Regen10 – Landscape Transition Pathways - Overview

- Regen10 has developed landscape-level transition pathways across five significant agricultural regions.
- A transition pathway represents a switch from the conventional agricultural practices common in the landscape to regenerative ones, that helps restore and rebuild natural systems.
- A key element of this process is understanding the economics of transitioning to regenerative agricultural practices as well as the potential environmental and social outcomes of such transitions at landscape level.
- The combination between countries and agricultural products was made based on geographical representation, impacts of production, data availability, and applicability of results. The choice of landscapes was primarily driven by their national-level importance in the production and export of the specific products.
- Regen10 recognizes that there is more than one way to create a regenerative food system. The proposed approaches are not prescriptive, and practices were selected after careful contextual analysis of their relevance and evidence of their intended outcomes.
- Broader evidence linking practices and outcomes is still greatly needed and highlights the importance of developing an outcomes-based framework, which Regen10 is currently doing.

Selected Landscapes

Country	Landscape	Focus Ag Product
Brazil	Querência City	Soy & Beef
India	Punjab State	Rice
United States	North Dakota	Wheat & corn
United Kingdom	East England	Potato
New Zealand	Waikato Region	Dairy

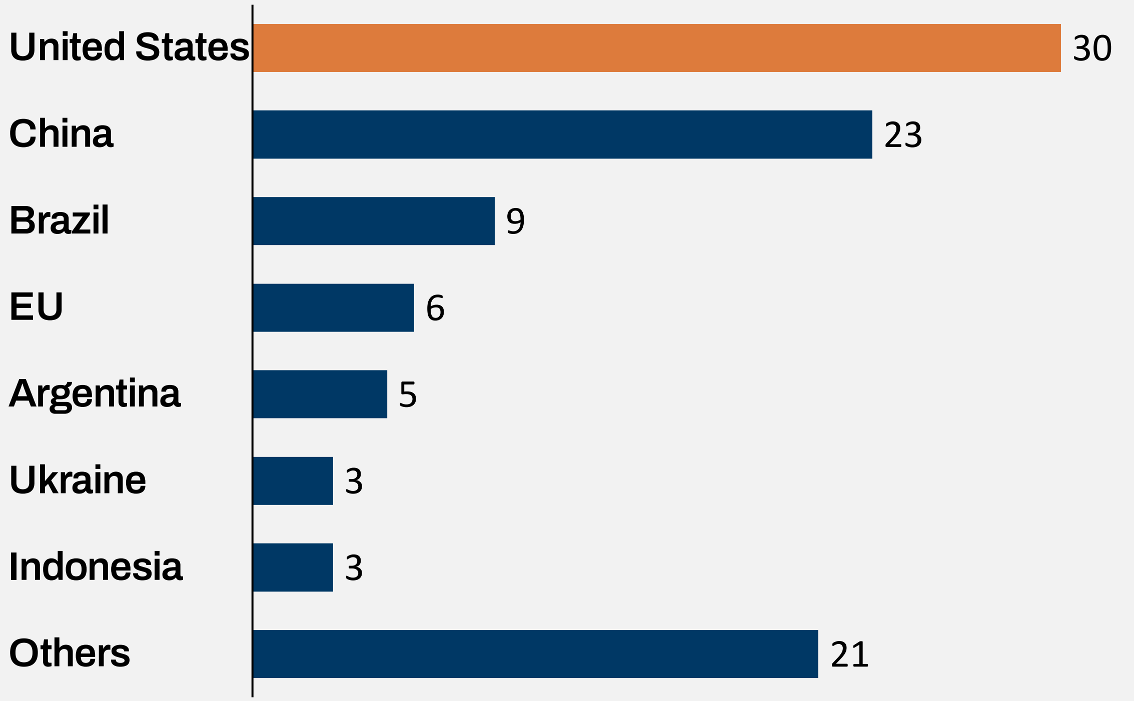
Source: Systemiq analysis.

