Name of the case study	Kugluktuk - Cultural and ecological dimension of food security-constrained by climate change - Canada [Loss of Resilience]	
What about this case makes it interesting? How does this case contribute to understanding of resilience and/or regime shifts in the Arctic?	Inuit communities in Kugluktuk rely heavily on subsistence. However, access to traditional food sources has been a challenge due to environmental and socio-cultural changes. Food systems have cultural and spiritual dimensions through subsistence activities. Traditional livelihoods provide a source of recreation, connection, therapy, beauty, and knowledge. Kugluktuk communities face a shift in cultural values and practices affecting their capacity to adapt and deal with change. Colonial legacy, wage labour, Western education are changing human nature relation, shifting youth interests. Less participation in traditional activities such as hunting, fishing, and sharing networks, higher rates of substance abuse and suicide, aging of elder's hunters are risking the loss of traditional knowledge. The loss of this knowledge threatens the community's food security and their historical adaptive capacity. Currently, climate change has generated several changes in the ecosystem that reinforce the shift in cultural perspective and restrict food security. First, landscape modification has affected the biodiversity of the area. Later the freezing, the lack of snow, and the decrease in rainfall have affected the area's biodiversity. Key food species such as caribou and arctic trout are less available. Regarding the cultural dimension, the risks associated with hunting trips in the current climatic condition exacerbated the sociocultural change faced by the community.	
Templated completed by: *Main contributor	Carla Lanyon, Stockholm Resilience Centre Juan Rocha*, Stockholm Resilience Centre	**Key references: Cite in the text using (1), (2), (3) etc. and provide a reference list at the bottom of the template.** (1) Panikkar, B., and B. Lemmond. 2020. Being on Land and Sea in Troubled Times: Climate Change and Food Sovereignty in Nunavut. *Land* 9:508. (2) Prno, J., B. Bradshaw, J. Wandel, T. Pearce, B. Smit, and L. Tozer. 2011. Community vulnerability to climate change in the context of other exposure-sensitivities in Kugluktuk, Nunavut. *Polar Research* 30(1):7363. **(*) Mainly all the information comes from (1). Otherwise, is explicit cited**

Reviewed by (name and affiliation)								
Category	**Resilience/ Adaptability**			**Loss of resilience**		**Transformation**		
				X				
Case study details:	**Country**	**Place**		**Scale – space**	**Scale – time**	**Sector(s)**	**Other (e.g. disturbance)**	
	Nunavut, Canada	Kugluktuk		549.6 km	1916-2020	Food Security		
Drivers (mark with X in appropriate boxes)	**Climate**	**Geopolitical**	**Mineral/ oil extraction & infrastructure**	**Tourism**	**Shipping**	**Biological invasion**	**Rapid demographic change**	**Other:**
	x		x					

	Biophysical:	**Social:**
1. Basic description of coupled social-ecological system in focus (What are the key components and stake holders) If possible draw a systems diagram or conceptual map of the case – this can be a series of diagrams to capture different periods in the case and	a) What types of ecosystem(s) and other major biophysical features are present? Shore, River, sea-ice. b) How are the case boundaries defined in terms of ecosystems or biophysical characteristics? The boundaries of the system are defined by traditional practices involving the Canadian mainland, at the mouth of the Coppermine River on the southwest coast of the Coronation Gulf.	c) Who are the key groups of people in this case? Inuit communities d) What kinds of livelihoods are important in the system? Tourism, government, and mining play an essential role in the local economy. Hunting and fishing as subsistence activities e) What institutions are key to this case? Government of Nunavut

the drivers/ actors/ events that characterize the period.		Kugluktuk community Kugluktuk Angoniatit: Hunters and Trappers association Elders f) How are the case's boundaries socially defined, and how do these social boundaries relate to biophysical boundaries? The administrative limits of Kugluktuk define the social boundaries.

2. Timeline Draw a timeline of *key* events/ developments to the case. Define the time period (decades – centuries) over which change is considered, Provide a brief description of event/ actors, and ecological impacts Is it possible to identify periods of change from one type of system to another, transformations? Identify disturbances or events that challenged, built, or reduced resilience or adaptive capacity in the system. Consider both biophysical and social dimensions. Mark particularly significant events with *.	1916: Establishment of the permanent trading post (2). 1950´s: Kugluktuk was established as a permanent Inuit settlement (2). 1966-1995: Weak trend towards later freeze-up dates and earlier break-up dates for lakes (2). 1970s: Semi-permanent hunting–trapping camps had disappeared (2). 1999: Nunavut Land Claims Agreement and the associated establishment of the Territory of Nunavut provided Nunavummiut with more decision-making power over issues that affect them and has helped shape a government reflective of their culture, traditions, and goals (2). 2005-2006: Snowmobile accidents related to change in the ice lead to death to young and elders (2). 2007: The government of Nunavut released a new suicide prevention strategy (2).

