers in the group managed livestock and poultry.
- Those who did were very concerned with the cost of compliance.

Recommendations for “Alaskanization”:

- Provide recommendations for small farms. Participants in this group deal with manure management by hand which takes a lot of time and energy.
- The required Manure Management Plan should include a component of sharing.
- Make connections to building and improving soil, which is crucial to Arctic agricultural development.

Needs:

- Technical resources and financial support are especially needed in this section.
- A way to share manure between livestock and vegetable farmers.

7. Landscape-level Biodiversity

Participant Comments:

- This section generally aligns with participants’ perception of salmon-safe farming.
- Applying the standards from this category would also address issues such as overfertilization and runoff raised in previous sections.
- This section felt disorganized to participants, because, although it was full of practices they enthusiastically supported, it was difficult to follow.

Recommendations for “Alaskanization”:

- Move this section from 7th to 1st in the standards due to its importance to salmon-safe farming and relevance to all of the other standards. The participants were all in agreement that if they had read this section first, they would be been more enthusiastically supportive of subsequent sections.
- This section introduces the other topics and highlights the importance of an interconnected ecosystem which makes it a good starting point.

Needs:

- Additional work to “Alaskanize” this section to local plants, pollinators, and wildlife.
- Develop salmon-safe content related to beekeeping.

Overall - Full Document

Participant Comments:

- Deliberate vagueness seems less like flexibility and more like a risk to the goals of salmon habitat protection and improvement.
- General concern about whether or not “Alaskanizing” Salmon-Safe certification would be an impactful investment of resources.
- Without clear requirements, there is a lack of incentives to go above and beyond.
- Homestead properties in Alaska may include different farm projects under different management on one property. For example, peonies are farmed on one section of the homestead while a vegetable plot and livestock are in another which may complicate Salmon-Safe certification of the whole property.

Recommendations for “Alaskanization”:

- Simplify confusing language, especially relating to the mandatory “performance requirements” and the rest of the performance requirements that are not required.
- Focus on positive alternatives rather than listing what is prohibited or not recommended.
- Changing “to the greatest extent operationally feasible” to “according to the farm plan”. This allows for flexibility, as long as it is deliberate and considered within the local farm context.
- Linking practices mentioned in standards directly to financial benefits for farmers would help promote standards (help save money and salmon!).

Needs:

- Grant funding to continue promotion of “Alaskanized” salmon-safe agriculture.
- Examples of farmers who are using these practices (minimal tillage, cover cropping, etc.) especially at a small scale.
- Video format of farmer profiles would be useful to ease concerns about regulation.
- Examples from different types and different scales of farming.

- Outreach materials (online as well as in-person to reach farmers and their customers with various levels of online engagement and access).
- Knowledge-sharing platform, especially for new farmers or farmers who are new to the local region.
- Lists of locally-relevant resources for financial and technical assistance (see Appendix D for a preliminary list).
- Directly connecting standards to cost savings for farmers, where appropriate.

Cook Inlet Watershed Farmers Working Conclusion

The working group component of Cook Inletkeeper’s Salmon-Safe Agriculture Project met or progressed toward its first three goals: to bring together a group of local farmers, to identify sustainable and responsible practices for farming on a salmon landscape, and to “Alaskanize” the salmon-safe principles. The process of adapting the salmon-safe principles to Alaska’s local landscape is still in process. The fourth goal, to promote the salmon-safe agricultural ethic through outreach is part of the next steps.

Overall, farmers' interest in Salmon-Safe fell into two categories:

1. Some farmers felt that the certification standards were in alignment with their current practices, so if certification were an option, they would probably participate.
2. Some farmers were not fully in support of certification, although they support the values, the “land and water ethic”, of the project. They expressed concerns that the demands on their time and financial resources for certification or potential infrastructure improvements required would be too high.

Direct financial incentives for certification in Alaska are not clear, with the exception of peony farmers who could use Salmon-Safe certification for market differentiation in national and international markets.

In addition, all participants were in support of adopting a salmon-safe land and water ethic, which meant developing locally-adapted best practices that farmers could implement to be

better stewards of salmon without being certified. This general support was expected but is not necessarily representative of most farmers in Alaska. Participants were recruited and incentivized with a stipend under the expectation of a 12+ hour time commitment to discussing farming in a salmon landscape, so those who chose to participate were generally supportive of such practices.

As noted in the summary above, farmers had concerns about both the content of the standards and the language used to explain them. Editing the entire fifty-page document for clarity was beyond the scope of the project. The first attempt to edit, rearrange, and seek feedback on an “Alaskanized” draft of two sections resulted in more questions than conclusions.

Since certification is not yet available in Alaska, a more immediately useful document, found in Appendix C, provides guidelines for farming in a salmon landscape. The guidelines were created with careful consideration of the Salmon-Safe certification requirements so farmers would be well prepared for certification if it were made available and desired. This document takes into consideration the goals of Cook Inletkeeper’s project and local farmer recommendations:

- Local farmers in the Cook Inletkeeper working group are already using many of these practices.
- The guidelines can be directed toward new farms to build a locally-focused salmon-safe land ethic.
- Guidelines align with Salmon-Safe Certification standards but do not guarantee certification if/when it becomes available.

In addition to “Alaskanizing” the certification standards, participants also wanted to have access to available local resources. This raised the question of what type of document would be most useful. Printed documents are convenient to provide at events but lack the instant access of online links. If the result were a living document, an organization would need to host and maintain it. A preliminary list of financial and technical resources available locally for farmers is

in Appendix D. This list addresses participant concerns about where to find financial assistance and technical support for these agricultural practices. Both the guidelines and resources documents are first drafts as this is a community-led project. Farmer feedback is crucial, and resources will be added as they are developed and discovered.

PESTEL Analysis

The results of the Cook Inlet Watershed Farmers Working Group show clear interest in developing sustainable agricultural practices that enhance salmon habitat on the Kenai Peninsula. However, translating interest and awareness into action is difficult without adequate support. Farmers face many demands on their time, attention, and financial resources. New farmers and new-to-Alaska farmers may not have access to information about sustainable, salmon-safe farming practices or the incentives to seek out this information. This issue is important to address while standards are in development so that all stakeholders in the state of Alaska can avoid costly mistakes made elsewhere in the Pacific Northwest.

Figure 26: *PESTEL analysis outline*

(Corporate Finance Institute, n.d.)

In order to address the various factors discussed in this Capstone project as well as in the Cook Inletkeeper’s working group, a PESTEL analysis follows. The PESTEL analysis is useful for this project because it is a framework used to analyze the macro-environment in which an organization operates and is typically used by businesses in risk management planning (Corporate Finance Institute, n.d.).

The following PESTEL analysis outlines macroenvironmental factors that support or hinder the development of salmon-safe agriculture in Alaska, specifically on the Kenai Peninsula. The PESTEL analysis highlights how the environment is different in Alaska from

elsewhere in the Pacific Northwest and adjustments that could be made to successfully support both agriculture and salmon in Alaska. This analysis is used to find leverage points that could provide more opportunities for farmers to participate in this type of local sustainable agriculture. Future outreach materials need to take these factors into consideration to be most effective.

Figure 27: *PESTEL for the development of salmon-safe agriculture in Alaska*

FACTORS	Summarizing information from “Setting the Stage” and “Case Study: ‘Alaskanizing’ Salmon Safe”
POLITICAL	● Salmon habit crosses landscapes managed by multiple landowners, and habitat protection efforts are not always supported ○ Kenai Peninsula Borough riparian buffer (ordinance for 50ft spawned heated debate) ● Recent State and borough land auctions and leases promoting agriculture ○ Nenana-Totchaket (see “Spotlight: Nenana-Totchaket”) ○ Kenai Peninsula Borough (O’Hara, 2021) ● Increasing political support for food systems ○ Farm and Food Caucus (Tarr et al., 2022) ○ Alaska Food Strategy Task Force (*Alaska Food Strategy,* 2022) ● In contrast with politically polarizing land development projects that negatively impact salmon (e.g. Pebble Mine, Ambler Road), salmon-safe agriculture could potentially raise bipartisan support due to general increasing awareness of food systems
ECONOMIC	● Alaskan food system vulnerable to supply chain disruptions so increasing supply of locally-available food is important ● Small farm size reduces access to economies-of-scale (USDA, 2017b) ● Issue of scale addressed in some cases by co-ops: ○ Alaska Beauty Peony Co-op (Alaska Beauty Peony Co-op*,* n.d.) ○ Alutiiq Grown collective (Alutiiq Grown, n.d.)

