# Growing Confidence in Forestry's Future

- Systems approach to:
  - Maximise the benefits from the existing forest resource
  - Build a more productive forest resource for the future
  - Ensure that future intensification is sustainable and does not jeopardise industry's licence to operate

- Goal is to build more productive, resource-efficient forests that provide the raw material base for added-value processing

- Achieved through shifting forest management to a "precision forestry" basis by integrating latest advances in:
  - Sensor technology
  - Tree physiology
  - Genetics
  - Forest ecology
- Engaging with innovation clusters
- Partner with Iwi to unlock the potential of their forest resources

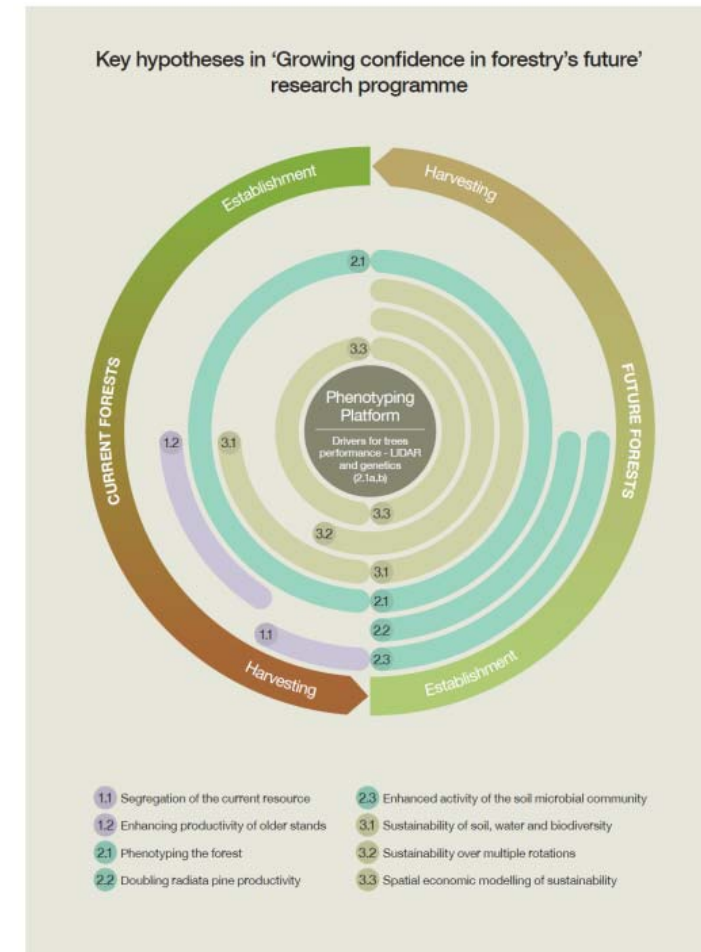# What did the stats tell us about trends in forest productivity/profitability ?
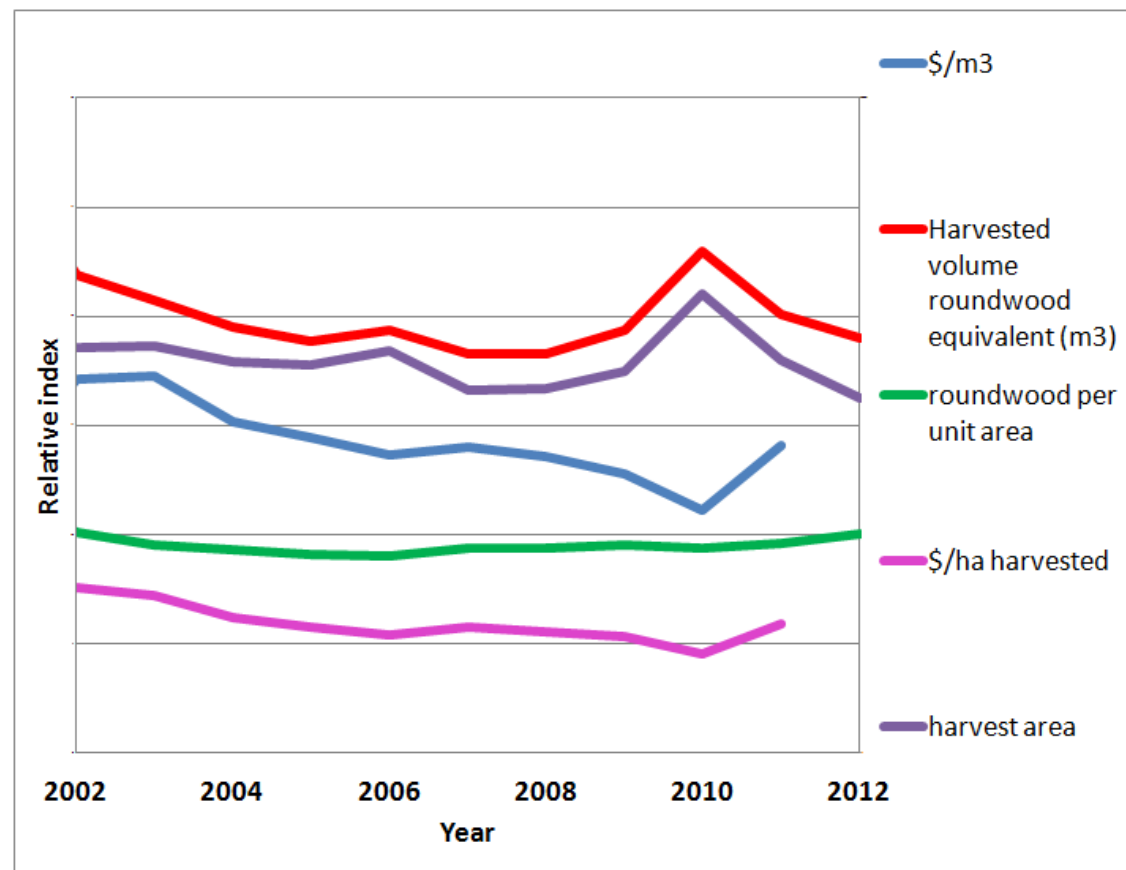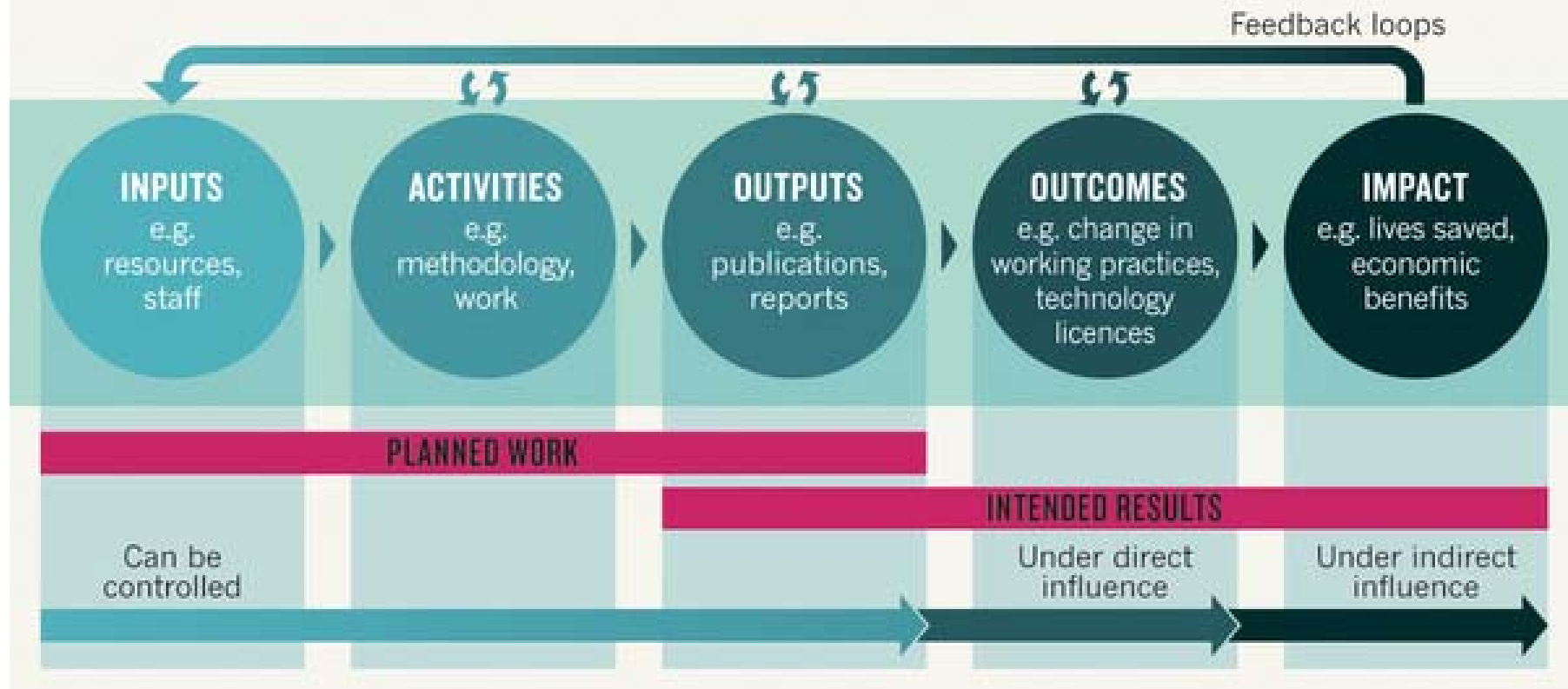
Branwen Morgan 2014. Research impact: Income for outcome. Nature 511, Pages:S72–S75
published:(24 July 2014)DOI:doi:10.1038/511S72aPublished online 23 July 2014

