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Risk Management Strategies of Desert Farming at Najed in Sultanate of Oman

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Abstract

Rhodes Grass crop is continuously cultivated in coastal area of Sultanate of Oman. This farm practices created a negative impact on the overall agriculture system and production. The government stopped the cultivation of Rhodes grass in coastal area and support farmers with a capital cost sharing in order to develop new agriculture area at Najed. Due to irrigation water policy regulations imposed by Water Resource Authorities and uncertainty of underground water availability, farmer and investors have little data to help in making investment decisions. The research aims to study and analyze appraisal of Rhodes grass cultivation at new area under risk and uncertainty and rank risk management strategies in terms of risk efficiency. The study applies a stochastic budgeting approach to evaluate the proposed government intensive strategies under uncertainty desert farming. The stochastic budgeting simulation is done by using @ Risk software that allows the representation of risk variables and draw NPV as probability distributions. Different incentives strategies are tested and study shows that raw material subsidy will reduce expected loss probability from 95% to 47% at Hanfeet location and from 83% to 48% at Dawkah area and also increase the chance of getting acceptable positive NPV. The SERF analysis shows that, raw material subsidy alternative in terms of risk efficiency is the most appropriate strategy for Dawkah Location and MRG is the most appropriate policy for Hanfeet Location. The analysis indicates that capital subsidy is not sufficient to mitigate risk at new locations. Government Authorities have to calculate the cost of each risk management tool and select one that could sustain agricultural activates at new area at Najed.

Keywords: project investment, economic efficiency, simulation model, risk management strategy

1. Introduction

Project risk analysis and management is a process which enables project management to mitigate risks associated with a project. Properly undertaken it will increase the likelihood of successful completion of a project to cost, time and performance objectives. Risks for which there is ample data can be assessed statistically. However, no two projects are the same. Often things go wrong for reasons unique to a particular project, technically or working environment. Dealing with risks in projects is therefore different from situations where there is sufficient data to adopt an actuarial approach. Because projects invariably involve a strong technical, engineering, environment and water policy innovative or strategic content a systematic process has proven preferable to an intuitive approach. Project risk analysis and management has been developed to meet this requirement.

Farmers in the Al-Batinah and Salalah coastal plains exploiting the good ground water resources and increase land cultivated by Rhodes Grass which is easy to grow and crop can be taken out at least six times a year. The excessive use of the freshwater has led to ingression of salinity in the area (Water Science 2010). This situation threats the ecosystem. The Ministry of Agriculture and Fisheries (MAF) was seized of this problem and carried out an exercise to solve the problem, at the same time meeting the fodder requirements of the livestock to match the needs of a growing population. The (MAF) decided to gradually stop the cultivation of Rhodes Grass in Al-Batinah and Salalah plains and at the same time develop substitute areas in the Najed to meet the fodder requirement.

The fodder production proposed project at Najed Area depends on the availability of irrigation water from underground. Farming in this area influenced by activities of farmers and farmers involvements in the water management; the interdependence creates difficulties to predict expected amount of irrigation water and increases complexity in decision making in crop and water allocation. Moreover, producers must also cope with yield uncertainties caused by underground water availability, diseases and pest damages and price uncertainties caused by changes in markets as well. Water requirements for crops in Najed area are fulfilled by underground water. As a result, the availability of water depends on natural as well as human and policy factors. The excessive use of underground water might affect the availability of irrigation water in Najed Area in Oman and affect farming sustainability and cause environment problems. This paper investigated the appropriate methodology of project appraisal study with underground water drawdown risk, new water policy at project area and Government subsidy program to reduce the risk and sustain fodder production from Najed project.

The Ministry of Regional Municipalities, Environment and Water Resources (MRMEWR) announced new water policy and advised the allowed quantities of water to be extracted out in the project area at Najed. The total quantity of water allowed to be extracted should not exceed 112 million cubic M/year and water extraction per well restricted to 30 Lit/Sec only. Moreover, the (MRMEWR) determined the distance and spacing between wells at project area should not be less than 1KM X 1KM so that water flow should not be affected. Moreover, the water policy also reduced the total center pivot cultivated area to 22 Hectares in stat of 50 Hectares in other coastal areas. As a result the total cultivated area constitutes of 20% of the total project area and this increased operation and capital cost of the project. as a result, investment in desert farming at new Najed area still rely heavily on government support. This is due to the fact that it is a capital intensive investment associated with great uncertainty. It is not only the common risk factors such as market prices and high capital cost that are relevant to desert farming projects but also risk factors such as annual fodder production and technical reliability.

The application of new water policy increased capital and operation cost and included uncertainty factors which will impact economic efficiency of the resources utilization and project viability. The risk and uncertainty are best thought of as representing a spectrum of unknown situations with which an analyst may be dealing, ranging from perfect knowledge of the likelihood of all the possible outcomes at one end (risk) to no knowledge of the likelihood of possible outcomes at the other (uncertainty). The Government decided to encourage privet investors to develop Najed Area by giving lands to farmers and give capital grants to privets project to achieve financial sustainability. However, the sustainable development of Najed Area should financially viable and meet the needs of the present without compromising the ability of future generations to meet their own needs.

Project feasibility study performed by using conventional methodology and calculated single-point estimates. Using this method, an analyst may assign values for discrete scenarios to see what the outcome might be in each. For example, in a financial model, an analyst commonly examines three different outcomes i.e. the worst case, best case, and most likely case. In conventional analysis, there are several problems with deterministic approach analysis as it considers only a few discrete outcomes and ignoring hundreds or thousands of others. It also gives equal weight to each outcome and ignores the interdependence between inputs, and impact of different inputs to the outcome. The feasibility study indicated that NPV is positive and IRR of the project is above 10%.