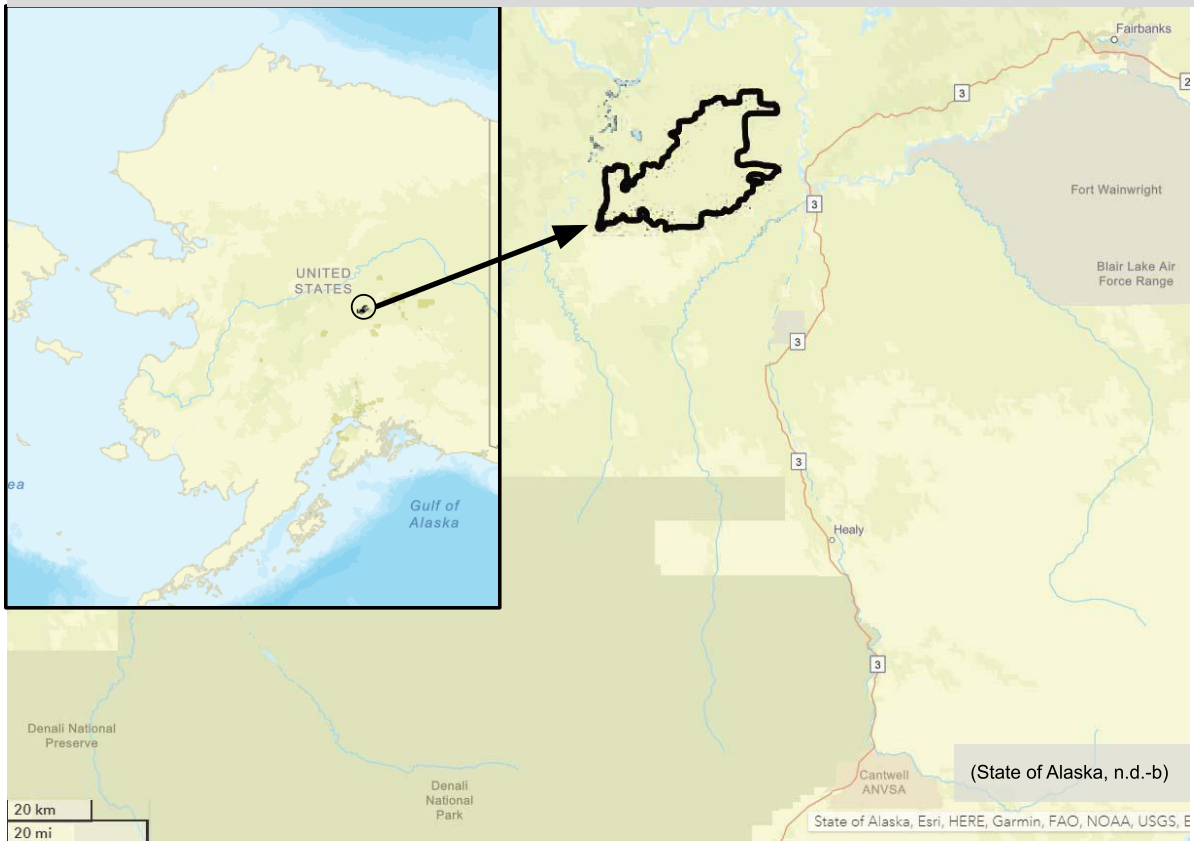
	• Increasing locally-purchased food keeps money in local communities • Alaska has high rates of direct-to-consumer agriculture (26% in 2017) (USDA, 2017b) • Nationwide rising food prices • Shortages of traditional food, salmon, in rural areas and expensive imported food (Hughes, 2021-a, 2021-b) • Tight margins for farmers and consumers unable/unwilling to pay more for local food means Salmon-Safe ecolabel holds little benefit (suggested by working group participants)
SOCIAL	• State with lowest population density and largest geographic area has potential space for agricultural expansion • Number of farms increased 40% from 2012 to 2017 compared to nationwide decrease of nearly 4% (USDA, 2017b) • Alaska Native peoples have long stewardship and kinship relationships with salmon • Alaska Native peoples frequently excluded from resource management decisions in the state • Large-scale agricultural projects on land traditionally used by Alaska Natives need their feedback and participation • Alaska Natives extremely underrepresented in agriculture (see “Indigenous-led Agroecology below”) • Non-native Alaskans value salmon for food security, ecological and economic value • Encouraging existing trends of self-sufficiency could support both wild foods like salmon and locally grown agriculture • Resistance to regulation may mean that farmers are unlikely to support certification and may not feel incentivized to participate voluntarily
TECHNO-LOGICAL	• Expansion of broadband internet increases connectivity (Early, 2022) • Farmers can use social media marketing and e-commerce to increase sales • Online sales grew during COVID-19 pandemic (Alaska Food Hub

	membership grew by 33% and sales increased by 211% in 2022) (Alaska Food Hub, 2021) ● Lack of processing and storage facilities limits agriculture intensification and expansion ● Potential for online training, webinars, conferences can increase participation from people in remote locations ● Online resources may exclude farmers and their customers who lack skills in technology (suggested by working group participants)
ENVIRON-MENTAL	● Climate changing faster in northern regions (see “Setting the Stage”) ● Agriculture intensifying in northern regions (see “Setting the Stage”) ● Salmon habitat in Alaska is largely intact but federal disasters declared for 14 fisheries (MacArthur, 2022) ● Farming is only one small part of land development in Alaska that impacts salmon habitat
LEGAL	● State regulations offer some protection to salmon habitat (State of Alaska, n.d.-a) ● Only a fraction of Alaska’s anadromous waters have been mapped so much salmon habitat remains unprotected ● Some measures to protect salmon from development such as riparian corridors are potentially viewed as threats to agriculture and private landowners ● Regulation changes, like the proposed Alaska Food Freedom Act (AFFA), expand retail opportunities for cottage foods and encourage agricultural expansion (State of Alaska, 2022) ● AFFA would potentially permit some sales of homemade foods in retail stores and in-state mail orders, which could increase local food availability especially in rural towns and villages

Spotlight: Nenana-Totchaket Agriculture Project

The State of Alaska plans to develop 100,000+ acres of agricultural land in the Nenana-Totchaket area in the Interior of the state, and the land auction for the first 30,000 acres began in the summer of 2022. The map in Figure 28 is from the State’s land auction website, with the project outlined in yellow between Fairbanks and Denali National Park.

Figure 28: Nenana-Tokchaket Ag Project Area



(State of Alaska, n.d.-b)

The 2020 completion of a road and bridge to this state-owned land opened up access to the Nenana Totchaket area, and the land auction brochure boasts this infrastructure as “the key to unlocking the development of millions of acres of land owned by the State, Alaska Native Corporations and the University of Alaska” (State of Alaska, 2022, p. 7). The project is advertised as a collaboration between stakeholders in federal, tribal, state, local, and private groups that is designed around “economic viability and environmental stewardship” (State of Alaska, n.d.-b). However, the project is not seen as a collaboration from a local and tribal

perspective but rather as a threat to sovereignty and food security (Ellis, 2022; Native Movement, n.d.).

State agricultural policies that strongly favor agriculture present both opportunities and risks to Alaska’s people and ecosystems. The brochure mentions the contract in progress for soil testing with the USDA Natural Resources Conservation District (NRCS) and the creation of a plan that will “synergize the latest agricultural technologies with time-tested sustainable production practices”, the details of what this entails are sparse (p. 7).

Figure 29: *Bridge to raw land up for auction in Nenana-Totchaket Agriculture Project*

(Ellis, 2022)

The available soil test results show class 4, 5, and 6 soils. Class 4 soils have “very severe limitations that restrict the choice of plants or that require very careful management or both”, and class 5 and 6 soils are less suitable for cultivation and restricted to “pasture, rangeland, forestland, or wildlife habitat” (p. 39). Despite these results, the State of Alaska encourages potential bidders to investigate for themselves whether the parcels and these general classifications would suit their agricultural needs.

Many local residents and Tribal members are critical of the speed of the process and lack of consideration for traditional hunting and harvesting uses of this land (Ellis, 2022; Native Movement, n.d.). Clearing the land and building infrastructure such as roads, especially before soil tests and natural resource surveys are complete, risks resulting in an overall decrease in food security for the local community. The large parcel sizes available may encourage industrial agriculture, potentially from out-of-state bidders with limited experience in Alaska’s climate and ecosystems. The requirements for protecting salmon are limited to the minimum required by the

state (the Fishway Act and the Anadromous Fish Act), to obtain approval before activities within or across a stream used by fish, typically related to streambank or streambed disturbances and crossings (State of Alaska, n.d.-a). This regulation avoids the most direct impacts on salmon, such as installing dams or rerouting streams for irrigation, of which numerous examples exist outside of Alaska. However, agriculture, especially large-scale monoculture and industrial agriculture, can impact salmon even if there is not a salmon-bearing stream across or along the property.

This land auction is happening now, so balancing the State’s perspective for nearly unrestricted agricultural development with a framework, like Salmon-Safe, that considers the health of the rest of the ecosystem and food system is urgent. Although Cook Inletkeeper and the watershed it supports are located in a different region of the state, the organization has expressed its concern about this project, saying:

> While increasing food security in Alaska through growing & producing more food in-state is critical, the Nenana-Totchaket land sale is not the right fit. Food security should not be used to privatize public land, degrade habitat, impact Indigenous subsistence, or open our state to the impacts of industrial agriculture from outside corporations. (Cook Inletkeeper, 2022)

In order to focus its resources on the local watershed, Cook Inletkeeper directs interested parties to Interior Alaska advocacy groups like the Fairbanks Climate Action Coalition, Alaska Public Interest Research Group, and Native Movement. Some of these organizations have already called for a halt to the land sale, submitting a letter to the Governor that asks for clarification of seven points and for the process to pause until these concerns are addressed. They are currently accepting signatures of support on the letter here: https://secure.everyaction.com/LSes9DdZi0G5WVpXtRqBcg2.

Recommendations

Cook Inletkeeper’s Salmon Safe Agriculture project is a step toward bringing multiple stakeholders together around the shared value of salmon. Local farmers, while supportive of the idea of salmon-safe agriculture and a salmon-friendly land ethic, expressed concerns about a limited economic incentive for certification which ultimately depends on what their customers value. The working group members’ enthusiastic participation is evidence that there is interest in developing salmon-safe agriculture in Alaska when supported by funding opportunities, technical support, and the consideration of an Alaskan context.

Jones et al. (2020) conclude that is no single, identifiable driver of salmon population decline in the Cook Inlet, but rather multiple drivers and different responses from separate populations. There are no ‘one size fits all’ solutions, so context-specific management strategies from stakeholders across the entire salmon landscape are crucial to supporting salmon in a warming climate and developing landscape. As agriculture intensifies in Alaska, it becomes an opportunity to connect consumers to the salmon landscape and raise awareness of the threat posed to salmon habitat by industrial agriculture. The case study analysis above provides support for the following recommendations:

- Continue advocating for the protection of the existing salmon system.
- Support farmers in a land stewardship role.
- Support Indigenous organizations and growers to hold leadership positions as the project continues.
- Share existing local salmon-friendly agricultural practices widely and support efforts to develop new ones.
- Focus on salmon-friendly practices that benefit farmers economically, such as improving soil health.
- Propose standards for agricultural development of state and borough land that align with a salmon-safe land ethic.
- Educate consumers about local food and the connection between salmon and agriculture.

Cook Inletkeeper Next Steps

Working group participants repeatedly voiced their need for information about salmon-friendly agricultural practices and as well as general Alaskan farming knowledge. Some farmers may be using sustainable practices without making the connection that they also benefit salmon. A lot of information already exists in many separate places, and Cook Inletkeeper can use its existing network to determine the best format and locations to share it.