3. Disturbances What are the key disturbances in the system (present and past)	a) Have there been major biophysical disturbances that are relevant for the case? Extreme precipitation events	b) Have there been major social disturbances that are relevant for the case? High rates of unemployment, relying on social assistance provided by the governments of Nunavut. High prices for imported food Technology integration in subsistence activities such as GPS, snowmobiles, motorboats, high power rifles, fuel, and other equipment The increased cost of hunting due to dangerous weather conditions.
4. Drivers of change Clarify what impacts these drivers have on the SES and if these are direct or indirect	a) What are the key biophysical drivers of change? Land-use change, development of mining industry. Warmer temperature	b) What are the key social drivers of change? Colonial encroachment Policies Restrictive land management Western education and residential schools separated their families, affecting the time and space to transmit subsistence hunting and survival skills and knowledge. The wage economy restricted the amount of time available for hunting.

5. Sources of adaptive capacity: What factors allow(ed) the system to adapt to disturbances in the past and present? Give a brief assessment of recent or on-going changes (+/-/0 = increasing/ reducing/ not affecting adaptive capacity)	a) Within the ecosystem? (-) Decrease in the availability of critical species such as arctic char and caribou (-) Land-use change affecting the habitat of different species (-) Change in seasonality has affected the habitat of caribou, declining the population (+) Increase the abundance of other species such as white fish (-) The development of mining industries has decreased the quality of the environment. (-) Decrease in the meat quality of arctic char (-) Increase in diseases in muskox population. (0) Arrival of new species. Wildlife species typically associated with more southerly regions, such as moose, red fox, pike, and some bird and insect species, have been observed in and around Kugluktuk	b) Within society (e.g. people, social capital, management, institutions, infrastructure): (+/-) The incorporation of technology increases access to land. However, purchasing the equipment requires money. (-) A shift in young people interest, more money and technology-oriented, than hunting and traditional practices (-) The decline of elder's hunters (-) Decrease of food security. Changes in the ecosystem decrease the access to country food, and the high prices of imported food constrain food security. (+) Inuit ancestral capacity to adapt and be resilient using traditional land-based knowledge and skills. (+) Inuit monitoring system to perceive the change in the environment (+/-) The sharing network is s an adaptive strategy to face food insecurity and climate change. However, there is a concern in the community regarding the sustaining of this practice (+) Hunting strategies to adapt, for instance, changing the routes, the seasons, and introducing technology (2).
The next two sections break down the information in Section I. While it is not necessary to fill these sections, if you have additional information pertinent to specific rows below feel free to enter the material.		
II.1-8 SES, resilience and adaptive capacity		

	Biophysical	Social
II.1. Where do we find change and resilience in the face of change?	a) Within nature: Change: The warmer temperature has changed the ice sea dynamics affecting the migration behaviour of species and the arrival of southern species. Later freeze has caused a decline in the caribou population. Arctic char is less abundant, and white fish has become a more abundant species. The quality of meat and the health of species have decreased. Impact on biodiversity due to mining activity that contaminates and fragmented the landscape. Permafrost is melting decrease, and the lack of snow has an impact on travel. Resilience: As an adaptation, species have changed their routes of migration to northern parts. An increase of other species in the area, such as white fish, could support food security.	b) Within society: Change: Traditionally Inuit people have a nomadic subsistence, having different sources of fresh food around the Arctic. Due to several drivers and disturbances related to colonial policies, Inuit-nature relations have become weaker, affecting the transmission of traditional knowledge. A cultural shift has been identified among Inuit communities, affecting the transmission of traditional knowledge. Inuit communities are more oriented to introduce technology, relieve the wage economy, exchange networks are less common, and selling picnic is the new trend. On the other hand, there is a decrease in hunters of the elderly that reinforces the risk of loss of traditional knowledge. Due to labour work, people have less time available to dedicate to the land. The lack of opportunities is generating frustration among Inuit youth, increasing suicide and substance abuse. Resilience: Inuit skills allow them to survive and adapt. Their connection with nature and spending time in land increase their mental health and human well-being. Despite the concern in sharing networks reproduction, this remains as an adaptive strategy to access food. Inuit communities still prefer country food due to the high nutritional value and cultural connection.
II.2. What are the system's key components?	a) Key Ecological components (e.g. lakes, coastal zones, caribou) Shores, rivers, sea-ice, caribou, muskox, marine mammals and birds.	b) Actors in society (e.g. individuals, groups, public or private organizations)? How are people organised – by geography, livelihood, family, etc.?

