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When the Natural Battery Fails: Climate Change, Water, and Food Security in Switzerland

For centuries, the Swiss Alps have worked like a natural battery for much of Europe. Winter snowfall charged the system; summer meltwater discharged it, feeding rivers and farms across the continent. That battery is now failing. Swiss glaciers have lost 12% of their remaining ice in just three years (Huss et al., 2024). The zero-degree line—the altitude at which precipitation falls as snow rather than rain—has already risen hundreds of meters and is projected to climb another 550 meters (Scherrer et al., 2021; MeteoSwiss & ETH Zurich, 2025). If even this wealthy, innovative nation faces food insecurity from disruption to the water cycle, it is an early warning for the rest of the world.

Climate change is turning Switzerland's water system from a stable, snow-dominated one—which stored water in winter and released it gradually through summer—into a volatile, rain-dominated one where water runs off immediately. When the battery can no longer hold winter precipitation as snow, water rushes off too soon in winter and runs short in summer when crops need it most. This timing problem is already visible in falling stream flows, shrinking glaciers, and harvests that swing between shortage and surplus. Switzerland is responding with major infrastructure projects, changes to its farming practices, and new store programs. But a likely gap remains: CO_2-driven nutrient loss in staple crops is largely invisible at the grocery store.

Switzerland's water crisis starts with one key change: the rising zero-degree line. This is the altitude at which precipitation falls as snow. Research tracking this line in northern Switzerland across the long historical record from 1871 to 2019 found that it rose by an average of 300–400 meters in most months of the year (Scherrer et al., 2021). That rise alone is significant, because precipitation that used to fall as storable snow at lower elevations is now falling as rain that runs off immediately. The steepest rises—600–700 meters—occurred in December and January, the exact months when snowpack normally builds up to supply the following summer's water (Scherrer et al., 2021). When the zero-degree line climbs the most in those months, the battery's charging season is disrupted at precisely the point it matters most.

Looking forward, Switzerland's official CH2025 climate projections forecast a further rise of 550 meters, which would cut snowfall by about 25% while rainfall nearly doubles (MeteoSwiss & ETH Zurich, 2025). This is not just a future risk. In August 2023, the zero-degree line hit 5,298 meters, the highest since measurements began in 1954 (Scherrer et al., 2021; Barron’s, 2023). At that altitude, precipitation was falling as rain even at elevations that are normally well above the snowline, meaning the charging zone for the natural battery had effectively disappeared across most of Switzerland's terrain during that event.

The loss of snow storage reverses the seasonal pattern across Switzerland's rivers. A major government study confirmed this flip: winter runoff is rising while summer runoff is falling across all catchment types (Muelchi et al., 2021). In winter, excess water causes erosion and flooding rather than refilling the battery. By summer, the moisture that once sustained crops through dry months simply is not there. Stream flow across 52 Swiss catchments has already dropped by about 10% per decade over the past 20 years, driven by reduced precipitation and rising temperatures (Michel et al., 2020). CH2025 projects that a typical summer drought will be 44% more intense under 3°C of warming (MeteoSwiss & ETH Zurich, 2025).

This seasonal imbalance does not stop at the riverbank—it reaches into the soil. A related federal analysis confirms that summer soil moisture is falling as higher evaporation and shifting rainfall make droughts worse (NCCS [National Centre for Climate Services], n.d.). Less soil moisture means crop roots absorb less water, which lowers both yields and nutritional quality. That is one pathway from the water crisis to the family table. There is a second, less visible one: rising atmospheric CO_2 is changing the chemistry of staple crops, causing them to build up more carbohydrate and absorb fewer minerals (Myers et al., 2014). Both threats trace back to the same root cause—the fossil-fuel-driven warming that is disrupting Switzerland's water cycle is also pushing atmospheric CO_2 to levels that silently degrade crop nutrition worldwide.

To understand what this timing problem means for Swiss families, it helps to know their situation. A typical household on the Swiss Plateau spends about 6.4% of gross income on food—roughly CHF 636 per month on average, rising to CHF 1,082 for couples with three or more children (BFS HABE [Swiss Federal Statistical Office, Household Budget Survey], n.d.). Because housing and other fixed costs take up most of the budget, food is the most flexible expense and the first to absorb a price increase—meaning climate-driven price shocks land hardest on larger families and lower-income households, the groups already spending the greatest share of their budgets on food. What makes this especially risky is that the Swiss diet relies heavily on the crops most vulnerable to water stress: the typical Swiss person eats about 56 kilograms of wheat, 45 kilograms of potatoes, and 23 kilograms of cheese per year (BauernZeitung, 2023; FreshPlaza, n.d.; Le News, 2022). These are not occasional foods—they are daily staples. And Switzerland only produces about 54% of its own food grains (BauernZeitung, 2023), so any significant drop in domestic yields forces the country to import more, pushing prices up most painfully for the households with the least budget room.

The 2023 potato crisis showed exactly how this plays out. A wet spring and dry summer cut the harvest 15% below average, forcing Switzerland to request more than 25,000 tonnes of emergency imports (Schweizer Bauer, 2023). The result: farmers were paid significantly more for their potatoes—between CHF 5 and 10 more per 100 kilograms than the year before (Schweizer Bauer, 2023). The following year, good weather reversed the situation entirely: the harvest was 35% above the 2019–2024 average, and prices fell by about CHF 12 per 100 kilograms (Schweizer Bauer, 2025). These two years in sequence tell the story clearly. A 15% shortage sent prices sharply higher; a 35% surplus sent them down just as fast. This kind of swing in both directions—shortage one year, glut the next—is the pattern that erratic precipitation produces, and it is likely to get more extreme as the climate becomes less predictable.

Switzerland has responded by embracing fruits and vegetables that look imperfect. Coop's Ünique brand has sold cosmetically non-standard produce since 2013, offering customers seasonal items at reduced prices while reducing farm-level food waste (Coop, n.d.). In February 2026, Migros, Switzerland's largest retailer, launched a permanent 'Save Food' line starting with potatoes from that year's large harvest (Migros, 2026). In short-supply years, these programs stretch domestic supply and soften price spikes. In surplus years, they give farmers a buyer rather than waste. On the food quantity and price side of food security, Switzerland has identified the problem and is actively working on it.

On food quality, however, the Swiss response has a gap. A research method that grows crops in outdoor plots with elevated CO_2 levels to simulate future atmospheric conditions was used to publish findings in *Nature* showing that at mid-century CO_2 levels (546–586 ppm), wheat loses 9.3% of its zinc, 5.1% of its iron, and 6.3% of its protein (Myers et al., 2014). Rice, soybeans, and field peas also lose nutrients (Myers et al., 2014). These are not minor reductions. Zinc, iron, and protein are the nutrients that support immune function, fuel children's growth, and help sustain healthy pregnancies. And the loss is invisible: the bread looks the same, weighs the same, and costs the same, but it delivers less nutrition per bite.

Because there is no signal at the store, neither shoppers nor policymakers have a way to notice the decline, which is exactly what makes it so difficult to address. For Switzerland, the wheat, potatoes, and legumes in Swiss diets are among the crops most affected. Combined with the harvest volatility described above, the result is less food at higher prices and food that is quietly less nourishing. This is what researchers call Hidden Hunger.

These risks connect directly to Swiss nutrition data. The country's own nationwide menuCH survey found that women of reproductive age consumed on average only about 60% of their recommended daily iron intake—a nutrient the WHO already links to immune function and healthy development in children (BLV, 2014–2015; Herter-Aeberli et al., 2025; WHO, n.d.). A population already near the margin for iron and zinc is exactly the group most harmed by a further 5–9% decline in staple grain nutrition. CO_2-driven nutrient loss does not create a crisis from nothing—it makes an existing shortfall worse.

Switzerland's existing strategies—including the Klimastrategie Landwirtschaft und Ernährung 2050 (Switzerland's federal agricultural and food climate strategy), food-waste programs, and store programs like Ünique and Save Food—are strong tools for affordability and waste reduction. But none of them make nutrient loss visible to shoppers at the grocery store.

This paper proposes a Nutrient Score label: a government-endorsed add-on to existing Swiss certification programs, starting with a pilot for potatoes and bread wheat—two of the Swiss dietary staples already shown to be vulnerable to climate-driven harvest swings. The label would use a simple three-tier system—green (higher nutrient content than typical), yellow (typical), or orange (lower than typical)—covering zinc, iron, and protein. The system would use Agroscope's existing variety trials to set nutrient benchmarks for wheat and potato varieties—reflecting what each variety typically grows under Swiss farming conditions, not a one-off lab test (Agroscope, n.d.). The label would be upfront that it shows expected ranges rather than exact values per item. Processed products like bread and pasta would only be included where the Swiss origin of the raw materials can be confirmed.

The program would run within two certification systems that Swiss retailers already use and trust: IP-SUISSE, which certifies farms meeting environmental and quality standards (covering around 18,000 Swiss farms), and Suisse Garantie, which certifies Swiss agricultural origin. Both Migros and Coop already display the IP-SUISSE and Suisse Garantie marks in stores and online. A Nutrient Score could be added to these existing marks without requiring a complete packaging redesign. By building on these trusted labels rather than launching a new logo from scratch, the Nutrient Score also aligns with a deeply ingrained Swiss consumer habit: reaching for produce that carries a mark of local quality and origin—something Swiss shoppers already do every day (Egnell et al., 2020).

A voluntary add-on is a more feasible option than the alternatives because it does not depend on the difficult path of establishing a legal requirement. Switzerland could instead require grocery stores to display a nutritional benchmark by law. However, recent votes suggest Swiss voters resist interventions that carry a visible price tag. In March 2026, 71% voted down a climate fund that would have spent up to 1% of the country's economic output each year on sustainability measures such as cutting greenhouse gas emissions, improving energy efficiency, and expanding renewables, with analysts pointing to voters' fear that the cost would land on households (SWI swissinfo.ch, 2026). Five years earlier, voters rejected the Drinking Water Initiative, which would have tied farm subsidies to avoiding pesticides, by more than 60% (Bloomberg, 2026). Neither vote was about nutrient labeling. But together they show a country that resists costly interventions in food and climate policy, whether the cost falls on taxpayers or on farmers—which is why the approach proposed here is designed to be voluntary, low cost, and low friction. A mandatory requirement would face an additional hurdle: any move in that direction would first need a

SECO (State Secretariat for Economic Affairs) legal review to confirm compatibility with international trade rules, including the Cassis de Dijon principle governing imported staples (SECO, n.d.).

The overall goal is straightforward: make nutrient quality visible to shoppers in the same way that farm origin and growing method already are. The path to get there follows five phases. Phase 1 establishes the data foundation—Agroscope and BLV develop testing methods and produce a cost estimate before any money is committed to scale. Phase 2 launches a voluntary pilot label under IP-SUISSE for potatoes and bread wheat. Phase 3 adds a consumer awareness campaign tied to existing Ünique and Save Food branding. Phase 4 expands to other Swiss-grown crops and formally evaluates whether voluntary participation is sufficient. Phase 5 integrates nutrient performance into Agroscope's official variety recommendations, so that breeders begin prioritizing zinc and iron content alongside yield.

The label itself does not put nutrients back into the product—it cultivates conditions to make the products more nutritious. This happens because shoppers are choosing food based on a signal about which products are more nutritionally dense, which gives farmers a reason to achieve higher scoring products to meet the demand for those nutritionally dense products that shoppers want to buy. Once nutrient quality enters Agroscope's official variety recommendations, breeders would start more readily selecting for nutrition alongside yield. Ultimately, this means shoppers are buying and eating healthier, doing so before existing nutritional gaps widen and new risks emerge. We already know biofortified crops can be prioritized in the market through incentives such as these (HarvestPlus, n.d.); what we need to see is whether gaps in Switzerland such as iron in women of reproductive age are improving as a result of such incentives (BLV, 2014–2015; Herter-Aeberli et al., 2025).

Starting with a voluntary pilot is key to success. Switzerland has already seen one voluntary nutrition label come and go. Nutri-Score—a color-coded front-of-pack system that rates packaged foods' overall nutritional profile on a scale from A to E—was adopted by some Swiss retailers but proved fragile: Migros dropped it in 2024 and Nestlé Switzerland announced it would phase it out as well (SWI swissinfo.ch, 2024a; SWI swissinfo.ch, 2024b; SWI swissinfo.ch, n.d.). The lesson is that standalone labels tend to disappear when retailers lose interest. Embedding the Nutrient Score inside established certification marks—rather than launching it as a separate front-of-pack logo—is the design choice that protects it from the same fate.

The label also connects to the imperfect-produce programs. If the pilot shows that cosmetically non-standard potatoes and bread wheat score just as high for zinc, iron, and protein as standard produce, that finding could give real, data-based backing to Ünique and Save Food campaigns.

In conclusion, Switzerland is the canary in the coal mine. Its natural battery is failing, its harvests swing between crisis and glut, and its bread is quietly losing nutritional value. On the question of how much food reaches the table, Switzerland has identified the problem and is working on it by embracing imperfect produce. On the question of what is in that food, nutrient loss remains largely invisible to shoppers, creating a likely gap in the country's food security plan.

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