Drought and climate adaptation program

DCAP3

CREATING ALTERNATE INCOME STREAMS TO INCREASE FARM PROFITABILITY AND BENEFIT THE ENVIRONMENT (UNISQ)

MILESTONE 5 REPORT

Identifying reinvestment options from ‘natural capital’ scheme investments that increase farmer drought risk mitigation and adaptation capacity

Report authors:

Kate Reardon-Smith & Shahbaz Mushtaq

Centre for Applied Climate Sciences, University of Southern Queensland, Toowoomba QLD

Acknowledgements:

Thanks to Jarrod Kath and Jayne Thorpe for discussions and feedback on a draft of this report.

Funding:

This project is funded by the Queensland Government's Drought and Climate Adaption Program (DCAP) that aims to improve drought preparedness and resilience for Queensland producers.

University of Southern Queensland

QFF QUEENSLAND FARMERS' FEDERATION

Queensland Government

Contents

This report

Building on our earlier analyses and reports (Kath et al. 2023; Reardon-Smith et al., 2023; Thorpe et al., 2023; Kath et al., 2024; Kath & Thorpe, 2024), this current Milestone 5 (MS5) report looks to identify actions that could use a portion of income generated from environmental (carbon, biodiversity) benefit or 'natural capital' scheme investments to re-invest in risk management/adaptation options that increase farmer drought risk mitigation and adaptation capacity. This relates to Step 3 in the overall 'logic' that informs this project (Figure 1).

Important points include:

- global meta-analyses indicate positive financial outcomes of diversified compared to simple farming systems; on average, diversified systems are at least as profitable as more simplified cropping systems, with comparable profits, gross incomes, and costs in developed countries and significantly higher gross and net financial returns in developing countries

- the economic feasibility of diversified farming systems (DFS) is related to their ability to mitigate risks associated with market fluctuations, input costs, and adverse weather conditions, particularly where operational management decisions, climatic risks and market dynamics for different aspects of the DFS are uncorrelated

- investment of profits - in adaptation, risk transfer, transformation and/or further income diversification projects – has potential to build sustainability and climate resilience across a range of scenarios but will likely become increasingly critical in marginal regions where average gross margins for cropping continue to decline.

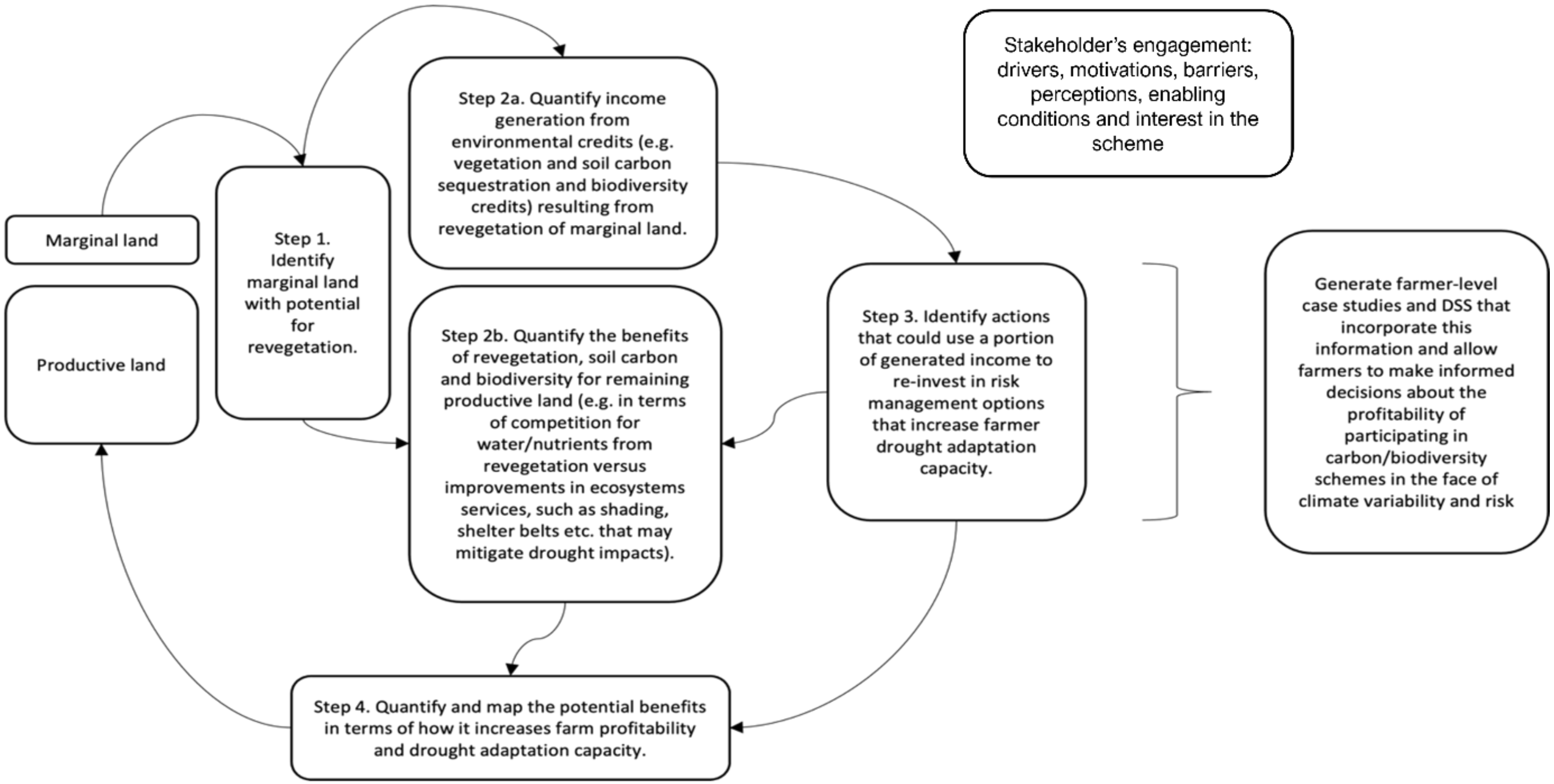

Figure 1. Schematic outlining the approaches and activities that are being undertaken in this project (DCAP3-UniSQ: 'Creating alternate agricultural income streams to increase farm profitability and benefit the environment').

The value of diversified farming systems – a brief literature review

As indicated in our MS4 report (Kath & Thorpe, 2024), environmental (carbon, biodiversity) benefit or 'natural capital' scheme investments such as agroforestry or shelter belt plantings are expected to deliver improved financial gross margin outcomes for farming enterprises in Queensland's climatically marginal cropping areas (Kath et al., 2023). This is especially true when the ecosystem services provided by such investments are taken into account (Figure 2). This concurs with a number of recently published global meta-analyses that have synthesised large numbers of studies investigating the advantages and challenges of diversified farming systems (DFS) in terms of both economic viability and ecological sustainability compared with conventional mono-cultural cropping systems (e.g., Tamburini et al., 2020; Beillouin et al., 2021; Sánchez et al., 2022b).

