The Science in Adaptive Management

'Adaptive management' is all the rage in international development circles. But to avoid yet another buzzword – we need to learn from the experience of natural resource science.

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Give a man a fish and you feed him for a day, goes the old adage, teach a man to fish and you feed him for a lifetime. But now development aid organisations are wondering: Improve the systems supporting fish farming and help the whole village feed themselves forever?

A market systems approach focuses on the underlying reasons why transactions do not benefit the global poor. When producers, consumers or workers cannot access the goods and services they need to survive and grow, then the root causes can be found deep in supporting systems like information, skills, finance and technology, or in the rules of the game which shape behaviour. In the words of the Springfield Centre, authors of the Operational Guide that codifies the approach, this is not about putting out fires but tackling the reasons why fires start in the first place[1].

Projects with a systemic change ambition face a very different set of challenges compared to 'traditional' interventions. If markets are framed as complex systems, then the precise pathways to impact are hard to anticipate, and the reasons for market under-performance may lead to intractable issues of power, culture and social norms. This is far from Development as Usual.

Adaptive management has been hailed as the way to deal with the uncertainty of this new implementing reality[2]. The idea of being adaptive - modifying what we do in response to new conditions - is intuitively easy to grasp. But examples of adaptive management remain elusive, and the term means many different things to many different people. Is it a prescriptive tool, or a call to arms for common sense? What distinguishes adaptive management from simply, well...just good management?

For answers, we went to the field where adaptive management first gained traction. Natural resource management focuses on the interaction between humans and the environment - like land, water, soil, plants and animals - to ensure that resources can be utilised whilst preserving ecosystems for future generations[3]. Largely in response to the failure of previous efforts, a series of seminal works by ecologists C.S. Holling in the 1970s and Carl Walter in the 1980s introduced the idea of 'adaptive management'[4].

We looked in environmental journals to learn how adaptive management has moved from paper to practice, extracting a set of 6 principles underpinning its real-world application[5]. We then reflected on our own journey running the Lab, an International Labour Organization (ILO) project using a market systems approach to improve working conditions in developing economies, to see how we could use adaptive management to unlock greater impact. This is what we found.

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[1] The Springfield Centre (2015)
[2] For example by the 'Doing Development Differently' movement and the USAID 'Learning Lab'
[3] C. Pahl-Wostl (2004)
[4] Holling initially called it 'Adaptive Environmental Assessment and Management'
[5] See bibliography for a full list of journals. The title of this article is a riff on Keith M. Moore's "Innovating for Sustainable Agriculture and Natural Resource Management: The Science of Adaptive Management"

Principle 1: Accept that there will always be outcome uncertainty.

Adaptive management is based on the premise that natural systems can be manipulated. Whether a waterway or woodland, people alter their surrounding environment – the flow of a river, the number of trees – through their actions. The trouble is, it is hard to say with any certainty what the consequences of these actions will be[6]. Intentionality may be far removed from actual impact[7].

> "Intentionality may be far removed from actual impact"

In an area of natural wetlands in southern Florida known as the Everglades, biodiversity had already suffered through centuries of human habitation and agriculture when, in the late 1940s, levees and pumps were installed to manage flood risk. This helped control water flows, but accelerated ecological damage and the number of avian species rapidly declined. By the 1990s, it became apparent that protecting the ecosystem while providing for water-related needs was not a simple task with a neat solution. Realising that there was no off-the-shelf fix, the United States Congress integrated an adaptive management component into a comprehensive environmental restoration programme[8].

The response to any new product or service offering in a market will likewise be uncertain – dependent on the specifics of the context rather than a matter of predictable, historically-informed 'best practice'[9]. More often than not, consequences will be both positive *and* negative, depending on which part of the system we look at. Pesticides may boost yields for smallholder farmers, but pollute drinking water - just as Florida's water management 'solutions' reduce flooding, but also destroy wildlife.

> "Outcome uncertainty is no excuse for ignorance"

Outcome uncertainty, however, is no excuse for ignorance. We can use models and trends to make predictions and assumptions, as long as we acknowledge these will always be a first iteration rather than set in stone. In complex situations, it takes time to realise positive change. The Everglades programme continues to this day, having made only minimal progress towards restoring the remaining eco-system[10].

