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AIO supplements 2021

Donor Portfolio Management for Sustainable Agricultural Projects

SUSTAINABLE DEVELOPMENT GOALS

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AIO supplements are produced to identify critical trends in the solutions to challenges to the performance of the agricultural sector and to identify needs to improve practice to sustain a growth in beneficial agricultural innovation.

Agricultural innovation is the result of processes being carried out in a different way for the first time in a given location. Where the innovation has impact on performance and is more efficient, the dissemination of the innovation, across geographic space, results in economic growth. However, today, the emphasis on sustainable economic growth signifies that beneficial innovations need to integrate efficiency and financial performance with securing rising real incomes, sustainability and lower carbon footprints.

With the advent of Agenda 2030's 17 Sustainable Development Goals there has been a move to align sustainable project portfolios with the priorities established by national SDG requirements.

Based on regular editorial reviews of published articles Agricultural Innovation has completed analyses to filter out essential messages from wide ranging content and multiple conclusions.

As a result of this process conducted through 2020-2021, we have identified a common theme linked to two operational areas that are essential to maintain an adequate rate of advance in applied innovation. These areas are:

- ***Donor and investor portfolio management***
- ***Sustainable project design and implementation management procedures***

Although distinct and involving different groups of practitioners these remain very closely linked and project and portfolio performance rely on a close coordination between each one.

Therefore, this year's Supplements focus on these leading issues.

This Supplement covers our findings in the field of ***donor and investor portfolio management.***

An accompanying Supplement concerning project design and management under the title,

"Design & Management for Sustainable Agricultural Projects"

Is available.

Supplements are designed to highlight key emerging issues under the title of each Supplement. The key issues and solutions are outlined and associated issues mentioned in note form only.

Editorial
Agricultural Innovation
July, 2021

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Agricultural Innovation is a medium of the Agence Press Européenne (APEurope) Group dedicated to the dissemination of information concerning relevant advances in knowledge and practical improvements in the state-of-the-art of agricultural practice with an emphasis on innovations contributing to the safeguarding of sustainable economic development.

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Portfolio Management of Sustainable Agricultural Projects

This edition summary

In 1992 and 2010 reports on reviews prepared by the World Bank on thousands of projects in their portfolio the failure rates for agricultural projects was found to be around 43%.

Because of defects in project design procedures and limitations in evaluation procedures at the project level, portfolio managers face the problem of managing without adequate information.

Portfolio management is the gateway and means of improving the quality of projects being funded. Project design and evaluation procedures need to be brought up to an operational level that improves the relevance of information for better portfolio management decision making.

In 2010, following the last World Bank report on the performance of their project portfolio, the OQSI (Open Quality Standards Initiative)[1] *initiated a decade long review of project cycle and portfolio management practice to identify gaps and to specify improved project design procedures and analytical methods and to propose practical means of delivering these through a coherent and effective project cycle management system.*

The challenge was to improve project level design and operational performance to levels of detail and relevance to provide an enhanced quality of information to support portfolio management and policy decision analysis.

The result of this effort was a new due diligence design procedure, supportive analytical methods and a set of specifications for a cloud-based software-as-a-service system SDGToolkit.

This edition provides a rundown on the principal findings of this work and describes some of the principal solutions of relevance to portfolio management.

Agriculture and Sustainable Development Goals

The Agenda 2030 Sustainable Development Goals (SDGs) are not sector-based but are based on what were previously referred to as cross-cutting issues. As a result, there is no common agricultural sector or project model to provide baseline orientation for project design procedures or guidance on all of the different SDGs and their indicators. The record shows that before Agenda 2030 was launched in 2015 agricultural project teams faced some difficulty in embedding cross-cutting issues into projects[2] that had well-defined principal objectives.

Agenda 2030 timing

[1] OQSI-Open Quality Standards Initiative was established by the George Boole Foundation Limited in 2010 to review project cycle management standards and to propose improved procedures and analytical methods for project design and implementation management

[2] OQSI, *"The Impact of trends in the international development environment on project performance"*, HPC, 2020.

When Agenda 2030 was launched in 2015, over 65% of the indicators had not been specified in such areas a climate action (SDG 13) and sustainability (SDG 12)[3]. Project cycle management guidelines had not been adapted to the new set of requirements. Indeed, the basic project cycle management guidelines had remained with little alteration for over 50 years[4].

The United Nations 2019 Sustainable Development Report noted a negative correlation between the form of economic growth and key SDGs. The critical SDGs that were not advancing were SDG 10, concerning the reduction of inequality with income disparity being a fundamental measure, SDG 12, relating to production and consumption sustainability, and SDG 13, on climate action.

A detailed review of project cycle procedures

A considerable amount of research and analysis was carried out between 2010 and 2020 by the OQSI as a component of the Decision Analysis Initiative managed by George Boole Foundation Ltd. into existing project cycle procedures. This initiative was established as a follow up investigation to enquire as to the causes of findings of the World Bank Portfolio Review of 1992[5] and the World Bank Independent Evaluation Group's (IEG) analysis of 2010[6] into the application of Cost-Benefit Analysis in projects. The 1992 portfolio review found that funded economic development projects had failure rates of around 35% and agricultural projects has failure rates of around 43%. The 2010 follow up by IEG did not detect any significant change in these failure rates,

Portfolio management

In this document, portfolio management is considered to be an operational role exercised on behalf of donors and investors who provide the funds for carrying out projects. Portfolio management has a critical role in overseeing and managing the quality of entry of projects into portfolios as well as monitoring and assessing project performance. This role depends upon other practitioners who design projects and to submit these as proposals for funding. During the operation of projects, the management is normally in the hands of project managers and team members. Project monitoring and evaluation is usually handled by independent M&E experts.

Therefore, portfolio managers need to receive reliable information concerning project proposals in the form of evidence to justify the particular project design as, subsequently, have access to adequate levels of detail and relevance of records on project performance.

The nature of project design and management requirements have changed significantly over the last 50 years. On the other hand, design and management procedures have hardly changed over the same period. Design requires experience and knowledge, not only of different cause and effect relationships across a range of disciplines but also a need for practical experience that provides a more realistic appreciation of what works and what does

[3] UN Sustainable Development Report, 2019.
[4] *Op. cit. footnote 1.*
[5] Wappenhans W., "*Evaluation of the Project Portfolio Performance of the World Bank*", 1992, World Bank.
[6] Independent Evaluation Group (IEG), "*Cost-Benefit Analysis in World Bank Projects*", 2010, World Bank

not. Many novel approaches to issues exist, but in practice, it is important to include contributions based on practical experience to avoid repeating errors of the past.

The complexity of modern project design involves social, economic and financial appraisals of different project design options which trace the impacts of each option on the physical environment, the living ecosystem and natural resources carrying capacity.

Design and operational information coherence

In assessing project designs and operational performance, the application of performance and sustainability criteria need to be detailed enough to enable portfolio managers to make informed decisions. This is because an accepted proposal becomes the project plan. A project plan's projections of expected performance become the benchmarks against which operational performance will be assessed. Therefore, there need to be transparent procedural steps to ensure a consistent standard of relevance data on all aspects of project performance. This provides the foundation for a coherent inter-project comparable data set for portfolio managers.

Standards and methods

The most widely applied project evaluation criteria are those developed by the OECD DAC[7]

These evaluation criteria have recently been extended by the addition of the criterion of "coherence". The list of evaluation criteria are as follows:

- Relevance
- Efficiency
- Effectiveness
- Impact
- Coherence
- Sustainability

Coherence, as defined by OECD DAC, relates to the compliance of a project with national policies and its alignment with other projects to avoid duplication of effort.

Resilience

The OECD DAC definition of sustainability is broad and it includes risk assessment. Portfolio managers have a specific need to understand the risks associated with each project option considering numerous factors and constraints. For this reason, the OQSI[8] added the criterion "resilience" to establish a separate and specific measure of risk assigned to each project option.

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[7] OECD-DAC is the Organization for Economic Cooperation & Development, Development Assistance Committee

[8] OQSI-Open Quality Standards Initiative was established by the George Boole Foundation in 2010 to take over the role of identifying due diligence procedures for project design and management and to specify analyses required to complete each procedure to endure adequate levels of analysis in the preparation of evidence in support of design and operational management decisions.

Procedural structures

The OECD-DAC evaluation criteria, while stated to be normative, are not supported by a detailed procedural structure on how to apply the criteria listed to different types of project event[9]. The OECD-DAC manuals do not provide any formalised guidance but make the matter of application of the criteria a question of evaluator discretion.

Work undertaken by the OQSI over the period 2010-2020 concluded that this could result in very different qualities of monitoring and evaluation assessments. This is because of such a system being too dependent upon the personal experience and habits of thoroughness of each evaluator. It was therefore possible to have two different evaluators assessing the same project coming to different conclusions; each evaluator exercising different levels of concentration of effort on different aspects of a project performance according to their past experience.

Coherence

The OQSI focus their efforts on accurate assessments of project potential and ongoing project performance. Therefore, their definition of the criterion term "coherence" is significantly different from that adopted by OECD DAC.

The OQSI emphasises the needs to portfolio manager's need to detect weak points in designs and in the operational performance in all aspects of project designs and activities.

Where coherence breaks down

Frequently plans are proposed and accepted with little attention paid to the quality of the original project design procedures or the options considered. Sometimes such details are not included as conditions of scoring for acceptable or eligibility for initial inclusion as valid proposals. Project setup is often merged with operations with most attention being given to operational task performance. As a result, setup periods can impose delays not planned for and disrupting the overall progress. Many M&E assignments do not report on operational project management decision effectiveness or do not report on the likely state of post-funding viability.

This state of affairs in unsatisfactory for portfolio managers whose job it is to keep up to date with what is happening in every project in a portfolio and to understand why there are changes in assumed performance.

Gaining coherence

To obtain this type of information it is necessary to maintain a coherence or compatibility of the application of evaluation criteria to all of the different activities that take place over a project cycle. For such information to be made available to portfolio managers it is necessary to maintain a consistent application of evaluation criteria, throughout the project cycle, applied to different types of activities and to record and report the results accurately.

[9] OQSI, "*The relevance of DAC criteria for the evaluation of development assistance*", DAI-2010-2020, 2018.

Therefore, the OQSI introduced a more formalised guidance to ensure that specific typical events or activities are evaluated. These include:

1. Project design – review of evidence used to justify the design
2. Project setup – completion to specification of tools, equipment and layout to operational status for each task
3. Operations – operational task performance in meeting project plan benchmarks
4. Operational decisions and outcomes – decisions taken in response to changes in conditions and estimates of their impact
5. Post-funding sustainability – based on operational experience, logic of adjustments to ensure post-funding economic viability and sustainability

On this basis, portfolio managers have access to a far more detailed set of reference points each with performance evaluations.

Frequency of evaluations

Under the conventional approach to monitoring and evaluation assignments some evaluation might occur just once during a project life time. Less frequently these are carried out on an annual basis, this is more common in private investments, while many M&E assignments are ex-post assessments on completion.

In the case of many M&E assignments concerning internationally funded projects, these are independent assignments carried out by specialists who have had no previous exposure to the projects being evaluated. There is, therefore, a considerable reliance on the level of detail and the quality of available documentation and having access to a well-informed team.

Operational costs

Monitoring and evaluation assignment team visits to project sites has become a high cost item. As portfolios increase in size this overhead has become significant factor in attempt to "optimise" the resources assigned to M&E.

However, as a result of Covid-19, such visits have been significantly curtailed and a gap exists in terms of resources and record keeping to maintain an effective M&E process. Covid-19 has imposed conditions that have enforced consideration of how to raise the quality of M&E information while using remote means of data collection, analysis and delivery of results.

Project Memory

The IEG and the OQSI noted that where project designs involve different departments or agencies there can be an atomization of documentation covering the contributions and the decision analysis involved. When individuals move on to other work there can be significant losses of institutional and project memory. This can be disruptive. Newcomers face difficulties in coming up to speed on project design details because of lack of documentation. In small teams, other members do not have time to spend furnishing the details newcomers require.

In many cases evaluation personnel are presented with out-of-date versions of project proposals and on occasions estimates such as the original economic rate of return analysis, in those cases where these were produced, is often missing.

To avoid such events which contribute to inefficiencies in time and resources, the OQSI recommended the creation of a central database which records all design and operational decision logic and outcomes, referred to as a ***Project Memory*** and a vital permanent source of data for portfolio management oversight.

OQSI solution

The OQSI solution is a management system that reduced the reliance of the higher cost M&E team visit-based assignments with a far lower cost remote operation. On the other hand, this system can support a portfolio management system that generates more reliable and detailed information on each project over its complete cycle. This is also associated with better comparative information on all projects in a portfolio. Any problems associated with conventional visit-based M&E frequency is resolved through real time monitoring & evaluation.

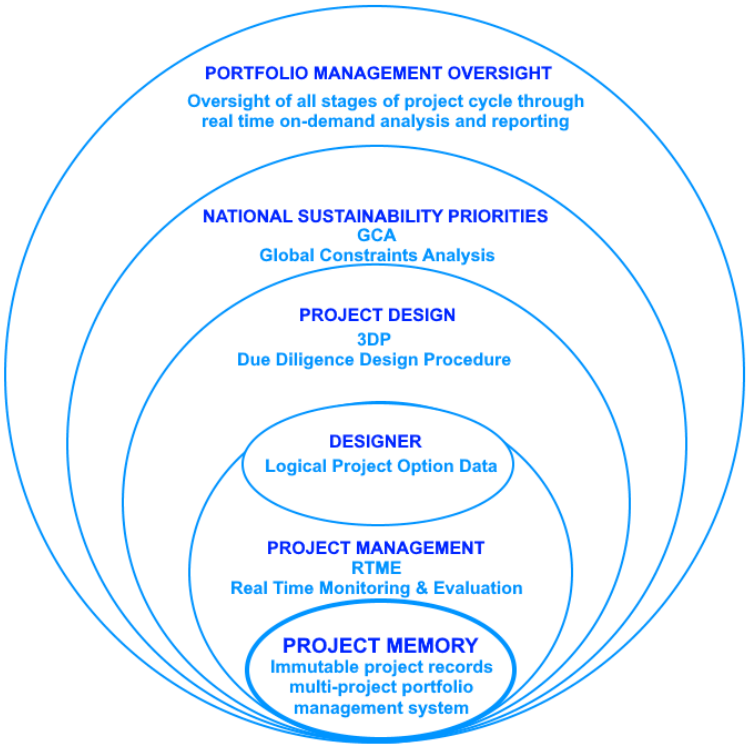
The Real Time Monitoring & Evaluation (RTME) system is part of the oversight provisions in a Due Diligence Design Procedure (3DP) which supports an on-demand analysis and reporting on any aspect of a project from design activities through to post-funding operations.

The 3DP is divided into four phases:

- GCA-Global Constraints Analysis – an analysis of national constraints to establish the project operational context
- 3DP-Due Diligence Design Procedures – stepwise analysis of critical factors and project level constraints and associated risks
- Designer – input of best feasible option as final design (proposed project)
- RTME-Real Time Monitoring & Evaluation – on demand analysis and reporting system with embedded monitoring and evaluation system

Figure 1 summarizes the layout of this system.

Figure 1: Data sets accessible for portfolio management oversight



Monitoring and evaluation system, details of relevance to portfolio managers

The Designer module contains the project design or plan in terms of number of tasks, processes involved, durations, physical, information and human resource inputs and values, output specifications and timeline/schedule.

The RTME contains modules for internal monitoring and evaluation of:

- Project design procedures and collected decision analysis data
- Task performance in establishing readiness of system to initiate operations (setup)
- Task performance completed at scheduled end of each task (activity)
- Decisions in response to changing conditions and the results of the decisions
- Adjustments made to operational plan/structure to ensure long term post-funding sustainability

The evaluation of the basic plan which would be the project proposal is accomplished by access to the information content of the GCA and the 3DP which contain all of the contributing analyses of the evidence-base for justifying the selected project option (Logical Project Option).

Therefore, portfolio managers can have access to a very detailed set of data upon which to base their own assessments and decisions.

The specific benefits of internal evaluations

The OQSI system configuration significantly increases the involvement of project teams in internal monitoring and evaluation tasks. M&E is regarded as an essential component of overall professional on-the-job training. Use is made of a design system supported by analytical tools that help build an involved team with a detailed knowledge in the operation of their project gained through instructional simulation of design options. This develops a team interest in evaluating to what degree analytical tool projections turn out to be correct or otherwise. This approach helps create a positive approach to subsequent evaluations as a means to test and learn more from the relationships between design intent and observed and measured outcomes. This can dispel what can be perceived to be negative attitudes towards external M&E assignments.

In those cases where external evaluations occur, on a visit-based or remote access, the external evaluators benefit from the resources of the Project Memory and RTME as well as dealing with a very well-informed team.

Overall, the combination of due diligence design procedures supported by analytical tools and the level of evaluations conducted during the project cycle are considered to be an excellent on-the-job-training environment for both novice and experienced team members helping build team cohesion and advancing the state of professional competence.

Learning systems, innovation and sustainable economic growth

The configuration of the OQSI due diligence design system and the configuration of analytical tools was created as a learning system based on the process approach recommended by the

ISO[10], BSI[11] and modelled on the long-established operation of agricultural extension systems. Annex 1 provides more information on this approach.

Lessons learned and innovation

The level of detail in the project design phases (GCA and 3DP) will contain information on leading edge and state-of-the-art technologies and techniques input by the practitioners as part of following the due diligence design procedural sequence. The subsequent RTME detailed evaluation records will assist in gaining a close to real time determination of lessons learned including benefiting the ongoing project as a result of this knowledge in supporting operational decisions under changing conditions. As a result, the level of detailed information available on lessons learned associated with project design is made readily available to portfolio managers. For each project it is possible to build a map of what has worked well, what was problematic and what risked or caused outcomes to be below expectations.

Because this information contains evaluations of project cycle phase-associated activities it is possible to also determine the competence of teams and decision makers in handling different types of issue ranging from design, benchmark-based performance evaluations and effectiveness of operational decision making. The way each of these turns out provides valuable insights for portfolio managers in establishing criteria for future project design evaluation and operational standards for the conduct of operations.

As a result, portfolio managers as portfolio gate keepers, can manage a refined process of advancing the quality and relevance of the knowledge base on levels of innovation in new projects associated with a better assessment of risk.

Addressing the principal Agenda 2030 project portfolio performance gaps

The 2019 Sustainable Development Report drew attention to the failure to address income inequality, sustainability and climate change effectively. The OQSI include these factors in the 3DP procedural steps. However, for project teams to input the appropriate information to close these common design content gaps, the OQSI developed analytical tools that are referred to as Options Benefit Analyses (OBA). These cover the issues in question to ensure that each is addressed in project designs. The OBA series, so far, include:

- OBA1 – standard Cost-Benefit Analysis
- OBA2 – Cost- Real Income analysis
- OBA3 – Cost-Carbon Footprint analysis
- OBA4 – Cost-Carrying Capacity analysis

OBA1 and OBA2 are referred to as Economic Rates of Return (ERR) analyses and OBA3 and OBA4 are referred to as Rates of Return to the Environment (RRE).

Annex 2 shows the OQSI Project design SDG critical path, a reference diagram into which the ERR-RRE trade off can be observed.

[10] ISO-International organization for Standards; ISO 9001 – process approach. Elements are closely related to minimum defects and minimum risk approaches to decisions making on projects.
[11] British Standards Institute.

Some relevant details associated with climate change

Although climate specialists and governments have established a target on permissible average temperature rises at 1.5ºC. The rise of less than 0.5ºC over the last 50 years has already had important negative impacts on agricultural production and production sites. See Annex 3 for an example of coffee production in Brazil.

The effect of seasonal variations in rainfall and temperatures can result in year on year variations in both of around +/- 15% above or below "average" trend lines. All regions experience seasonal cycles of temperature and rainfall extremes over irregular cycles of about 4-5 years duration. As a result, in seasons with raised temperatures, the actual temperature can rise by at least 5ºC above the moving average. This can result in an accelerated rate of evapotranspiration and loss of water. Often, in such seasons, yields are low, some crops fail and famines can result. This likelihood is increasing as the moving average temperatures rise. The reality is that many crops which were previously adapted to their local environmental conditions are being subjected to increasing temperature and water deficit stress. This is creating a state of affairs where average potential yields are declining.

In terms of project financial and sustainability performance it is necessary to proactively select crop genotypes or varieties that are more heat and drought tolerant in order to reduce the seasonal impacts of temperature extremes. The trade off is that in rainfed conditions, heat and drought tolerant crops tend to have lower yields/ha.

Altitude is an important variable because with each gain of 100 metres in altitude average and seasonal extremes fall by around 0.6ºC. As a result, altitude can have a significant impact on the yield potential of a specific crop as well as the resulting annual availability of water to the crop.

Lastly, soil texture is referred to as a locational-state factor since the water holding capacity of soil[12] varies with its texture classified on the basis of sand, silt and clay content (a particle size classification). As a result, the amount of water available to plant roots varies with soil texture and temperature that drives the levels of evapotranspiration of water into the atmosphere to determine the annual water deficit[13].

The interaction of water availability, temperatures and altitude are shown on a decision analysis model in Figure 3.

Locational-state genotypic sequencing

The significance of this phenomenon is that economic and financial projections on expected project performance, based on standard production systems, are generating over-optimistic estimates of economic rates of return (CBA-Cost-Benefit Analysis). It is necessary to adjust expected cash flow projections according to the feasible performances of selected genotypes for a proposed production system in any given location[14]. The OQSI has proposed a practical analytical procedure known as ***locational-state genotypic sequencing*** as a requirement in the process of optimizing project designs. This is a fundamental step in reducing risks

[12] Sandy soils allow water to drain away, silt has a better water holding capacity and clays can bind water molecules so tightly (high tension) that a plant cannot use the water.

[13] Annual water deficit is a calculation to determine the overall availability of water to a crop. It is the difference between rainfall and the total of run off and evapotranspiration.

[14] McNeill, H. W. "*The Role of Micro-Bio-Climatic Zoning & Genotypic Mapping",* SEEL, July, 2009.

associated with declining yields within a probability map of highly likely occurrences during the operations of any project.

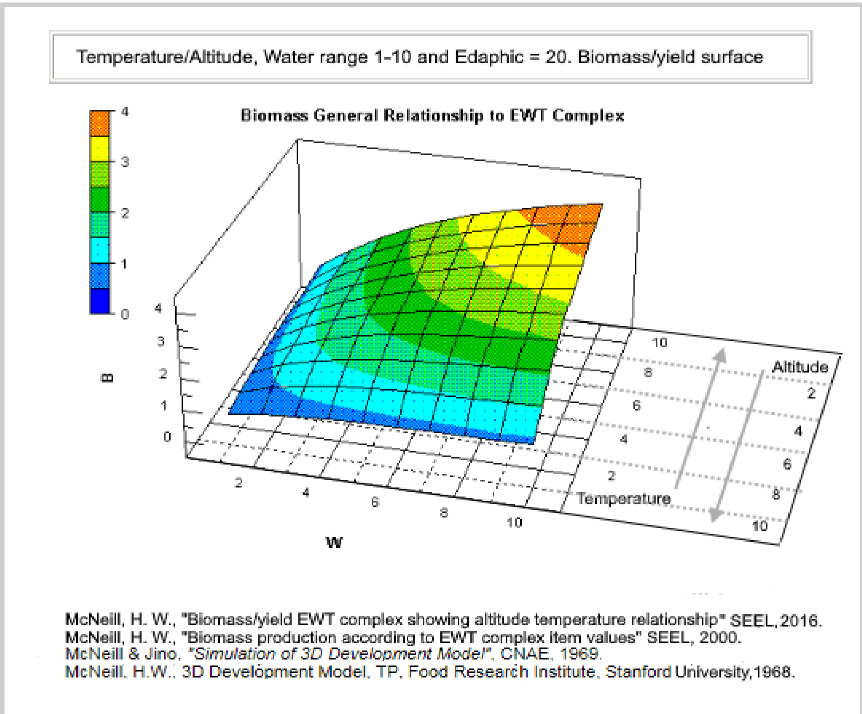
The OQSI has included LSGS as an essential step in project design and this is linked to the evaluation criterion of “resilience” as an economic basis for calculating costs associated with optional production system risks

Genotypic sequencing is reliant on what are referred to as locational-state variables[15] which include:

- the moving average and seasonal variances in temperatures and rainfall
- site altitude
- soil texture

These variables define the bioclimatic parameters that demarcate agroecological zones each of which can be used to identify the crops adapted to such zones. The important detail, added by the OQSI procedures is the accommodation of the fact that average temperatures are increasing and seasonal variations, for which data exists, are accounted for in yield and cash flow projections used to determine income and economic rates of return.

Figure 2: Example of a projection generated by a decision analysis model showing the relationship between locational-state variables and biomass (yield)



Where:
B is biomass or yield;
W is available water;
T is temperature corrected by altitude;
E is edaphic(soil fertility and texture fixed at 10)

[15] Locational-state is a term derived from Locational-State theory which is concerned with the relationships between the states of variables which vary with their location in space (coordinates: longitude, latitude and altitude) and time (chronological and age of target variable e.g. plant or animal)

Cash flow projections

The IEG in their 2010 Review of over 2,000 large projects, noted that the use of economic rate of return (ERR) estimates such as cost-benefit analysis (CBA) had declined. By 2010 only around 20% of approved projects by the World Bank had been subjected to ERR calculations.

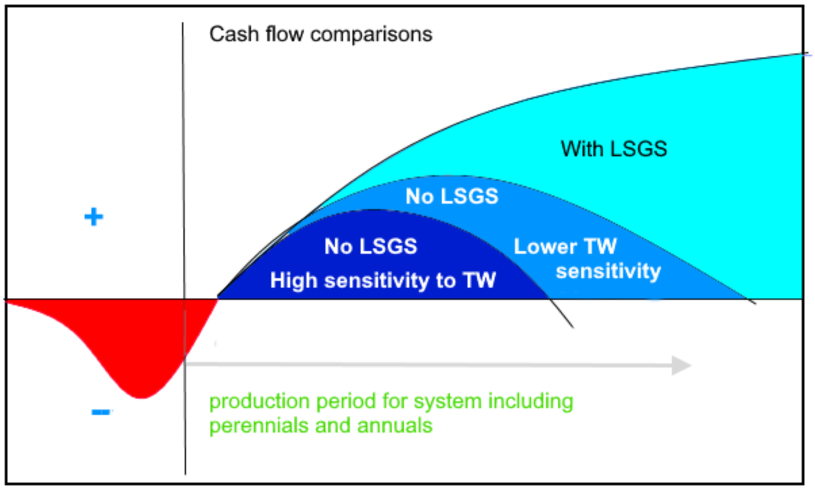
They also noted that amongst those projects applying ERR analysis only one appeared to have completed this procedure correctly.

The IEG reasoned that one reason for the reduction in use of ERR was the fact that many projects have output that is difficult to price and therefore cost-effectiveness was a more suitable basis for potential performance appraisal.

The OQSI, applying their analysis to agricultural projects considers this logic not to apply because of the production of tangible goods and sometime services which can be priced. Since the inputs used in establishment and operations of projects can be costed OQSI considers pricing of output to have an essential role to conduct comparative analysis of production system options in terms of comparative financial risk.

The OQSI also noted that there had been no adjustment to the reality of crop yield declines under climate change. In fact, when this analysis was complete in 2010 through 2020 the Bank had not introduced any consideration of these factors in their recommendations for EER calculations. Figure 3 compares cash flows of projects making use of LSGS with projects no adopting this approach.

Figure 3: Comparison of cashflows of production projects with production systems adjusted through locational-state genotypic sequencing (LSGS) and production systems with crops with different levels of sensitivity to temperature and water stress (TW)



Handling complexity and the Project Memory

Whereas these analyses of increased complexity are essential steps in project design, portfolio managers do not have to become concerned with this level of detail, indeed, this would probably not be possible on even small project portfolios. All of the procedures and their results are recorded and therefore the role of the portfolio manager is to check that procedures have been completed satisfactorily.

The OQSI have established that the RTME system provides analyses and reports for portfolio managers in narrative, tabular and graphic formats. The narratives are human readable text-based content generated by the RTME system. OQSI has recommended the inclusion of automatic narrative generation in order to avoid misinterpretation of complex analyses. As a result, the portfolio manager is provided with a clear guidance as to the thoroughness with which each design procedure has been completed together with the risk analysis mentioned under the resilience rubric.

All data from all phases of the 3DP is held in a Project Memory. Therefore, there is a unique source of information on all aspects of a given project.

The Project Memory has other benefits which have been included to respond to observations made by the Independent Evaluation Group at the World Bank concerning loss of data and data atomization and missing original project financial projections and he circulation of different versions of project documentation. The other safeguard is that new members of teams replacing others who have moved on, can come up to speed in a relatively short period by accessing the Project Memory data and thereby reducing the institutional memory loss caused by the loss of key personnel.

Annex 1: Learning systems, innovation and sustainability

The OQSI base the logic of the overall 3DP and associated analytical tools on the process approach applied by agricultural extension systems for many years. This approach is now a standard promoted by the ISO, and BSI as well as OQSI.

The process approach is the basis for quality management such as zero defects approaches to repetitive tasks such as manufacturing.

However, the approach is applicable to a wide range of tasks and is the basis for learning and a constant refinement or innovation in tasks.

In terms of learning this approach is based on an original concept for on-the-job training of young agricultural researchers by the Strides Foundation[16] established by Nakhlatec.se. The George Boole Foundation extended the practical aspects of this approach as a basis for on-the-job training for project teams managing sustainable agricultural economic development projects for the SDG environment.

The repetition of tasks follows a sequence of planning what to do, doing it, checking to see if intended results are being achieved and then taking actions to adjust the planned techniques for carrying out the task and repeating the process as illustrated in Figure 4.

A considerable amount of the logic applied to OQSI recommendations for procedures as well as the overall configuration of the procedural steps and analytical tools are based on work developed at SEEL-Systems Engineering Economics Lab[17].

Seminal work by technologists and economists established that around

Figure 4: Process approach to training

[16] STRIDES-Scientific Training & Research Initiative for Development, Education & Sustainability proposed on-the-job training for young researchers and was developed by Nakhlatec.se in collaboration with Navatec.com. Navatec.com updates involved a change of name in 2019 to SDGToolkit.com.

[17] SEEL-Systems Engineering Economics Lab as established in 1983 to monitor global network applications technologies. Since 1986 SEEL has been a leading decision analysis techniques development centre basing its initial research work on the output of the Decision Analysis Group at Stanford Research Institute. Staff also worked on the learning systems development work at the Information Technology and Telecommunications Task Force established to develop practical applications in knowledge engineering (AI) in all sectors of the economy including agriculture.

80% of economic growth is derived from the learning through completing repetitive tasks so as to develop individual competence or skill (tacit knowledge) as well as through observation and monitoring of performance generating data and information (explicit knowledge). These type of knowledge, practical and intellectual, invariably result in people identifying better ways to accomplish tasks in the form of innovations that save energy, time and resources. As a result, this form of innovation results in higher productivity and real output and economic growth.

The structuring of work sequences to maintain a learning system is beneficial to all levels of competence from novices to very experienced individuals and results in all involved constantly refining their ability to carry out all tasks in an increasingly competent fashion. For this reason, the OQSI due diligence design procedures have the sequence observed and the analytical tools enable the simulation of design options to promote instructional simulation. This is one of the most effective ways to generate understanding of a project options before committing funds and resources and facing any attendant risks. As a result, the system is not only an integrated development environment it is an environment that promotes innovation because it is a learning system. As a result, the adoption of this system helps all concerned learn and constantly improve their abilities in project design, operational task management and decision making and improvement of the quality of data generated in all phases of the project cycle.

Because of the complexity of the design and management of agricultural projects that need to achieve performance targets across a wide array of performance objectives and criteria including social, financial, environmental and sustainability, a learning system based on the process approach is the best means of avoiding mistakes and reducing risks.

The OQSI has summarised the benefits of the learning system based on the process approach to include:

- Integration and alignment of all processes to achievement of national and project objectives
- Efforts remain focused on process effectiveness and efficiency
- Improvement in the effectiveness of portfolio management
- Improvement in the confidence to donors and management in the gradual improvement in portfolio performance
- Improvement in the confidence to donors and management concerning the constant improvement in reliability and performance of teams
- Transparency of all operations and their performance across all project cycle phases
- Learning contributes to lower costs, reduced delays and more effective use of resources
- A measurable improvement in the consistency and predictability of results
- Constant realizations on ways to improve overall performance
- Full team involvement, commitment and ownership as a result of well-defined responsibilities
- A constant advance in professional standards and capabilities

Technical spin-offs

SEEL has developed two important spin-offs to enhance the effectiveness of learning system operations and analysis.

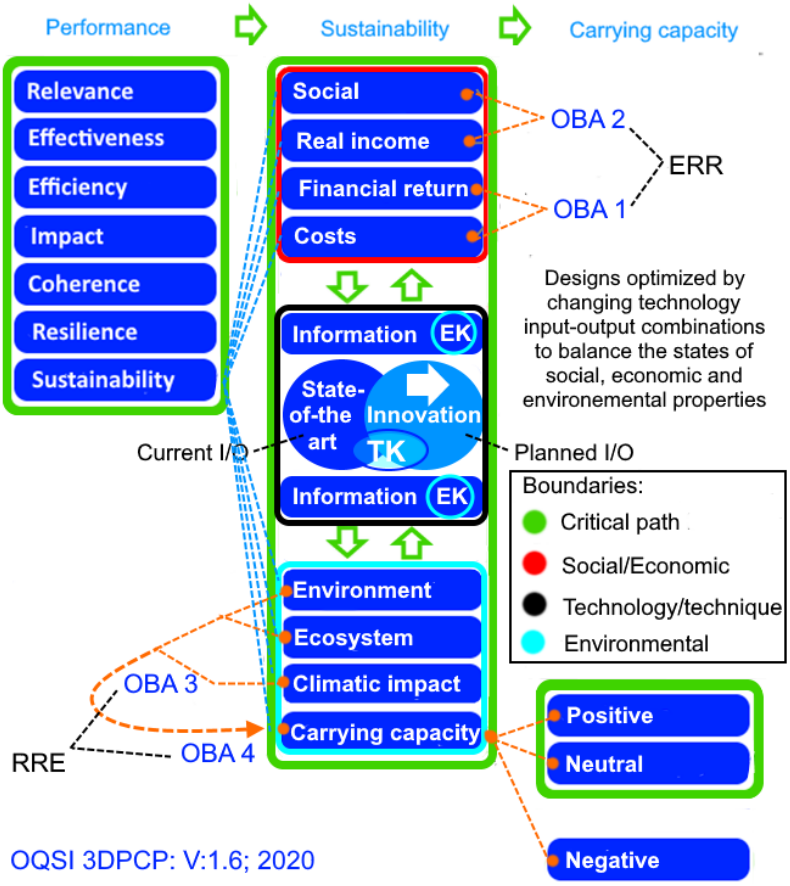
One is the Accumulog an immutable database section identified in 1986 and used to accumulate data in Project Memories. This has blockchain characteristics.

The other is Locational-Stage Theory (LST), also identified in 1986 as a way to improve the quality of target datasets for agricultural decision analysis models. In terms of agricultural applications, LST helps improve the quality of datasets by increasing the explained variance in datasets. LST is used to identify incomplete datasets and to specify complete datasets depending on the application.

The natural resources locational-state data collected for applying locational-state genotypic sequencing is based on this theory.

Annex 2: OQSI Project design SDG critical path

Figure 5. The OQSI project design SDG critical path



The OQSI project design critical path[18] is a work in progress and therefore evolving*. **The latest version will be different from that shown here***.

By way of explanation:

- There are two sets of criteria, performance and sustainability set out as vertical columns
- The sustainability performance links to the different sustainability criteria which are divided into social/economics, technological/technique and Environmental
- EK refers to explicit knowledge (data, information and cause and effect knowledge)
- TK refers to tacit knowledge the human resources capabilities in carrying out both physical and intellectual tasks which over time improve creating the constantly evolving foundation for innovation
- ERR refers to Economic Rates of Return to a project based on CBA incorporating LSG

[18] Decision Analysis Initiative 2010-2020 Final Report, George Boole Foundation, September 2020.

- RRE refers to Rate of Return to the Environment to determine carrying capacity impacts

- LSGS is Locational-State Genotypic Sequencing

Annex 3: The impact of recent temperature rises on coffee production in Brazil.

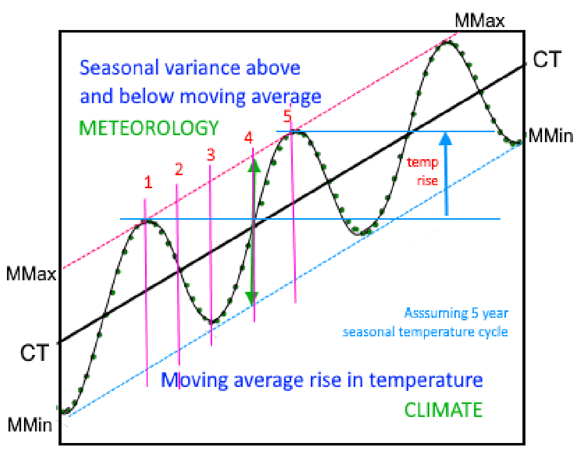
Between 1975 and 2015 the main centres of Brazilian coffee production have had to migrate to different locations as a result of changes in temperature since 1975.

By 1975, coffee production in the State of Parana was being reduced because of the frequency of frosts impacting coffee production. This had important consequences because Brazil was the world's largest coffee producer and exporter.

Production moved to a warmer frost-free zone in North East Sao Paulo State. By 1985-1990 coffee production in North East Sao Paulo was failing as a result of reduced yields and occasional failures to produce. The reason was that annual temperatures above 33^{o}C were killing the coffee flowers and therefore preventing the formation of fruits or coffee berries. Between 1995 through 2015 coffee production moved to higher altitude regions in the State of Minas Gerais which, because of the altitude were cooler and not subject t flowering seasons with temperatures exceeding 33^{o}C. In the meantime, with continued temperature rises, the frequency of frosts in Parana has declined to insignificance resulting in coffee production beginning to return to this region.

The evidence climate change in terms of rainfall intensity linked to temperature rises is particularly evident in rain fed agricultural production systems. The important message is that unless care is exercised in the selection of crops for production in any specific location there is a risk that within a decade, conditions will have changed to such an extent that the production of some selected crops is no longer feasible. This is because of the ecophysiology of the crop, linked to its genetic makeup and DNA is no longer able to adapt to seasonal variance in temperatures and water availability in terms of maintaining yields or even having any yield at all. Basically, the agroecological classification that was applicable at the initiation of a project is in transition and, as a result, the agroecological conditions will have changed, impacting yields and costs within a decade.

Figure 6 Seasonal variance of temperatures and rainfall on rising moving average temperature

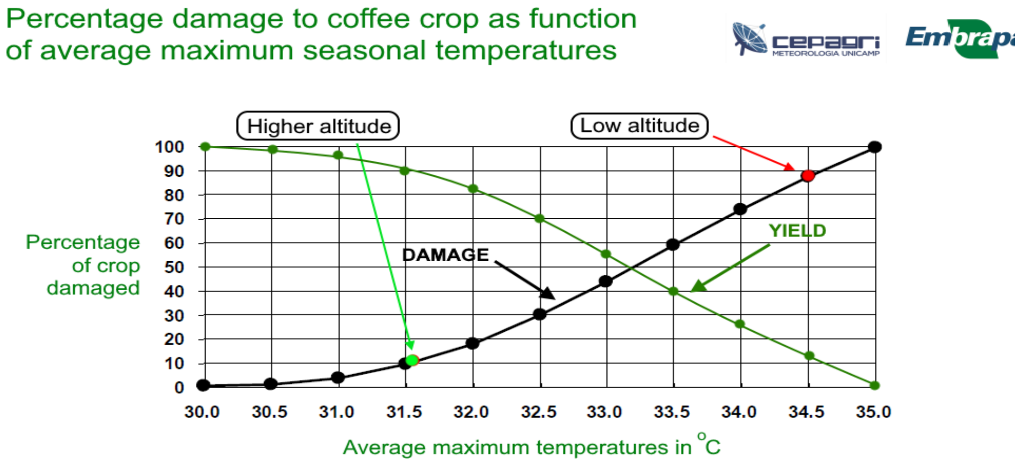


This has significant implications for the decision analysis applied to agricultural projects in terms of the selection of production systems that combine sustainability with financial feasibility, while allowing for the adjustments that need to take place under changing bioclimatic (agroecological) conditions.

Currently methods applied in agroecological zoning are based principally on calculations based on the slow-moving changes in average annual temperature and rainfall regimes. Agroecological zoning, such as those applied by FAO, are ***climatic*** agroecological zones, they are based on a moving average of temperatures recorded. However, this ignores the varying impacts of this are a direct function of ***seasonal or meteorological variance around the moving climatic averages***. Depending upon the region and local conditions there are seasonal cycles in levels of rainfall and ambient temperature that seem to alternate over cycles of a 4-5 years on average. So, around the moving average of temperature and rainfall CT-CT there are seasons when variance is negative (below average) MMin-MMin and others when it is positive (above average) MMax-MMax so both temperature and rainfall can vary over a large range, in either direction and independently, by a factor of at least 15% around the moving average. So, a peak average temperature during the flowering period of coffee, based on a climatic agroecological zone, might be 30ºC but in a warmer seasonal peak, in a time series of average conditions. However, although we speak in terms of "climate change" the 15% gain would represent a rise to 34.5ºC.