North Dakota – USA – Wheat & Corn

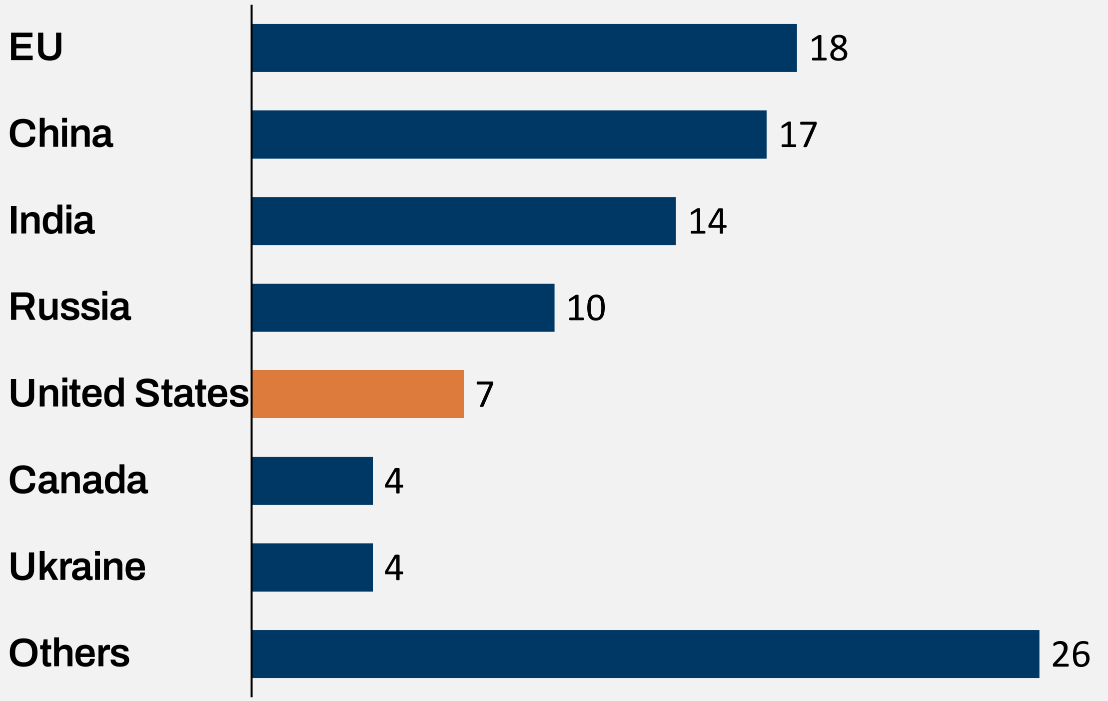
The United States leads global corn production and is a significant player in wheat

- Corn and wheat staple row crops are essential components of diets (mostly wheat) as well as feed and energy crops (mostly corn), making the US a leading producer and exporter of both
- The United States outputs to 30% of global corn and 7% of global wheat production.

Corn Production (% of global)



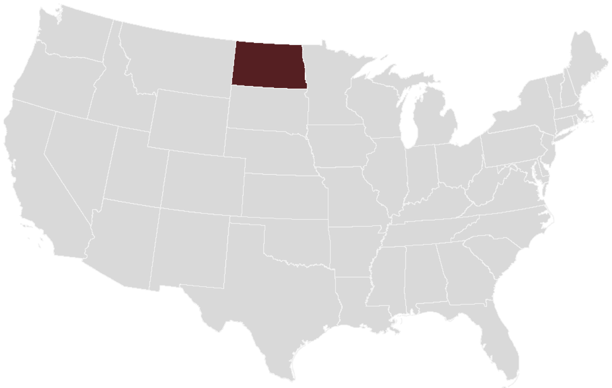
Wheat Production (% of global)



Sources: FAOStat 21, OEC

North Dakota (ND) is a major row crop producer, but changes to the climate and soil are adversely affecting its productivity

- Agriculture is the state's largest industry, accounting for nearly 25% of the economy and about 90 percent of the land-use.



Landscape information

- Geographical Area: 18.3M ha
- Agricultural Area: 15.8M ha
- Net Harvest Area[1]: 8.0M ha
- Population: 0.779M (40% rural)
- Land holdings: ~26.000
- Average farm size: 620 ha

Current Challenges

Environmental & Agronomic:

- Relatively short and increasingly unpredictable growing season.
- Soil salinity and acidity affecting nutrient availability, microbial activity and plant growth.
- Degradation of aquatic ecosystems associated with fertilizers, pesticides, and herbicides runoff.
- Economic:
- Volatile net farm income from yields and market price shifts.
- Upward pressures on land rates and growing corporate influence on farmland ownership.