> "If we are not committed to developing markets, then we are likely just distorting them"

If time or patience are in short supply, then we should leave the system alone. Prior to his work on adaptive management, C.S. Holling developed resilience theory: That there is more than one alternative stable state for ecosystems, and management actions should be careful not to exceed a threshold that would negatively alter the system state[11]. If we are not committed to developing markets, then we are likely just distorting them. We worked with a United Nations Joint Programme in Peru to analyse the underlying reasons why the quinoa value chain was not delivering good jobs and incomes for smallholder producers. But the impossible pressures of a one-year implementation period led to pressure to roll-out quick fixes. When the project delivered temporary financial and training support to cooperatives and farmers, they risked displacing local market actors - the banks, exporters and seed companies - who were positioned to provide more sustainable services. Then like the levees and pumps in Florida, a rush for simple 'solutions' in situations of complex outcome uncertainty will most likely lead to a net negative impact.

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[6] Allen (2015)
[7] The intentionality-impact gap has been highlighted by Jed Emerson, the originator of the concept of blended value
[8] Story from Water Science and Technology Board (2004)
[9] Rist et al (2012)
[10] Williams & Brown (2012)
[11] Allen et al (2011)

Principle 2: Define the management problem

Adaptive management requires a clear problem definition. What resource issue is being addressed, and what boundaries - whether geographic, hierarchical or networked - frame the system(s) of interest?

An estimated 5% of Europe's electricity will come from offshore wind farms by 2020. Yet the environmental impact of these structures is largely unknown. When deciding on the location for a new facility, engineers need to balance the need to keep costs down with the need to protect fisheries and marine life. At the outset, the details may be in outline - what type of turbine should be used where - but the goal is clear: Find an optimal site that maximises efficient energy production but minimises eco-system damage[12].

Systemic change projects begin with initial understanding of the problem: Why are markets currently failing the poor[13]? Based on this, they outline a credible vision for how the market needs to change and continue to work better after project exit. This vision – the project goal – needs to be concrete enough to focus action, but broad enough to allow space for adaptation. Too tight and projects end up being boxed-in with inappropriate technical fixes: Think of the many international development training programmes that end up being a solution in search of a problem. But too wide and things become too vague: Aims like 'poverty reduction' or 'capacity building' do little to galvanise practical project-specific action. The wind farm builders are not trying to solve the world's energy problems, but neither are they just connecting a few underwater cables to a service platform and hoping for the best.

Goals, of course, can be refined and modified as experience grows and the problem becomes clearer[14]. In the small island state of Timor-Leste, we worked with the 'BOSS project' - an ILO business support programme aimed at addressing the problem of low-productivity jobs in micro and small enterprises. Initially focusing on the horticulture sector, the project envisioned a de-risked market where wholesalers were comfortable sourcing from rural farmers. But when an analysis of project impact threw up a challenge – that the productivity gaps in agriculture were so large, that even sizeable profit gains for smallholders would not lead to qualitatively 'better' jobs – the project was able to make an informed pivot away from agriculture to intervene in higher value added sectors like tourism. But unless projects begin with a clearly defined and bounded management problem – and derive their systemic change goal from that - they will likely have failed before they even start.

Principle 3: Realise that success depends on simultaneous experimentation with alternatives

Adaptive management involves testing different options to see which can resolve the management problem. This means implementing multiple alternative actions *at the same time* to learn which is the most effective[15].

In the Helena National Forest in Montana, a local resource management committee sought to address the issue of widespread tree mortality caused by mountain pine beetles and spruce budworm[16]. Many perspectives were

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[12] Williams & Brown (2012)
[13] The Springfield Centre (2015)
[14] Water Science and Technology Board (2004)
[15] Reever et al (2006)
[16] Story from Larson et al (2013)

gathered to inform different treatment options for forest restoration: from the more severe (retention harvest, which involves retaining some clumps of trees but cutting down large swathes) to less severe (seed-tree harvest, which involves retaining a few widely spaced-out trees for seed resources) to untreated controls. Rather than choose which single treatment to begin with, all three options were implemented in parallel in different areas of the forest to learn which was the most effective in that particular eco-system.