Another concern was that agriculture is not the only or biggest impact on salmon habitat in the area but that it often has the most negative publicity and feedback. The farmers agreed that this position of visibility could also give them a platform to showcase best practices for farming in a salmon landscape and potentially influence their neighbors and other industries. The farmers were concerned about regulation from the outside and preferred this certification model to be community- and farmer-led from inception, taking Alaska’s specific context into consideration. The working group project aligned with this multi-stakeholder grassroots approach. However, the project is lacking representation of Indigenous growers and should seek additional feedback, starting with the Intertribal Agriculture Council whose members participated in the working group.

Cook Inletkeeper can:

- Create and share short, colorful social media posts to raise general public awareness of the connections between salmon and agriculture. See existing outreach infographics in Appendix E.
- Additionally, highlight topics that are specifically Alaskan, such as using salmon as fertilizer.
- Share findings with Salmon-Safe to inform their certification update process.
- Scale salmon-safe practices to Alaska’s small farms.
- Develop outreach materials that tell the story of WHAT farming on a salmon landscape is and WHY it is important (directed toward farmers and local food consumers).

- Work with the local community college to add salmon-safe agriculture to course curriculum, including video production assignments.
- Additionally, share content with other schools with horticulture, agriculture, and natural resource management programs (King Tech High School in Anchorage, Alaska Pacific University’s Spring Creek Farm in Palmer, etc.).
- Supporting Indigenous-led agriculture projects and encourage Salmon-Safe to do so as they consider expansion into Alaska.
- Reach out to farmer participants for photos that capture farming practices that align with Salmon-Safe (cover cropping, biodiversity on field margins and riparian areas, minimal tillage, manure management systems, water conservation methods, etc.).
- Promote salmon-safe agricultural practices that have economic benefits to farmers.
- Publish profiles of local growers, including peony farmers, who are farming on a salmon landscape.

Policy Recommendations

Policy measures that protect salmon habitat can be polarizing and divisive. In Washington State, the Lorraine Loomis Act failed in the 2022 legislative session. This bill, supported by many local Tribal governments and vehemently opposed by agricultural and real estate stakeholders, would have increased riparian buffers to 100 feet on each side of current and historical salmon passage across the state. The bill spawned such headlines as “Fish vs. farming battle set up with the introduction of Lorraine Loomis Act” and nicknames like the “big dumb buffers bill”, and it did not pass (Colston, 2022; State of Washington, 2022). As agriculture expands northward, these conflicts may increase in frequency as well, and Alaskan policymakers can prepare by studying salmon ecosystems in the Pacific Northwest and what policy measures are having an impact. The Alaska Food Policy Council’s Advocacy Committee could be informed about salmon-safe farming and its importance to help build efficient connections and raise awareness among members of the state government.

First and foremost, existing salmon habitat, including key headwater ecosystem areas, needs protection, and this aligns with policy recommendations in California and Washington. Washington State Governor Inslee’s Salmon Recovery Office produced a report in 2021 suggesting that salmon populations in the state were on the brink of extinction. The group’s recommendations include giving priority “to the needs of salmon and other natural resources in land-use plans, long-term infrastructure planning processes and related regulatory programs”. They highlight the importance of groundwater and cold springs, and they support the Governor in working with Tribes to “establish a statewide standard for protecting fully functioning and healthy land along streams and rivers for salmon” (Zemek, 2021).

Similarly, the California “State of Salmonids” 2017 report concludes that “if native salmon, trout, and other coldwater fishes are going to continue to be part of California’s natural heritage, it is essential to invest in productive and diverse habitats to promote salmonid resilience” (Saumuel & Katz, 2017). The authors recommend giving the highest priority to the few remaining fully functioning river ecosystems in the state to protect salmonid diversity.

Policy recommendations for promoting salmon-safe agriculture in Alaska include:

- Recommend salmon-safe agriculture for Nenana-Totchaket Agriculture Project, especially no-till or minimal till methods to reduce carbon emissions from raw land development.
- Recommend salmon-safe agriculture for the Kenai Peninsula Agriculture Initiative. The borough is seeking 100 new farm contracts of 5-160 acres over the next 10-15 years (Pierce, 2018).
- The increasing number of small farms is uniquely Alaskan, and incentivizing this type of community-scale growing instead of large, industrial monoculture farms could help avoid some of the worst impacts on salmon habitat seen elsewhere in the Pacific Northwest.
- Advocate for suitable comment periods for agricultural land development initiatives and actively seek feedback from Tribal groups.
- Recommend agricultural-related infrastructure development such as farm roads and structures that do not impact salmon habitat.

Indigenous Leadership

Alaskan Natives are underrepresented in the agriculture industry in Alaska. On the Kenai Peninsula in 2017, there were eight American Indian or Native Alaskan farmers and 434 white farmers reported by the USDA Census of Agriculture (USDA, 2017a). In the entire state, from 2012 to 2017, the number of American Indian or Native Alaskan farmers grew from 50 to 65 while the number of white farmers increased from 1128 to 1604 (USDA, 2017b).

As agriculture increases in Alaska, questions of where, how, and how much cannot be fully considered without the consent, input, and participation of Alaska Native people. Access to traditional and subsistence foods in Alaska is sometimes directly threatened by land development such as mining and agriculture. Indigenous groups in NWT, Canada, are incorporating the agri-food industry into their local food systems, especially as access to traditional foods declines. Price et al. (2022) conclude with two questions to prompt further research:

1. What stewardship practices are important and how can Traditional Knowledge and agricultural knowledge be shared and brought together?
2. What does a broader social or political movement look like in defense of Indigenous territory and food sovereignty in the region, and how does agroecology support it? (p. 12)

Further developing salmon-safe agricultural practices in Alaska, which may include supporting Salmon-Safe certification, will need to ask questions like those. Cook Inletkeeper can continue to advocate for Indigenous-led agricultural projects and bring together diverse stakeholders around salmon. These are some potential partners in the next steps of the Alaskanizing Salmon Safe Agriculture Project:

- The Intertribal Agriculture Council: https://www.indianag.org/alaska
- Alaska Village Initiative’s agAlaska program: https://agalaska.org/
- Tyonek Grown: https://ttcd.org/programs/tyonek-grown-program/
- Calypso Farm’s Indigenous Agriculture program: https://calypsofarm.org/indigenous-agriculture/

- Alutiiq Grown food hub: https://www.alutiiqgrown.com/
- RurAL CAP’s Growing Rural Opportunities for Wellness program: https://ruralcap.org/

Conclusion

Very little research directly links salmon habitat and agriculture, so this paper is an attempt to follow all the threads of this food web and highlight relevant and ultimately related topics. Cook Inletkeeper’s project was the beginning of a larger conversation between growers and resource stewards. Increasing the capacity for food production in the State of Alaska is not only about expanding agriculture, it is also about protecting existing traditional sources of food, like salmon. As climate change increasingly impacts both agriculture and salmon, the questions raised in this paper will remain relevant. Although temperatures may increase beyond what is tolerable to salmon in some areas at some point in the future, managing key freshwater habitat areas with care promotes healthy ecosystems with benefits to all other affected species, including humans.

References

AFPC Advocacy & Policy Committee. (2021, June 22). *2021 Alaska food security investment recommendations*. Alaska Food Policy Council. https://www.akfoodpolicycouncil.org/blog/2021/6/22/2021-alaska-food-security-investment-recommendations

Alaska Beauty Peony Co-op. (n.d.). Retrieved September 16, 2022, from https://alaskabeautypeony.com/

Alaska Food Hub. (2021). *Alaska Food Hub 2015-2020: Operational review & future planning*. Cook Inletkeeper.

Alaska Food Policy Council. (2012). *Food in Alaska: Food systems, security, and policy in the 49th state*. https://static1.squarespace.com/static/584221c6725e25d0d2a19363/t/5aa02410c83025dd22763c46/1520444433164/AFPC+Food+in+AK_11-7-12_Final.pdf

Alaska Food Strategy Task Force legislation passes Senate. (2022, May 17). *Alaska House Coalition*. https://akhouse.org/2022/05/17/alaska-food-strategy-task-force-legislation-passes-senate/

Alutiiq Grown. (n.d.). Retrieved September 16, 2022, from https://www.alutiiqgrown.com

AMAP. (2021). *Arctic climate change update 2021: Key trends and impacts. Summary for policy-makers*. Arctic Monitoring and Assessment Programme (AMAP). https://www.amap.no/documents/doc/arctic-climate-change-update-2021-key-trends-and-impacts.-summary-for-policy-makers/3508

Beach, B. (2022, August 10). *Dry Creek Restoration Project gets underway with Aug. 16 ceremony at Gallo Site*. US Army Corps of Engineers, San Francisco District. https://www.spn.usace.army.mil/Media/News-Stories/Article/3123468/dry-creek-restoration-project-gets-underway-with-aug-16-ceremony-at-gallo-site/

Bernton, H. (2022, August 28). The salmon mystery of Bristol Bay. *The Seattle Times, Anchorage Daily News*. https://www.adn.com/alaska-news/2022/08/28/the-salmon-mystery-of-bristol-bay/

Carothers, C., Black, J., Langdon, S. J., Donkersloot, R., Ringer, D., Coleman, J., Gavenus, E. R., Justin, W., Williams, M., Christiansen, F., Samuelson, J., Stevens, C., Woods, B., Clark, S. J., Clay, P. M., Mack, L., Raymond-Yakoubian, J., Sanders, A. A., Stevens, B. L., & Whiting, A. (2021). Indigenous peoples and salmon stewardship: A critical relationship. *Ecology and Society*, *26*(1), art16. https://doi.org/10.5751/ES-11972-260116

Cline, T. J., Ohlberger, J., & Schindler, D. E. (2019). Effects of warming climate and competition in the ocean for life-histories of Pacific salmon. *Nature Ecology & Evolution*, *3*(6), 935–942. https://doi.org/10.1038/s41559-019-0901-7

Colston, M. (2022). *Some good news and some bad news from Washington’s 2022 legislative session*. Washington State Lake Protection Association. https://www.walpa.org/waterline/june-2022/some-good-news-and-some-bad-news-from-washingtons-2022-legislative-session/

Cook Inletkeeper. (2021). *Salmon-Safe Agriculture: Alaskanizing principles for farming on a salmon landscape*.