		Families are the core of society. Within families, men are involved in hunting, fishing, and trapping. The role related to subsistence activities is harvesting and collecting plants. Elder is the holder of ancestral knowledge to reproduce traditional livelihoods. The young population are more interested in wage labour and does not speak the traditional language
II.3. What are the key linkages? E.g. ecosystem services, resource extraction. These linkages should exist. If there are not mutual links between social and ecological components the case is not a social-ecological system.	a) From nature to society (e.g. ecosystem services) - Supporting services - Primary production - Knowledge and educational values - Traditional livelihoods.	b) From society to nature – modifying nature, extracting resources (e.g. hunting, mining, water pollution) - Fishing - Hunting - Collecting - Pollution
II.4. What are key interactions?	a) What are the key ecological interactions within the case? With warmer temperatures and extended ice and snow-free seasons, wildlife species typically associated with more southerly regions, such as moose, red fox, pike, and some bird and insect species, have been observed in and around Kugluktuk. (2). Changes in the climate have affected the seasonality of the area, later freeze up in the Northwest Passage are common, affecting the migration routes of Caribou. Now the species	c) What collaborations, conflicts, or other key linkages exist between actors? Conflict among Elder and youth may appear. Elder feel frustration regarding the shift of interest in young Inuit people. Elders recognized the value of traditional knowledge and skill for resilience; therefore, they try to transmit this to the younger generations.

	have moved forward to the north, decreasing the community's access to this species. Freezing rain event during winter for ice layer, impeding caribou eating the vegetation (2). On the contrary, the lack of precipitation has decreased the vegetation constraining the caribou access to food. b) What are the most important biophysical tele-connections to distant systems? Climate change affecting	Sharing networks: This sharing may be among family, closer friends, or in the community. Through radio announcements to share a harvest with someone in need Psychology support from the government Subsidies from the government to achieve a minimum standard of life d) Between local actors and distant actors? Mining industries and Inuit community
II.5. Culture	a) How is the relationship between society and nature viewed? Traditional livelihoods link Inuit people with their landscape. The landscape has allowed the development of traditional knowledge and skill. b) What meanings are attributed to nature and to interactions with nature?	c) What are key cultural features of relevance for the case? Food systems are a key cultural feature. Food systems allow the reproduction of traditional livelihoods, sharing networks, values, and spiritual ties. d) What are key cultural practices and beliefs related to nature? Sharing networks or ningiqtuq, involve a complex web of hierarchies and traditions for sharing food harvested from hunting. This sharing may be among family, closer friend, or in the community through radio announcements to share a harvest with someone in need.
II.6. Disturbance What are important types of stress & shock	a) Describe important biophysical or ecological shocks and stresses (e.g. floods, storms, etc). -2007 extreme precipitation event -Decrease of the precipitation in the area	b) Describe important social shock and stresses (e.g. austerity policies, changes in government policy, introduction of new technologies, etc) Introduction of technologies for hunting.

		Subsides policies to support the Inuit community and achieve a minimum stand of life High rates of unemployment High prices for imported food Technology integration in subsistence activities such as GPS, snowmobiles, motorboats, high power rifles, fuel, and other equipment Increase the cost of hunting due to hazard climate conditions
II.7. What are key slow variables Changes that occur over decadal or longer time scales	a) What types of ecological processes (e.g. loss of permafrost, shifts in species composition) are driving important long-term changes in ecological structures and processes? -Loss of permafrost (2) -Shift in species composition, a decrease of Arctic char, and increase of white fish. -Change in the composition of arctic char meet.	b) What types of slow social processes (e.g. aging, population growth, loss of language) are driving important changes in social institutions and behaviours? Aging of elders, decreasing the number of experienced hunters. The shift in youth interest decreasing the reproduction of traditions Monetization of country food due to the investment needs to afford the technology. Is expected to sell country food than sharing Loss of Inuinnaqtun. The young generation does not know their traditional languages preventing young people from connecting with elders (2) Westernization of Inuit society

II.8. Relationships with ecological regime shifts	a) Are ecological regime shifts driving further ecological change or pressure? Land-use change is affecting the biodiversity of the area. Climate change, the increasing temperature is transforming the Arctic into a warmer environment change the system. b) Are external or internal ecological dynamics potentially or producing ecological regime shift(s)?	c) Can social stresses or major changes be attributed to ecological regime shifts? Food security is constrained by climate change, decreasing the availability and distribution of key species for the Inuit diet. d) Are there specific social practices that might be contributing to ecological regime shifts The increase of industries in the area is changing the landscape.
II.8 Regime shifts	**If a regime shift exists and is important to this case describe it below.** **No regime shift exist** Please indicate whether the regime dynamics are well-established, contested, or speculative.	
II.8.a. Detailed description of alternate regime shifts A case study can contain more than one type of regime shift	Briefly describe the structure of each regime. What does each regime look like? What are differences in ecosystem structure and function? (e.g. permafrost loss, vegetation change)? How do the properties and behaviours of regimes differ? (e.g. collapse of subsistence food sources, fundamental change in types of livelihoods, change in governance institutions, new actors with significant political power who transform decision making)	
II.8.b. Feedback mechanisms within the system that maintain each regime	Ecological feedback mechanisms	Social feedback mechanisms