Market systems interventions - a defined package of activities that contribute to a systemic change goal - can be viewed as competing hypotheses to be tested[17]. Through experimentation we try lots of things, recognising that most will fail: But failure allows us to understand the trade-offs associated with promoting one management action over the other[18].

This is different from the mind-set of researchers running experimental studies, such as randomised control trials. Adaptive management experimentation focuses on *improving* how we address a particular problem at hand, rather than trying to *prove* a generalizable cause-effect model to show 'what works'[19]. Testing alternative actions is not the search for perfect solution, but to see which one of the many imperfect options brings us closest to realising the systemic change vision. The forest restoration committee in Montana was not looking for a panacea for pine beetle mortality, but to find out which of the range of possible actions available to them was the 'best fit' in their unique context.

The adaptive management concept of 'active' experimentation originated because it was thought that most conventional resource management was too 'passive': settling on a single preferred course of action based on best available information, and then modifying that over time[20]. In our experience, most market systems projects still deploy passive management techniques. They choose a single strategy and then use trial-and-error to iteratively improve it based on experience. This is 'learning by doing', but it can be slow.

In Zambia, a joint ILO and Food and Agriculture Organisation (FAO) project called 'Yapasa' developed an intervention strategy that linked a provider of finance, an input provider and youth farmers in a contract farming arrangement. Yapasa ran the model over an agricultural season, but found that the bank they had chosen to partner with had neither the incentive nor capacity to change. To test the revised model, they had to wait until the planting season the following year. As a three-year project, there were only so many rolls of the strategy dice they could afford. Adaptive management, in contrast, would have set up multiple alternative interventions to achieve the same aim - perhaps three different types of smallholder procurement models implemented in different locations, or with three different partners over the same season - recognising that success depends on simultaneous experimentation with alternatives to accelerate the learning process.

Principle 4: Make decision-useful data the only data you require

Adaptive management means making tough choices about which strategies should be scrapped or scaled up. For informed decision-making, reliable data is required; but since adaptive management is geared to action, the data needs to be as real-time as possible.

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[17] Bryan et al (2009) and Owens (2009), cited in Rist et al (2012)
[18] Larson et al (2013)
[19] The same point is made by Andrews, Pritchett and Woolcock (2012)
[20] Walters and Holling (1990), in Rist et al (2013)

At the University of Melbourne, Professor David Karoly is unhappy with the pace of climate data. It used to require years – and a best case of six to twelve months – to link individual weather events to global warming, but Professor Karoly's team is working towards much quicker feedback: Seeking to identify the causes of weather events within a week[21]. As part of the World Weather Attribution programme, Karoly says "what we're trying to do is communicate as quickly as possible in a way that is scientifically robust".

Market systems projects rely on similarly rapid but rigorous data. To reject or revise interventions, we need to know which actions are showing prospects for scale, sustainability and social value before it is too late to course-correct. There may be little to do to affect the trajectory of global warming if scientists wait 1,000 years for the perfect data set to arrive.

> "Market systems projects rely on rapid but rigorous data"

In adaptive management, data collection needs to be 'quick and dirty' more than 'slow and clean'. Long surveys are often eschewed for shorter sets of more frequently administered questions[22]; the views of stakeholder groups, many of whom may have conflicting perspectives on the efficacy of the management actions, are collected; and the constraints of time and resources may mean accepting less statistical certainty[23]. Prior to the Lab, we worked on a UK Aid-funded rural development project in Nepal called 'Samarth' to set up an early warning system that checked the value proposition of new business innovations. As soon as a new 'bottom of the pyramid' product or service hit the market, the project ran spot surveys to find out about customers' poverty profile and their perceptions about pricing, quality and utility – immediately feeding this information back to project management and partner firms to allow for real-time revisions. Decision-useful data was the only data required.

Principle 5: Enforce structure to tighten the feedback loop between data and action

Adaptive management aims for double loop learning. More than just correcting deviations in planned versus actual - for example, whether a dike has been built high enough to avoid flooding[24] - the idea is to continually question fundamental assumptions that underpin the very problem being addressed[25], like whether a dike is even the most appropriate strategy in the face of changing precipitation levels[26].