Cook Inletkeeper. (2022, September 4). *While increasing food security in Alaska through growing & producing more food in-state is critical* [Status update]. Facebook. https://www.facebook.com/inletkeeper

Corporate Finance Institute. (n.d.). *PESTEL - Overview, factors, examples, financial analysis*. Retrieved August 17, 2022, from https://corporatefinanceinstitute.com/resources/knowledge/strategy/pestel-analysis/

Deep time connections. (n.d.). SASAP: State of Alaska Salmon and People. Retrieved September 15, 2022, from https://alaskasalmonandpeople.org/topics/deep-time-connections/

Dunleavy, M. (2022, September 16). *Administrative Order No. 338*. State of Alaska Office of Governor Mike Dunleavy. Retrieved September 16, 2022, from https://gov.alaska.gov/admin-orders/administrative-order-no-338/

Dunleavy, M. (2022, April 25). *Administrative Order No. 334*. State of Alaska Office of Governor Mike Dunleavy. https://gov.alaska.gov/admin-orders/administrative-order-no-334/

Early, W. (2022, August 10). *Federal broadband officials tout “once-in-a-generation” opportunity to expand internet access in Alaska*. Alaska Public Media. https://alaskapublic.org/2022/08/10/federal-broadband-officials-tout-once-in-a-generation-opportunity-to-expand-internet-access-in-alaska/

Ebertz, O. (2022, July 25). *“People are running out of food”: Subsistence closures leave Yukon River residents with few options*. KTOO. https://www.ktoo.org/2022/07/25/people-are-running-out-of-food-subsistence-closures-leave-yukon-river-residents-with-few-options/

Educational fishery. (n.d.). Kenaitze Indian Tribe. Retrieved August 16, 2022, from https://www.kenaitze.org/tribal-member-services/tribal-fishery/

Ellis, T. (2022, July 8). *Nenana-area residents say state is moving too fast on agricultural land sales.* Alaska Public Media. https://alaskapublic.org/2022/07/08/nenana-area-residents-say-state-is-moving-too-fast-on-agricultural-land-sales/

Endangered, fhreatened, and candidate species in Alaska. (2022, May 5). NOAA. https://www.fisheries.noaa.gov/alaska/endangered-species-conservation/endangered-threatened-and-candidate-species-alaska

Fall, J. A. (2016). Regional patterns of fish and wildlife harvests in contemporary Alaska. *ARCTIC*, *69*(1), 47. https://doi.org/10.14430/arctic4547

Fall, J. A., & Kostick, M. L. (2018). *Food security and wild resource harvests in Alaska* (No. RC12). Alaska Department of Fish and Game Division of Subsistence. http://www.adfg.alaska.gov/static/regulations/regprocess/gameboard/pdfs/2018-2019/se/rcs/rc012_ADF&G_Subsistence_Food_security_whitepaper.pdf

Farms. (n.d.). *Salmon-Safe*. Retrieved August 16, 2022, from https://salmonsafe.org/certification/farms/

Flaherty, E., Kirkpatrick, K., & Snow, T. (2019). *Human and environmental well-being in Alaska’s Kachemak Bay watershed: An ecosystem services assessment*. University of Michigan School for Environment and Sustainability. https://deepblue.lib.umich.edu/handle/2027.42/148820

Food Security and Waste. (n.d.). Wilfrid Laurier University, GNWT-Laurier Partnership Report. Retrieved August 18, 2022, from https://www.wlu.ca/academics/research/reports/gnwt-report/profiles/food-security.html#malandra

Garibaldi, A., & Turner, N. (2004). Cultural keystone species: Implications for ecological conservation and restoration. *Ecology and Society*, *9*(3), 18. https://doi.org/10.5751/ES-00669-090301

Goldstein, A., Turner, W. R., Spawn, S. A., Anderson-Teixeira, K. J., Cook-Patton, S., Fargione, J., ..., & Hole, D. G. (n.d.). Protecting irrecoverable carbon in Earth’s ecosystems. *Nature Climate Change*, *10*(4), 287–295. https://doi.org/10.1038/s41558-020-0738-8

Governor’s Salmon Recovery Office. (2020). *2020 state of salmon in watersheds: Executive summary* (p. 28). Washington State Recreation and Conservation Office. https://stateofsalmon.wa.gov/wp-content/uploads/2020/12/StateofSalmonExecSummary2020.pdf

Graham, C. (2020, September 30). *The science behind Salmon-Safe: Building a healthy future for British Columbia*. Salmon-Safe BC. https://www.salmonsafe.ca/post/manage-your-blog-from-your-live-site

Hannah, L., Roehrdanz, P. R., K. C., K. B., Fraser, E. D. G., Donatti, C. I., Saenz, L., Wright, T. M., Hijmans, R. J., Mulligan, M., Berg, A., & van Soesbergen, A. (2020). The environmental consequences of climate-driven agricultural frontiers. *PLOS ONE*, *15*(2), e0228305. https://doi.org/10.1371/journal.pone.0228305

Homer Farmers Market. (n.d.). Retrieved August 18, 2022, from https://farmersmarketcoalition.org/wp-content/uploads/2016/08/Homer-FM-500x375.jpg

Hughes, Z. (2021a, September 7). *Amid an unprecedented collapse in Alaska Yukon River salmon, no one can say for certain why there are so few fish*. Anchorage Daily News.

https://www.adn.com/alaska-news/rural-alaska/2021/09/06/amid-an-unprecedented-collapse-in-alaska-yukon-river-salmon-no-one-can-say-for-certain-why-there-are-so-few-fish/

Hughes, Z. (2021b, September 7). *‘The economy of the Lower Yukon is gone.’* Pulitzer Center. https://pulitzercenter.org/stories/economy-lower-yukon-gone

Jernigan, V. B., Huyser, K., Valdes, J., & Simonds, V. (2016). Food insecurity among American Indians and Alaska Natives: A national profile using the current population survey—Food security supplement. *Journal of Hunger & Environmental Nutrition*, *1*, 1–10. https://doi.org/10.1080/19320248.2016.1227750

Jones, L. A., Schoen, E. R., Shaftel, R., Cunningham, C. J., Mauger, S., Rinella, D. J., & St. Saviour, A. (2020). Watershed-scale climate influences productivity of Chinook salmon populations across southcentral Alaska. *Global Change Biology*, *26*(9), 4919–4936. https://doi.org/DOI: 10.1111/gcb.15155

Justin, W., & Black, J. (2019). An Indigenous forward. *SASAP: State of Alaska Salmon and People*. https://alaskasalmonandpeople.org/wp-content/uploads/2019/03/An-Indigenous-Forward.pdf

Lackey, R. T. (2003). Pacific Northwest salmon: Forecasting their status in 2100. *Reviews in Fisheries Science*, *11*(1), 35–88. https://doi.org/10.1080/16226510390856529

Laforge, J. M. L., Dale, B., Levkoe, C. Z., & Ahmed, F. (2021). The future of agroecology in Canada: Embracing the politics of food sovereignty. *Journal of Rural Studies*, *81*, 194–202. https://doi.org/10.1016/j.jrurstud.2020.10.025

Langdon, S. (2019). *Governance and subsistence working group* (State of Alaska Salmon and People). National Center for Ecological Analysis and Synthesis (NCEAS). https://alaskasalmonandpeople.org/working-group/governance-and-subsistence/

Langdon, S., Westley, S., & Rinella, D. (2019). Deep time—Salmon and people in Alaska before contact. *SASAP: State of Alaska Salmon and People*. https://alaskasalmonandpeople.org/wp-content/uploads/2019/03/Deep-Time.pdf

Langlois, K. (2017, September 18). *Farming in Alaska is increasingly possible*. High Country News. https://www.hcn.org/issues/49.16/agriculture-farming-in-alaska-is-increasingly-possible

Lemay, M. A., Radcliffe, J., Bysouth, D., & Spring, A. (2021). Northern food systems in transition: The role of the emerging agri-food industry in the Northwest Territories food system. *Frontiers in Sustainable Food Systems*, *5*, 661538. https://doi.org/10.3389/fsufs.2021.661538

Ma, M. (2019, June 4). *Early lives of Alaska sockeye salmon accelerating with climate change*. Phys.Org. https://phys.org/news/2019-06-early-alaska-sockeye-salmon-climate.html

MacArthur, A., & Bethel, A. R. M., KYUK-. (2022, January 25). *Federal disasters declared for 14 Alaska fisheries*. KTOO. https://www.ktoo.org/2022/01/25/federal-disasters-declared-for-14-alaska-fisheries/

Marcoe, K., Collins, C., Corbett, C., Burke, M., Kolp, P., & Hanson, A. (2018). *Lower Columbia River thermal refuge study, 2015–2018*. Lower Columbia Estuary Partnership and US EPA.

Martin, M. C. (2019, August 23). *Warm waters across Alaska cause salmon die-offs*. The Bristol Bay Times. http://www.bristolbaynews.com/article/1934warm_waters_across_alaska_cause_salmon

Mauger, S., Shaftel, R., Leppi, J. C., & Rinella, D. J. (2017). Summer temperature regimes in southcentral Alaska streams: Watershed drivers of variation and potential implications for Pacific salmon. *Canadian Journal of Fisheries and Aquatic Sciences*, *74*(5), 702–715. https://doi.org/10.1139/cjfas-2016-0076

McKinley Research Group. (2022). *The economic value of Alaska’s seafood industry*. Alaska Seafood Marketing Institute. https://www.alaskaseafood.org/wp-content/uploads/MRG_ASMI-Economic-Impacts-Report_final.pdf

Meadows, D. H. (2008). *Thinking in systems: A primer* (D. Wright, Ed.). Chelsea Green Publishing.