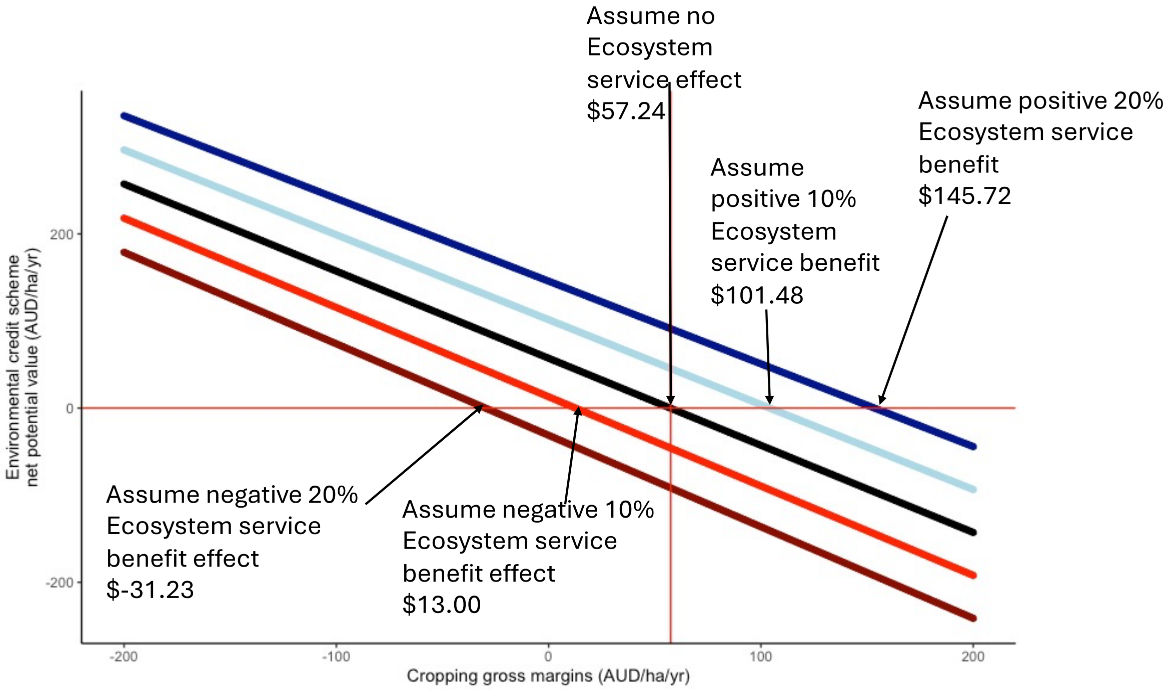

Figure 2. The average estimated transition point between agricultural gross margins and potential environmental credit schemes under a range of ecosystem benefit scenarios. The different coloured lines represent the five ecosystem service disbenefit/benefit (-20%, -10%, 0%, 10%, 20%) scenarios that were tested and reported in Kath & Thorpe (2024). The dollar values shown correspond to the average cropping gross margins below which farmers could start considering environmental credit schemes when ecosystem services are considered. Note that, of the 82 studies included in this study, only one indicated disbenefit (reproduced from Kath & Thorpe, 2024, Figure 11).

These meta-analyses consistently indicate that, on average, diversified systems are at least as profitable as more simplified cropping systems, with comparable profits, gross incomes, and costs in developed countries and significantly higher gross and net financial returns in developing countries (Sánchez et al., 2022b). While initial set-up costs may be higher for diversified systems due to the increased range of operations, over the long term, DFS achieve cost-effectiveness through more effective resource utilisation and enhanced ecological benefits that support more sustainable and resilient agricultural production systems (Sánchez et al., 2022b). Such evidence underscores DFS as a viable strategy for enhancing the economic outcomes of agricultural enterprises. The economic feasibility of DFS is further supported by their ability to mitigate various risks associated with market fluctuations, input costs, and adverse weather conditions, especially where operational management decisions, climatic risks and market dynamics for the different aspects of the DFS are uncorrelated (Sánchez et al 2020b). As a risk management strategy, DFS appears particularly valuable in safeguarding farm incomes in the face of increasing challenges driven by shifting climatic regimes and globalised market dynamics.

As indicated, in addition to enhanced economic outcomes, integrated practices such as crop rotation, agroforestry, and the incorporation of native vegetation species (i.e., habitat restoration) also provide multiple co-benefits. These include enhanced biodiversity, ecosystem function and provision of ecosystem services essential to the long-term sustainability and resilience of agricultural landscapes and production systems. For example, crop rotation and minimum till practices aid in mitigating risks due to pests and diseases and the impacts of adverse weather conditions, while improving soil health and fertility over time (Chahal et al., 2021; Neupane et al., 2021), while planting/retention of shelter belt vegetation (e.g. windbreaks) helps conserve soil moisture (Oliver et al. 2005; Cleugh et al. 2020), and provide habitat for insects, birds and bats that predate on pest insects and/or facilitate pollination in crops (Tamburini et al., 2020; Ramírez-Fráncel et al., 2022). The cumulative effect of these ecological practices not only supports sustainable agricultural production but also contributes to broader environmental goals such as biodiversity conservation and climate mitigation efforts.

On-farm investment decisions

Recent moves – in Queensland (e.g., the Land Restoration Fund (LRF), Reef credits), Australia (e.g., Emissions Reduction Fund (ERF)) and internationally (EU & USA Payment for Ecosystems Services (PES) programs) – to develop financial mechanisms such as markets for ecosystem services that incentivise sustainable practices offer increased on-farm investment opportunities to agricultural producers (Thorpe et al., 2023). Such environmental benefits payment schemes sit alongside a range of alternative investment options, a number of which are already available to producers. Hence, a decision to invest in a carbon or biodiversity benefits project is likely to be made in the context of other potentially relevant choices. These range from 'no investment' options such as might be experienced in a 'bad' year when enterprise gross margins are poor to negative, either due to a failed crop (e.g., Mendelsohn, 2007; Kim & Mendelsohn, 2023) or some form of market downturn or failure (e.g., Grant et al., 2021; Zhou and Laurenceson, 2022), to potential investments in farm improvements, adaptation or transformation options, as outlined in (Figure 2; Table 1).