II.8.c. What key changes drive regime shifts? Describe how these changes alter the state of the system or feedback processes.	a) Drivers of ecological regime shifts (either social or ecological). b) How do these changes alter biophysical feedback processes?	c) Drivers of social regime shifts (either social or ecological). d) How do these changes alter the social feedback processes?
II.8.d. Ecosystem services substantially impacted by regime shift	a) Changes in ecological processes that produce ecosystem services	b) Changes in demand for ecosystem services (market and non-market) c) Changes in the institutional context of ecosystem services e.g. changes in access and changes in how ecosystem services are valued as expressed by rules and regulations.
II.8.e. What is (+/-) impacted by changes in ecosystem services directly or indirectly	a) Impacts from regime shift on ecological components	b) Impacts from regime shift on social actors .
II.8.f. Potential cascading effects	Describe, if any, the likelihood of potential ecological cascading effects to other SES	Describe, if any, the likelihood of potential social cascading effects to other SES
II.8.g. Where do actors intervene to alter regime shift dynamics and who can do the intervening? This can be listed here	Ecological oriented interventions .	Socially oriented interventions

or marked with (*) in the table above		

REFERENCES/ SOURCES CITED:

(1)	Panikkar, B., and B. Lemmond. 2020. Being on Land and Sea in Troubled Times: Climate Change and Food Sovereignty in Nunavut. *Land* 9:508.
(2)	Prno, J., B. Bradshaw, J. Wandel, T. Pearce, B. Smit, and L. Tozer. 2011. Community vulnerability to climate change in the context of other exposure-sensitivities in Kugluktuk, Nunavut. *Polar Research* 30(1):7363
(3)	

GLOSSARY OF TERMS IN THE TEMPLATE

Actor	We use this term generally to look for individuals, groups, organisations, and so on that structure actions and/ or are stakeholders.
Adaptive capacity	Is the capacity of actors in the system to manage resilience in order to stay within a desired state during periods of change. This is related to the diversity in the system behind the provision of a function.
Disturbance	This refers to any disturbance to the system, regardless of scale, duration, intensity and frequency. See shock and stress.
Driver	Actor or process that directly or indirectly affects change in a social-ecological system. External means that the system in question (the scale being looked at) is unable to affect the driver in question – there is no feedback from the system to the driver.
Ecosystem services	The goods and services humans derive from ecosystems. These include: provisioning, regulating, cultural ecosystem services respectively.
Feedbacks	A change within a system that occurs in response to a driver, and that loops back to control the system. A feedback can help to maintain stability in a system (negative or balancing feedback), or it can speed up processes and change within the system (positive or enhancing feedback). Feedback processes play a very important role in determining system thresholds and in maintaining system resilience.
Institution	Here we refer to the humanly devised constraints that shape human interactions, such as rules, norms and laws. These can be formal or informal. Note that we are not referring here to institutions as organisations.
Regime shift	For complex systems, a substantial and enduring reorganization of the system, where the internal dynamics and the extent of feedbacks undergo change.

Resilience	This is a property, in this context of social-ecological systems. It relates to the capacity of a system to cope with disturbances and recover in such a way that they maintain their core function and identity. It also relates to the capacity to learn from and adapt to changing conditions, and when necessary, transform.
Shock	A sudden, unexpected disturbance. This kind of disturbance is often punctual, and has important impacts on large parts of the system.
Slow variable	When analysing complex system is often useful separating “fast” and “slow” variables. Fast variables often represent the primary concern of ecosystem users, for instance game or crop production. Slow variables shape the behaviour of fast ones but change slowly with respect to the overall dynamics of the system. Examples of slow variables might include permafrost thawing for a social-ecological system of Arctic hunters where the fast variable is game, or soil organic matter for an agricultural system where the fast variable is crop production.
Stress	This is a disturbance that has long persistence and often low intensity in impact.
Social-ecological system	This is an interwoven system of human societies and ecosystems. This concept emphasises that humans are part of nature and that these components function in interdependent ways. In the template identifying these interactions between the components aims to identify the processes and actors/ components that interact and particularly the feedbacks between the human-related components and the ecosystems/ biophysical components.
Stakeholder	See “actor”
Systems Diagram	This is using a diagram to illustrate the configuration of a system. This is done by defining its structure, function, and feedbacks. For a case there may be more than one diagram if the system changes in character (actors, processes, drivers, disturbances, feedbacks etc.) over time.
Timeline	The goal with the timeline is to capture important events – both punctual and over longer periods of time, identifying the causes of these events and the actors/ processes involved. This should be done chronologically and distinguishing events.