Meter, K., & Goldenberg, M. P. (2014). *Building food security in Alaska*. Crossroads Resource Center. https://akfoodpolicycouncil.files.wordpress.com/2013/07/14-09-17_building-food-security-in-ak_ken-meter_lr.pdf

Mixon, R. (2021). *A market management-centered approach to building farmers markets in Alaska* [Capstone]. Prescott College.

Moyle, P. B., Lusardi, R. A., Samuel, P., & Katz, J. V. E. (2017). *State of the salmonids: Status of California’s emblematic fishes 2017*. Center for Watershed Sciences, University of California, Davis and California Trout.

Native Movement. (n.d.). *Nenana-Tochaket Road public comment*. Retrieved September 15, 2022, from https://www.nativemovement.org/takeaction

Noon, M. L., Goldstein, A., Ledezma, J. C., Roehrdanz, P. R., Cook-Patton, S. C., Spawn-Lee, S. A., Wright, T. M., Gonzalez-Roglich, M., Hole, D. G., Rockström, J., & Turner, W. R. (2022). Mapping the irrecoverable carbon in Earth’s ecosystems. *Nature Sustainability*, *5*(1), 37–46. https://doi.org/10.1038/s41893-021-00803-6

O’Hara, A. (2021, January 15). *Borough looks to revamp agricultural lease rates*. Peninsula Clarion.

https://www.peninsulaclarion.com/news/borough-looks-to-revamp-agricultural-lease-rates/

Peterdy, K. (2022, July 21). *SWOT analysis*. Corporate Finance Institute. https://corporatefinanceinstitute.com/resources/knowledge/strategy/swot-analysis/

Pierce, C. (2018). Kenai Peninsula agriculture initiative and pilot project. *Kenai Peninsula Borough Land Management*, 14. https://www.kpb.us/images/KPB/LND/Ag_Project/White_Paper-KPB_Agricultural_Land_Plan_and_Pilot_Project_December_2018.pdf

Potter, B. A., Reuther, J. D., Holliday, V. T., Holmes, C.E., Miller, D. S., & Schmuck. (2017). Early colonization of Beringia and northern North America: Chronology, routes, and adaptive strategies. *Quaternary International*, *444*(Part B), 36–55.

Price, M. J., Latta, A., Spring, A., Temmer, J., Johnston, C., Chicot, L., Jumbo, J., & Leishman, M. (2022). Agroecology in the North: Centering Indigenous food sovereignty and land stewardship in agriculture “frontiers.” *Agriculture and Human Values*. https://doi.org/10.1007/s10460-022-10312-7

Quinn, T. P., & Adams, D. J. (1996). Environmental changes affecting the migratory timing of American shad and sockeye salmon. *Ecology*, *77*(4), 1151–1162. https://doi.org/10.2307/2265584

Rantanen, M., Karpechko, A. Y., Lipponen, A., Nordling, K., Hyvärinen, O., Ruosteenoja, K., Vihma, T., & Laaksonen, A. (2022). The Arctic has warmed nearly four times faster than the globe since 1979. *Communications Earth & Environment*, *3*(1), 1–10. https://doi.org/10.1038/s43247-022-00498-3

Reed, T. E., Schindler, D. E., Hague, M. J., Patterson, D. A., Meir, E., Waples, R. S., & Hinch, S. G. (2011). Time to evolve? Potential evolutionary responses of Fraser River sockeye salmon to climate change and effects on persistence. *PLoS ONE*, *6*(6), e20380. https://doi.org/10.1371/journal.pone.0020380

Robbins, J. (2019, September 16). How long before these salmon are gone? ‘Maybe 20 years.’ *The New York Times*. https://www.nytimes.com/2019/09/16/science/chinook-salmon-columbia.html

Salmon-Safe. (2018). *Salmon-Safe certification standards for farms, version 2.7*. Salmon Safe Inc. https://salmonsafe.org/wp-content/uploads/2018/03/Farms-Standards-Version-2.7-May-2018.pdf

Schoen, E. R., Wipfli, M. S., Trammell, E. J., Rinella, D. J., Floyd, A. L., Grunblatt, J., McCarthy, M. D., Meyer, B. E., Morton, J. M., Powell, J. E., Prakash, A., Reimer, M. N., Stuefer, S. L., Toniolo, H., Wells, B. M., & Witmer, F. D. W. (2017). Future of Pacific salmon in the face of environmental change: Lessons from one of the world’s remaining productive

salmon regions. *Fisheries*, *42*(10), 538–553. https://doi.org/10.1080/03632415.2017.1374251

Skinner, G. (2013, June 19). *Assembly keeps habitat law on the books*. Homer News. https://www.homernews.com/news/assembly-keeps-habitat-law-on-the-books/

State of Alaska. (n.d.-a). *Fish habitat regulations*. Alaska Department of Fish and Game. Retrieved August 13, 2022, from https://www.adfg.alaska.gov/index.cfm?adfg=habitatregulations.prohibited

State of Alaska. (n.d.-b). *Nenana-Totchaket Agricultural Project*. Alaska Department of Natural Resources. Retrieved February 8, 2022, from http://dnr.alaska.gov/ag/nentot/

State of Alaska. (2022). *2022 Alaska state agricultural land offering* (Auction 494). Alaska Department of Natural Resources, Division of Agriculture.

State of Washington. (2022). *2022 legislative priorities*. Department of Ecology. https://ecology.wa.gov/About-us/Budget-legislative-priorities/2022-Legislative-priorities

Tarr, G., Hughes, S., Rauscher, G., Kowasaki, S. (2022, March 12). *Alaska used to grow more of its own food. Let’s get back to that.* Anchorage Daily News. Retrieved August 17, 2022, from https://www.adn.com/opinions/2022/03/12/opinion-alaska-used-to-grow-more-of-its-own-food-lets-get-back-to-that/

Thoman, R., & Walsh, J. E. (2019). *Alaska’s changing environment: Documenting Alaska’s physical and biological changes through observations*. International Arctic Research Center, University of Alaska Fairbanks. https://uaf-iarc.org/alaskas-changing-environment/

Thompson, C. (2020, July 23). Thermal hopscotch: How Columbia River salmon are adapting to climate change. *Columbia Insight*. https://columbiainsight.org/thermal-hopscotch-how-columbia-river-salmon-are-adapting-to-climate-change/

Threats. (2011, January 9). *California Trout*. https://caltrout.org/threats

Tillotson, M. D., & Quinn, T. P. (2016). Beyond correlation in the detection of climate change impacts: Testing a mechanistic hypothesis for climatic influence on sockeye salmon (*Oncorhynchus nerka*) productivity. *PLOS ONE*, *11*(4). https://doi.org/10.1371/journal.pone.0154356

Tucker, A. (2021, March 7). *From ashes to greenhouses: How this N.W.T. community is getting closer to sustainable food*. CBC. https://www.cbc.ca/news/canada/north/kakisa-nwt-working-toward-local-sustainable-food-march-3-1.5936534

Unc, A., Altdorff, D., Abakumov, E., Adl, S., Baldursson, S., Bechtold, M., Cattani, D. J., Firbank, L. G., Grand, S., Guðjónsdóttir, M., Kallenbach, C., Kedir, A. J., Li, P., McKenzie, D. B., Misra, D., Nagano, H., Neher, D. A., Niemi, J., Oelbermann, M., … Borchard, N. (2021). Expansion of agriculture in northern cold-climate regions: A cross-sectoral perspective on opportunities and challenges. *Frontiers in Sustainable Food Systems*, *5*, 663448. https://doi.org/10.3389/fsufs.2021.663448

US EPA. (2003). *EPA region 10 guidance for Pacific Northwest state and tribal temperature water quality standards* (EPA 910-B-03-002). US Environmental Protection Agency, Region 10 Office of Water. https://www.noaa.gov/sites/default/files/legacy/document/2020/Oct/EPA%20%282003%29%20Guidance.pdf

US EPA. (2021). *Columbia River Cold Water Refuges Plan* (EPA-910-R-21-001). U.S. Environmental Protection Agency. https://www.epa.gov/sites/default/files/2021-01/documents/columbia-river-cwr-plan-final-2021.pdf

US National Park Service. (n.d.). *Restoration and current research*. Olympic National Park. Retrieved August 12, 2022, from https://www.nps.gov/olym/learn/nature/restoration-and-current-research.htm

USDA. (2017a). *Kenai Peninsula Area Alaska* (2017 Census of Agriculture). USDA NASS. https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Census_by_State/Alaska/index.php

USDA. (2017b). *State Profile: Alaska* (2017 Census of Agriculture). https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/County_Profiles/Alaska/cp02122.pdf