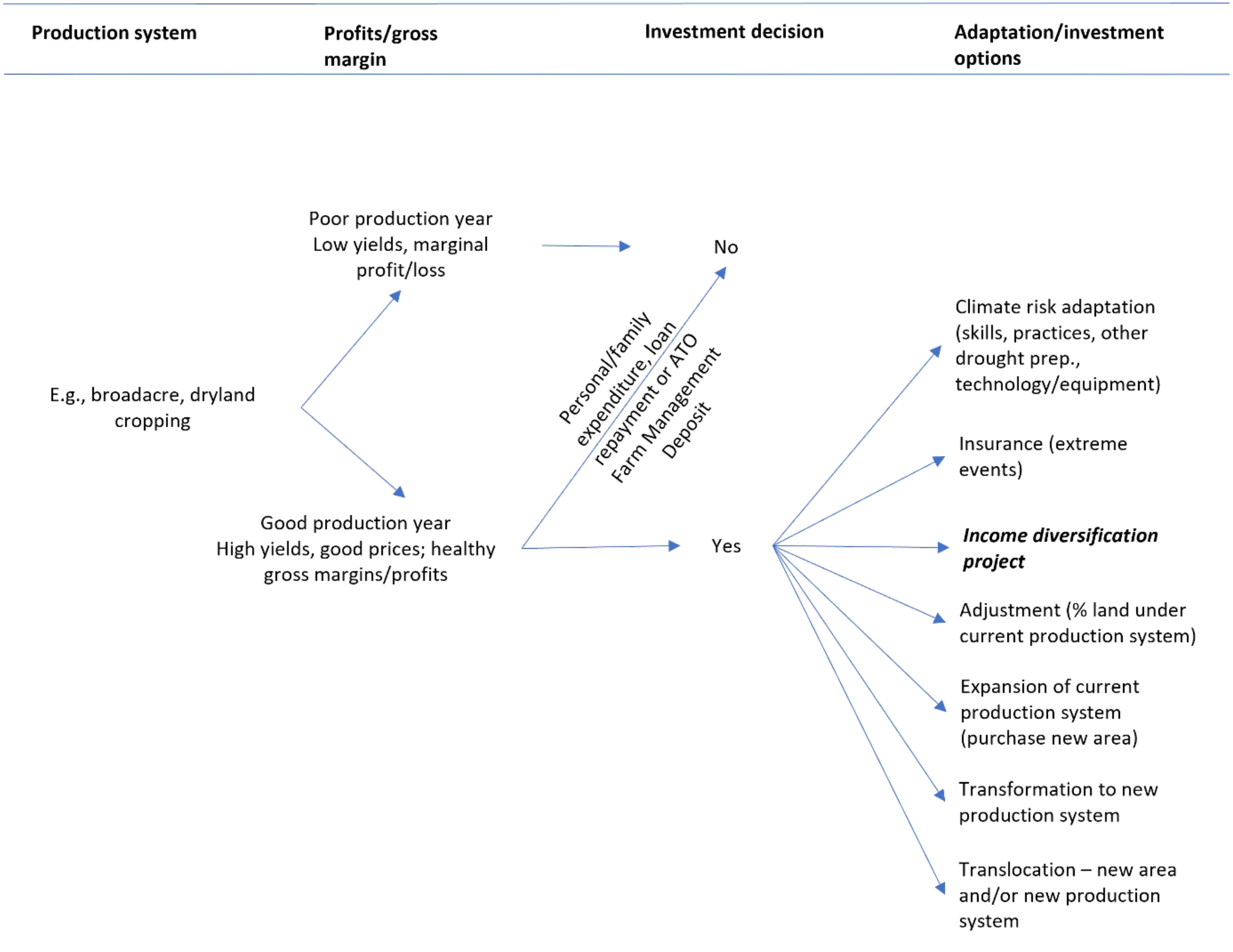

Figure 3. Potential investment options available for Australian broadacre crop production systems (details in Table 1)

Table 1. Details of potential investment options available for Australian broadacre crop production systems

Investment option	Detail	References
Farm Management Deposit (FMD) Scheme	FMD accounts allow primary producers to make tax deductible deposits during years of good cash flow and withdraw them during bad years → income smoothing.	Australian Tax Office, 2022; e.g., West et al., 2021
Climate risk adaptation options	Include skills, practices, technology, equipment, drought preparation … doing things 'better'	e.g., Cradock-Henry et al., 2020; Hughes et al., 2022; McKenzie et al., 2024
Crop insurance – drought, extreme rainfall, hail, frost, and excessive heat insurance	Climate risk transfer to insurance sector	e.g., Mushtaq et al., 2020, 2022
Environmental (carbon, biodiversity) credit projects	Income diversification projects based on environmental markets & payment for delivery of (additional) environmental benefit according to prescribed methodologies.	Clean Energy Regulator, 2024; Queensland Government, 2024a, 2024b; Thorpe et al., 2023
Expansion of current production system	Smaller farms tend to have lower profit margins than larger farms due to economies of scale	e.g., Jackson et al. 2020; Hughes et al., 2022
Adjust the proportion of different production systems	e.g., in mixed farming (cropping-grazing; wheat-sheep) systems	e.g., Ghahramani & Bowran, 2018; Ghahramani et al., 2020
Transformation	New production system (same location) … doing things 'differently'	e.g., Mushtaq, 2018; McKenzie et al., 2024
Translocation	New location – either the same or a new production system	e.g., Mushtaq, 2018; van Leeuwen et al., 2024

** Thanks to Gordon Stone, Adjunct Assoc Professor, University of Southern Queensland, Centre for Applied Climate Sciences, and Director, Agri-Business Development Institute for advice that assisted in identifying investment options.*

As discussed in earlier reports (Kath et al., 2023; Thorpe et al., 2023; Kath et al., 2024; Kath & Thorpe, 2024), new environmental (carbon, biodiversity) income diversification projects offer further options for consideration when making such investment decisions. However, it is widely reported and understood that agricultural producers are often hesitant to adopt new practices, particularly where the financial implications are unclear, and uncertainty exists in terms of policy and markets (e.g., prices)/other financial implications (Piñeiro et al., 2020). Such hesitancy extends to decisions about the adoption of diversified farming practices such as carbon and biodiversity benefit projects. Our stakeholder survey and MS3a report indicates that lack information and uncertainty about legal and governance arrangements and financial implications for their existing enterprise were reasons given for non-adoption (Reardon-Smith et al., 2024). Previous studies indicate that the widespread adoption of more diversified production systems is often also constrained by entrenched economic incentives, discourse and policies that promote industrialized agriculture, as well as limited agroecological knowledge, insufficient market support and supply chain constraints (Sánchez et al., 2022b). More broadly, there are also questions around scalability issues, and gaps in knowledge regarding the costs and benefits associated with different diversification investment strategies. Addressing these challenges requires targeted interventions that promote knowledge sharing, technological innovation, and supportive policy frameworks.