Within programme outcomes

- By 2019, systems approaches adopted by the industry have moved forest management onto a "precision forestry" basis
  - New segregation approaches are being used operationally
  - Mid-rotation interventions are being applied to increase productivity
  - Remote sensing technologies are providing quantitative information on forests that is being used to guide management
  - Phenotyping platform has been used to identify elite individual trees for at least one trait
  - Forest industry's licence to operate has been maintained under intensified regimes

- Researchers and iwi are working in partnership to identify the pathways for Māori economic development through sustainable forest management.

- There is better connectivity between forest growers, processors and their end customers, which has resulted in an additional $2 billion p.a in export receipts.

Key hypotheses in 'Growing confidence in forestry's future' research programme

1.1 Segregation of the current resource
1.2 Enhancing productivity of older stands
2.1 Phenotyping the forest
2.2 Doubling radiata pine productivity
2.3 Enhanced activity of the soil microbial community
3.1 Sustainability of soil, water and biodiversity
3.2 Sustainability over multiple rotations
3.3 Spatial economic modelling of sustainability

Industry outcomes

- Influence of GxExS on wood properties
- Ability to predict which stands will respond to mid rotation interventions
- Confidence in wood quality after intervention
- Sustainability evidence based
- Productive capacity benchmarked (size of the pie)
- New LiDAR and remote sensing tools
- Whole of forest measurement and phenotyping
- Strategies for increasing productivity (closing the gap)

# Doubling Radiata Pine Productivity: what is the size of the pie?

LETTER

Closing yield gaps through nutrient and water management

Nathaniel D. Mueller[1], James S. Gerber[1], Matt Johnston[1], Deepak K. Ray[1], Navin Ramankutty[2] & Jonathan A. Foley[1]

the spatial patterns of agricultural management practices and yield limitation, and the management changes that may be necessary to achieve increased yields. We find that global yield variability is heavily controlled by fertilizer use, irrigation and climate. Large production increases (45% to 70% for most crops) are possible from closing yield gaps to 100% of attainable yields, and the changes to management practices that are needed to close yield gaps vary considerably by region and current intensity. Furthermore, we find that there are large opportunities to reduce the environmental impact of agriculture by eliminating nutrient overuse, while still allowing an approximately 30% increase in production of major cereals (maize, wheat and rice). Meeting the food security and sustainability challenges of the coming decades is possible, but will require considerable changes in nutrient and water management.