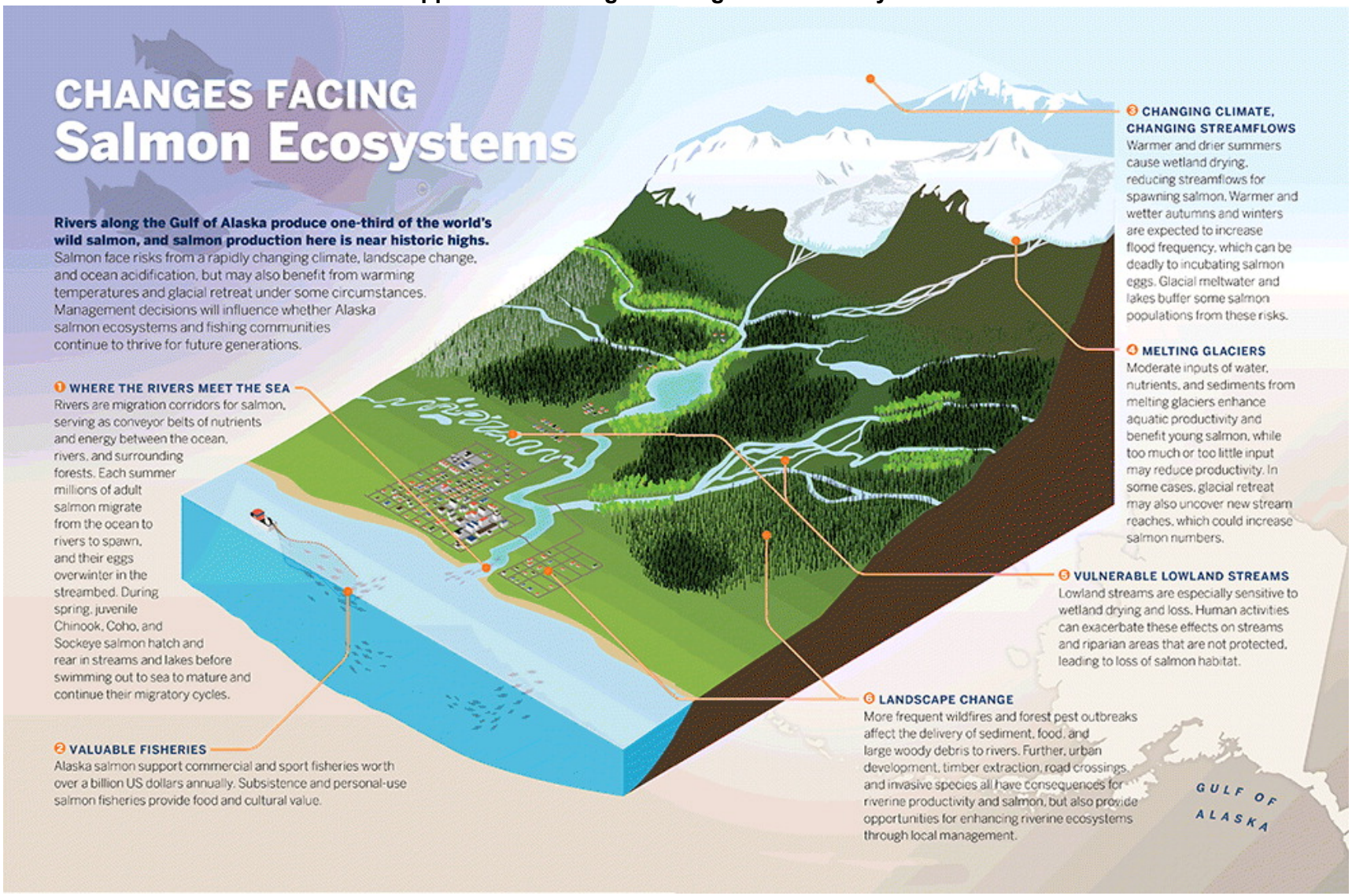
USGCRP, (2018). Chapter 26: Alaska. In D. R. Reidmiller, C. W. Avery, D. R. Easterling, K. E. Kunkel, K. L. M. Lewis, T. K. Maycock, & B. C. Stewart (Eds.), *Impacts, risks, and adaptation in the United States: Fourth National Climate Assessment: Vol. II*. U.S. Global Change Research Program. Retrieved May 5, 2021, from https://nca2018.globalchange.gov/chapter/26/

Walker, C. M., Whigham, D. F., Bentz, I. S., Argueta, J. M., King, R. S., Rains, M. C., Simenstad, C. A., Guo, C., Baird, S. J., & Field, C. J. (2021). Linking landscape attributes to salmon and decision-making in the southern Kenai Lowlands, Alaska, USA. *Ecology and Society*, *26*(1). https://doi.org/10.5751/ES-11798-260101

Wild Salmon Center. (n.d.). *Pacific salmon*. Retrieved June 13, 2022, from https://wildsalmoncenter.org/salmon-species/

Zemek, S. (2021, January 14). New State Report Shows Salmon Still Near Brink of Extinction in Washington State. *Recreation and Conservation Office, Washington State*. https://rco.wa.gov/salmon-still-near-brink-of-extinction/

Appendix A: Changes Facing Salmon Ecosystems



(Image from Schoen et al, 2017

Appendix B: Cook Inletkeeper Watershed Farmer Working Group Session Analysis

Session 1: In-stream Habitat, Riparian and Wetland Vegetation (01/12/2022)

The certification standards in this session focused on areas with active salmon streams running through or bordering the farm. This situation did not apply to all of the farmers. The Alaska Department of Fish and Game (ADF&G) maintains a catalog of streams, rivers, and lakes around the state that are known to be habitat for the spawning, rearing, or migration of anadromous fish, such as salmon. The waters in this catalog are protected by state law but additional water surveys have found more extensive habitat. ADF&G note that the list is updated annually but is still incomplete, representing “a fraction of the streams, rivers, and lakes actually used by anadromous species” (Overview, n.d.). Therefore, the Cook Inletkeeper participants suggested that any uncataloged persistent waterway or stream (flowing during the whole summer season, not just snowmelt from the spring thaw) could be presumed salmon habitat. The stream could be checked for juvenile salmonids using minnow traps. The farmers agreed that this should be the best practice but also questioned how the time, training, and materials required would be provided.

The Salmon-Safe certification standards require farmers to comply with local laws and regulations, and to go above and beyond what is required in order to help salmon thrive. The Anadromous Fish Act requires approval from ADF&G “before altering or affecting ‘the natural flow or bed’ of a specified anadromous water body”. Such activities, some of which are common to farming, include: “road crossings, gravel removal, mining, water withdrawals, the use of vehicles or equipment in the waterway, stream realignment or diversion, bank stabilization, and the placement, excavation, deposition, or removal of any material”. The Fishway or Fish Passage Act requires authorization for “activities within or across a stream used by fish if it is determined that such uses or activities could represent an impediment to the efficient passage of resident or anadromous fish”. (Fish Habitat Regulations, n.d.).

A big topic of discussion was salmon-friendly culverts. When culverts are installed too high, a single road crossing can prevent salmon populations from moving upstream. According to the Kenai Watershed Forum’s culvert assessment, 48% of culverts provide inadequate fish passage (Culvert Assessment, n.d.). Farmers with stream crossings on or near their properties were concerned about the costs of installing or upgrading infrastructure.
The second Salmon-Safe certification standard addresses riparian and wetland areas. Again, the first step was to determine the local requirements and regulations. This is a topic for debate on the Kenai Peninsula. The current ordinance protects a 50-foot buffer on either side of a cataloged salmon stream; however, there has been significant opposition and proposals to scale back these protections by landowners who feel that such regulation prevents them from improving their property (Chandler, 2015; Walker et al., 2021). Salmon-Safe Certification requirements provide considerable flexibility on this topic, recommending an average of 50-100 feet with a minimum of 35 feet.

Participants discussed increasing the firmness of some language in the standards including phrases like “impacts are minimized” and “adequately vegetated” (p. 14). For example, a streambank adequately vegetated with reed canary grass, a harmful invasive in riparian zones, might pass certification.

Since one goal of the working group is to develop and share best agricultural practices for Alaska, the group discussed the importance of baseline studies of agriculture's impact on soil and water temperatures and how that, in turn, impacts salmon habitat. Baseline farm and river studies that focus on raw land development are lacking, specifically in climate-driven agricultural frontiers (Hannah et al., 2020).

Salmon-Safe has marked certain certification “performance requirements” as “required as a pre-condition for certification” (p.10). Those that are unmarked “are mandatory, but may be implemented during the certification process, or as a requisite requirement, be implemented over time for conditionally certified farm operations” (p. 10). None of the ten performance requirements under the riparian section and a single requirement of the nine under the wetland section (F.2.2.i pictured here) are marked as mandatory. In practice, this deliberate vagueness seems less like flexibility and more like a risk to the goals of salmon habitat protection and improvement. Without clear requirements, there is a lack of incentives to go above and beyond. Participants found this language problematic throughout the remaining sessions and clarification was a priority.

Standard F.2.2: Wetlands are protected and wetland buffers established to the greatest e operationally feasible. Wetland protection is prioritized to provide off-channel salmonid (f habitat, improved water quality, additional floodplain storage or other habitat benefits as ated with proper wetland function.[25]

Performance requirements:

I. Wetlands not currently in production remain set aside and protected to the greatest extent operationally feasible. If 100 percent of such wetland area cannot remain set aside and protected, wetland loss is mitigated on site to the greatest extent operationally feasible in a way that contributes to overall site ecological and hydrological functions. R

II. In dedicated agricultural production areas, wetlands are protected by a minimum 25-foot uncultivated buffer or to the greatest extent operationally feasible.[26]

Restoration Efforts:

I. Impacts to wetland functions, including water quality, water quantity and habitat connectivity are minimized within 100 feet of wetlands to the greatest extent operationally feasible.

II. Problem invasive plants in both wetlands and wetland buffers are identified, removed and replaced with suitable plant species adapted to site conditions. Whenever possible, native species are selected over other plants.

III. Wetlands and wetland buffers should be vegetated consistently with local intact reference wetland conditions. Wetland vegetation, whether emergent, scrub-shrub or forest is characteristic of local reference wetlands and is

Session 2: Water Use Management and Erosion Prevention (01/26/2022)

Working group participants found this section of the standards less applicable when scaled down to small farms. The discussion centered around what irrigation practices are relevant to local farms. The list includes pocket ponds, catchment ponds, deep wells, shallow wells, drip tape, and discharge slopes, none of which are mentioned in the standard. Participants were unaware of local farmers drawing water for irrigation directly from salmon streams, but that it could happen. According to the ADF&G, any water withdrawals from a cataloged salmon stream can only happen after being granted a permit. All participants agreed that alternatives should be the focus of the standards rather than the adaptation of irrigation systems that draw from salmon streams, such as using fish screens and diversions. Farmers are seeking resources for low-cost, gravity-fed, efficient irrigation systems. Locally, many farmers rely on water conservation because it is prohibitively expensive to drill a well or have water delivered. Some farmers are already conserving water but are not making the connection that they are helping salmon as well. Farmers also suggested ranking the best practices so farmers could choose what would work best for their farm as well as have the biggest impact.

Participants stressed that building healthy soil prevents water loss and reduces the need for irrigation. Soil health should be prioritized much more than in the salmon-safe standards. Of the 11 requirements listed in this section, only the two restoration efforts mention building soil. “Reduced or minimum tillage allows plant residues to accumulate on the soil surface. This increases organic matter in the soil and increases soil organism diversity.” “Crop rotation is used to build soil to the greatest extent operationally feasible.” (p. 20).