Support for more informed decision-making about which investments might be worthwhile/beneficial in particular contexts is generally lacking. To address this gap and drive meaningful change in agricultural practices, pivotal support, such as clear policy settings, market incentives, and access to technological resources are needed to facilitate the transition to diversified farming systems. Variability in climatic conditions and production responses across different contexts means that such approaches must also be context-specific and tailored to local conditions and goals. Developing such improved regionally-targeted support for decision-makers requires collaborative co-innovation partnerships among stakeholders including farmers, researchers, policymakers, and consumers (Ingram et al., 2020; Fieldsend et al., 2022). While a comprehensive co-innovation approach is currently beyond the scope of this project, clear evidence of the benefits and costs involved in adopting income diversification options such as environmental benefit payments is an essential first step and will be addressed in our MS6 report.

When should an enterprise diversification decision be made?

Crop production systems in Australia's (and especially Queensland's) highly variable climate are subject to significant inter-seasonal and inter-annual variability (Figure 4). This adds significant uncertainty around when it might be best to make a decision about investing/reinvesting and which investment/reinvestment decision to make at any particular time.

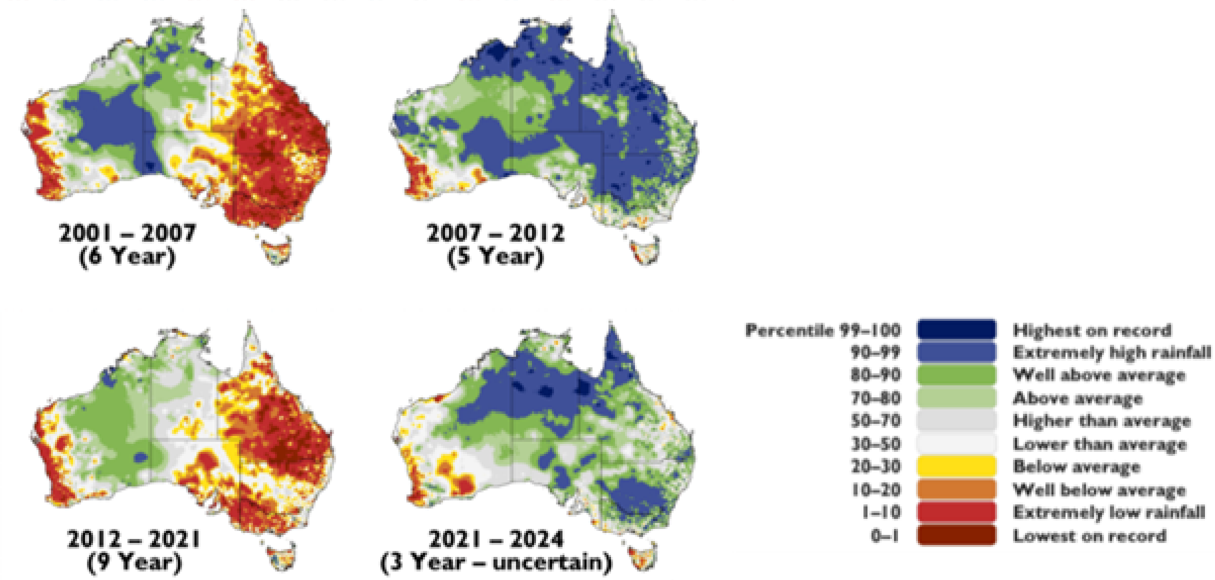

Figure 4. Australia's extended wet and dry periods (April – March) relative to historical records (1889-2024): patterns in climatic variability since 2001. Percentiles are rainfall anomalies. Source: Queensland Government (2024), based on McKeon et al. (2021). Available at: https://data.longpaddock.qld.gov.au/static/posters/WetDryDroughtPoster.pdf (accessed 30 May, 2024)

Our earlier reports (Kath et al., 2024; Kath & Thorpe, 2024) investigated the point at which, financially, the decision to diversify a broadacre cropping enterprise in identified climatically-marginal regions of Queensland becomes imperative. Our MS2 report (Kath et al., 2024) indicated the potential average gross margin threshold of $57.24/ha/yr for strategic decision-making in Queensland's climatically marginal cropping regions (identified in our MS1b report: Kath et al., 2023).

Assuming that a decision was made at some point to engage in a carbon or biodiversity benefits project, our subsequent MS4 report (Kath & Thorpe, 2024) then assessed the average gross margin threshold for further investment decisions. This assessment took into consideration the diversified income stream and the value of ecosystem services that would also be generated over time by such a project. This raised the average gross margin threshold for further decision-making, depending on the assumptions around the value of ecosystem services to the production system, to $101.48/ha/yr (with an assumed 10% contribution from ES) or $145.72/ha/yr (20%), as shown in Figure 1. While this is a higher threshold, the potential for ongoing deterioration in climatic conditions remains (Kath et al., 2023; Wang et al., 2023); hence, the implication here is that further investment in either adaptation, risk transfer, transformation and/or income diversification would be warranted where average gross margins for the enterprise, though improved, continue to decline and especially where they approach these indicative values.

As previously mentioned, producers are faced with a range of options for reinvestment when they have the capacity to do so, either in a more profitable year/phase (Figure 4) or by drawing on funds from their Farm Deposit account (ATO, 2024) or when they receive carbon sequestration and biodiversity benefit payments. As indicated in the last panel of Figure 5, such reinvestment options include a range of adaptation and risk transfer options as well as expansion/replication of the carbon or biodiversity-benefits project or investment in an alternative income diversification project. Such a decision would, in theory, further enhance the positive economic outcomes of the enterprise, derived from the diversified income stream and supporting beneficial ecosystem services, as well as the climatic resilience of the diversified farming system – enabling additional investment/reinvestment decisions over time.