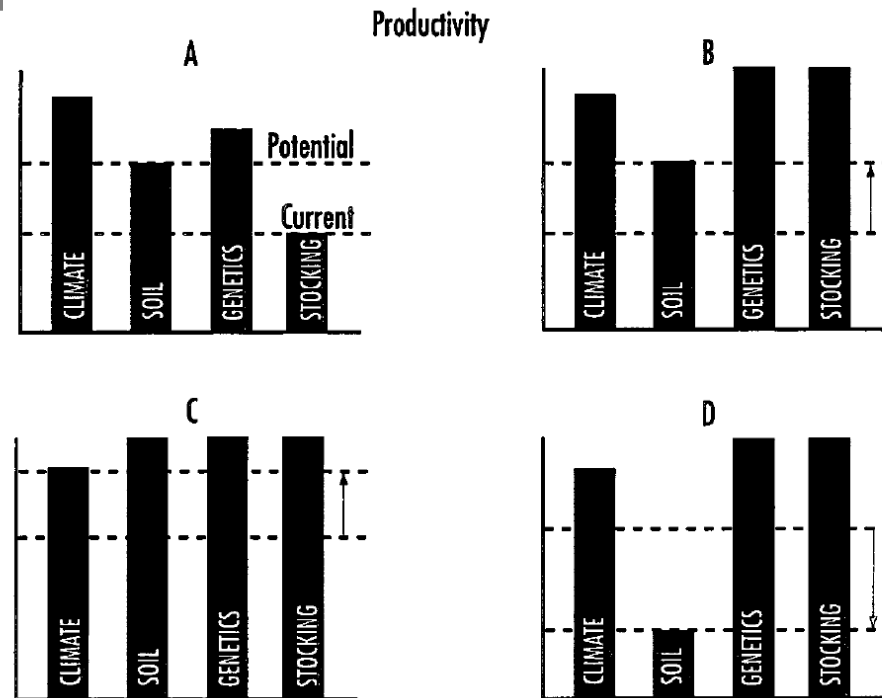Opportunities for agricultural intensification were analysed for
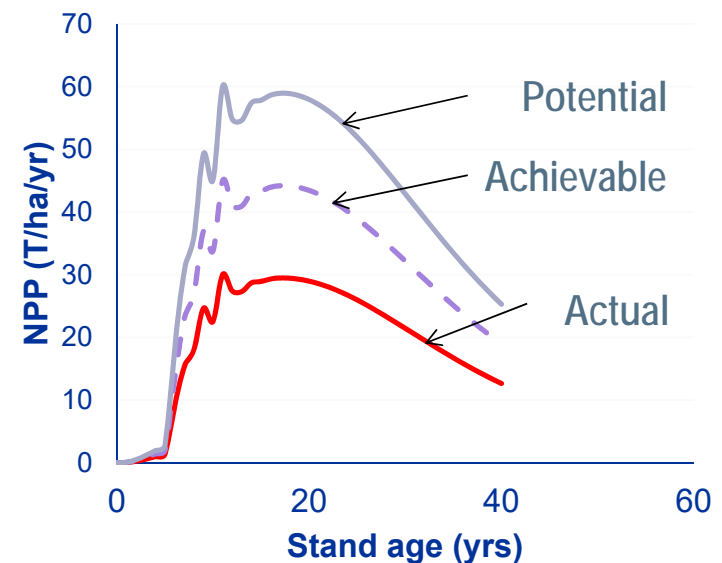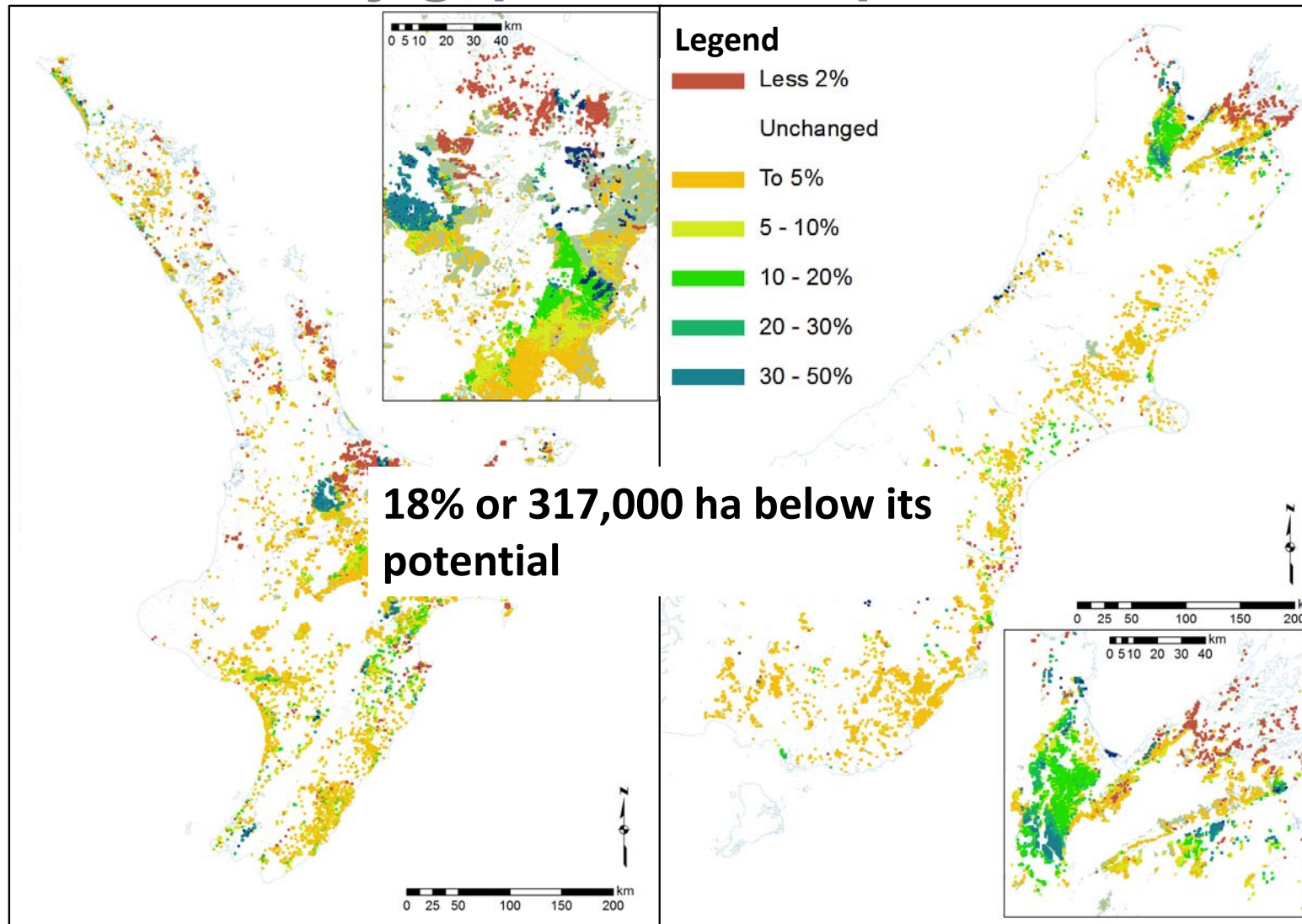
What levers are there to pull?