Social:

- Public incentives not always favoring regenerative farming.
- Hidden health costs associated with agrochemical exposure.
- Rural communities experience declines in population as farms consolidate

Wheat fields extend across the state

Figure: Jenny Schlecht. Extracted from Agweek

Row crop mosaics in ND`s Red River Valley

Figure: Doc Searls. Extracted from Flickr

Notes: [1] excludes permanent pasture, range land, conservation areas and infrastructure
Source: USDA, NDSU, North Dakota Government , ND Wheat Commission, Expert interviews

An alternative approach for ND food crop fields includes broader rotation schemes along with cover crops and grazing

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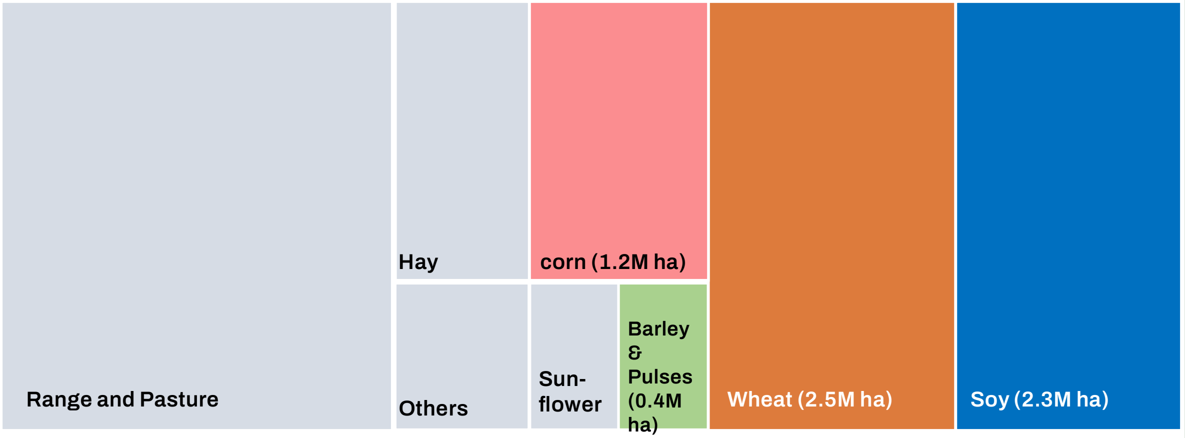
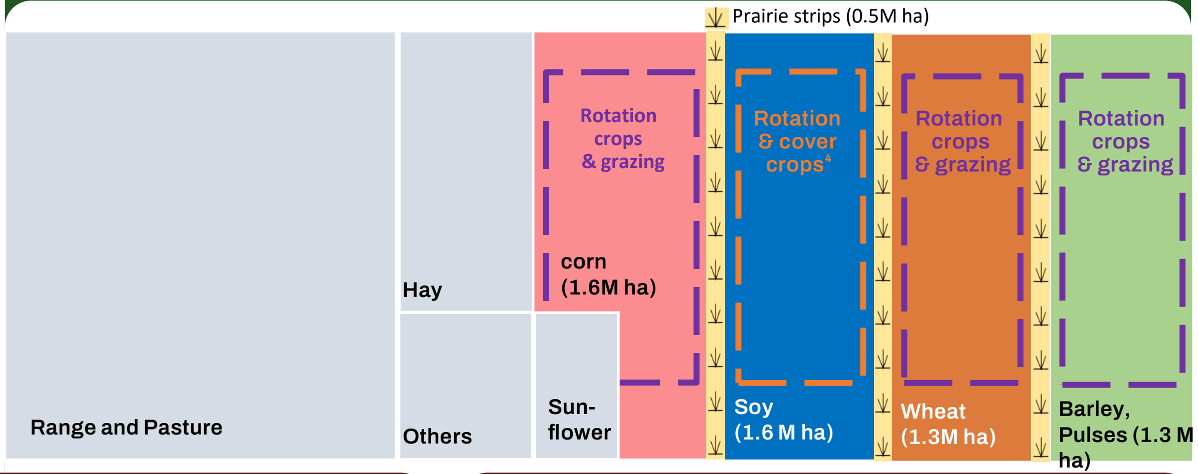
Current State of Agricultural Land-use[1]



Alternative state for Wheat, corn, Soy, Barley and Pulse fields



Transition pathway hypothesis

- Diversify wheat and corn, as well as soy, barley and pulse fields by introducing more diverse crop rotations combined with adaptative multi-paddock grazing, where livestock integration is possible.
- Adoption of multispecies (polyculture) cover crops to keep soil covered for as long as possible and provide extra grazing or harvested feed-source opportunities.
- Broad introduction of prairie strips to protect watersheds, reduce soil erosion, shelter and foster beneficial insects and wildlife, and permit occasional grazing along the edge of field.
- Adoption of minimum to no soil disturbance practices to keep live roots on the ground, facilitating water retention and nutrient distribution.
- Balancing the overall yearly planted area of each crop[2,3] to allow for further land-use and income diversification at farm and the landscape level.