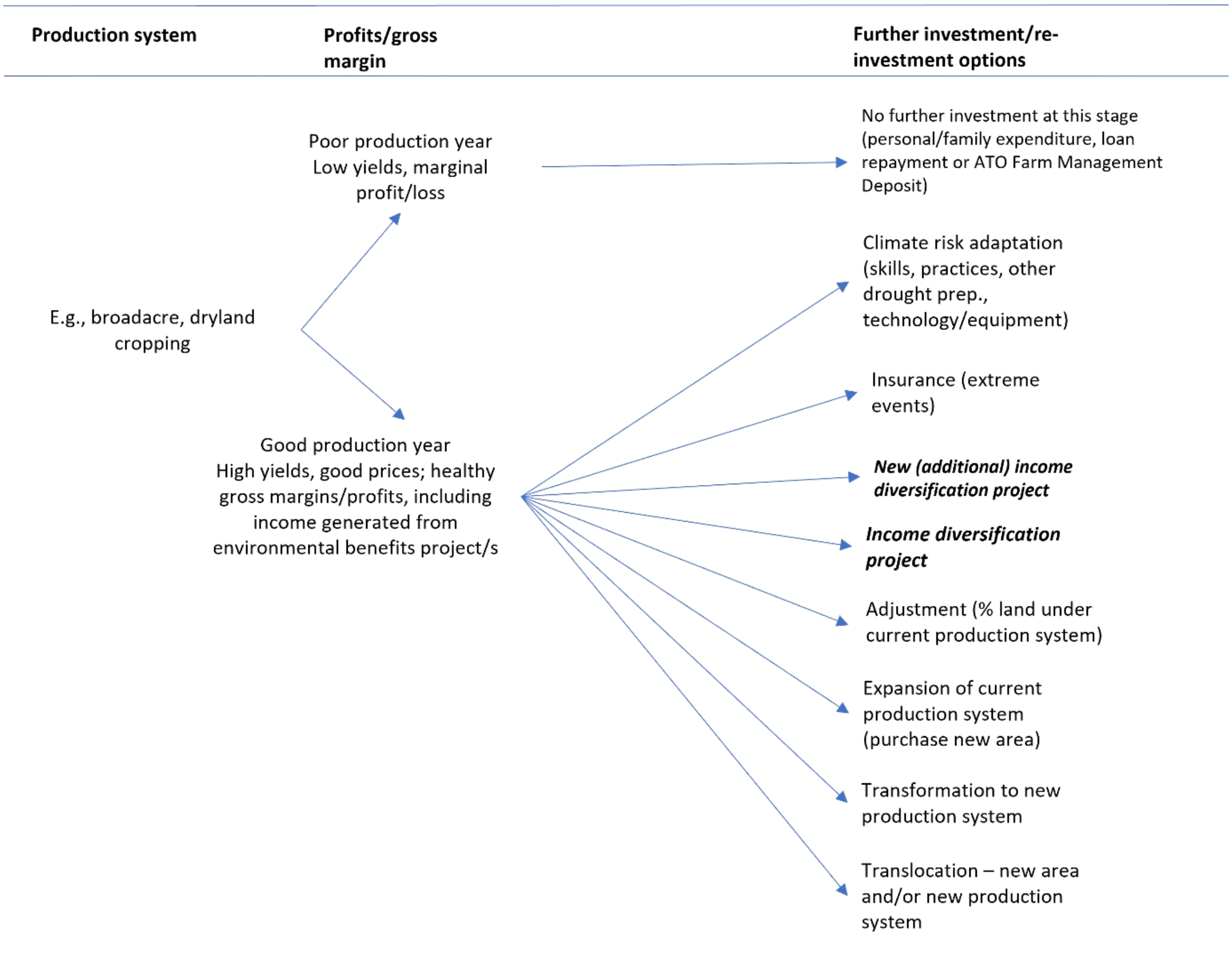

Figure 5. Potential reinvestment options available for Australian broadacre crop production systems (please refer to details in Table 1)

While our earlier analysis has identified critical decision-points for diversification, it should also be noted that such investment decisions are not, and should not be, driven by declining gross margins alone. Many producers are already pre-emptively/proactively investing in income diversification projects and other strategic options that build the resilience of their production system/s and better ensure the sustainability of their livelihoods. As examples, these options are more explicitly explored, in terms of feedbacks (tradeoffs and synergies), for three different investment/reinvestment options for broadacre cropping systems in Appendix A (Figures 6-9).

Next steps

In the next phase of this DCAP3 project (MS6), we will conduct preliminary cost-benefit analyses of a selection of different income diversification options currently available, and specifically in relation to climate risk identified across Queensland's crop production regions.

References

Australian Taxation Office (2022). *Farm Management Deposits*. Commonwealth of Australia Australian Taxation Office (ATO): Canberra ACT. Available at: https://www.ato.gov.au/businesses-and-organisations/income-deductions-and-concessions/primary-producers/in-detail/farm-management-deposits-scheme (accessed 25 June, 2024).

Bell, L.W., Moore, A.D. and D.T. Thomas, D.T. (2021). Diversified crop-livestock farms are risk-efficient in the face of price and production variability. *Agricultural Systems* 189, 103050. https://doi.org/10.1016/j.agsy.2021.10305

Beillouin, D., Ben-Ari, T., Mal´ezieux, E., Seufert, V. and Makowski, D. (2021). Positive but variable effects of crop diversification on biodiversity and ecosystem services. *Global Change Biology* 27(19), 4697-4710. https://doi.org/10.1111/gcb.15747

Bowman, M.S. and Zilberman, D. (2013). Economic factors affecting diversified farming systems. Ecology and Society 18(1), 33. http://dx.doi.org/10.5751/ES-05574-180133

Chahal, I., Hooker, D.C., Deen, B., Janovicek, K. and Van Eerd, L.L. (2021). Long-term effects of crop rotation, tillage, and fertilizer nitrogen on soil health indicators and crop productivity in a temperate climate. *Soil and Tillage Research* 213, 105121. https://doi.org/10.1016/j.still.2021.105121

Clean Energy Regulator (2024). *ACCU Scheme Methods*. Australian Government Clean Energy Regulator (CER): Canberra ACT. Available at: https://cer.gov.au/schemes/australian-carbon-credit-unit-scheme/accu-scheme-methods (accessed 27 June, 2024).

Cradock-Henry, N.A., Blackett, P., Hall, M., Johnstone, P., Teixeira, E., and Wreford, A. (2020). Climate adaptation pathways for agriculture: Insights from a participatory process. *Environmental Science & Policy* 107, 66-79. https://doi.org/10.1016/j.envsci.2020.02.020

Fieldsend, A.F., Varga, E., Biró, S., Von Münchhausen, S. and Häring, A.M. (2022). Multi-actor co-innovation partnerships in agriculture, forestry and related sectors in Europe: Contrasting approaches to implementation. Agricultural Systems 202, 103472. https://doi.org/10.1016/j.agsy.2022.103472

Garibaldi, L.A., Oddi, F.J., Miguez, F.E., et al. (2020). Working landscapes need at least 20% native habitat. *Conservation Letters* 14(2), e12773. https://doi.org/10.1111/conl.12773

Ghahramani, A. and Bowran, D. (2018). Transformative and systemic climate change adaptations in mixed crop-livestock farming systems. *Agricultural Systems* 164, 236–251. https://doi.org/10.1016/j.agsy.2018.04.011

Ghahramani, A., Kingwell, R.S. and Maraseni, T.N. (2020). Land use change in Australian mixed crop-livestock systems as a transformative climate change adaptation. *Agricultural Systems* 180, 102791. https://doi.org/10.1016/j.agsy.2020.102791