S. Quiroga (2010) use Monte carlo simulations to estimate crop yield risk to water variability. Monte Carlo Simulation models were used in this study to quantify risk and uncertainty in desert farming at Najed Area. The quantitative risk analysis will provide decision makers a means of estimating the probability that the project NPV will fall below zero, or that the project IRR will fall below the opportunity cost of capital. The model will also help in improving water management policy and achieve project objectives simultaneously: sustaining irrigated agriculture for food security and preserving the associated natural environment. The three support systems that have been compared are a government investment subsidy and operation subsidy programs and Minimum Revenue Guarantees (MRG) system that run over the first ten years of production.

Using Monte Carlo Simulation dynamic model for project appraisal was addressed by Savvakis C. Savvides in (1994). He argued that this integrated analysis provided a range of outcomes that can reduce the risk of uncertainty and give more reliable results for investor. Additional information related to adaptive and robust policies applied to the management of water and aquatic ecosystems can be found in Blumenfeld et al. (2009); Carpenter, Brock and Hanson (1999); Chen et al. (2009); Folkes et al (2002), MA (2005); Sanders and Lewis (2003).

2. Data Collection and Methodology

The project evaluation first task is to estimate the future values of the projected project variables by using available information and data regarding a specific situation of the past to predict a possible future outcome of the similar project. The approach normal used in investment appraisal is to calculate a “best estimate” based on the available data and use it as an input to build the project evaluation model. The analysis estimated the most likely outcome for project evaluation such as (NPV) and (IRR).

2.1 Data Collection

Data is collected from various sources to build stochastic budget models. The source of data summarized as under:

1) Current Alternative Location parameters (yields, price , inputs costs) :
   a. Historical data from Farmers at study area.
   b. Ministry of Agriculture statistics (2013).
   c. Agricultural Research Center.
2) Capital cost of the project (irrigation system – agri. Machineries):
   a. Quotation.
   b. Najed Project Company and feasibility study.
3) Water policy & new regulation :
   a. Ministry of water resource.
   b. Ministry of Agriculture & Fisheries.
   c. Previous studies.

2.2 Net Present Value

The NPV was used as an evaluation criterion. The net cash flow, calculated by subtracting the cost from the revenue, was discounted by the interest rate to obtain the NPV of the project. If NPV is a function of all both deterministic and stochastic variables, the resulting NPV gets a range of values instead of a single value obtained in a conventional deterministic financial evaluation. NPV is obtained from the below formula.

$$NPV = \sum_{n=0}^{N} \frac{C_n}{(1+r)^n}$$

Where,

ci = the net cash flow in year n (n = 0, 1, 2, ….. n), represented by farm income in this study.

n = the planning period which equals twenty years in the current analysis.

r = the discount rate.

2.3 Monte Carlo Simulation

Monte Carlo simulation is a computational algorithm designed to evaluate the variability or stochastic of the input variables of a model. It can be used to model the effects of key variables on the NPV of a given proposal. The process involves, first, the identification and assessment of the key variables. For each key variable, we fit a probability density function that best describes the range of uncertainty around the expected value. For this purpose, we used historical data at growing area and data from MAF statistics (2013) and Agriculture Research Center (2007). The model including these variables is then calculated using randomly-generated input values taken from the underlying probabilistic distribution function. The computer model combines these inputs to generate an estimated outcome value for (NPV) and (IRR). The process is repeated (ten thousand times). Monte Carlo simulation model is currently regarded as the most powerful technique for cash-flow analysis. It is useful when there are many variables with significant uncertainties. The more complex the project and the more risks and uncertainty that are associated, the more valuable Monte Carlo simulation analysis will be.

The dynamic simulation model based on the Net Present Value (NPV) and the Internal Rate of Return (IRR) were used in this research for the evaluation of project feasibility of fodder crop growing at Najed Area and compared with the conventional NPV calculation method. The stochastic budgeting and stochastic efficiency methods are used to consider risk and uncertainty variables in the model presented in study area.

The developed model is based on a net present value calculation done as a Monte Carlo simulation. Also project IRR and stochastic efficiency in respect as PDF are used to evaluate and rank the investment alternatives. For Najed Project investment Hanfeet and Dawkah location scenarios tested compared with Salalah reference model. Three different water reduction levels (0.10, 0.30, and 0.50) have been analyzed for each Farm location. The three support systems that have been compared are a government investment subsidy and operation subsidy programs and Minimum Revenue Guarantees (MRG) system that runs over the first ten years of production.

Firstly a dynamic, stochastic simulation model of a Rhodes Grass farming was developed to evaluate the economics of investments in desert farming and sustainability. The model was designed to characterize agriculture parameters and economical complexities of a Rhodes Grass farming within a partial budgeting framework by examining the cost and benefit streams coinciding with investment in desert farming and high risk areas. A secondary aim was to develop the model in a manner conducive to future utility as a flexible, farm-specific decision making tool. The basic deterministic model was constructed in Microsoft Excel 2010 (Microsoft, Seattle, Washington). The @Risk 5.7 (Student Version for Academic Use) from (Palisade Corporation, Ithaca, New York) add-in for Excel was utilized to account for the stochastic nature of key variables in the Monte Carlo simulation model.

2.4 Model Structure

The modeling process began by defining a series of inputs to describe the initial status and behavior of the farm system. The underlying behavior of the Rhodes Grass growing system was represented using current knowledge and recorded data from MAF and literature. The purpose of qualitative risk analysis in this study is to provide a high level of understanding of risks of the project. Such analysis may increase attention of project management and water policy team members to the top risks they need to manage effectively, Qiu Ling Guo (2001) and James (2007).

The main risk and uncertainty variables identified in Najed Project were :

- Project capital increase and it is effect on NPV and IRR.
- Underground water availability and it is effect on crop yield and NPV and IRR.
- Crop selling price volatility and it is effect on NPV and IRR.
- Cost of production per ton and it is effects on NPV and IRR.
- Annual increase in sales price and unit cost.
- Total sale volume for year one of the project.
- Irrigation water policies and it is effect on crop yield and NPV and IRR.
- Rhodes Grass crop yield variation at 3 proposed project locations.