On the sustainable productivity of planted forests

ROBERT F. POWERS
Pacific Southwest Research Station, USDA Forest Service, Redding, CA, USA

Figure 3. Relationship between current and potential productivity of a plantation as constrained by climate, soil, genetics, and stocking. (A) An understocked stand is performing at less than potential as limited by the natural properties of the soil. (B) Improvements in genetics and stocking increase productivity to the level constrained by the soil. (C) Soil amelioration (fertilization, drainage) raises productivity to a new potential set by local climate. (D) Both current and potential productivity are reduced through soil degradation.

Productivity gap: all levers pulled

18% or 317,000 ha below its potential

Legend
- Less 2%
- Unchanged
- To 5%
- 5 - 10%
- 10 - 20%
- 20 - 30%
- 30 - 50%

What are challenges to increasing forest productivity?

– Most forests post silviculture

– Lack of interventions

– Don't want to compromise wood properties

– Investment horizon of future forests, what ever we do we need to get more from less

– Intensification has to be sustainable and within limits

Age class distribution
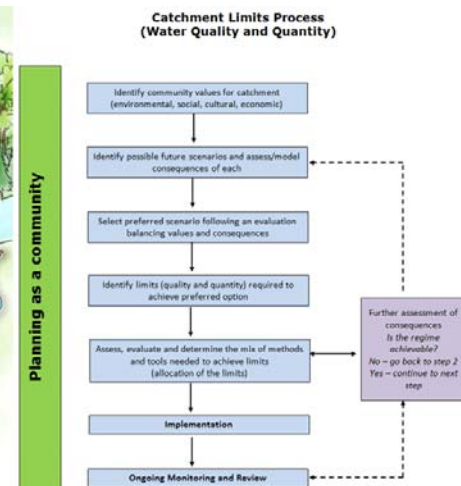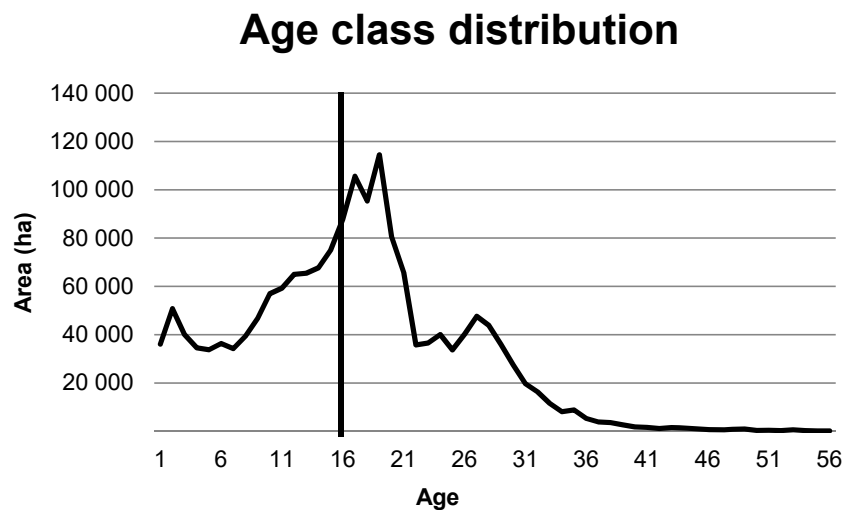
Industry Outcomes: Strategies for increasing productivity