Grant, J.H., Arita, S., Emlinger, C., Johansson, R. and Xie, C. (2021). Agricultural exports and retaliatory trade actions: An empirical assessment of the 2018/2019 trade conflict. *Applied Economic Perspectives and Policy* 43, 619–640. https://doi.org/10.1002/aepp.13138

Hughes, N., Lu, M., Soh, W.Y. et al. (2022). Modelling the effects of climate change on the profitability of Australian farms. *Climatic Change* 172, 12. https://doi.org/10.1007/s10584-022-03356-5

Ingram, J., Gaskell, P., Mills, J. and Dwyer, J. (2020). How do we enact co-innovation with stakeholders in agricultural research projects? Managing the complex interplay between contextual and facilitation processes. *Journal of Rural Studies* 78, 65-77. https://doi.org/10.1016/j.jrurstud.2020.06.003

Jackson, T., Hatfeld-Dodds, S. and Zammit, K. (2020). *Snapshot of Australian Agriculture*. ABARES. https://www.agriculture.gov.au/abares/products/insights/snapshot-of-australian-agriculture-2021

Kath, J., Mushtaq, S. and Reardon-Smith, K. (2023). *Identifying Climatically Marginal Cropland*. Unpublished report (MS1, September 2023), DCAP3 Project 'Creating Alternative Income Streams to Increase Farm Profitability and Benefit the Environment (UniSQ)'. Drought and Climate Adaptation Program (DCAP): Queensland Government, Brisbane. 22 pp.

Kath, J., Reardon-Smith, K., Thorpe, J. and Mushtaq, S. (2024). *Mapping and Quantifying Environmental Credit Opportunities in Queensland Cropping Zones*. Unpublished report (MS3, January 2024), DCAP3 Project 'Creating Alternative Income Streams to Increase Farm Profitability and Benefit the Environment (UniSQ)'. Drought and Climate Adaptation Program (DCAP): Queensland Government, Brisbane. 34 pp.

Kath, J. and Thorpe, J. (2024). *Assessing the Potential Ecosystem Service Effects of Natural Capital Schemes for Agriculture.* Unpublished report (MS4, March 2024), DCAP3 Project 'Creating Alternative Income Streams to Increase Farm Profitability and Benefit the Environment (UniSQ)'. Drought and Climate Adaptation Program (DCAP): Queensland Government, Brisbane. 26 pp.

Kim, S.M. and Mendelsohn, R. (2023). Climate change to increase crop failure in U.S. *Environmental Research Letters* 18, 014014. https://doi.org/10.1088/1748-9326/acac41

McKenzie, D.K., Joyce, J., Zander, K.K. et al. (2024). Eastern Australian farmers managing and thinking differently: Innovative adaptation cycles. *Environmental Management* 73, 51–66. https://doi.org/10.1007/s00267-023-01873-2

McKeon G., Stone G., Ahrens D., Carter J., Cobon D., Irvine S. and Syktus J. (2021) Queensland's multi-year Wet and Dry periods: implications for grazing enterprises and pasture resources. *The Rangeland Journal* 43, 121-142. https://doi.org/10.1071/RJ20089

Mendelsohn, R. (2007). What causes crop failure? *Climatic Change* 81, 61–70. https://doi.org/10.1007/s10584-005-9009-y

Mushtaq, S. (2018). Managing climate risks through transformational adaptation: economic and policy implications for key production regions in Australia. *Climate Risk Management* 19, 48-60. https://doi.org/10.1016/j.crm.2017.12.001

Mushtaq, S., Kath, J. and Reardon-Smith, K. (2022). Innovations for a climate resilient sustainable agricultural sector. *The Australian Farmer: A Digital Publication and Knowledge Tool for the Forward-Thinking Farmer* II, 237-238.

https://www.theaustralianfarmer.com/innovations-for-a-climate-resilient-sustainable-agricultural-sector

Mushtaq, S., Kath, J., Stone, R. et al. (2020). Creating positive synergies between risk management and transfer to accelerate food system climate resilience. *Climatic Change* 161, 465–478. https://doi.org/10.1007/s10584-020-02679-5

Neupane, A., Bulbul, I., Wang, Z. et al. (2021). Long term crop rotation effect on subsequent soybean yield explained by soil and root-associated microbiomes and soil health indicators. *Scientific Reports* 11, 9200. https://doi.org/10.1038/s41598-021-88784-6

Piñeiro, V., Arias, J., Dürr, J. et al. (2020). A scoping review on incentives for adoption of sustainable agricultural practices and their outcomes. *Nature Sustainability* 3, 809–820. https://doi.org/10.1038/s41893-020-00617-y

Queensland Government (2024a). *The Land Restoration Fund*. Queensland Government, Brisbane QLD. Available at: https://www.qld.gov.au/environment/climate/climate-change/land-restoration-fund (accessed 27 June, 2024)

Queensland Government (2024b). *Reef Credit Scheme*. Queensland Government, Brisbane QLD. Available at: https://www.qld.gov.au/environment/coasts-waterways/reef/reef-credit-scheme (accessed 27 June, 2024)

Reardon-Smith, K., Mushtaq, K., Kath, J. and Thorpe, J. (2023). *Farmer Perceptions of Environmental Market Income Diversification Schemes*. Unpublished report (MS3A, January 2024), DCAP3 Project 'Creating Alternative Income Streams to Increase Farm Profitability and Benefit the Environment (UniSQ)'. Drought and Climate Adaptation Program (DCAP): Queensland Government, Brisbane. 29 pp.

Rosa-Schleich, J., Loos, J., Mußhoff, O. and Tscharntke, T. (2019). Ecological-economic tradeoffs of diversified farming systems – a review. *Ecological Economics* 160, 251–263. https://doi.org/10.1016/j.ecolecon.2019.03.002

Sánchez, A.C., Jones, S.K., Purvis, A., Estrada-Carmona, N. and de Palma, A. (2022a). Landscape complexity and functional groups moderate the effect of diversified farming on biodiversity: a global meta-analysis. *Agriculture, Ecosystems & Environment* 332, 1-12. https://doi.org/10.1016/j.agee.2022.107933

Sánchez, A.C., Kamau, H.N., Grazioli, F. and Jones, S.K. (2022b). Financial profitability of diversified farming systems: A global meta-analysis. *Ecological Economics* 201, 107595. https://doi.org/10.1016/j.ecolecon.2022.107595

Tamburini, G., Bommarco, R., Wanger, T.C. et al. (2020). Agricultural diversification promotes multiple ecosystem services without compromising yield. *Science Advances* 6, 1–8. https://doi.org/10.1126/SCIADV.ABA1715

Thorpe, J., Reardon-Smith, K., Mushtaq, S. and Kath, J. (2023). *Options and Cautions: Environmental Credits, Practice, and Payments for QLD Land Managers*. Unpublished report (MS2B, September 2023), DCAP3 Project 'Creating Alternative Income Streams to Increase Farm Profitability and Benefit the Environment (UniSQ)'. Drought and Climate Adaptation Program (DCAP): Queensland Government, Brisbane. 37 pp.