Set of changes used

- Cover crops: polycultures to keep soil covered and provide forage
- Crop diversification: multiyear dynamic crop systems[2]
- Livestock: integration of adaptative grazing into crop rotation
- Edge of Field: prairie strips
- Growing practices: minimum soil disturbance/ tillage, nutrient management, use of manure

Notes: [1]USDA 2022. The area used for Hay, Sun-flower and other crops was not included in the study due to the focus on food crops. [2]Dependent on regionally adapted species, economics, farmer knowledge, expected weather, and infrastructure. [3]Indicative for 2022, the overall area for each crop will fluctuate yearly but single crop dominance should be avoided in the farm or landscape. [4] Limited to grasses after soy due to short growing season left. Source: USDA 2022, NDSU, Systemic analysis, expert interviews.

Modelling the transition for a typical farm suggests breakeven around year 4 and payback by year 8 in cash terms

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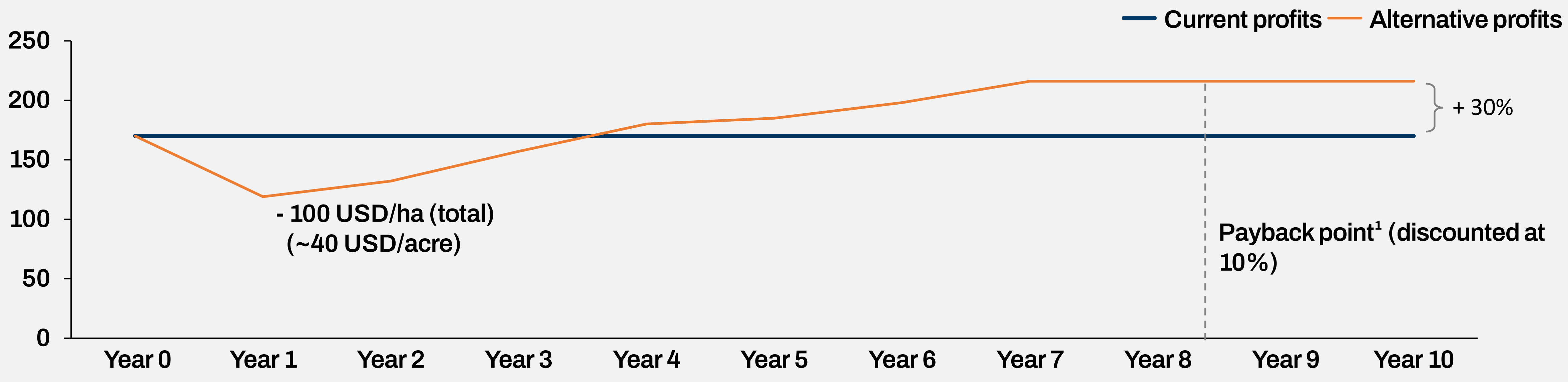
Comparison between yearly net income: current vs alternative state, undiscounted cash (USD/ha)



- Farms' profitability decreases during an interim transition period and reaches a point of equilibrium 30% higher in the alternative state after year 8.
- The initial drop in profitability relates largely to costs for introduction of cover crops and prairie strips, infrastructure for grazing, capital recovery for machinery and modest impacts on corn and soy yields.
- The higher profitability levels after transition are associated with declines in fertilizers and agrochemical inputs, slight increases in cereal crop yields, and revenues from land rents or feed sources for grazing.
- Farmers would forgo ~100 USD/ha (~40 USD/ acre)in cumulative profits before profitability returns to current state levels (undiscounted cash).
- For an average 620ha (farm, a short-term cost of ~$60k (profits lost in years 1-3) is offset by expected additional profit of ~$150K in years 4-10, resulting in a net gain of ~$90K over the 10-year period (undiscounted cash).[3]