- Road map of what levers to pull to go from A to B
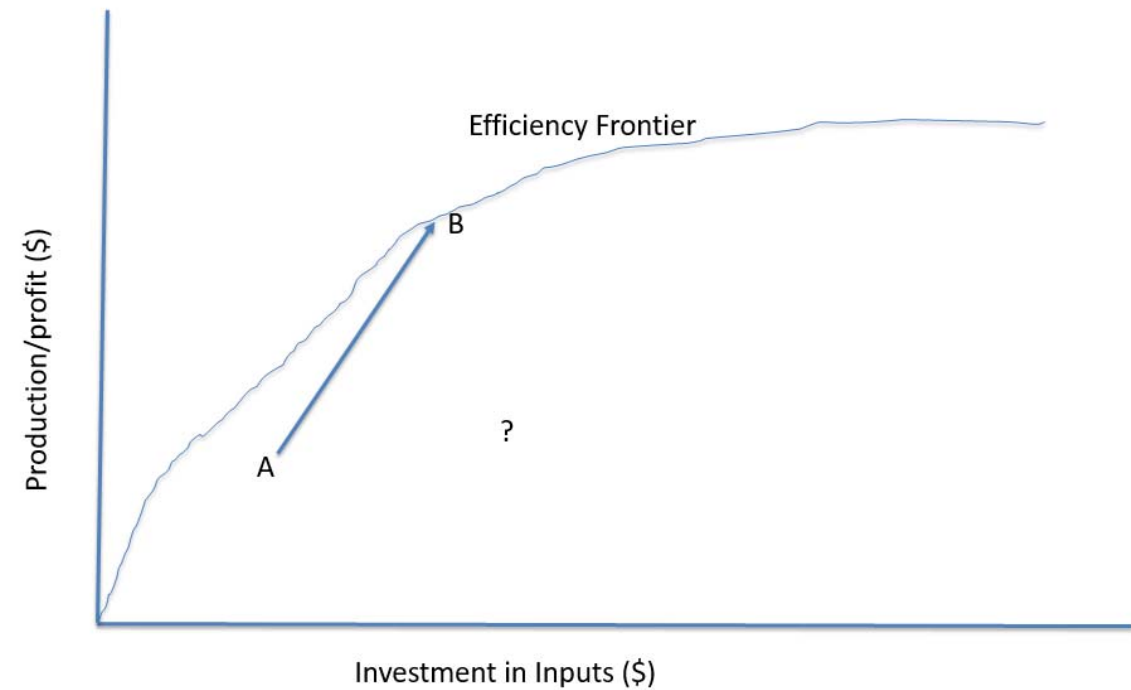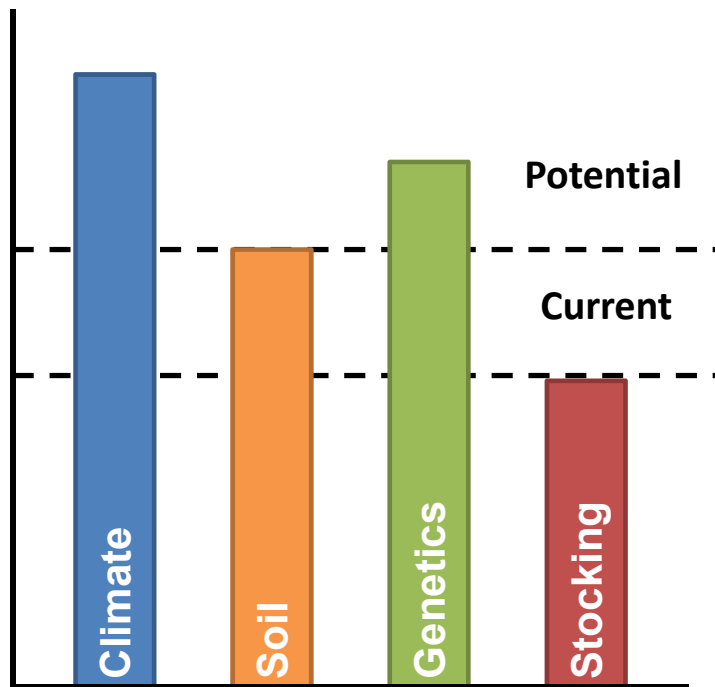
Stocking

Am I doing everything I can right now?

- Map productivity gap, Is there one? how big is the prize?
- Stand density assessments – have I got enough trees to make the most of my site?
- Final crop stocking model, how much wood/value can I expect?
- Wood quality assessment GxExS and product quality prediction – what have I got?
- Silvicultural review, what can I do differently?
- Next generation inventory systems will provide me more information, cheaply and usefully for better decisions and tradeoffs e.g. stocking vs stand health

Overall lever impact

- Improved silvicultural regimes to fully occupy site and produce more better wood

Soil

What can I do to the soil and to the crop to close the gap?

- Predicting demand for nutrients, what is the N gap? Can the soil support what I want to grow?
- NuBalM into Forecaster for setting targets for productivity and resource requirements
- Site specific fertilizer recommendations, not just N.
- Balanced fertilisers to improve tree nutrition and growth and modify soils
- New foliar fertilisers

How can I get the most out of my forests?

- Accelerator trials – long term research focus on GxExS
- Growth promotion / beneficial microbes/biostimulants
- Site modification

- **Overall lever impact**
- More interventions for existing stands and future stands to produce more better wood

Genetics

What is next?

- Phenotyping platform – forest scale assessment and identification of high performing stands/trees/sites
- Match variation in resource use efficiency with site resources for improved resource efficiency
- More for less - better quality seedlings leaving the nursery gate for less input (financial / environmental benefits) forest managers and nursery management working together and targeting seedling properties for sites (one size may not fit all)
- More than one genome in the forest (microbiome engineering)

- Spinoff work with RPBC e.g. quantifying genetic gain

Overall lever impact

- More control on planting decisions and forest outcomes for more better wood

Economic and Social

What are environmental consequences of forest management practices?