van Leeuwen, C., Sgubin, G., Bois, B. et al. (2024). Climate change impacts and adaptations of wine production. *Nature Reviews Earth and Environment* 5, 258–275. https://doi.org/10.1038/s43017-024-00521-5

Wang, A., Tao, H., Ding, G., Zhang, B., Huang, J. and Wu, Q., (2023). Global cropland exposure to extreme compound drought heatwave events under future climate change. *Weather and Climate Extremes* 40, 100559. https://doi.org/10.1016/j.wace.2023.100559

West, S.C., Mugera, A.W. and Kingwell, R.S. (2021). Drivers of farm business capital structure and its speed of adjustment: Evidence from Western Australia's Wheatbelt. *The Australian Journal of Agricultural and Resource Economics* 65, 391-412. https://doi.org/10.1111/1467-8489.12415

Zhou, W., and Laurenceson, J. (2022). Demystifying Australia-China trade tensions. *Journal of World Trade* 56(1), 51-86. https://doi.org/10.54648/trad2022003

Appendix A: Income diversification through investment/re-investment in natural capital projects

In order to envisage the way in which a decision to incorporate environmental (carbon, biodiversity) income diversification projects into an existing agricultural production enterprise and the potential synergies or trade-offs that may occur, we have developed conceptual diagrams for three potentially feasible decisions (from the range of ERF methodologies currently available through the Commonwealth ERF program (Thorpe et al., 2023)) for marginal cropping lands in Queensland (Kath et al., 2023).

The following diagrams (Figures 6 – 9) indicate the influences (positive or negative) between critical variables or factors influencing gross margins within diversified broadacre cropping systems.

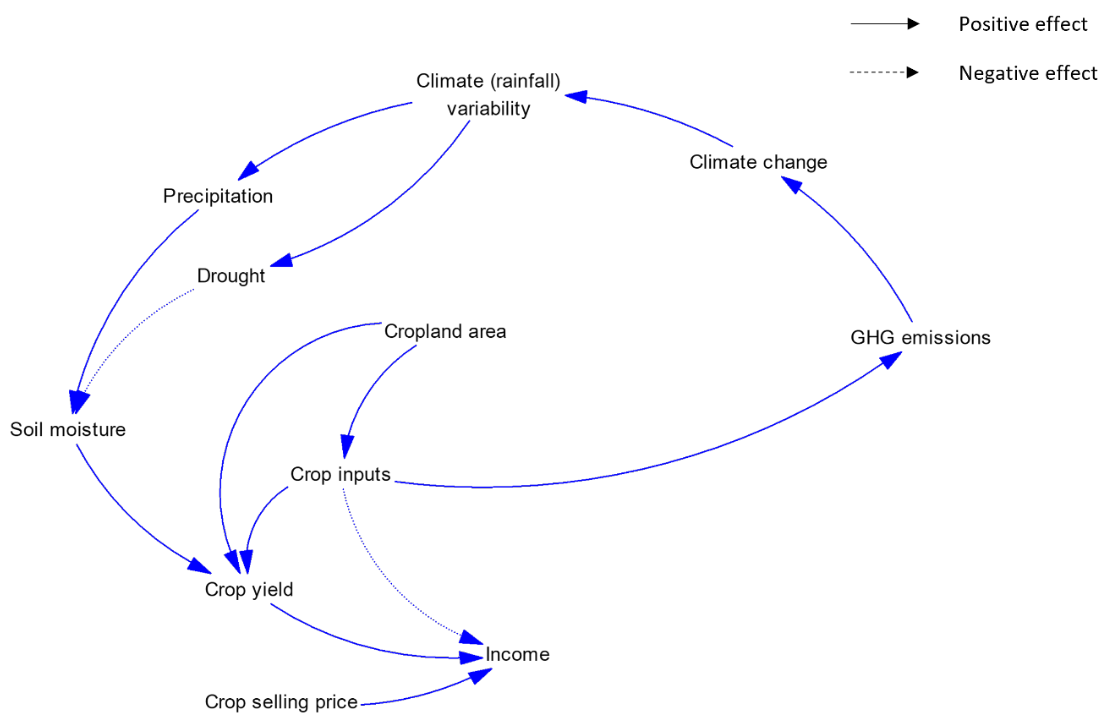

Figure 6. Influence diagram - Broadacre cropping system

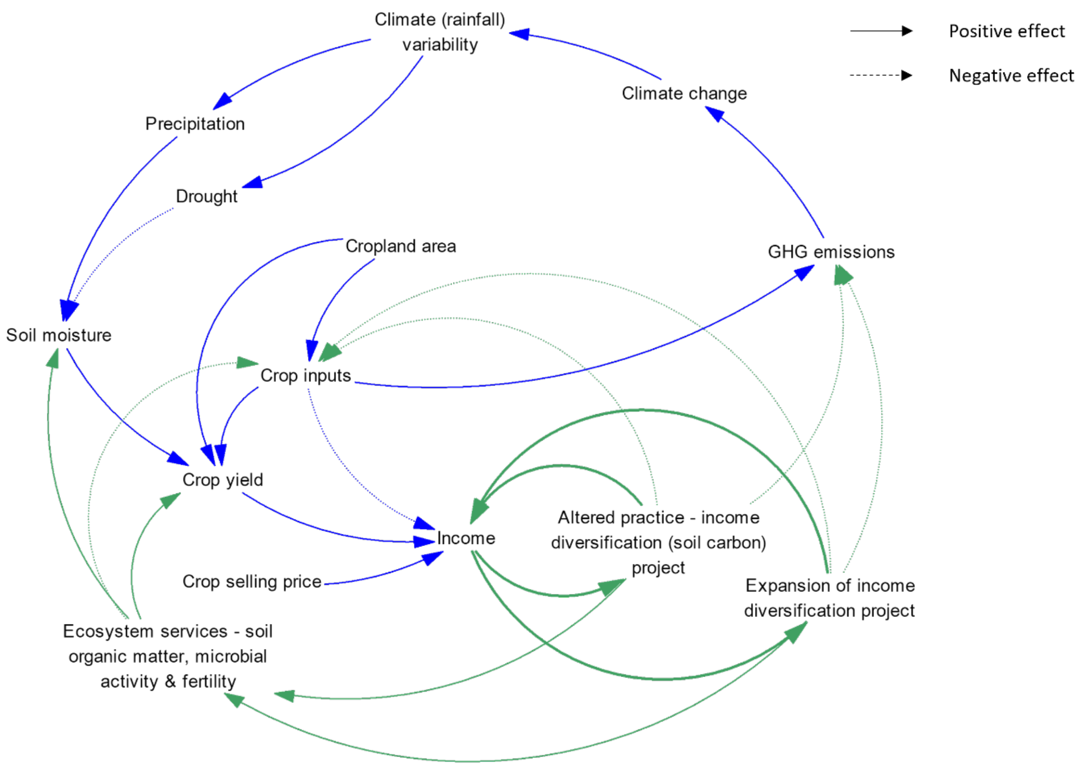

Figure 7. Influence diagram - Broadacre cropping system with income diversification – soil carbon (ERF) project. Green arrows indicate the influence of the environmental benefits payment scheme.