> "Continually question fundamental assumptions that underpin the problem being addressed"

To mitigate the impact of dam operations on the Columbia River Basin's chinook salmon stocks, water flows are adjusted based on what was learned from previous water releases and the resulting eco-system response. A working group meets regularly for course corrections. They set maximum and minimum daytime flows in order to accommodate peak electricity demand and ensure breeding areas do not to dry up because of water fluctuations[27]. But, based on this experience, there is growing recognition that habitat restoration may require going beyond adjusting water flows for individual species recovery, and instead require a multi-watershed, basin-wide effort to rebuild fish stocks[28].

In market systems projects, the constant meetings, reviews and go/no-go decision events may not always be exciting, but they are often essential. By

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[21] See http://sustainable.unimelb.edu.au/karoly
[22] Larson et al (2013)
[23] Reever et al (2006)
[24] Hess et al (2012)
[25] Wording used by Michael Quinn Patton in describing Developmental Evaluation
[26] Hess et al (2012)
[27] Story from Williams & Brown (2012)
[28] Murray and Marmorek (2004)

> "Projects can plug the leak between information and action – where data is collected but not used to inform decision-making"

providing a safe space for data to be digested, projects can plug the leak between information and action - where data is collected but not used to inform decision-making[29]. Market systems projects often use widely accepted process frameworks, such as the [Donor Committee for Enterprise Development (DCED) Results Measurement Standard](#), to bring discipline to the learning process. In Zambia, it was a tale of two projects. Remember Yapasa? It built a structured monitoring system using the DCED Standard, holding regular portfolio and sector review meetings to reflect on the data they collected, and to review and revise their intervention strategies accordingly. This provided a means to drop, or to build on, promising actions, and grow towards better impact. By contrast, their sister project in the construction sector eschewed structured outcomes monitoring which meant that, even in face of growing doubts about efficacy of their training packages, they carried on implementing The Fixed Plan. Setting one level of water flow for the Columbia River dam may be the easy thing to do, but it does not necessarily lead to positive impact.

Of course, transformative learning - where perceptions are altered through a "process of reflection and critical engagement"[30] - requires accepting the possibility of fundamental change. As mentioned in an article in the [Harvard Business Review](#), for this to happen, people need a *growth* rather than a *fixed* mind-set: seeking challenges and new learning to accept that no matter how good you think you are, you can always get better through disciplined effort and experience. In these cases, structured learning events go a long way towards closing the gap between data and action.

Principle 6: Make better decisions over time

> "Adaptive management is a means to the end of better decision-making"

Adaptive management is a means to the end of better decision-making. By iteratively repeating the adaptive management cycle - set out in figure 1, below - resource managers can be pro-active in the learning process, generating empirical knowledge about the system to reduce uncertainty and take more informed action for better outcomes[31].

In the United States, duck-hunting regulations are set on an annual basis. Each year, the Fish & Wildlife Service (USFWS) collects new information on waterfowl abundance and compares predicted to observed population sizes. Only after collecting and analysing data from aerial surveys and hunter questionnaires is a new set of regulations proposed – based on the likely effects of previous years' regulations. The USFWS acknowledges that the consequences of hunting regulations cannot be predicted with certainty, since many unknowns are involved like variations in weather conditions and the timing of migration. But by using data to update models, they can gradually optimize regulatory choices. This should eventually identify which model is most appropriate to inform effective rule-setting[32].

> "Understanding complex things is time- and effort-dependent"

Market system complexity does not mean things are so in flux that everything is impossible to understand, but that understanding complex things is time- and effort-dependent[33]. Firms come and go, economies expand and contract, new products and services grow and decline, prices move up and down. We can never act with absolute certainty, or with perfect information to-hand, but we will always have to make a call about whether, when and how act. As Allen

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[29] Re-rephrasing of Rist et al (2013)
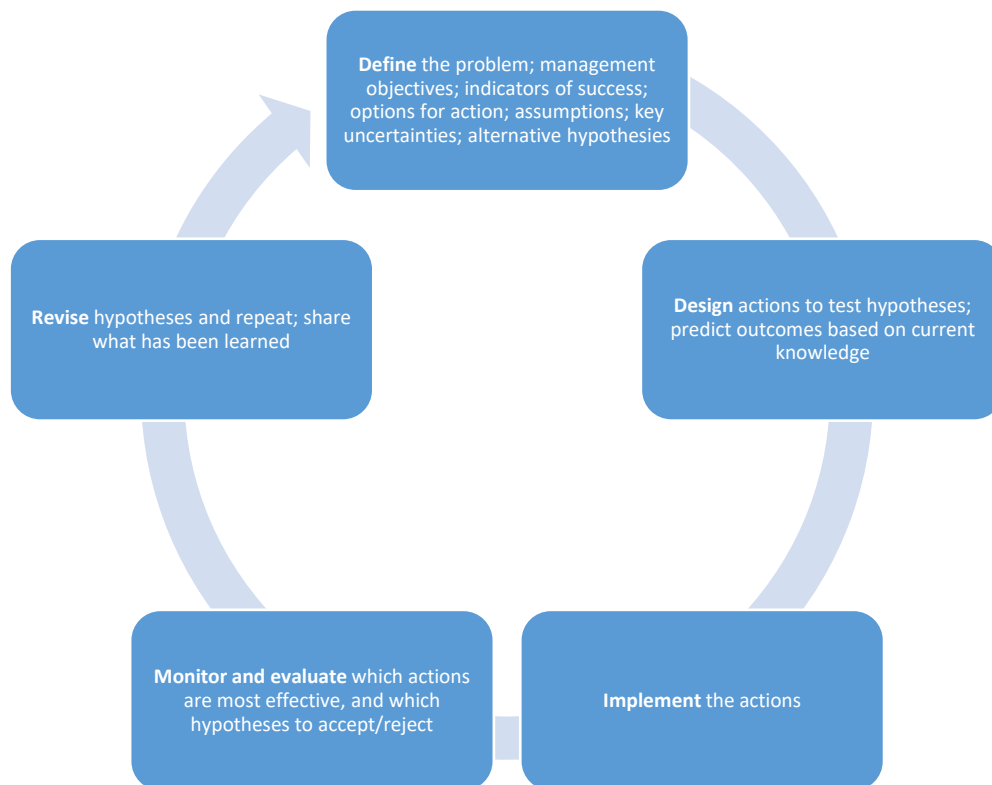[30] Armitage et al (2007)
[31] Rist et al (2013)
[32] Based on http://www.fws.gov/birds/management/adaptive-harvest-management.php
[33] Paraphrased from Ripley & Nippard (2014)

et al (2011) write: "Adaptive management is...based on the philosophy that knowledge is incomplete and much of what we think we know is actually wrong...There will always be inherent uncertainty... but management decisions must still be made"[34].

Through real-world action, and not just academic theorising, projects can learn more quickly about the system. We documented the journey taken by the 'Kuza Project', run by Adam Smith International, which aims to address selected root causes of youth unemployment in Kenya's second city, Mombasa. Kuza management knew their destination was a viable model for sustainably employing hundreds of Mombasa County youth, but their first steps towards this vision were small, and often turned out to be dead ends – since there were many complexities involved in catalysing youth-inclusive jobs[35]. Instead of passively accepting the assumptions they had identified, Kuza decided to pro-actively test them out through action research: 'delivering' short-run micro-pilots; 'measuring' quickly to gather useful information on the effectiveness of their actions as they went along; and 'learning' to draw meaningful conclusions and adapt. Kuza was recently shortlisted as a finalist for Social Project of the Year at the APM Project Management Awards, in part thanks to their embrace of a progressive approach to learning that allowed the project to make better management decisions over time.

Figure 1 – The adaptive management cycle, according to Murray and Marmorek (2004)[36]

Define the problem; management objectives; indicators of success; options for action; assumptions; key uncertainties; alternative hypothesies

Design actions to test hypotheses; predict outcomes based on current knowledge

Implement the actions

Monitor and evaluate which actions are most effective, and which hypotheses to accept/reject

Revise hypotheses and repeat; share what has been learned

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[34] Allen et al. (2011)

[35] See the MarketShare Associates paper 'Crafting Kuza: Towards a systemic approach to job creation for youth in Mombasa"

[36] Adapted version based on Murray and Marmorek (2004)

Demystifying adaptive management

In international development, adaptive management is increasingly being used as a synonym for 'flexible' or 'sensible' management. It has been hailed as the only way to manage in complex systems; and even put forward as an alternative approach for intervening in market systems[37].

But adaptive management is not just the antithesis of management by blueprint. If it does become the kind of 'adjusting as we go along' that projects should have been doing anyway - then what is adaptive management other than a repackaging of common sense? The danger is that adaptive management is placed on a pedestal as the answer to all of development's linear logframe woes, which are more to do with entrenched organisational cultures and industry-wide incentives[38].

We understand adaptive management, instead, to be a process for better integrating learning with action. Holling – the so-called father of adaptive management – formally defined it as "a structured, iterative process of robust decision-making in the face of uncertainty, with an aim to reduce uncertainty over time via system monitoring"[39]. In practice, it involves simultaneously testing different options to address a clearly defined problem where the precise cause-effect relationships are unknown[40]. It is clearly more than a management style, but not (yet) a codified methodology or tool.

The core adaptive management principles could bring significant value to market system projects - as a way to speed up learning and test multiple hypotheses about pathways towards systemic change. As Reever et al write, adaptive management is so powerful because even though multiple possible (positive and negative) outcomes are acknowledged, managers do not need to wait until they have exhaustively researched all alternatives before proceeding[41].

In this light, adaptive management can be seen as a unifying framework for some of the many innovations circling social impact: the experimentation and goal-focus of Problem-Driven Iterative Adaptation; the simultaneous evaluation of different treatment arms from randomised control trials; and the actionable insights and tight feedback loops of lean data.

But unless we develop a shared understanding by what is meant by the term, adaptive management will come to mean everything - and ultimately nothing. And without such clarity, then we may suffer the fate as natural resource science. Over thirty years since Holling introduced the term, the environmental literature is damming: adaptive management is much talked about but much misunderstood[42], confusion persists about what it actually entails[43], and it has

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[37] See, for example, the presentations at http://tinyurl.com/gsy5l6q
[38] See Maclay (2014). Entrenched international development industry cultures include placing self-preserving spin (e.g. PR success stories and politics) over substance (e.g. mission achievement or having a positive impact), burying bad news and failures, and perverse incentives include the widespread use of short-term target-hitting and input-based performance measures (such as 'grand funding received' or 'delivery rates').
[39] Holling (1978)
[40] According to Rist et al (2013), over time, active and passive came to be used as different 'versions' of adaptive management, rather than as different approaches – a significant source of confusion in the adaptive management literature.
[41] Paraphrased from Reever et al (2006)
[42] Williams & Brown (2012)
[43] Rist et al (2013)

been widely misused[44]. As a result, some say that adaptive resource management remains more aspirational than put into action[45].

So if we want to avoid adding yet another term to the long list of development buzzwords, then a good place to start would be to draw lessons from the use of adaptive management in natural resource science. It would be a sad irony if, in trying to adopt what is essentially a process to learn through experience, we fail to learn from the experience of others.

About the authors

Matt Ripley has a decade of experience leading economic growth and private sector development programmes in frontier markets. He is currently working with value-driven investors, foundations, consultancies and UN agencies to use business and consumer insights to unlock social impact. He was previously team leader for the Lab, and has also managed the agri-business portfolio for a large market systems development programme in Nepal. Matt has written extensively about the need for the international development industry to shift from an excessive focus on data collection towards more insightful data use.

Sabine Jaccard specialises in urban ecology and holds a Masters in Environmental Science from the University of Geneva. She has worked in the International Labour Organization in its Green Jobs Programme and Enterprise Department, as well as for the Impact Hub Geneva. Sabine's academic training and professional career have led her to pursue an interdisciplinary approach, focusing on environmental justice and social equity.

THE VIEWS EXPRESSED HEREIN ARE THOSE OF THE AUTHORS AND DO NO NECESSARILY REFLECT THE VIEWS OF THE INTERNATIONAL LABOUR ORGANIZATION

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[44] Murray and Marmorek (2004)
[45] Rist et al (2013)

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