The qualitative risk assessment performed after identified risk parameters by estimating the following :

- Risk probability of occurrence of each parameter.
- Risk impacts on project objectives such as crop yield, revenue and NPV and IRR of the project.

The quantitative risk analysis is performed after selecting key parameters and the probability and consequence of all individuals risk combined on parameters affecting the project financial performance and cash flows. The result of the analysis includes a probability that a project will meet its quantitative objectives and cash flow projection. All probability distribution of the parameters are incorporated in to Monte Carlo Simulation Model which allows evaluation and quantified risks range as shown in table (1).

Table 1. Input parameters distribution used in MCS models

Risk	affects	Distribution	Absolut/ percentage	Impacts		
				Min	Most likely	Max
1st year Sale volume	Revenue	Normal	Percentage	19 667		21 072
Increase in sales ton	Revenue	Triangular	Percentage	1%	2%	5%
Sale Price/ton	Revenue	Triangular	Absolut	90	95	100
Unit cost/ton	Cost	Triangular	Absolut	65%	68%	70%
Increase in sales price	Revenue	Triangular	Percentage	1%	3%	5%
Yield reduction	Revenue	Compound	Percentage	2%	5%	7%
Water reduction Probi.	Yield	Risksimtable	Absolut	0.1	0.3	0.5
Water reduction/year	Yield	Binomial	Absolut		0.1	
Water recharge/year	Yield	Binomial	Absolut		0.2	

The study runs three scenarios and six Stochastic Monte Carlo Simulation Models to evaluate the following :

- Compare Salalah reference model with two new farm locations model at Najed area.
- Impact of the new water policy to NPV and IRR of the project.
- The government incentive program that can reduce risk and uncertainty impacts of Najed Agriculture Development Project.

This section presents the model variables in coastal (Salalah reference model) and desert areas (Hanfeet and Dawkah location). Desert farming area received government incentive to encourage farmers to develop Najed area. Salalah location model represent area with no water shortage, whereas the other two location scenarios represent different water shortage levels and new water policy implementation area. Parameters used in the Salalah scenario and Najed area scenario reflects an expected new water policy, project capital cost, crop yield, total sale volume, sale price and per unit cost of production for each Farm location. The estimation of each input variable and probability distribution at each location identified and incorporated in the analysis.

A Latin hypercube sampling procedure with @risk add-in software from Palisade Corporation (5.7 Student Version for Academic Use) was used to evaluate the budgets for a large number of iterations, Rajaa (2005). In the simulation, values of parameters entering into the model were chosen from their respective probability distributions by Latin hypercube sampling technics and were combined according to functional relationships in the model to determine NPV and IRR project outcome. The process was repeated a large number of times to give estimates of the output distributions of the performance measure which was expressed as cumulative distribution functions (CDFs) and summarized in terms of the moments of the distributions. The results presented here are based on 10 000 sample simulation experiments.

Random sampling is used to estimate empirical cumulative distributions for the key variables. The probability distribution is a distribution of all possible values associated with a stochastic variable. A probability density function (PDF) represents the complete distribution of a stochastic variable and empirically measures values of the random variable producing a histogram depicting relative frequencies of output ranges, this histogram resembles the random variable's probability density.

2.5 Project Risk Allocation

Risks are generally shared by the different partners but some are better able to cope with certain specific risks than others. The risk-sharing must be reasonable with risk-taking offset by profit as the objective is not to maximize risk transfer but optimize risk allocation.

In Najed Project private investors are not prepared to bear some of the risks related to the development and operation of the new desert area at Najed. They think that the associated risks are too high, and that if they bore the risks they would not be able to recover their costs. The risks that the potential private investors are not prepared to bear are:

- Yield reduction risk: The risk that not enough yields will be produced from the project, or that there will no enough yield to recover the operation and investment cost of the project. The perceived risk is high mainly because local farmers in the project areas have very low levels of yield compare to costal area.
- Control of sale price risk: The risk that Government wants to keep sale price below RO 100 /ton. The perceived risk is high mainly because livestock farmers in the areas have very low levels of income and cannot offer high fodder crop price.
- Cost per ton increase risk: The risk of raw material cost, operation and maintenance cost will be increased.
- Hydrology risk: Risk that there is not enough water and water level drawdown. The new water policy imposed control the extraction of water to (30 liters/sec) from well. The Government must bear this risk.
- Capital cost increase risk : The capital cost of the project increase from 16 Million to 22.8 Million and project cost overrun reach 142%. The Government provided a grant of RO 11.26 Million to support internal infrastructure and to compensate capital cost increased and reduce the effect of project overrun.

According to the net present value distribution, we can analyze the feasibility of the project. From the NPV distribution characteristics, we can get some information such as NPV expectation value, loss probability of the project and so on. This can provide more comprehensive information than a single net present value. By taking dynamic simulation method, this paper analyses the probability distribution features of the NPV in Najed project, regarding the annual production as a random variable which generate a certain NPV and IRR distribution.

The random variation characteristics of key factors such as the price, production cost and so on are not obvious.

Therefore, sensitivity analysis was performed. Specifically, in the simulation, each of these factors is set as a different value respectively and then the probability distribution curve of NPV under different factors obtained respectively. So that we could obtain project earns probability and loss probability and other information under different factors values. In this way, we can carry on comprehensive analysis of the influencing factors affecting the NPV and IRR of the project, thus providing the reliable basis for rational decision making and relevant risk management strategies.

3. Result and Discussion

3.1 Stochastic Simulation Dynamic Model

The NPV of Salalah Farm without Government subsidy is 62 thousand rials increased to 915 thousand rials with raw material subsidy program. For Hanfeet and Dawkah Farms NPV with Government capital subsidy is negative and record -1.8 Million and -3 Million rials respectively as shown in Figure (1). These results shows Farms under new water policy imposed by Government Authorities are highly exposed to underground water availability risk.