These two requirements raise concerns. First, the sentence about reduced or minimal tillage is not phrased like a requirement but simply gives information. This is a consistent issue with the phrasing of the standards.

Example:

Restoration Efforts:

i. Reduced or minimum tillage allows plant residues to accumulate on the soil surface. This increases organic matter in the soil and increases soil organism diversity.

ii. Crop rotation is used to build soil to the greatest extent operationally feasible.

Instead, the standard should be to use reduced or minimal tillage along with recommendations for implementation (how much of the farmed area, how to increase this practice, what equipment is needed, who has this experience).

Second, the group did not approve of the phrase “to the greatest extent operationally feasible” and discussed substituting the more concrete “according to the farm plan”. This allows for flexibility, as long as it is deliberate and considered within the local farm context. Salmon-Safe

clarifies the use of this phrase as a way to “balance guideline compliance with productivity, finances, and other site-specific conditions that may limit the ability of an operation to incorporate a portion of the standards” and that the judgment of feasibility rests with the local evaluator (p. 6). Participants were concerned that this idea of feasibility limits the innovation of local agriculture to develop best practices that both protect salmon habitat and improve farmland, such as water conservation and soil building. Linking these practices directly to financial benefits for farmers would help promote these practices.

The farmers then had a lively discussion of various cover crop experiences, challenges, and successes. The diversity of practices and the excitement as various experiences were shared is evidence that a knowledge-sharing platform would be useful. New farmers especially are looking for local information.

The standards suggest using deep-rooted native plants, but most plants native to Alaska have shallow roots. A list of local examples would be useful, as well as further clarification of categories of plants (native, non-native, noxious weeds, invasive species) so that farmers could make the best choices for their locations.

The participants suggested that the biggest source of runoff and unstabilized soil that they observed was farm roads. Only one requirement, that “to the greatest extent operationally feasible, farm roads are stabilized”, addressed this issue, and farmers, especially those developing raw land, would like additional guidelines (p. 19).

A discussion of the value of certification began during this session. Farmers are concerned that agriculture is not the only or biggest impact on salmon habitat in the area but that it often has the most negative feedback. The farmers agreed that this position of visibility could also give them a platform to showcase best practices for farming in a salmon landscape and potentially influence their neighbors and other industries. The farmers were concerned about regulation from the outside and if this certification model could be community- and farmer-led from the inside or the ground up. It’s important to create standards that hold people accountable but are also flexible enough to work for individual locations.

Session 3: Animal Management (02/09/22)

The discussion around this section of the standards was shorter due to the composition of the working group. Relatively few farmers had experience with livestock, but those who did were very concerned about the costs of compliance. The information in this section is more technical and implementation is more expensive than other standards. All farmers felt the standards focused too much on large-scale operations with few guidelines for small farms. Participants in this group deal with manure management by hand which takes a lot of time and energy. The conversation about homestead farming and scale began in this session and would continue throughout the project.

Reindeer farming is a developing industry in Alaska with no representation in this group. More research, outreach, and discussion are needed in order to “Alaskanize” the section on animal management in Alaska. This refers to both domesticated livestock and reindeer management.

Alaska has shorter summers and long winters, so rotational grazing and reseeding may need to be adjusted. One requirement is that watering facilities be installed that “limit or eliminate” livestock access to streams (p. 25). Participants suggest that examples of efficient waterers and systems be provided, especially with specific requirements of different animals, different scales, and ways to keep them from freezing.

Part of this section is a manure management plan. One sentence in the standard, that “manure has a high nutrient resource value that can be utilized to reduce fertilizer needs and to help avoid contamination of waterways” is informative but does not explicitly link to a best practice (p. 25). Farmers in the group exclaimed that if anyone needed help managing manure, they would be more than happy to use it. Many local vegetable farmers lack a supply of manure and so manure management should include a component of sharing. Soil building is particularly important in Alaska, especially during land conversion, and this could be further emphasized in the standards.

Session 4: Integrated Pest Management and Water Quality Protection (02/23/22)

This section of the certification standards is robust and includes the following five substandards with 21 total requirements: soil fertility, avoiding use of high hazard pesticides, the implementation of an IPM program, the responsible and safe use of pesticides, and materials storage. The section on soil fertility focuses on avoiding overfertilization and runoff rather than on building soil. The section also contains the first of two mandatory items, that “nutrient application is timed to minimize runoff” (p. 21). The other is that “no pesticide from the High Hazard Pesticides List is to be applied” (p. 22). However, certified farms may still use chemicals from this list if approved in advance by Salmon-Safe by submitting a variance request and if the use “represents a negligible hazard to water quality and fish habitat” (p. 39). Including a list of acceptable and encouraged products and practices would make this section more appealing to local farmers.

This session was of particular concern to participants involved in Alaska’s peony industry. This cut flower industry is particularly suited to northern climates because the flowers, harvested before opening and ship well, and the timing of the harvest season is offset from the rest of the world. Peonies are susceptible to the botrytis fungus which is treated with the fungicide copper sulfate. Although it is an approved organic fungicide, it is on Salmon-Safe’s high-hazard list, as copper products are particularly harmful to salmon. Peony farmers in Alaska represent a large percentage of farms, and some are particularly interested in Salmon-Safe certification. Cut flowers cannot be USDA Certified Organic, so Salmon-Safe could be a useful tool for market differentiation. However, farmers are hesitant to participate in regulation that may not support their production.

Participants again stressed that building soil quality is an important part of the IPM strategy. Soil testing and plant tissue testing can be expensive for farmers, especially when required repeatedly. Participants suggest that in their experience, systems with minimal or no tillage that use composting and biological amendments do not have the same issues of overfertilization and could rely less on testing. There was some discussion on the value of testing versus direct observation as well as some experiences with cheaper methods of field testing plant tissue.

Standard F.5.3.iv “Growers adopt soil fertility and cultural methods that help crops build natural pest resistance, attract pests away from crops and help slow the arrival and migration of pest species to crops” was praised by the group (p. 22). The farmers participated in an animated discussion of various weed and pest management techniques. They also voiced concerns that warming temperatures are increasing pressure from different pests. Again, participants lamented the lack of a central hub that could host this information and these discussions, especially for new farmers.

One particularly Alaskan addition to this section is the use of salmon as a fertilizer. Some farmers bury or compost fish waste leftover from their own personal salmon fishing. There are at least two Alaskan-made commercial products. One is Fishy Peat, a soil amendment made from a combination of fish meal, seaweed, native peat, and some lime. Another is Alaska Salmon Fertilizer, a fermented fish emulsion made from Kenai River salmon scraps. This product also addresses the issue of fish pollution caused by the fish scraps that litter the beach and add too much nitrogen to the water at the mouth of the Kenai River during the personal use and subsistence fishing season.

In general, the requirements in this section apply more to the chemical application practices of conventional agriculture common in the lower 48. The concern is that as agriculture increases in northern latitudes and the state of Alaska promotes favorable land leases for larger farms, these conventional practices may become more common. The working group participants agree that creating standards now is ideal while acknowledging the difficulties of finding the time to do so and engaging the public prior to an actual problem occurring.

Session 5: Biodiversity (03/09/22)

This section addresses biodiversity at many levels including soil organisms, beneficial insects, birds, and bats. It also includes biodiversity within fields using crop rotation and intercropping. The section also encourages the protection of non-cultivated areas on the farm property including forests, wetlands, grasslands, and fence rows. Participants found this section to be extremely relevant to their perceptions of salmon-safe farming. The application of practices from this section would also clearly address issues such as overfertilization and runoff raised in previous sections.

The standard clearly divides practices into supporting biodiversity in actively cultivated areas of the farm as well as non-farmed areas. This raised the question of the Alaskan homestead property that includes many different activities in non-farmed areas. Some homestead farms are

large family enterprises where those with different views may have different farm projects on the same land. In some situations, peonies are farmed on one section of the homestead while a vegetable plot and livestock are in another which may complicate Salmon-Safe certification of the whole property.

While the main points of this section had the enthusiastic support of the working group participants, the details were confusing. The standard is titled “Landscape-Level Biological Diversity Enhancement” and includes five subsections. Each of those has a number of requirements. The final two subsections are written the same but are followed by different requirements. Examples:

Standard F.7.4: Protect and restore permanent non-farmed areas, including forests, wetlands, marginal fields, unimproved grasslands, fence rows or other areas that are not actively farmed to promote refuges for biodiversity.

Performance requirements:

i. Incorporate native flowering plants[42] that attract beneficial insects in areas that are not actively farmed.

ii. Encourage development of areas with plantings that include both structural (trees, shrubs, and groundcover species) and species diversity along field borders and irregularly shaped areas of the farm to offer wildlife habitat and encourage beneficial insects.

Standard F.7.5: Protect and restore permanent non-farmed areas, including forests, wetlands, marginal fields, unimproved grasslands, fence rows or other areas that are not actively farmed to promote refuges for biodiversity.

Performance requirements:

i. Encourage wide ranging rodent-eating terrestrial predators through farm management practices.

ii. Habitat features on the property are connected by vegetated corridors to other habitat areas on the farm and on adjacent properties to the greatest extent operationally feasible.

Some requirements in this section are entire paragraphs that functionally include multiple instructions. Example:

Standard F.7.3: Implement farm practices that protect and maintain habitat for beneficial insects and wildlife within fields and field margins.

Performance requirements:

i. To the extent operationally feasible, harvest forage crops and mow to manage grass in sections (alternate mowing) to ensure that beneficial insects and wildlife have some habitat intact at any given time. Practice mulch mowing and maintain a mowing or grazing height that is no less than 3 inches in order to protect soil from weed establishment. Omit mowing from the annual maintenance cycle and implement biannual or varied mowing. Where possible, mow native species only after they have gone to seed.

This section felt disorganized to participants. It was full of practices they could support but was difficult to follow. The section needs considerable adjustment to be “Alaskanized” to local plants, pollinators, and wildlife. Moose can demolish a field of vegetables and easily destroy a fence. Wildlife corridors that connect forest to field could cause problems. Farmers shared numerous wildlife stories, such as birds of prey snatching up lambs and lynx hunting poultry. The participants both wanted to support wildlife but also needed systems that provide protection from thriving wildlife.