- What ecosystem services and benefits do I provide to the environment and society? (FIF)
- What might these services and benefits be worth and who might pay? (FIF)
- What is the full value of my forests?
- What products can I grow and what is their quality and fit for purpose?
- How many rotations are possible?
- How sustainable is my forest in terms of economic, environmental and social outcomes?

Overall Lever impact

- Future intensification is economically, environmental sustainable and socially acceptable

Why pull the levers?

Efficiency Frontier

Production/profit ($)

Investment in Inputs ($)

A

B

C?
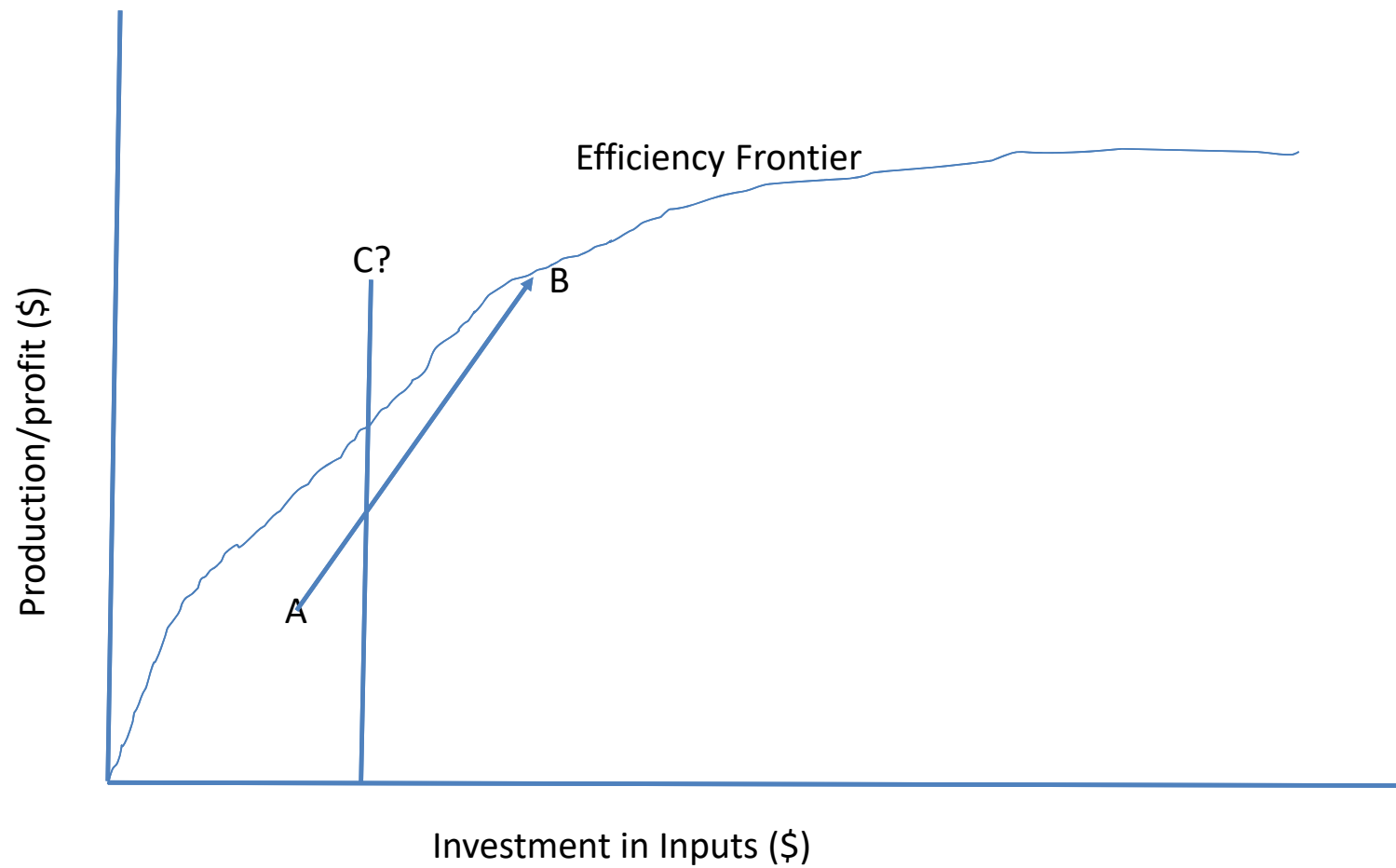
Where will the money come from better forest management?

- Existing forests
  - Segregation - what to harvest or not
  - My wood is better than yours (no guesses)
  - More volume, no loss in wood quality through intervention

- Future forests (Accelerator trials)
  - Rapid canopy closure
  - Capture nutrients after harvest rather than lose them
  - More rapid genetic expression
  - Rapid weed control hence less herbicide less often
  - Rapid wood production
  - Less variable crop
  - Lower time cost of money
  - Less risk
  - First in line next time around

Where will the money come from better forest management? (cont.)

- Transforming inventory
  - cheaper measurement
  - More knowledge of resource
- Transforming disease detection and forest condition
- Greater asset value – no guesses
- More valuable land – no evidence of degrade
- Faster tree breeding timeframes from forest phenotyping
- Payments for ecosystem services
- License to operate, freedom to operate
- Better engagement and uptake of research findings (building on successes)

Joining the dots – creating outcomes

- A better story, or better stories and more stories

PATHWAY TO IMPACT

Each of CSIRO's Flagship projects is guided by this framework, which gives project leaders a way to think about their work so they can plan and monitor for impact.