The results of each scenario contribute to the decision making process as they shed light on the potential positive and negative economic and ecological implications of proposed water policy changes. Each scenario was ultimately designed to understand two primary effects: firstly, changes to project yield and income due new water policy implementations. Secondly, changes in underground water availability and its effect on yield and NPV. The research analysis results of different conventional and simulations models are presented in Table (2).

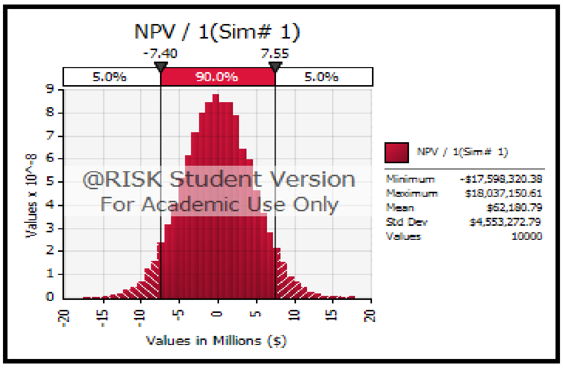

Figure A. Model (1) SMCS Salalah Model

(without GS & with 0.10 water reduction effect)

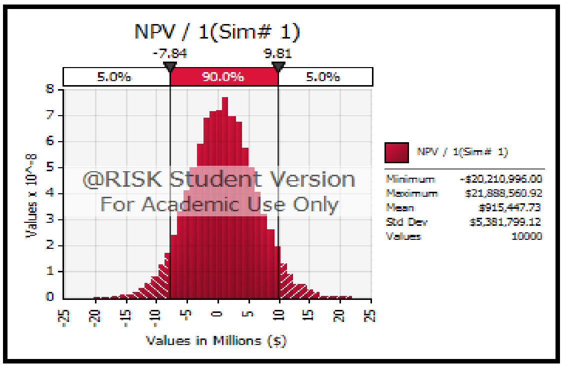

Figure B. Model (2) SMCS Salalah Model

(with GS & with 0.10 water reduction effect)

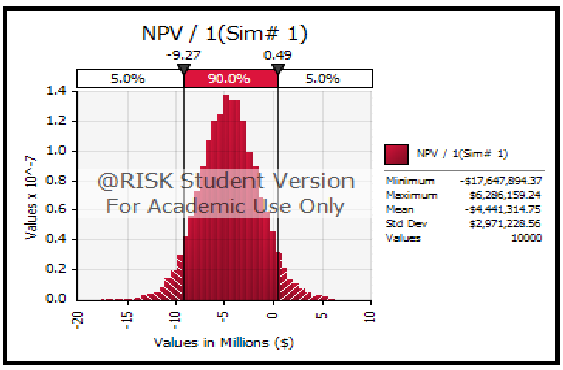

Figure C. Model (3) SMCS Hanfeet Model

(without GS & with 0.10 water reduction effect)

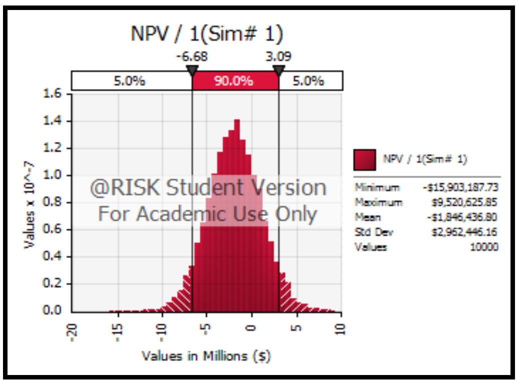

Figure D. Model (4) SMCS Hanfeet Model

(with GS & with 0.10 water reduction effect)

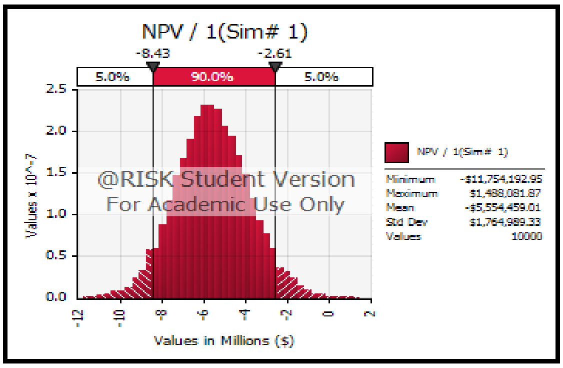

Figure E. Model (5) SMCS Dawakah Model (without GS & with 0.10 water reduction effect)

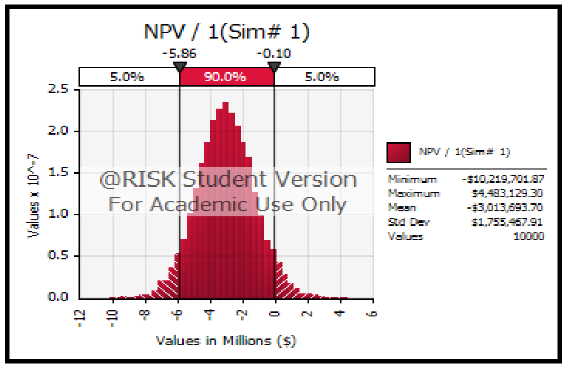

Figure F. Model (6) SMCS Dawkah Model (with GS & with 0.10 water reduction effect)

Figure1. SMCS Models for NPVs of Three Farms with & without GS and (with 0.10 water reduction effect)

Three Probabilities of water reduction were tested in the study with percentage of (0.1 – 0.5 – 0.9) by using Risksimtable Function with and without Government subsidy program. The model simulation produces a range of possible outputs of NPV and IRR represented in histograms or/and cumulative probability distributions addressing a level of 90% confidence for each different outcome. Table (2) presents Conventional and Stochastic Monte Carlo Simulation Model results of NPV and coefficient of variation for each farm location with 0.10 water levels reduction probabilities. The conventional analysis does not give a complete picture of the project viability and risk degree associated with desert farming. The expected loss ratio were calculated for different farm location and reveals that Government subsidy reduce expected loss ration by 0.15 % and 0.22 % for Hanfeet and Dawkah Farm respectively.

Table 2. NPV and CV for Salalah, Hanfeet, and Dawkah locations, without and with Government subsidy-Conventional and Stochastic Monte Carlo Simulation Model Results

Scenario Analysis	**Salalah**	**Hanfeet**	**Dawkah**
Conventional Model Analysis			
NPV	2 878 601	(2 895 923)	(3 793 210)
IRR	18%	3%	-1%
SMC Model without Government Subsidy			
Mean NPV	62 181	(4 441 315)	(5 554 459)
CV	73.22%	-0.67%	-32%
IRR	13%	-4%	-11%
Expected loss ratio	0.49	0.74	0.89
SMC Model with Government Subsidy			
Mean NPV	915 448	(1 846 437)	(3 013 694)
CV	5.88%	-1.60%	-0.58%
IRR	17%	3%	-6%
Expected loss ratio	0.48	0.63	0.69

3.2 Government Subsidy and Stochastic Simulation Dynamic Model

The Government provided a grant of RO 11.26 Million to support internal infrastructure to compensate capital cost increased and reduce the effect of project overrun. Capital costs of the project increased from 16 Million Rials to 22.8 Million Rials at the stage of face one of the project implementation. Project cost overrun also affected NPV and has been incorporated in the models. The research also investigated if Government support sufficient enough and can cover the stochastic variations of future operation risk and project overrun risk. The analysis reveals that Government subsidy program increased NPV of Salalah Farm and reduced losses for

Hanfeet and Dawkah Farms location.

Salalah farm got the highest NPV and IRR while Dawkah farm got the lowest. The required level of confidence is the acceptable level of risk that the investor would take and reach 90% in this project. The probability of Salalah farm model to be profitable (NPV>0) is 40% without subsidy and increased to 50% with Government subsidy. The spread among minimum and maximum NPV for Salalah farm is higher than other farm locations. The models also tests 3 probabilities of water reductions of 10%, 30% and 50% and its effect to NPV. The NPV decreased with the increase of the probability of water reduction in each model.

The Coefficient of Variation or risk degree was calculated to compare NPVs of different location models. The larger the CV is the greater the risk is. The CVs of NPVs for Salalah Farm Model increased with the increased of probability of water reduction without Government Capital subsidy. The analysis shows CV increase with water reduction probability increase in Government subsidy scenarios. The Government Capital subsidies reduce degree of risk as presented in table (2). It could be stated that all locations are less risky after Government subsidy. The analysis also shows that the new locations recommended by Government Authorities at Najed Area such as Hanfeet and Dawkah are still getting a negative NPV and Government capital subsidy could not recover losses. However, this shows additional support and incentives should be given to farms at new location at Najed.

Salalah Farm with raw material subsidy and with sufficient underground water (new water policy not in place) has minimum, mean, and maximum NPVs of R.O. -20 million, 0.915 million, and 22 million, respectively with a confidence level of 90%. Under these circumstance the chance of getting negative NPV 43.5%. The project management has to decide the amount of risk they are willing to take in this case as almost 52% of the probability mass is between 0 and RO 9.8 Million keeping in mind the other farm location even after modeling with Government raw materials subsidy are in less favorable circumstances.

The NPVs of Salalah Farm with and without Government subsidy program are all higher than the minimum, mean, and maximum for Hanfeet and Dawkah location at new developed area at Najed. Hanfeet Farm with Government support program (with 0.10 probability of water reduction) returned simulated NPVs of R.O. -16 million, -1.8 million, and 9.5 million for the minimum, mean, and maximum respectively. The chance of getting negative NPV is 74% and project viability is only 26% compare to 52% for Salalah Farm.

3.3 Risk Management Strategies and Cost of Subsidy

Water quality and quantity protection policy in study area has been based passed so fare on capital cost subsidy program. Financial incentives program should be used to encourage investors and farmers for adopting improved water management practices. The Government incentive and subsidy analysis performed to evaluate subsidy policies and estimate the cost of each policy. Minimum Revenue Guarantee, raw material subsidy and price subsidy were tested at each farm location.

Regression Tornado Graph analyses were performed to see what factor has the most influence to NPV. The analysis shows raw material cost is the second factor influencing NPV with negative coefficient parameters of (-0.110). The Government subsidy analysis shows that raw material subsidy is more cheaper and cost 4.012 Million Rials for Hanfeet farm and 6.218 Million Rials for Dawkah farm for ten years as shown in Table (3).

Table (3) also shows price subsidy is less risky than other subsidy as CV is lower for price subsidy model which is equal to 14.26%. However, for Dawkah farm MRG Minimum Revenue Guarantee subsidy is less risky than other subsidy. The costs of subsidy program for ten years were also calculated and shows that raw material subsidy is the cheapest alternatives for Government to implement.

Risk efficient for risk management tools alternatives were identified using Stochastic Efficiency with Respect to Function (SERF) criteria for a range of risk attitudes. The Government subsidy analysis for Hanfeet farm shows that MRG is risk efficient strategy followed by sale price subsidy and Raw Material subsidy as shows in Figure (2). Figure (3) shows raw material subsidy is the most risk efficient strategy followed by sale price subsidy and MRG for Dawkha farm. The analysis also shows Government capital subsidy paid to Hanfeet and Dawkah Farms are not enough to compensate Salalah location Farmers and encourage them to move to new area at Najed.

Table 3. Probability density of government subsidy strategies analysis results of Hanfeet and Dawkah Farm Location – Statistics for NPVs for each Government subsidy policy and cost

Strategies	Strategy (1)	Strategy (2)	Strategy (3)	Strategy (1)	Strategy (2)	Strategy (3)
Location	**Hanfeet Location**			**Dawkah Location**		
Subsidy	MRG	RM	Price	MRG	RM	Price
5%	(7 867 168)	(7 836 935)	(7 847 095)	(7 586 845)	(7 642 260)	(7 624 740)
10%	(6 040 646)	(6 043 943)	(6 039 246)	(5 859 314)	(5 851 980)	(5 856 811)
15%	(4 828 496)	(4 821 096)	(4 830 385)	(4 684 134)	(4 677 335)	(4 682 068)
20%	(3 861 206)	(3 860 572)	(3 865 737)	(3 761 670)	(3 740 161)	(3 739 823)
25%	(3 033 629)	(3 040 660)	(3 049 745)	(2 966 753)	(2 942 438)	(2 920 248)
30%	(2 299 862)	(2 264 379)	(2 281 593)	(2 251 465)	(2 187 985)	(2 218 599)
35%	(1 614 053)	(1 577 215)	(1 614 156)	(1 579 776)	(1 538 124)	(1 575 561)
40%	(973 942)	(929 653)	(979 925)	(937 246)	(879 907)	(969 500)
45%	(306 439)	(273 096)	(309 678)	(318 459)	(257 197)	(372 476)
50%	311 635	310 120	327 454	289 947	329 236	286 297
55%	936 003	958 886	914 702	869 178	954 884	894 740
60%	1 552 564	1 610 303	1 574 843	1 511 914	1 546 507	1 510 047
65%	2 233 344	2 254 136	2 253 916	2 158 167	2 173 805	2 155 499
70%	2 920 274	2 950 086	2 954 615	2 811 053	2 859 336	2 851 878
75%	3 673 507	3 685 935	3 680 734	3 561 297	3 610,752	3 545 122
80%	4 509 868	4 572 336	4 557 734	4 404 892	4 426 485	4 360 391
85%	5 504 671	5 533 913	5 536 014	5 354 123	5 370 991	5 350 783
90%	6 729 670	6 707 888	6 820 858	6 650 209	6 576 013	6 727 497
95%	8 725 064	8 647 243	8 645 423	8 568 675	8 374 810	8 503 146
Mean	346 216	347 660	353 059	352 881	347 803	342 631
SD	5 025 199	5 000 396	5 033 328	4 935 402	4 887 834	4 921 602
CV	14.514%	14.383%	14.26%	13.986%	13.996%	14.364%
Skewness	0.0516	0.0058	0.0583	0.1114	0.02714	0.0819
Kurtosis	3.0722	3.0239	3.091	3.2054	3.031	3.1725
Min	(20 642 149)	(22 404 056)	(19 394 499)	(19 295 365)	(17 392 901)	(21 661 069)
Max	21 865 885	19 700 196	22 087 003	20 615 957	18 625 350	21 330 630
Range	42 508 034	42 104 252	41 481 502	39 911 322	36 018 251	42 991 699
Expected loss ratio	0.486	0.532	0.467	0.483	0.483	0.504
Gov. Cost	17 976 955	4 012 820	17 588 298	39 188 197	6 218 034	35 214 325

The NPV calculated by using conventional approach is unable to address and properly evaluate the impact of the risk and revenue sharing mechanisms between the private and public sectors as an integrated part of the financial evaluation of Najed Project. In other words, the conventional NPV approach is unable to determine the correct market value of the government support option such as capital cost subsidy. Therefore, there are many concerns about the validity of the results and reliability of using the conventional NPV analysis approach for economic evaluation of such a project. However, the conventional NPV approach applied as a basis of decision making in Najed Project gave a miss leading information to privet investors and Government as the financial solvency of the project and creditworthiness of the investor would be in trouble in future and will result in the possible project failure.

The described limitations of the conventional NPV approach can be overcome by using a different approach for evaluating investments under uncertainty. The Monte Carlo Simulation Models Analysis is used for Hanfeet and Dawkah Locations and the model result showed unviable results. There were low probability to get (NPV≥0) i.e. 4% for Hanfeet Location and negative NPV for Dawkah location.

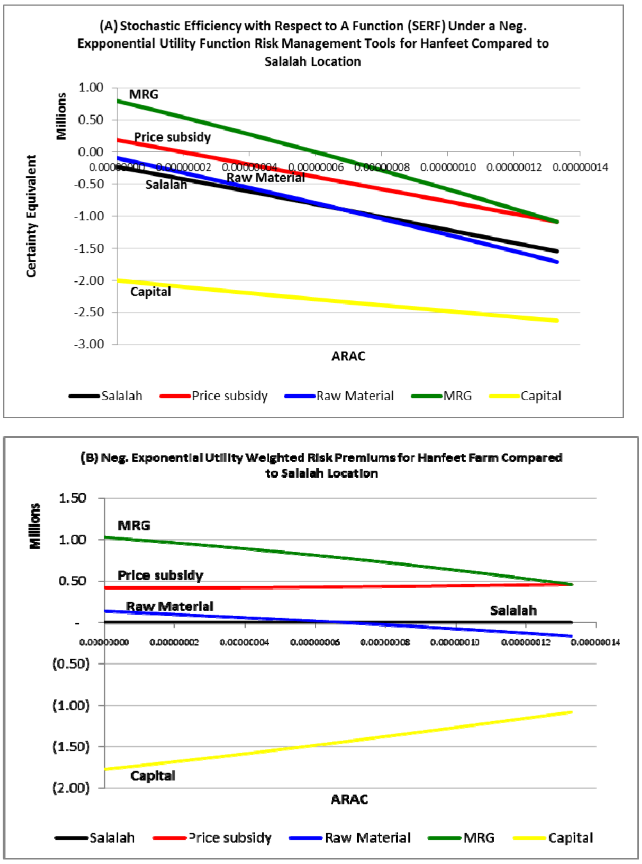

Figure 2. Risk efficient policy for Hanfeet Farm

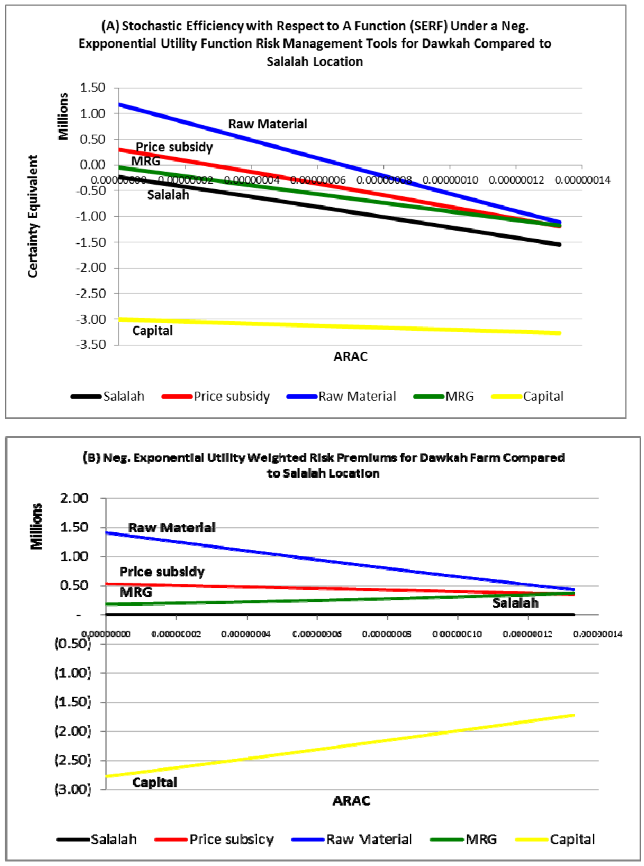

Figure 3. Risk efficient policy for Dawkah Farm

The Monte Carlo Simulation Models Analysis is used for Hanfeet and Dawkah Farms by using advanced simulation model analysis techniques with NPV of RO 350 000 (Salalah's location NPV). The raw material subsidy determined by using the goal seeks add-in from Excel to set NPV equal to Salalah's location NPV. Goal Seek analysis available in @Risk Program allows the Analyst to find a specific simulated statistic for a parameter cell such as raw material unit cost increase (for example, the mean or standard deviation) by adjusting the value of another cell and output such as the recommended and acceptable level of NPV.

To achieve NPV of Salalah reference model the annual sale volume growth rate should be increased to 15.36% which is not possible in Hanfeet. As a result, Government has to implement MRG, Raw material subsidy or price subsidy program approaches to compensate farm losses. Table (4) shows distribution statistics of raw material subsidy program required to obtain Salalah Location NPV of RO 350 000 at Hanfeet Location.

Government raw material subsidy program will reduce expected loss probability from 95% to 47%. The chance of getting acceptable positive NPV is also increased to 47% with raw material subsidy compared to 95% of negative NPV without raw material subsidy as shown in Figure 4 below.

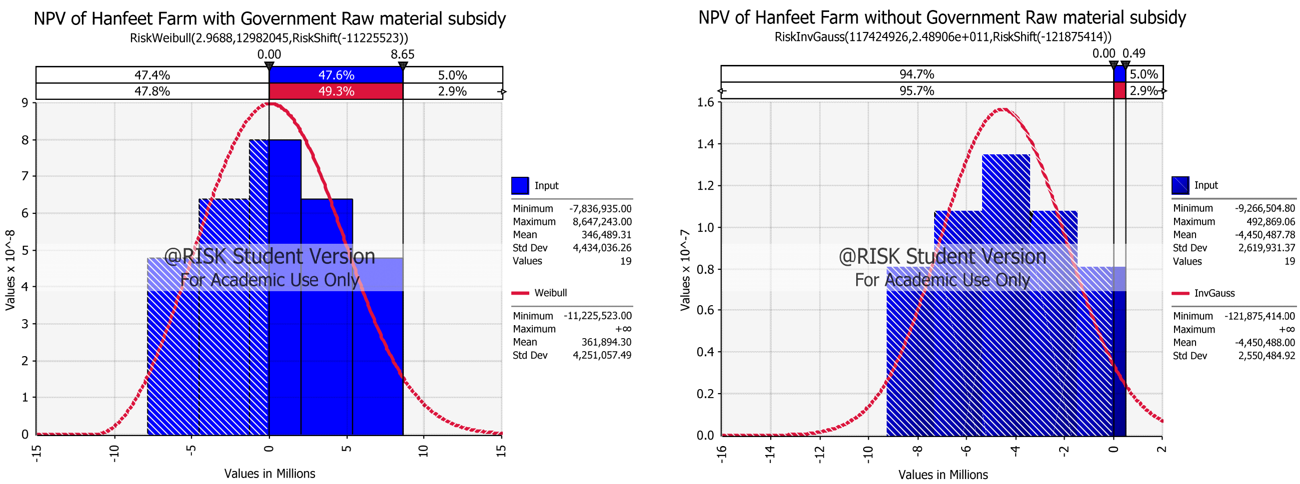

Figure 4. NPV of Hanfeet Farm with & without Raw Materials Government Subsidy Programs

Table 4. Distribution statistical analysis of NPV of Hanfeet Farm with & without RM Government Subsidy

	Hanfeet With Government Subsidy	Hanfeet Without Government Subsidy
NPV Mean	346 489	-4 450 488
Mode	959 769	-5 210 144
Median	310 119	-4 468 505
Std. Deviation	4 434 036	2 619 931
CV	12.798	0.589
Skewness	0.0014	0.062
Kurtosis	3.004	3.006
Expected Loss ratio	0.475	0.949

For Dawkah Farm raw material subsidy to maintain and achieve NPV of Salalah reference model will cost Government RO 6 Million in ten years. This financial incentives program will reduce expected loss ratio from 83% to 48% and increased the chance of getting acceptable positive NPV to 47% as shown in Figure 5 below. Table (4) shows distribution statistics of raw material subsidy program required to obtain Salalah Location NPV of RO 350 000 at Hanfeet Location.