At 30ºC there is no damage to coffee flowers (*Arabica spp.*), so the fruit setting takes place and coffee berries are produced achieving a normal yield. On the other hand, at 34.5ºC 90% of the coffee flowers are killed resulting in no fruit setting or berry formation and about 10% of normal production (see below).

Figure 7: The association of coffee crop damage with temperature



adapted from: Pinto, H. S., *"AgroTalk - The Brazilian agriculture zone*", CEPAGRI, EMBRAPA.

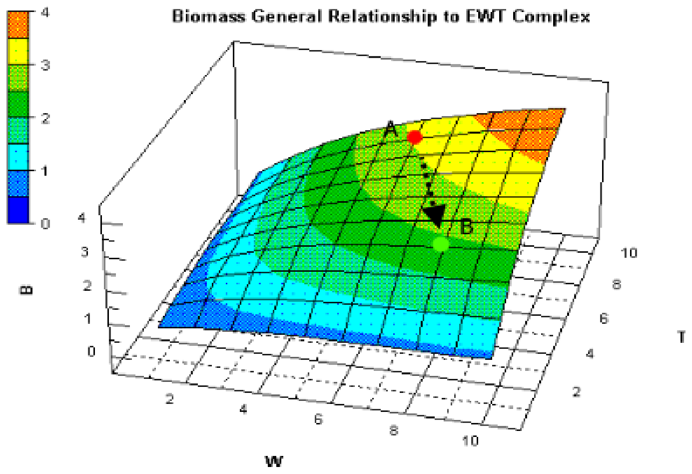
This is an example of location becoming unsuitable for coffee production as average temperatures rise but the warning comes in an initial warmer season in the cycle when a crop fails. This is followed by subsequent seasonal peaks in temperature, separated by the characteristic cycle, when the percentage of crop impacted increases. In this case, locational-state analysis points to temperature as being the problem although the rising temperatures are likely to also increase evapotranspiration in that season, and therefore water deficit which, in rain fed coffee, is likely to result in an overall decline in yields even if not all flowers are affected. The locational-state solution is to move coffee production to a zone with lower temperatures which in practical terms means moving from the current altitude to a higher altitude where average temperatures are lower. Moving to an altitude some 400 metres higher than the current production would lower average temperatures by 2.5ºC or an average of 27.5ºC. Applying the same seasonal variance calculation to this the maximum expected variance in warmer seasonal cycles would be 31.6ºC which would see a damage to the crop reduced to just 12%.

The lower evapotranspiration, depending upon the rainfall and soil texture, could result in higher compensatory yields than outweigh this level of loss resulting from flower damage.

The geographic movement described above can be represented on a general biomass locational-state production surface, on the right, as the movement from point A in a regime of higher temperatures to point B a regime of lower temperatures and improved water deficit (water availability) at a higher altitude. The particular production surface for coffee in the hostile environment is however, not as shown on that projection but in reality, it takes the form of the production surface shown in Figure 8, in which reflected the reduction in biomass achievable as a result of the higher temperature at flowering time.

Figure 8. Modification of coffee biomass production surface to show impact of higher temperatures beyond the 33°C threshold

Temperature & Water range is 1-10; Edaphic is fixed at 20; The surface plot is Biomass

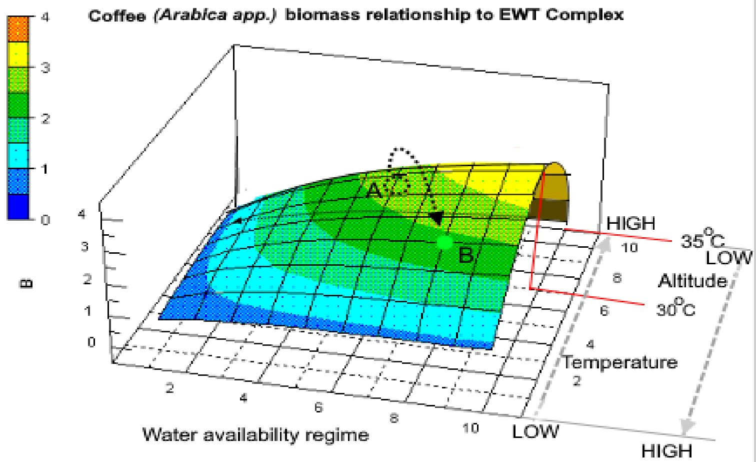


McNeill, H.W., *"Biomass production according to EWT complex item values"*, 2000, SEEL.

Based on: McNeill, H.W., 3D Development Model, TP, Food Research Institute, Stanford University, 1968 and McNeill & Jino, *"Simulation of 3D Development Model"*, CNAE, 1969.

The general locational-state plant biomass production surface is provided above and the specific biomass production surface for coffee (Arabica spp.) showing temperature sensitivity is provided below.

Temperature & Water range is 1-10; Edaphic is fixed at 20; The surface plot is Biomass



McNeill, H. W., "Implications of coffee *(Coffea Arabica spp.)* for farm planning and project design", DAI 2020-2030, SEEL-Systems Engineering Economics Lab, 2021.

Links to key organizations referred to in this document

	Links	Location	Country
BSI	British Standards Institute	London	UK
GBF	George Boole Foundation	London	UK
IEG WB	Independent Evaluation Group	Washington	USA
ISSO	International Organization for Standardardization	Geneva	Switzerland
Nakhlatec	Nakhlatec.se	Lund	Sweden
OECD DAC	Organization for Economic Development & Cooperation, Development Assistance Committee	Paris	France
OQSI	Open Quality Standards Initiative	Portsmouth	UK
SDGToolkit	Sustainable Development Goals Toolkit	London	UK
SEEL	System Engineering Economics Lab	Portsmouth	UK
WB	World Bank	Washington	USA