Feedback loops

| INPUTS e.g. resources, staff | ACTIVITIES e.g. methodology, work | OUTPUTS e.g. publications, reports | OUTCOMES e.g. change in working practices, technology licences | IMPACT e.g. lives saved, economic benefits |

PLANNED WORK

INTENDED RESULTS

Can be controlled

Under direct influence

Under indirect influence

Success to date against programme outcomes

- By 2019, systems approaches adopted by the industry have moved forest management onto a "precision forestry" basis
    - New segregation approaches are being used operationally (operational trials)
    - Mid-rotation interventions are being applied to increase productivity (operational trials)

    - Remote sensing technologies are providing quantitative information on forests that is being used to guide management (operational)

    - Phenotyping platform has been used to identify elite individual trees for at least one trait
    - Forest industry's licence to operate has been maintained under intensified regimes (operational)

- Researchers and iwi are working in partnership to identify the pathways for Māori economic development through sustainable forest management. (VM partnerships)

- There is better connectivity between forest growers, processors and their end customers, which has resulted in an additional $2 billion p.a in export receipts. (On horizon)

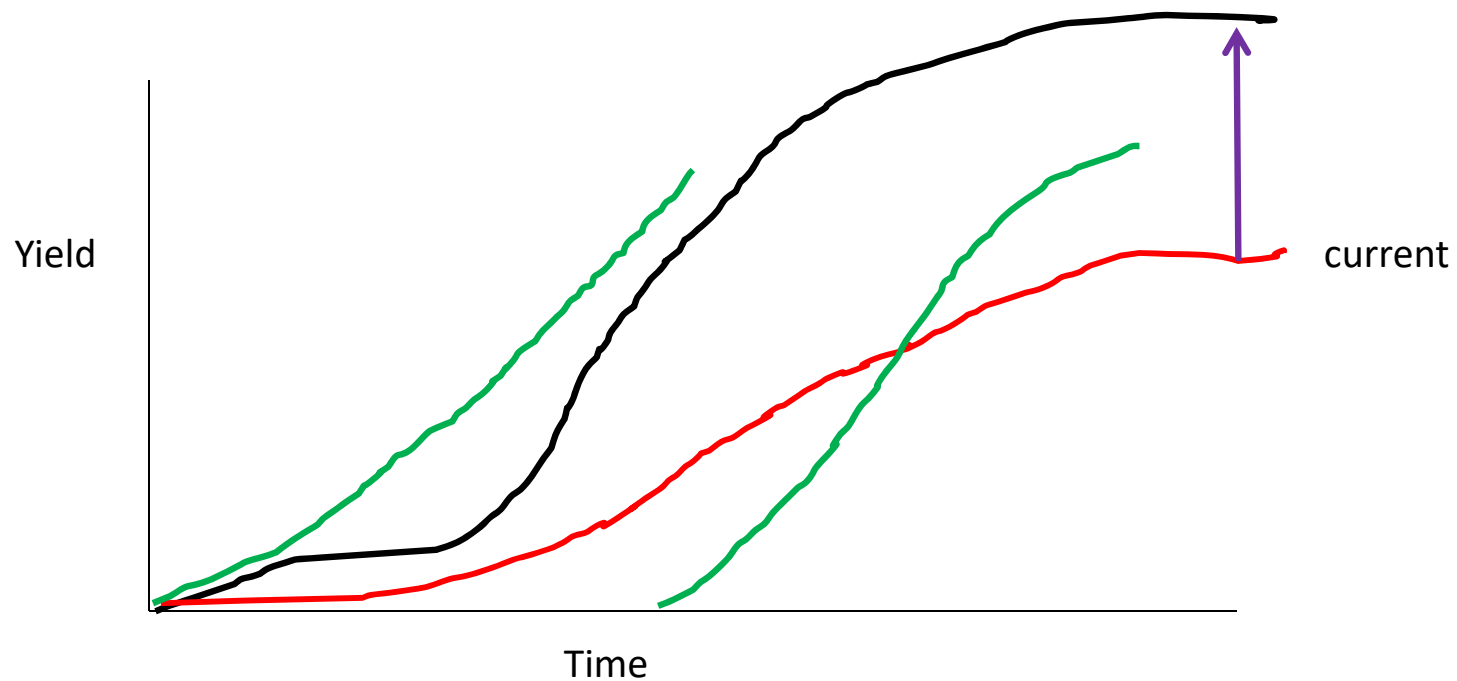# What do the stats 2001-2018 tell us about recent trends in forest productivity/profitability?
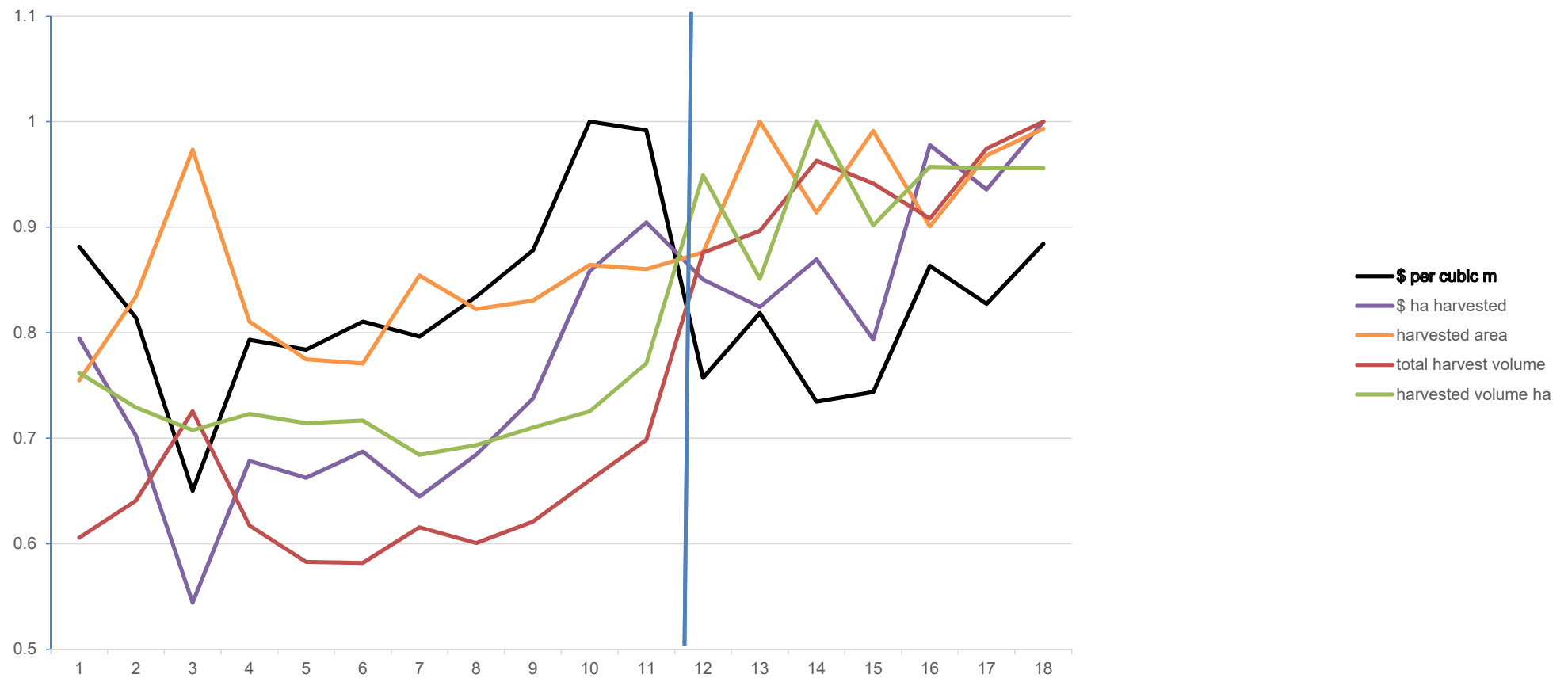
What can we expect?
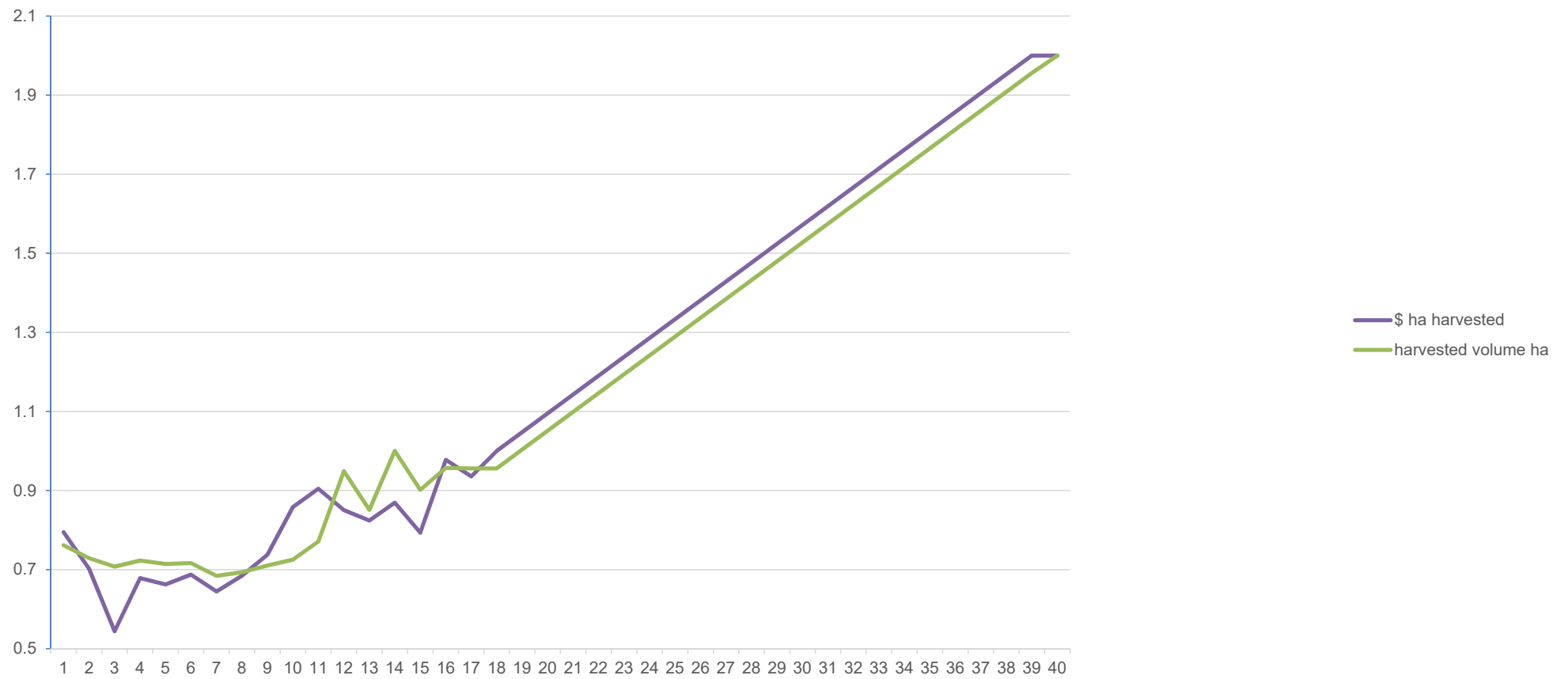
And if we could pull all the levers at once how would we manage forests?

- How we implement an increase in productivity may have consequences for how we manage our forests and reduce the unintended risks

Conclusions

- Ability to get things done now
- More knowledge
- More options, new ways
- On to track with growing confidence in forestry's future
- more capability and investment
- Billion trees - time to put our confidence in forestrys future in to practice

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Date: