



Risk Proofing Nova Scotia's Agriculture:
Grape and Wine Industry
Risk Assessment System (AgriRisk)

Report on Workshops and Start-up
March 2017



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Nova Scotia Federation of Agriculture would like to recognize the collaborative relationships that exist among Agriculture and Agri-Food Canada and the Nova Scotia Departments of Agriculture and Environment.

Introduction

At the end of March, 2017 the Nova Scotia Federation of Agriculture along with its lead partners (Nova Scotia Environment and Nova Scotia Department of Agriculture) and consultant (Tim Lynam), hosted three days of workshops to start-up its AgriRisk project (Risk Proofing Nova Scotia Agriculture: A Risk Assessment System). We¹ would like to extend a heartfelt thank you to everyone who joined us and helped to make the workshops a success. We are also grateful to everyone who expressed an interest in being involved although prior engagements or wintery conditions meant it was not possible at the time. For all of you, this summary will give you an overview of what we did at the workshops and what we achieved, as well as next steps and key milestones for the project.

In addition to hosting the workshops, we were fortunate to have the opportunity to present at the Winery Association of Nova Scotia (WANS) AGM, share information about the project at the Grape Growers Association of Nova Scotia (GGANS) AGM, and engage in 13 additional meetings to begin conversations about the project.

In the coming months we look forward to building on this early work, deepening the understanding of and engagement in the project, and integrating critical feedback from you into the AgriRisk work. We welcome and encourage feedback and questions at any time.

AgriRisk Project

The AgriRisk project, which is funded through Agriculture and Agri-Food Canada's AgriRisk Initiatives, is a pilot project focusing on Nova Scotia's grape and wine industry. The goal is to develop a user-friendly risk-assessment tool for stakeholders in the industry (e.g., growers and wineries) that assess current and future risks associated with climate change and the changing socio-economic landscape in the province. The tool will provide grape growers, wineries, and others along the grape value chain to interactively assess the impact of events (e.g., climate change or price change), and various mitigation factors or changing circumstances (e.g., changes in consumer tastes) across the chain in order to evaluate risks (or opportunities) and plan risk mitigation strategies. Using quantitative and expert knowledge based analysis the project will use a state of the art statistical modelling approach built on Bayesian Network models that merges existing data with expert knowledge. The tool will enable growers and others in the industry to easily see relationships between key elements of the grape and wine value chain. For a presentation with a straightforward explanation of Bayesian Networks please visit AgriRisk's website: <http://nsfa-fane.ca/programs-projects/agrisk/>.

Workshop Overview

Workshop 1 – Grape and Wine Value Chain Workshop: The purpose of the first workshop was to identify how key stakeholders conceive the grape and wine industry of Nova Scotia. The target audience for this workshop was stakeholders who are involved directly in the industry (e.g., grape growers and wineries). Presentations focussed on overviews of the AgriRisk project and Bayesian Network approach, and key activities involved generating an overview of the elements of the grape and wine value chain, and variables that impact it, and essential data sources that can help us understand the risks that each variables pose to the success of the industry

¹ For a list of who we are please see the list in Appendix A.

Workshop 2 – Technical Workshop: The purpose of the second workshop was to identify data relationships and key data gaps in relation to developing a Bayesian Network model of risks faced by the grape and wine industry of Nova Scotia. The focus was to confirm key parameters important for the industry and help define data deliverables for the project. The target audience for this workshop was grape and wine experts and data providers. Presentations focussed on overviews of the AgriRisk project and Bayesian Network approach, and shared the model of the grape and wine value chain that emerged from activities at workshop 1. Discussion and group work focused on identifying data sources, gaps, and synthesis.

Workshop 3 – Validation Workshop: The purpose of the third workshop was to critically review and refine the preliminary model and conceptualization of the risk assessment tool developed for the grape and wine industry of Nova Scotia. The target audience for this workshop was representatives from each segment of the value chain and to include stakeholders and data providers. The meeting was timed to coincide with the Wine Development Board meeting that afternoon, at which we were also presenting. Unfortunately the meeting was cancelled due to poor weather conditions. Presentations focussed on overviews of the project and the Bayesian Network approach, and the knowledge and engagement system we had to date. Discussion focused on identifying gaps in the preliminary model, challenges and opportunities moving forward, and next steps.

Participation

Participation in the start-up workshops and associated meetings included a wide variety of stakeholders and experts within Nova Scotia’s grape and wine value chain including academics and data providers; names and affiliations are listed below.

Organization
Grape Growers Association of Nova Scotia
Winery Association of Nova Scotia
Perennia
Devonian Coast Wineries
Vinyard at Church Street
One Ten Vinyards
Saint Mary's University
Acadia University
Dalhousie University School of Planning
Nova Scotia Department of Agriculture
Department of Agriculture
NSLC
NS Tourism
Department of Internal Services - GIS (GeoNova)
Applied Geomatics Research Group
Corporate Research Associates
Applied Geomatics Research Group
Agriculture and Agri-Food Canada
CanMac Economics Ltd
ClimAction Services

Conceptualization of Nova Scotia's Grape and Wine Industry

Nova Scotia's Grape and Wine Value Chain Components

Results of the workshops and meetings combined with a review of relevant reports and academic publications has resulted in the development of a high level conceptual model of Nova Scotia's grape and wine industry as well as key processes within each component. Figure 1 on the right shows the high level conceptual model. The first workshop generated a broad acceptance of the first three components as a linked system and subsequent workshops expanded this model to add purchase and consumption to the high level concept model.

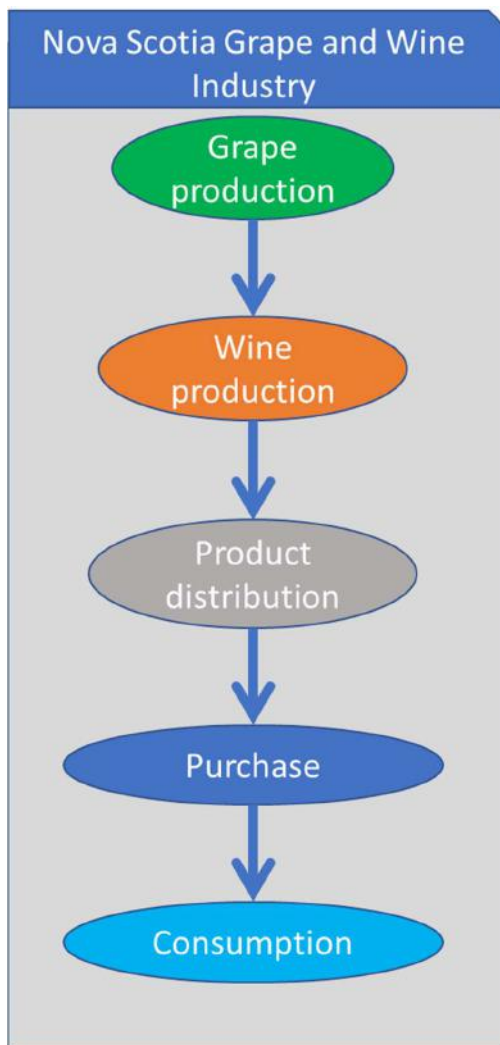


Figure 1. High Level Conceptual Model.

Key Processes Within Value Chain Components

Workshop participants identified key processes within the first three components of the model. These can be found in Figure 2 below. Within the grape production component of the model, key processes include site selection, soil preparation, root stock/variety selection, planting, trellising system, equipment selection, vineyard management, pest management, and harvesting. Key processes identified in the second component – wine production – include communication between grower and winery, the assessment of quality, fermentation, treatment pre-bottling, and bottling. Distribution component processes include transport, storage, packaging, display, and the provision of information. The development of an understanding of key components within the purchase and consumption components is in progress. These components and their key processes will provide the foundation of the Bayesian Network model that we will use to explore the risks in the grape and wine industry of Nova Scotia.

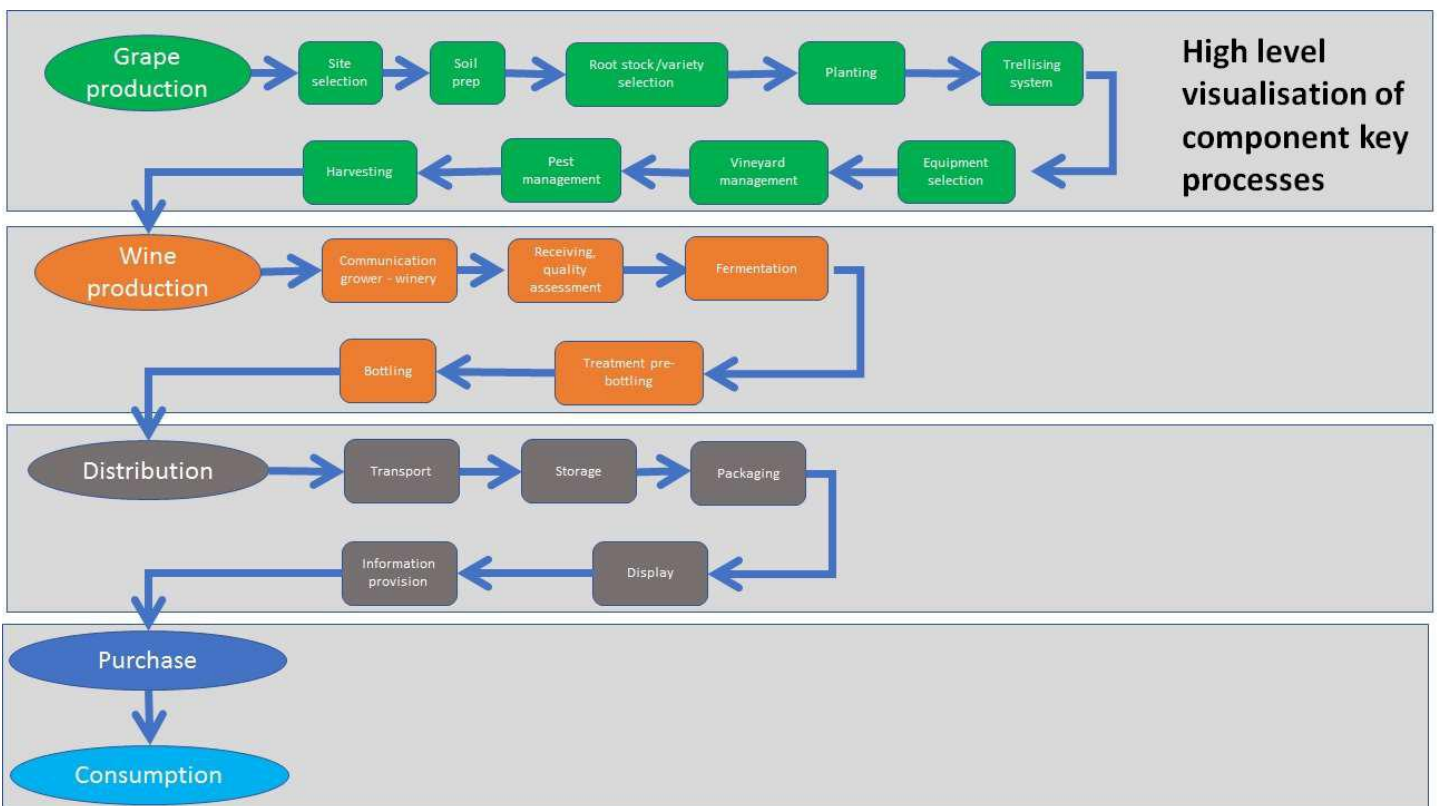


Figure 2. High Level Conceptual Model of Nova Scotia's grape and wine industry showing details within each component. This is a process oriented conceptual model which shows the key processes that underpin grape and wine production, distribution, and consumption.

At the moment the components are at varying stages of development and this is because of the complexity of the components and also because of the degree to which we have been able to work with stakeholders including growers and wineries. The process is ongoing and we are continuously seeking insight into refining it. If you have insight about how to improve it please let us know. The goal is to end up with the best possible model of the industry so the resulting risk assessment tool will be useful to all stakeholders within the industry.

Deeper Understanding of Key Processes - Site Selection

At the workshops participants we were also able to help us understand the complexity that underlies some of the key processes they deal with. Due to these complexities, there will need to be some detailed models nested within certain component of the model in order to get a better understanding of the variables within them that present risks (or opportunities). For example, workshop participants highlighted the importance of site selection in the grapes production process and the factors that need to be considered. Figure 3 below shows a detailed model of key variables that influence site selection for growing grapes. Variables fell within three clusters: climate, soil, and landscape elements. The climate cluster includes growing degree days, frost free days, and days below three critical low temperatures. Soil suitability is influenced by soil type, depth, pH, drainage, water table depth, and soil fertility. And landscape elements include distance to a large water body, elevation, air drainage barriers, distance to winery, aspect, and slope. The goal will be to have conversations with growers and wineries to help identify which variables are important and how they should be related to each other. Existing data and expert knowledge about the variables will be needed in order to determine the extent to which they predict site suitability. The Bayesian model uses probabilities so that is what we will be aiming to understand. For example, if a site has soil type “A”, a depth of “B”, and a pH of “C”, what is the probability that site will have “excellent” soil suitability?

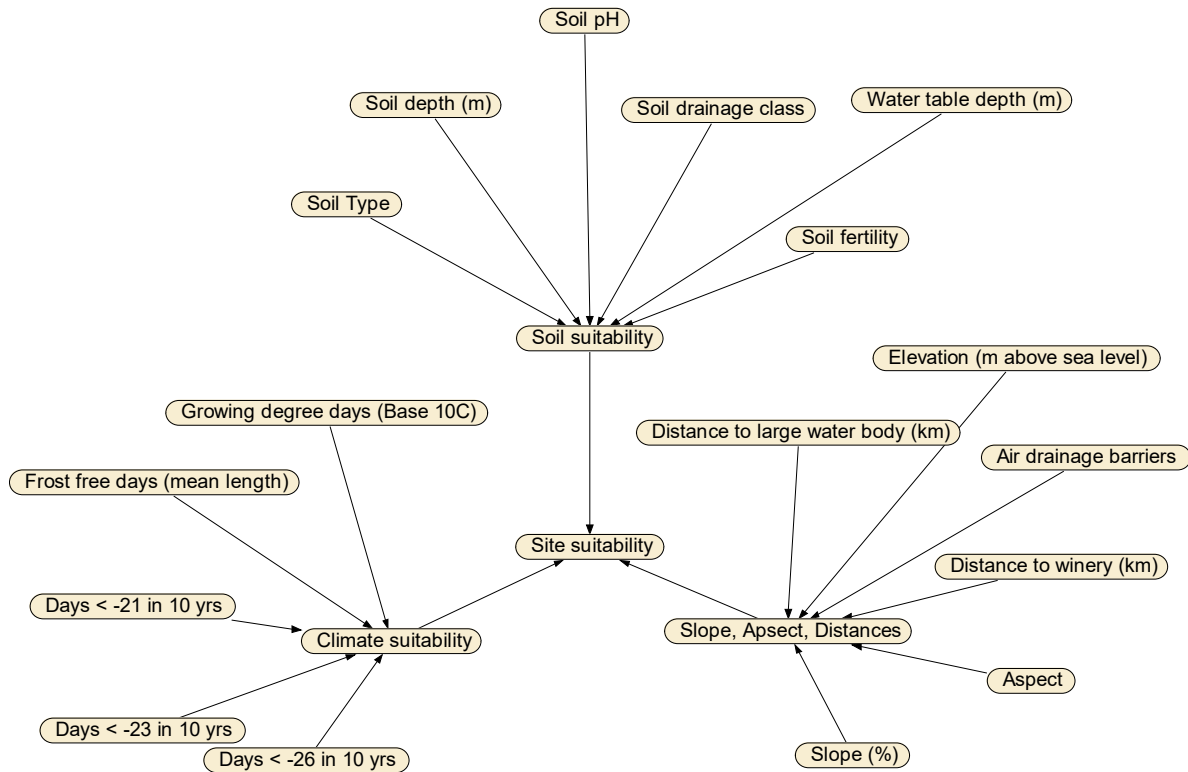


Figure 3. Conceptual model of the key variables that influence site selection for growing grapes..

The Grape Production Component Risk Assessment Tool: A Hypothetical Walk-through

In order to get a sense of how the Bayesian Network will link the processes identified by workshop participants and function as a risk assessment tool, we will do a walk-through of the grape production component as an example. Figure 4 on the next page shows the high level conceptual model as it could appear depending how it will be refined by growers and wineries.

The numbers that are used are dummy numbers that illustrates some of the possible variables and relationships for a grape yield and profit model. Blue boxes (called nodes) reflect climate variables; green nodes are management variables; brown nodes are biophysical variables and yellow nodes are economic variables. [grey nodes could be ignored for now – they are statistical parameters]. The numbers or text on the left hand side of each box are the possible states for that particular variable (note that in Bayesian Network all continuous variables like temperature, weight, or cost have to be converted into discrete variables).

The bars to the right and the numbers in the central column reflect the probability associated with each state. For example looking at the large yellow box “profit” you can see there is a 31.9% chance (or probability of 0.319) that profit takes the state “2000 to 3000”. The average (and standard deviation, or how much variation there is) profit is shown at the bottom of the profit node and equals 2480 (2300). This representation is a summary of the probability structure in the data.

When we have the actual network completed through the AgriRisk project, which will have been developed using real data and expert knowledge, and tested by stakeholders, a grape grower or winemaker will be able to click on any of the states for any of the nodes and see how that selection impacts the probabilities of states elsewhere in the grape production model. An important point to note about assessing risk using a Bayesian Network in this way is that they can simultaneously identify opportunities (such as the probability of profits exceeding a target level) as well as risks.

For a high level conceptual model of the wine production component, and the wine purchase and consumption model please see Appendix B. As mentioned before, these portions of the model are at varying stages of completion. We welcome insight in order to further understand and develop these components.

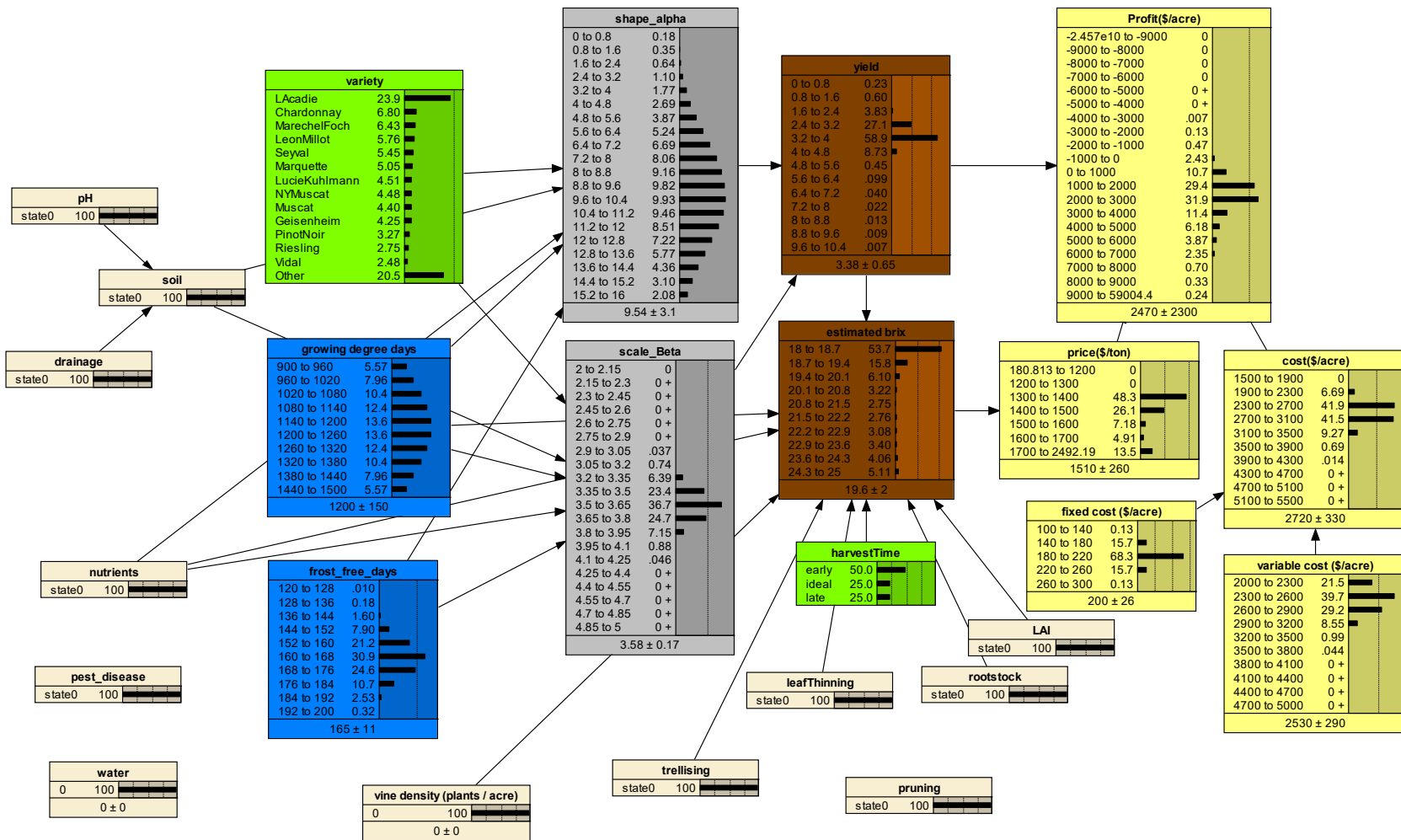


Figure 4. High level conceptual model of grape production component of the grape value chain as it could appear in the Bayesian Network risk assessment tool

Data lists

The Bayesian Network that we are developing to help stakeholders assess risks (and opportunities) to Nova Scotia's grape and wine industry runs on data. For example, climate data like rainfall, temperatures, and wind, soil data like pH, depth, drainage, and vineyard management practices like trellising, leaf thinning, and pruning, will all be used to help understand outcomes like yield and profit. Data is critical in order to understand the relationships that currently exist between these variables (what soils produce best yield for specific varieties?). Understanding current relationships is critical in order to be able to predict how yield or profit may change given changing climate and sociodemographic factors.

Through our discussions with each of you in meetings or workshops we have developed provisional data lists: lists of the key variables that will go into developing the Bayesian Network models. We are currently in the process of identifying sources for existing data and gathering it together so we can produce the models. We would be happy to share the full lists with you so please contact the Project Manager (contact information on page 13). Data lists include:

- Climate variables (e.g., growing degree days, wind extremes, precipitation)
- Biophysical variables (e.g., soil, water table depth, sea level)
- Labour supply variables (e.g., population projections, age/gender)
- Wine production variables (e.g., variety, grape yield to juice, sales, prices)
- Grape production variables (e.g., management action, yield, costs)
- Land use transition variables (e.g., land value change, land use policies, social vulnerability)

As with other aspects of the project, we welcome input on these variables lists in order to help refine and improve the risk assessment tool.

Technical teams

To make sure that we have the best possible knowledge and data going into the Bayesian Network models we have put together 4 technical teams to guide us in the collection and evaluation of all data. These teams will also ensure the quality and utility of the models and analyses we complete. We anticipate having the following technical teams with leads shown in brackets:

- GIS and spatial analysis Technical Team – Mark MacPherson (Nova Scotia Department of Agriculture)
- Economics Technical Team – Mark MacPherson (Nova Scotia Department of Agriculture)
- Grape and Wine Production – Melissa Quinn (Nova Scotia Department of Agriculture)
- Distribution, Consumption and Tourism – TBD
- Bayesian Network Modelling and Sustainability – Tim Lynam (Reflecting Society)

In addition to these quality control and advisory teams the project has an operational group and a governance group. Figure 6 on the next page shows the governance structure for the work.

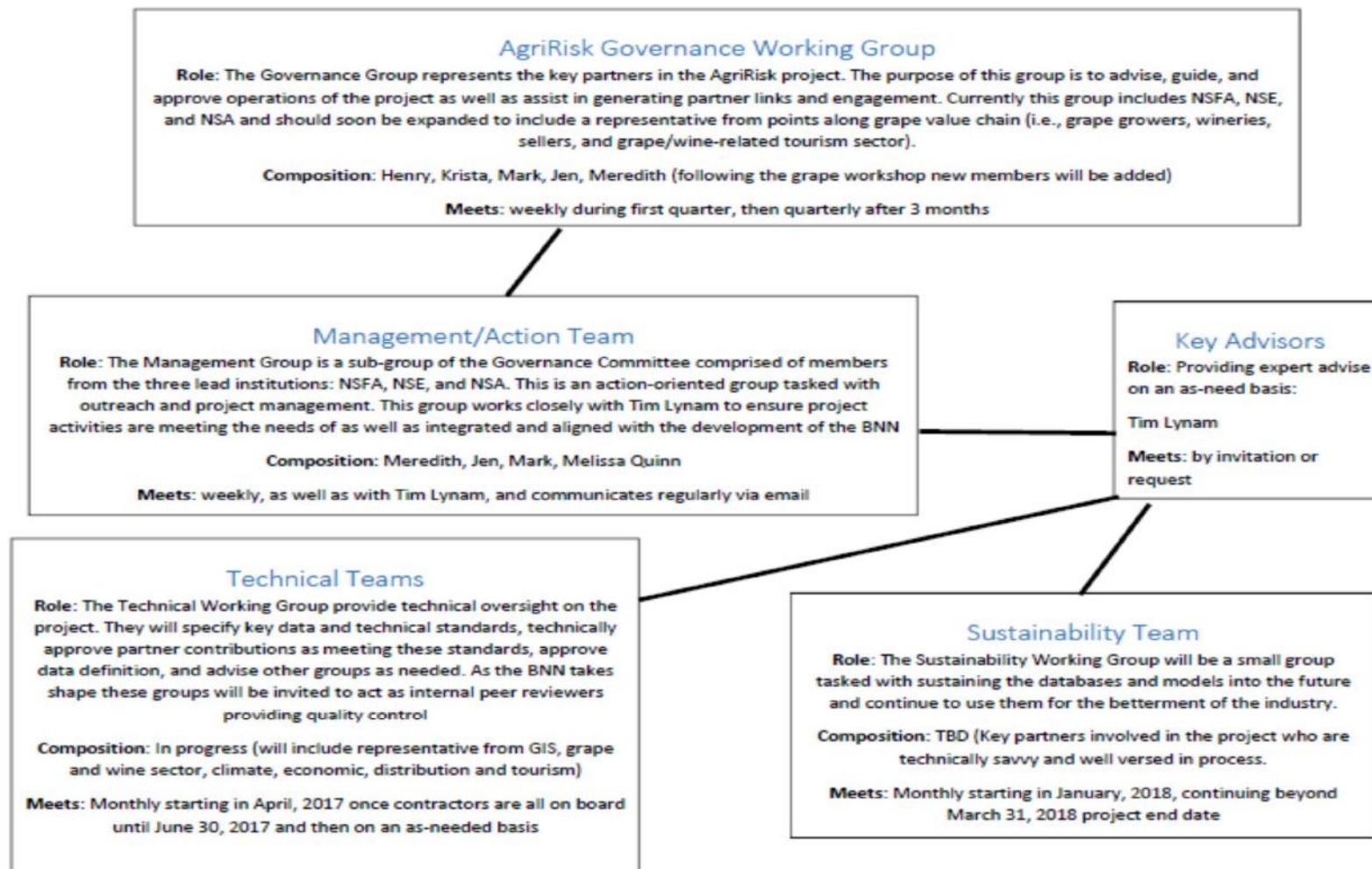


Figure 6. AgriRisk governance and advisory structures.

Next Steps

Over the coming months the AgriRisk team will be working hard to produce a high quality assessment tool during the condensed timeframe in which we have to do it. Next steps include

- Finalising all data lists and contracts with data providers
- Deepen engagement with grape growers and wine producers
- Finalise composition, meeting schedules and Terms of Reference for all technical teams
- Refine conceptual models
- Collect, collate and clean data
- Develop and test preliminary statistical models
- Test preliminary models with users
- Refine the models and develop user scenarios
- Use the models with users to explore risk scenarios
- Complete reporting and delivery of all AgriRisk products

Milestones and Engagement Opportunities

Engagement will be a critical component of the success of this work. For anyone interested in being involved in contributing to, testing, or refining the tool future workshops will provide an opportunity to do so. If you are a grower or winery who is interested in learning more or becoming involved please let us know. We would be happy to visit with you one-on-one to talk about the project.

There will be 3 main activities following the workshops and happening over the next year in order for the outcome of this work to be successful

- 1) Now to September 2017: Building the models and identifying and integrating the data. The outcome will be the preliminary model ready for testing.
- 2) September 2017: An opportunity to test and help refine the model will happen when the preliminary model is ready. Feedback and comments will be invited and welcome. We plan to have a workshop or feedback session where users will have the opportunity to look at and comment on the model
- 3) January/February 2018: The model will be refined. We will have an analytic workshop at this point where users will be able to work through scenarios and see how the tool can be used.

Sustainability of the tool will be important. In the next few months we will be developing a sustainability team to help ensure the tool is updated and maintained as it is continued to be used by stakeholders.

For more Information

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<http://nsfa-fane.ca/programs-projects/agririsk/>

Appendix A – Who are we?

Throughout the report there is reference to “we”, which is not very specific. The list below shows you who we are.

Name	Organization
Henry Vissers, Executive Director	Nova Scotia Federation of Agriculture
Meredith Flannery, Project Manager	Nova Scotia Federation of Agriculture
Jen Graham	NS Department of Environment
Kevin Bekkers	NS Department of Agriculture
Mark MacPherson	NS Department of Agriculture
Melissa Quinn	NS Department of Agriculture
Janice Plumstead	NS Department of Agriculture
Tim Lynam	Reflecting Society

Appendix B – Wine Production & Wine Purchase/Consumption Model