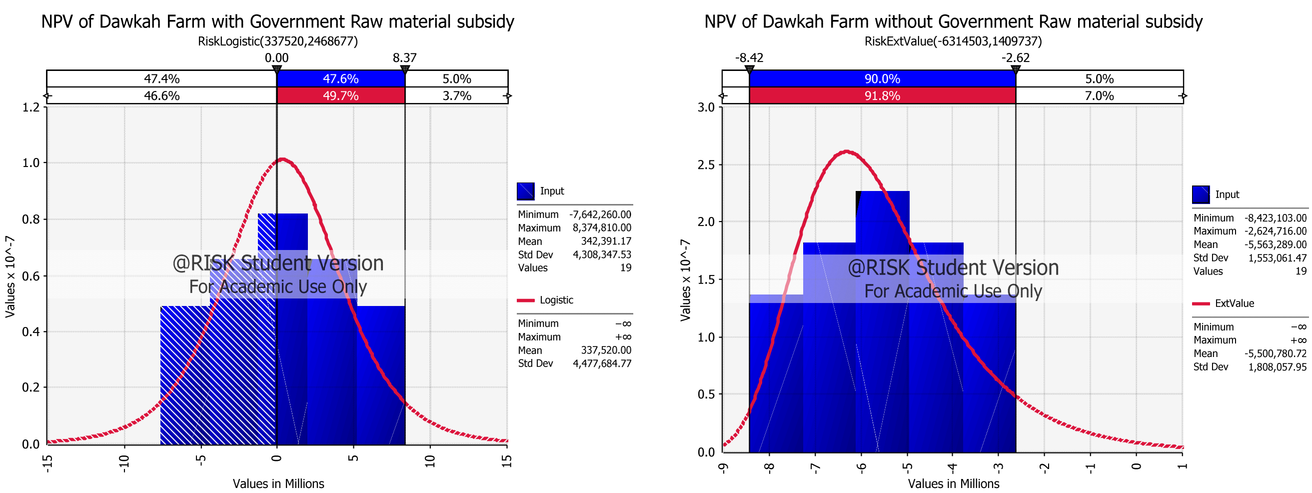

Figure 5. NPV of Dawkah Farm with & without Raw Materials Government Subsidy Programs

The fat tail Kurtosis at Dawkah Farm without raw material subsidy of 5.4 and Skewness of 1.139 indicates more risk will face farmer without Government raw material subsidy. The introduction of raw material subsidy program results in spreading NPV observation around the mean symmetrically and keeping Skewness near to (0) figure. The analysis also shows risk reduction as Kurtosis reduce from 5.4 to 4.2 as shown in table (5) below.

Table 5. Distribution statistical analysis of NPV of Dawkah Farm with & without RM Government Subsidy

	Dawkah With Government Subsidy	Dawkah Without Government Subsidy
NPV Mean	347 803	-5 556 191
Mode	202 750	-5 070 682
Median	329 236	-5 581 467
Std. Deviation	4 887 834	1 762 995
CV	14.053	0.317
Skewness	0.0071	1.1390
Kurtosis	4.231	5.420
Expected Loss ratio	0.483	0.826

4. Conclusion

The main task of this paper is to investigate risk management strategies efficiency and project viability and sustainability. The paper also identified the key variables such as raw material variable, crop yield and other main and key variables which effect NPV and IRR of the project. The project analyst normally utilizes information available regarding a specific event of the past (Salalah reference model) to predict a possible future outcome at new farming area at Hanfeet and Dawkah Farms. Under such circumstance conventional project evaluation approach is not recommended and dynamic simulation analysis is the appropriate methodology to incorporate risk and uncertainty.

In traditional methods, we can select the project with only the greater expected NPV and IRR, but it will often lead us to suboptimal decisions as the expected return on investment (NPV) of a decision quite often carries a high degree of uncertainty with interrelated dynamics. The use of dynamic simulation analysis and underground water risk analysis in this study did not gave a single value of NPV but gives a range of values and allocate probability of all possible expected NPV and IRR under different level of underground water. The prospective investor and Government are therefore provided with a complete risk/return profile of the risk management strategies and this will enhance investment decision and estimate incentive required to sustain projects at Najed Area.

The cost of uncertainty of the Dawkah Project Area is high due to lack of information available to investors. As a result, more information has to be obtained regarding underground water availability before Government Authorities distribute more lands to farmers and privet sectors at Najed area.

The Government grant of 11.26 Million Rials are given to Najed Project to be used in project infrastructure. This grant increased project viability in case of low risk of water availability areas, but with high risk of underground water more Government subsidy supports are needed to mitigate risk. Figure 2 and 3 shows capital subsidy is not sufficient to mitigate farming risk at Hanfeet and Dawkah location.

The project risk analysis using Monte Carlo Simulation technics shows that the project probability distribution of NPV is completely below the zero in case of sever water shortage. The expected loss ratio for Dawkah area is 0.83 without government capital cost subsidy. However, the government capital cost subsidy might reduce risk ratio to 0.48 but more financial incentives are required as the project is totally exposed to risk.

New water policy needs to be reformed and adjusted to cope with risk inherit the project. Moreover, Najed Project needs to be reformed and redesigned to suit the investor requirement and achieve project sustainability.

While there were still some private incentives to adopt such as irrigation technologies, the strength of these incentives is likely to vary among farm location area and these incentives may be insufficient due to high costs of adoption new water policy and uncertainty about returns from adoption. Uncertainty surrounding the impact of adoption of different water policy and technologies is an important barrier to adoption. Studies on investment under uncertainty show that uncertainty and irreversibility of investment would cause farmers to delay the investment decision even when the investment appears to be profitable according to the net present value (NPV) calculated through conventional calculation methodology.

The SERF analysis shows that raw material subsidy alternatives in terms of risk efficiency is the most appropriate strategy for Dawkah Location and MRG is the most appropriate policy for Hanfeet Location. The Government Authorities and investors at study area has to calculate the cost of each risk management tool and select appropriate policy that could achieve sustain agriculture activates at new developed area at Najed.

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