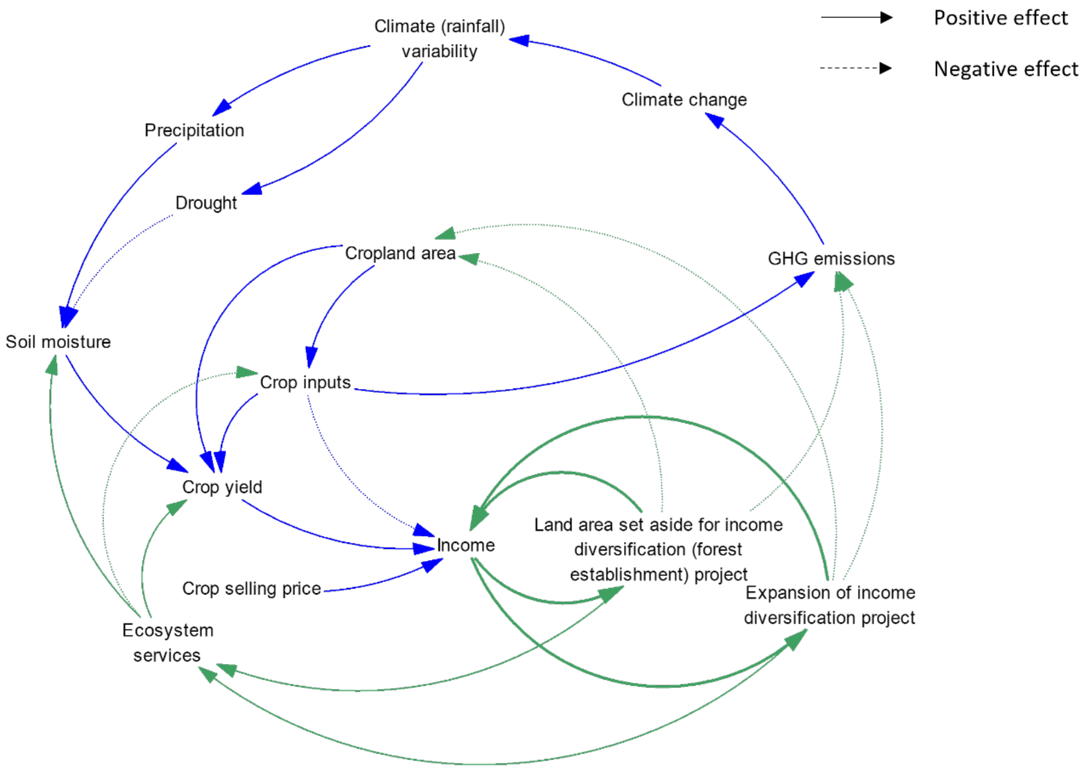

Figure 8. Influence diagram - Broadacre cropping system with income diversification – forestry establishment (ERF) project. Green arrows indicate the influence of the environmental benefits payment scheme.

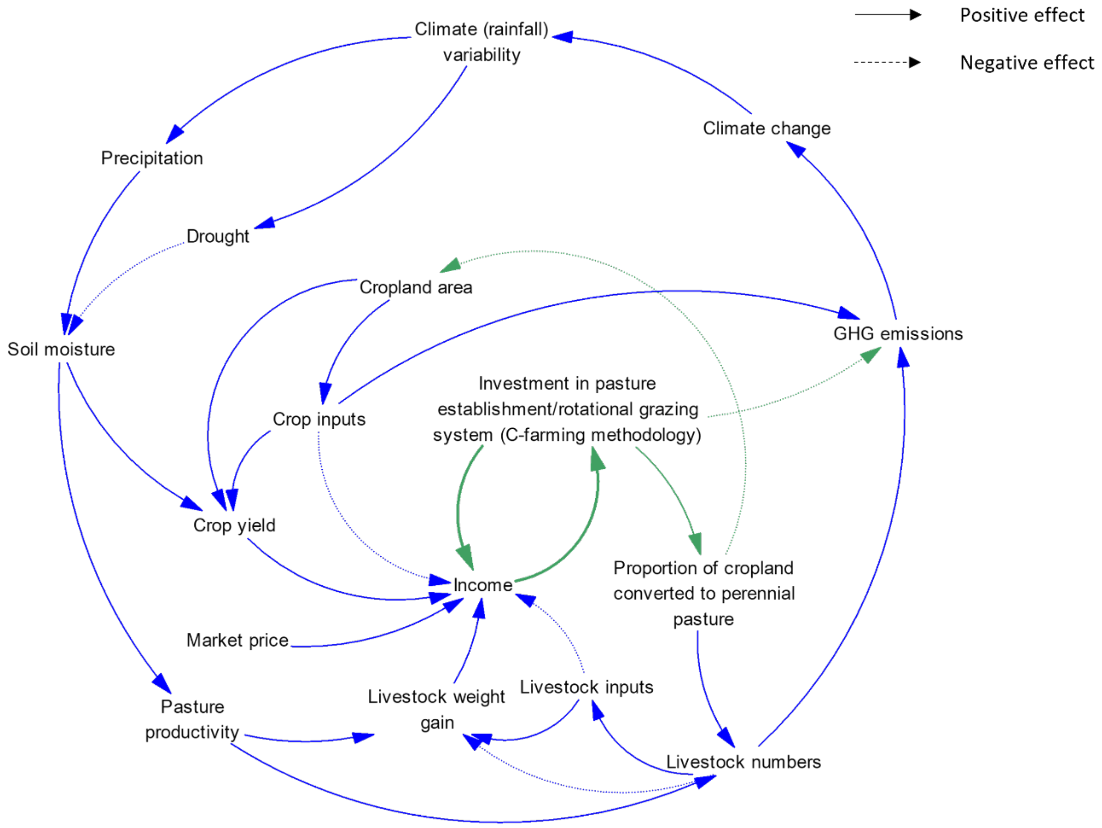

Figure 9. Influence diagram - Broadacre cropping system with income diversification – shift to mixed grazing with pasture establishment and rotational grazing (Qld Reef Credits) project. Green arrows indicate the influence of the environmental benefits payment scheme.