Notes: [1]When accumulated profits from alternative state surpasses those from current state. [2]Model focuses solely on the agricultural landscape (aggregation of farms) and do not contemplate costs for eventual new landscape level infrastructure or market channels. Conservatively assumes no carbon revenues, green premiums, or increase in land value. Landscape transition happens all at once. [3] Costs and returns will vary based on the farm's size and portfolio. Source: Systemiq analysis

The transition is economically viable yet narrow, and financial success depends on careful implementation

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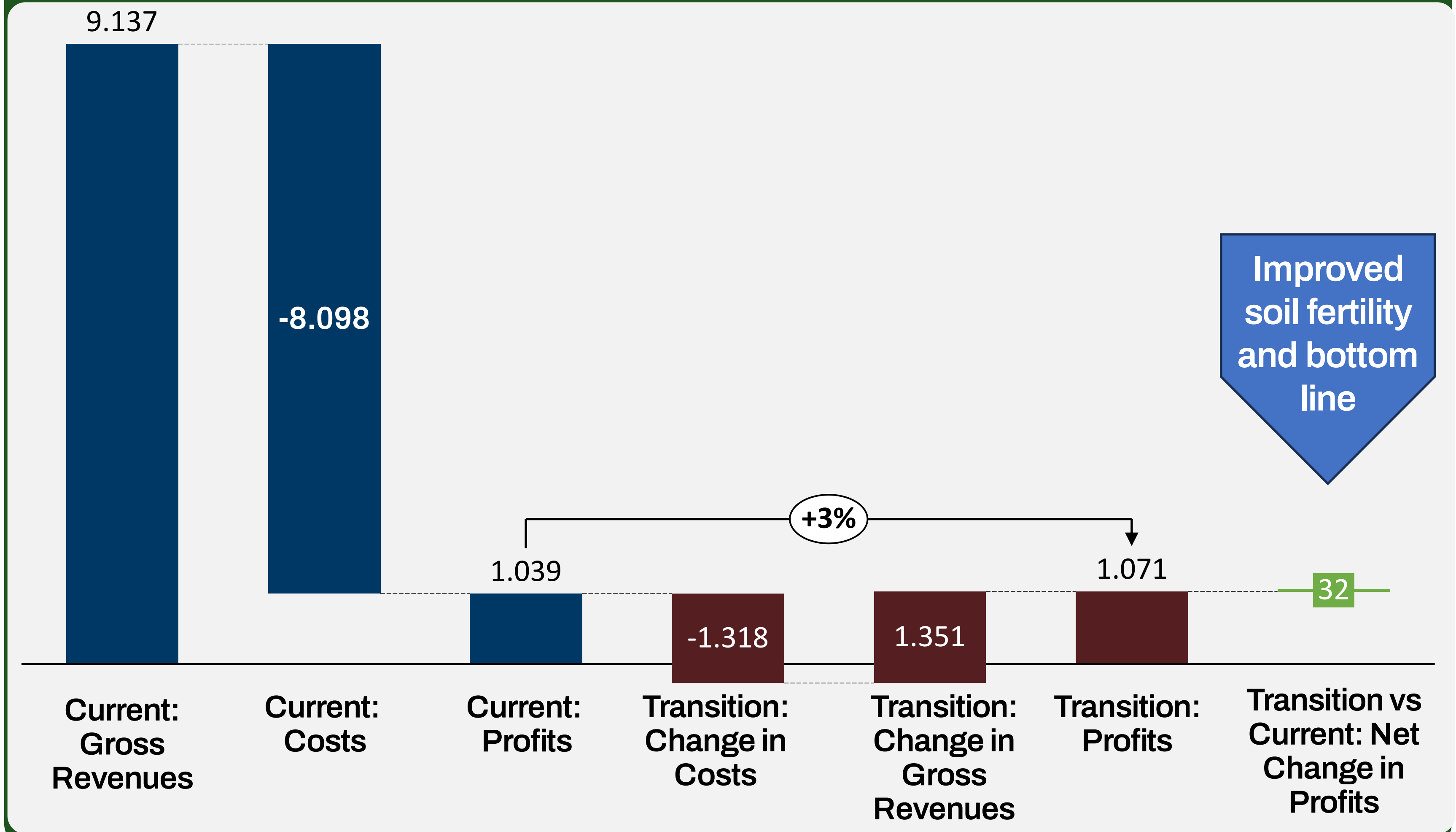
10-year Cumulative income and expenditures – NPV[1] discounted with 10% rate (USD/ ha)



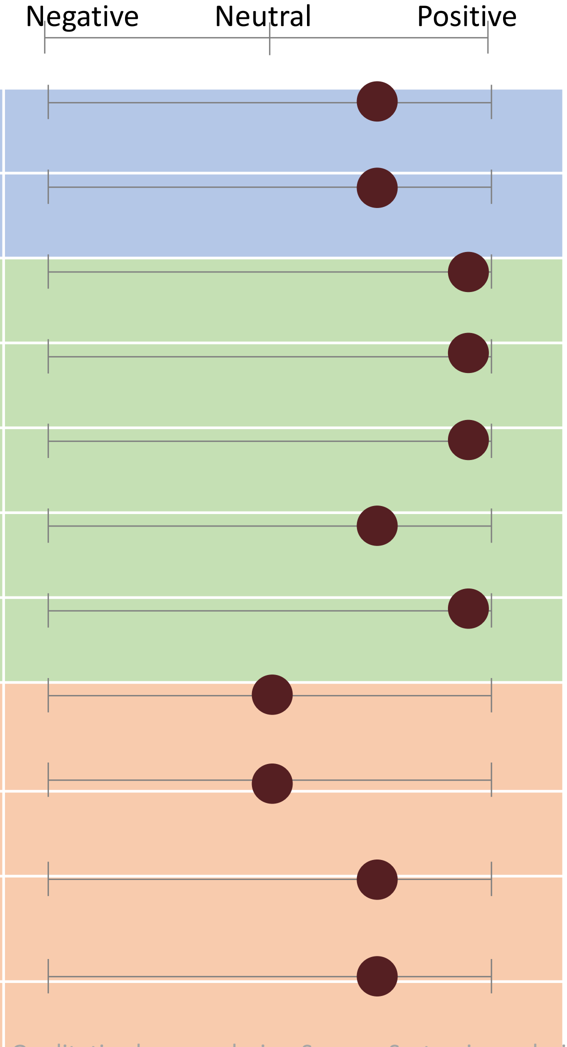
- Boosting the adoption of combined regenerative agricultural practices represents a marginally profitable transition, yielding approximately $32 USD/ha or ~$260 million USD in NPV over 10 years for the landscape.
- Post- Transition cumulative profitability is ~3% higher, with added benefits in soil fertility and revenue resilience.
- Upfront investments and higher Opex[2] for cover crops are the main contributors to the increase in transition costs.
- The significant fluctuations in transition costs and revenues underscore the necessity for precise implementation to safeguard the farm business.

Notes: [1]Net Present Value. [2]Operating Expenses
Source: Systemiq analysis (methodology paper under development)

Positive environmental outcomes deriving from the shift serve as further incentive for the landscape

Regen10 Framework landscape level outcomes[1]	Category	Indicative impact from transition
Increase economic diversification and resilience	Economic	
Increase landscape value creation	Economic	
Optimize landscape biodiversity & habitat functionality	Environmental	
Minimize water, soil and air pollution	Environmental	
Improve water availability	Environmental	
GHG emissions minimization	Environmental	
Optimize carbon sequestration and storage	Environmental	
Enhance inclusivity and empowerment of local communities	Social	
Enhance well-being of the local communities	Social	
Increase employment, knowledge and education	Social	
Optimize access to safe and nutritious food	Social	

Economic | Environmental | Social



Notes: [1]Regen10 Outcome Framework Indicators for Landscapes from zero-draft version. Qualitative base analysis. Source: Systemiq analysis

Key implications and recommendations

- A successfully executed shift to regenerative practices can boost both the landscape's vitality and farmers' income over time.
- The environmental gains from adopting regenerative agricultural practices can compensate for a challenging business scenario.
- For transition to be possible, we need to:
- Provide farmers with in-depth knowledge of complex growing systems, including multi-year crop sequencing, crop-environment interactions, and grazing dynamics.
- Offer financing options, in addition to current public support, with insurance and repayment terms that address potential setbacks during the adaptation phase.
- Create additional revenue streams, such as carbon credits or premiums, stimulated by the private sector to improve the short-term business case for growers.

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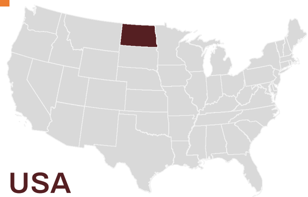
Regenerative practices can enhance ND's ecosystem vitality and farmers' incomes, creating resilience to the landscape economy

Summary



A narrow, yet economically attractive, transition to regenerative agriculture can help ND farmers improve soil fertility and bottom lines in the next decade

Current state of agricultural landscape

Agronomic & Environmental

- **Short and increasingly unpredictable growing season,** degradation of aquatic ecosystems, and low nutrient availability due to soil salinity and acidity.

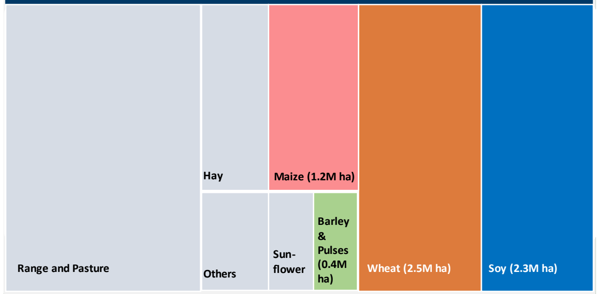
Economic

- Volatile net farm income from yields and market price shifts coupled with upward pressures on land rates.

Social

- Misaligned public incentives to stimulate regenerative farming, hidden health costs associated with agrochemical exposure, and gradual loss of rural population as farms consolidate.

Current agricultural land-use at landscape level



Transition pathway hypothesis

Diversify crop fields and integrate grazing

- Introduce multiyear dynamic crop rotations intercalated with adaptative multi-paddock grazing and harmonize planted area for each crop at farm and landscape.

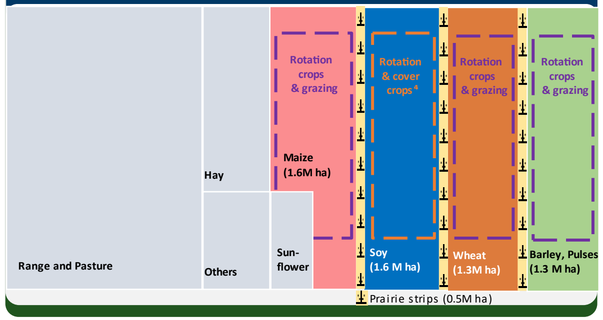
Manage edge of field for biodiversity

- Introduce prarier steps and manage edge of field to reduce soil erosion, shelter and foster habitat for pollinators and wildlife, and provide supplemental grazing for livestock.

Minimum to no soil disturbance

- Foster regenerative practices to keep live roots on the ground, facilitating water retention and nutrient distribution.

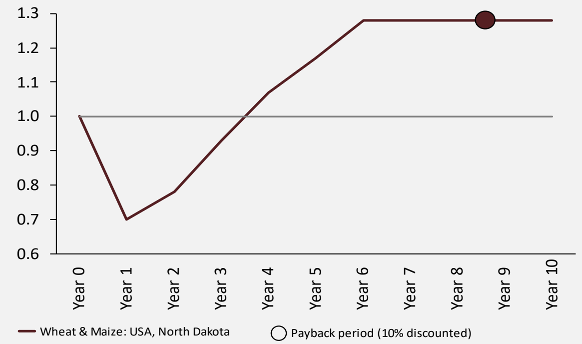
Alternative land-use at agricultural landscape level



Results of economic modeling

- Over 10 years, the cumulative effect of a transition to regenerative agriculture is positive with an average added value of 32 USD/ha and a payback[3] by the mid of year 8 (10% discounted).
- Profitability lowers during an interim period and reaches a point of equilibrium 30% higher after year 7.
- The higher profitability levels after transition are associated with declines in fertilizers and agrochemical inputs, slight increases in cereal crop yields, and revenues from land rents or feed sources for grazing.

Change in net profitability over a 10 years period for proposed transition pathway (alternative state/current state) Indicated in relative terms



Implications and recommendations

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- Create additional revenue streams, such as carbon credits or premiums, stimulated by the private sector to improve the short-term business case for growers.

Note: [1]Net Present Value 10% rate. [2]Costs and returns will vary significantly based on the farm's portfolio. Model focuses on the agricultural landscape and do not contemplate eventual investments in new landscape level infrastructure and market channels. Conservatively assumes no carbon revenues or green premiums. Landscape transition happens all at once. [3] When accumulated profits from alternative state surpasses those from current state. Systemiq analysis for **Regen10.org**