Salmon-Safe does not have any content that promotes beekeeping, a practice that is popular locally for the financial benefits of selling honey at farmers markets and directly to local brewers, as well as for pollination services. Peony farmers in particular see the benefits of adding honeybees to their farms even though most peonies are harvested prior to blooming. Peony plants produce a sticky nectar outside of the buds. This sugary substance can cause mold issues during transport, but honeybees can keep the buds clean and improve the quality of the product. Overall, participants agreed that this section had a lot of potential for Alaska but also needed a lot of work.

Session 6: Conclusion (03/23/22)

In session six, participants discussed potential next steps with a focus on outreach. Participants suggest that creating videos about each standard profiling different farms and different scales would be particularly valuable to inform farmers and ease potential concerns about regulation. Overall, farmers' interest in Salmon-Safe fell into two categories. First, some farmers felt that the certification standards were in alignment with their current practices, so if certification were an option, they would probably participate. Second, some farmers were not fully in support of certification, but also did not oppose it. They expressed concerns that the demands on their time and financial resources for certification or potential infrastructure improvements required would be too high. Direct financial incentives for certification in Alaska are not clear, with the exception of peony farmers who could use Salmon-Safe Certification for market differentiation in national and international markets.

In addition, all participants were in support of developing locally-adapted best practices that farmers could implement to be better stewards of salmon without being certified. This general support was expected but may not be representative of most farmers in Alaska. Participants were recruited with the expectation of a 12+ hour time commitment to discussing farming in a salmon landscape, so those who chose to participate were generally supportive of such practices. Additionally, representatives from Salmon-Safe joined for the final discussion. They shared that Salmon-Safe is updating its standards in 2022 with an additional focus on climate resiliency, healthy soils, and Traditional Ecological Knowledge. The organization is receptive to input from Alaska during the updating process.

Appendix C: Supporting Salmon through Agriculture on the Kenai Peninsula

Introduction: The following guidelines are developed from practices followed by local farmers engaged with Cook Inletkeeper on the 2022 Salmon-Safe Agriculture Project and informed by the current scientific literature on northern agriculture and ecosystems. Salmon-Safe certification* is not a requirement, nor is it currently available in Alaska. The best practices included in the guidelines are compatible with current Salmon-Safe certification standards but do not guarantee compliance.

Steps for Supporting Salmon through Agriculture on the Kenai Peninsula

1. If you have a salmon stream or wetland area on or bordering your farm, familiarize yourself with federal, state, borough, and local regulatory requirements. Only a fraction of rivers, streams and lakes have been mapped and included in Alaska’s Anadromous Waters Catalog, so assume any perennial waterway is potential salmon habitat.
    a. If you have salmon habitat or potential salmon habitat on your farm, you can maintain and improve it to help your salmon neighbors. Salmon face increasing thermal stress and habitat fragmentation due to climate change and land development. Your salmon-friendly farm can support salmon throughout their lifecycle.
    b. Use this habitat awareness to install new roads, barns, and other infrastructure in locations that do not impact salmon.
    c. If you don’t have salmon habitat, your farm still matters to salmon. We consider the entire watershed to be salmon habitat. The groundwater that flows beneath your fields may enter salmon habitat downstream and provide critical cold water refugia that mitigate thermal stress caused by warming streams. You can focus on best practices for groundwater protection, soil building, and increasing biodiversity.
    d. If you farm in a greenhouse or high tunnel, you can still learn how the structures on your farm may impact water flows, work to build soil, increase biodiversity, and plan future expansion in ways that will support salmon habitat.
2. Do not withdraw water from salmon streams. Choose alternative irrigation and livestock watering sources to protect salmon streams.
3. Enhance habitat complexity for salmon and other wildlife
    a. Protect and increase vegetation in riparian buffers that are at least 50 feet wide. Trees, shrubs, and groundcovers are all important for bank stabilization, reducing runoff and erosion, and providing habitat. Alders are particularly beneficial to salmon habitat as their shade cools the water and the nitrogen they produce feeds the microinvertebrates that are a food source for juvenile salmonids. Woody debris and leaves that fall into the stream improve habitat by reducing flow rates and providing shelter for juveniles.
    b. Use fencerows, field margins, and other available spaces for native and beneficial plants, especially flowering plants for pollinators.

    c. Learn to identify beneficial plants and avoid noxious weeds in these areas and seek help if you are unsure.
4. Build soil health. This is important for existing farms and new farmers converting raw land. Agricultural land conversion, particularly in northern latitudes, has the potential to release large amounts of carbon into the atmosphere. However, soil building techniques can increase carbon storage. Healthy soil also reduces runoff, increases water and nutrient retention, and grows healthier plants.
    a. Use no-till or minimal tillage methods
    b. Use rotational grazing to minimize soil compaction
    c. Use cover crops and crop rotation where possible
5. If you have livestock or poultry, store manure in a way that does not contaminate surface or groundwater. Reach out to other farmers for help; local vegetable farmers are seeking sources of manure to build their soil.
6. Develop an Integrated Pest Management (IPM) strategy that protects ground and surface water, as well as salmon from agricultural chemicals. Use local resources for assistance.
    a. Use soil fertility and other methods that help crops build natural pest resistance, attract pests away from crops, and slow the migration of pests to crops.
    b. Increase field observation to enable early detection of issues
    c. Do not use chemicals on Salmon-Safe’s High Hazard Pesticide List
    d. Share your knowledge! Help us create a list of salmon-friendly IPM methods including products and application timing.
7. Help with outreach and be part of this process. It is a community- and farmer-led project. If you’ve had success with all or some of these guidelines or suggestions for further development, let us know! Tell your customers. Share your experience with new farmers. Outreach during upcoming state land leases is particularly important as it involves the agricultural conversion of large parcels by potentially out-of-state farmers.

*If you are interested in Salmon-Safe certification you can reach out directly through the website https://salmonsafe.org/certification/farms/. If you would like to be informed of future information sessions related to Salmon-Safe certification in Alaska, join our mailing list here (in progress).

Appendix D: Technical and Financial Resources for Alaskan Farmers

In the Salmon Safe working group, farmers mentioned financial and technical assistance as barriers to implementing salmon-friendly agricultural practices. Farmers and other participants shared resources informally during the meetings.

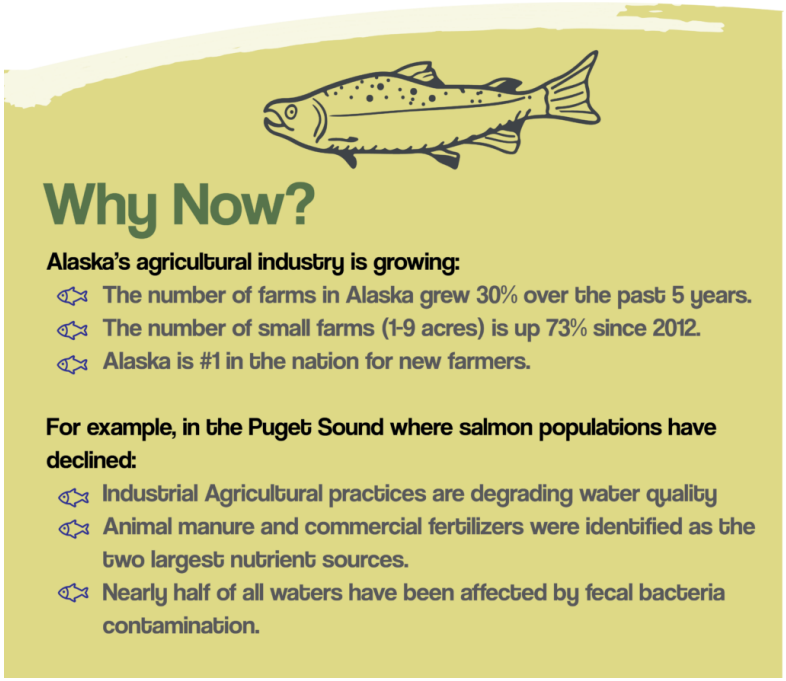
This is a first attempt to capture that information in a semi-organized way. Please feel free to edit and fill in gaps.

Program	Organization	Type	Notes
Anadromous Waters Catalog	ADF&G	Information	See if a location has salmon habitat on or bordering it and to test any unmapped waterways to add to the catalog
Groundwater Contribution to Salmon	KBNERR	Information	Salmon habitat is impacted by farming through groundwater even if it does not have salmon habitat on or adjacent to it
Streambank Rehabilitation workshops	ADF&G	Technical	
Alaska Plant Materials Center	Alaska Plant Materials Center	Technical	Revegetation, soil conservation, invasive plants
Integrated Pest Management Program	UAF Cooperative Extension Service	Technical	
Kenai Cost Share Project	ADF&G	Funding	Funding and technical project design assistance to sustain and enhance salmon habitat
Kenai Borough Habitat Protection Tax Exemption Program	Kenai Peninsula Borough	Funding	Tax exemption for increased value of property due to habitat protection and restoration projects within 150 feet of anadromous water bodies
Western IPM	Western IPM	Funding	
Environmental Quality Incentives Program	NRCS	Funding, Technical	High tunnel & Irrigation Systems
Conservation Stewardship Program	NRCS	Funding, Technical	Cover crops, grazing plans, wildlife habitat, etc.
Ecological Science	NRCS	Technical	Science-based support for many farming practices

Conservation Planning	NRCS	Technical	Free technical assistance for everyone
Conservation Innovative Grants	NRCS	Funding	Technology development and transfer for conservation concerns, production and operational benefits
Rangeland Assessment in Alaska	NRCS	Funding, Technical	

Appendix E: Cook Inletkeeper Materials (2021)

From https://inletkeeper.org/our-work/healthy-habitat/salmon-safe-farming/



1. Conserve water to limit water withdrawls
2. Minimize erosion, compaction, and loss of vegetation from livestock
3. Keep water free from pesticides/fertilizers/manure
4. Maintain stream buffers of native vegetation
5. Keep stream channels open from obstructions
6. Support and enhance biodiversity

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