

**Application Of
Decision Support System
in Ecosan Promotion
in Western Nepal**

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Abstract

Since the current way of sanitation practice in urban and rural areas of world is generally following the same trend of centralized collection system and treatment of the waste if possible and then finally dump in the river or any suitable place of earth which consequently causes various problems in lake, river, soil, in a word, to the environment.

Lack of treatment plant and linear flow of the nutrients in current sanitation practices has increased subsequently dependency on the chemical fertilizer world wide. The aim of this study is to find out first the optimal sanitation alternative for the existing communities from two different geographical location from high altitude and low altitude of Nepal. Alternatives for sanitation are chosen from the general practice in rural areas of Nepal; such as biogas integrated sanitation, conventional latrine system which comprises with or without ring system pit hole, septic tank (not common in rural areas), urine separation flush toilet and urine separating dry toilet. In addition, the second aim of this study is to change the optimal alternative to the ecological sanitation alternative; either USFT or USDT. For the purpose of this study, Generic Multi-Attribute Analysis (GMAA) as the decision support system is used as the method to analyse and promote the suitable sanitation practice.

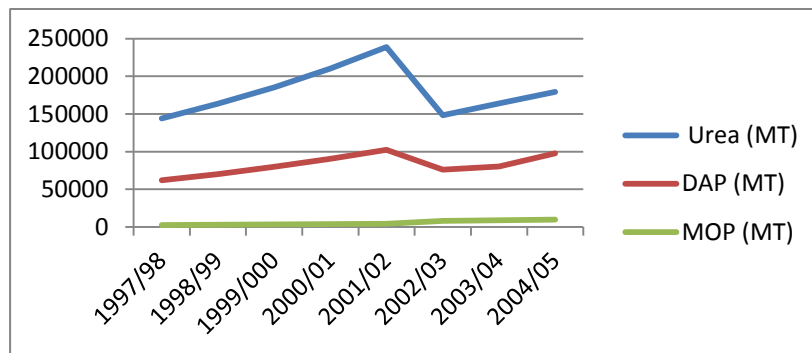
Finally, it is concluded that; weights given to the various sub-objectives, utilities for the different attributes and the responses from the participants that draws the conventional and biogas integrated as the optimal sanitation have to be changed with a proper plan in order to have the ecological sanitation as the optimal one.

Introduction

Problem of sanitation

Disease: Water Sanitation and Hygiene (WASH)-associated diseases remain among the top ten leading causes of morbidity in the Nepal. Diarrhea is the second largest killer among under five-year-olds (Amrit rai paper-1)

Fertilizer need: The use of fertilizers in Nepal is increasing to meet the food demand of nation, the productivity of agriculture should be increased. For this, the pesticides and fertilizers should be used in adequate amount.



(Source: Fertilizer Unit of Ministry of Agriculture and Cooperatives. 2062)

As from the above trend, the use of fertilizers is seen decreasing and increasing but in a way, the demand has to be fulfilled either by importing or producing within the country.

[Fertilizer Unit of Ministry of Agriculture and Cooperatives, 2062. Demand, Import and Distribution of Fertilizers since Deregulation (unpublished), Nepal Government.]

Government's plan

The Master Plan aims to attain national sanitation goal in the given time frame for better hygiene, health and environment. And it focuses on sustainable changes on hygiene behaviors and proper use of toilet and waste management practices in urban and rural areas. [Reference]

Sanitation Goal	Toilet Coverage of	By
Goal I	60%	2012/13
Goal II	80%	2014/15
Goal III	100%	2016/17

Table:

[http://www.wsscc.org/sites/default/files/publications/kamal_adhikari_sanitation_and_hygiene_master_plan_2011_nepal.pdf]

Sanitation gap: National sanitation coverage has reached 43% by 2010 though the sanitation coverage is lower in the rural areas where the majority of the population (more than 80%) resides. There is a wide gap of sanitation coverage between rural (37%) and urban

(78%) (NMIP, DWSS) (National Management Information Project, Department of Water Supply and Sewerage Report 2010)

Personal view: Since, the plan is to achieve toilet coverage with proper use of toilet and waste management practices, usual way of sanitation practice doesnot fulfill the above proper waste management practices with the centralized collection system and all the nutrients contents are not going back to the field which is not sustainable. Those above seen gap can be fulfilled with ecosan that provides fertilizer in communities

Advantage of ecological sanitation: [Ecological_Sanitation:pdf SIDA]

- If the ecological sanitation is adopted on a large scale, it would protect our groundwater, streams, lakes and the sea from faecal contamination.
- Less water would be consumed.
- Farmers would require less amount of expensive commercial fertilizers.
- contributing not to degrade environment.
- A major advantage of eco-san systems is that they have the potential to increase sanitation coverage of the unserved more quickly than any other method.
- An eco-san system can be build entirely above ground, they allow construction anywhere a house without polluting the ground water.
- if properly managed and maintained do not smell or produce flies and other insects. Moisture levels are too low for fly breeding. Odourless and flyless toilet.

Personal view: Urbanization is growing and the need for proper sanitation facilities is also increasingly demanded by the people living in the area and government has failed to facilitate the population with proper sewerage system with right treatment plan inorder to save the environment.

Objective of the Study

The thesis has two major objectives. the first objective is to find out the optimal sanitation alternative in the selected study areas with the help of decision support system (DSS); Generic Multi-Attribute Analysis (GMAA) is used as the DSS tool to find the optimal solution. Since, the geography of Nepal is such a varied in altitude that the communities in high altitude have completely different cultural, social, economical, environmental

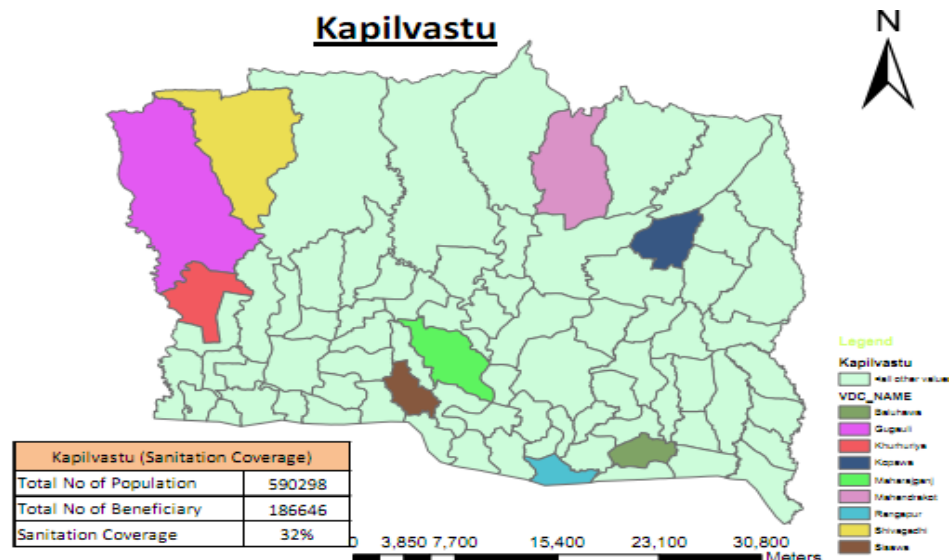
differences. Consequently, we had to suppose that there must be some differences that draws the different optimal sanitation alternatives.

Secondly, the next objective is to find the reason why the ecological sanitation alternatives are not yet optimal alternative in the study area. Changing the weights given to the attributes, sub-attributes, utilities given to the attributes and the responses from the people; would make the eco-san as the optimal alternative. Mostly, the utility were drawn on the people's responses and assumed that those belief would make certain sanitaion alternative as the optimal without giving the scientific and true utility for the attributes.

Scope of the Study

Since, the thesis topic itself gives the clear idea that my aim is to use of DSS in eco-san promotion in western Nepal. As per the plan, i have selected the GMAA as the DSS tool and two different geographical location with varried altitude. Mahendrakot VDC from Kapilbastu District with low altitudet and Arman VDC from Myagdi District with high altitude. [introduce the altitude, temperature, precipitation..etc]

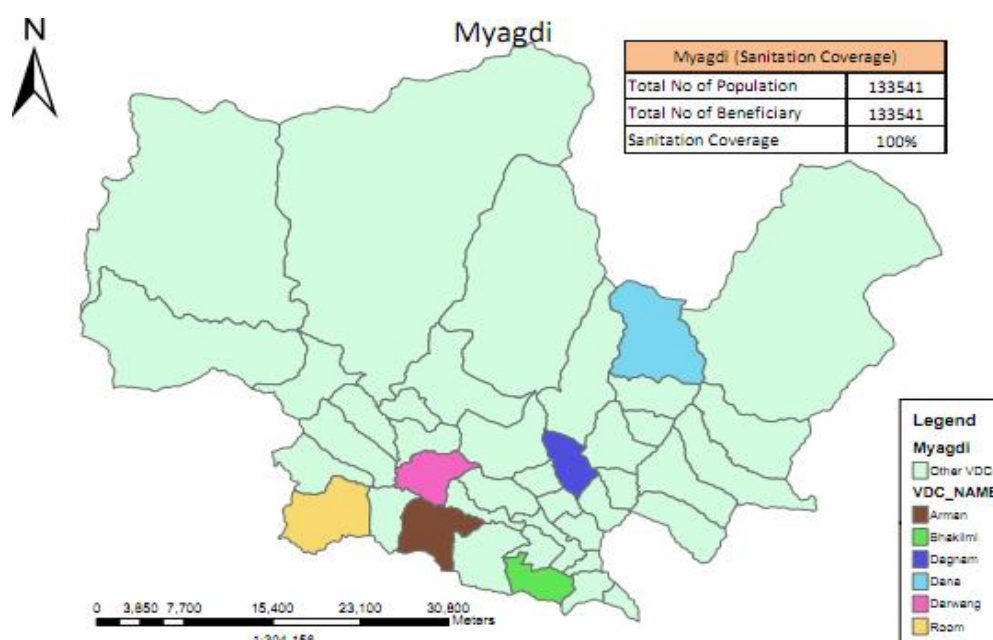
General features of Kapilbastu:



Latitude	:	N27o40'52.2" - N27o45'37.9"
Longitude	:	E83o02'50.8" - E83o02'58.1"
Altitude	:	121 m – 192m
Climate	:	Warm and humid
Temperature	:	Max. 42o C and Min. 6.4o
Rainfall	:	1285 ml/year
Land	:	Plain and fertile

Rivers/pond : Kondre, Gudurung rivers and Pond of Bhelai
Occupation : Agriculture
Agricultural Products : Rice, Wheat and Vegetables

General features of Myagdi:



Latitude :
Longitude :
Altitude : 800-3000m
Climate : warm but not humid
Temperature : Max 35 Min 5
Rainfall :
Land :
Rivers/pond :
Occupation : Agriculture
Agricultural Products : Rice, Wheat and Vegetables

Promotion of ecological sanitation in those selected study area is the primary goal of the project. For which, major subjective attributes that are primarily important in choosing the sanitation alternatives are prepared so as to find the optimal sanitation alternative and to analyze the gap or people's lacking knowledge on the certain attributes which in uplifting in future would promote eco-san efficiently.

RWSSP-WN has been working in several western districts in water supply and sanitation projects; among which two districts were chosen for my project from high and low altitude geographical location.

Alternative Strategies

Urine Separating Flush Toilet:

This is simply a conventional toilet where water is used to flush the faeces and collected in the pit hole or in septic tank or in concrete ring used pit hole yet urine is collected through a pipe contained through the the pan or by use of conical flask and a jorgin.



USFT (Picture taken during the field visit at Kapilbastu District)

RWSSP-WN had provided the few households with a cone and a gallon to collect the urine with the few information of collecting it and using it in vegetables. However, the people have very few knowledge on the use of urine since it has to mix with proper quantity of water which even depends on the type of vegetables and its age from the time of seed swon in the field. Nonetheless, those farmers with the urine separating devices has been using urine learnign with their own hit and trial method.

Urine Separating Dry Toilet

This is the perfect example of ecological sanitation practice where urine and faeces are collected separately and recyceld with the proper methods. Since, nepalese are accustomed with use of water for anal cleansing, the dry toilet has to be incorporated with another passage for the anal cleansing water which makes the toilet more complex compared to other alternatives.

Biogas Integrated Toilet

Biogas presents itself as one of the most promising alternatives besides its energy gains, biogasalso reduces the work burden of fetching fuelwood from the near by forests for

the rural people and gives pollution less cooking fuel. In addition, it also gives the end product as the fertilizer which after some dried period of time, could be used in the field as fertilizer. It seems more environment friendly and improves health and sanitation situation. [Reference: A glimpse into community and institutional biogas plants in Nepal By Dr Ing. Arquitecta Joana Forte –Nepal 2011]



Biogas Integrated Toilet (Picture taken at Myagdi District)

Conventional Toilet

Basic forms of toilet that do not treat any human waste and only collected in the pit hole; after when the pit hole gets full, people somehow manages to empty the pit hole again if the toilet is made up of concrete ring system otherwise, another new pithole is the only way for continuing sanitation. Moreover, this is the most used toilets in all over the country.

There are two types of conventional toilet which is defined as the temporary and permanent toilet. Temporary toilet is constructed by digging the pithole in the ground and locally available material as wood like material are used as pan with a covering and is constructed until the permanent toilet equipment are accessed. Consequently, permanent toilet is considered as the use of concrete rings which acts as the barrier on the dug pithole wall.

Septic tank toilet are so common in urban areas despite its expensive construction cost but in rural areas, very few people constructs those toilet.

Methodology

Generic Multi-Attribute Analysis (GMAA) was used as a DSS tools to access the optimal sanitation alternative and to analyse the basic three foundation of sustainability known as the economical, social and environmental with its attributes as a quicker way in promoting ecological sanitation. Firstly, a model was created as the objective, sub-objective and then its branches as the attributes attached in it.

Objective: Objective in this model was taken as to fulfill the first part of my work which is to access the optimal sanitation solution among the four sanitation alternative USFT, USDT, BI and Conventional Toilet for the studied area.

Sub-objectives: Basically, three foundation of sustainability economical, social, and environmental were supposed to consider as the sub-objective but here, the technical knowledge required for the various alternative seemed very much crucial in choosing the alternatives as compared to the other environmental, social and economical sub-objectives. Above sub-objectives are further categorized with interrelated terms as the sub-objectives of sub-objective which is shown in figure below.

Attributes: Terms that are on the right side of the GMAA model are known as the attributes and measurement was basically done for these attributes in analysing the DSS tools.

Mahendrakot VDC, Kapilbastu District

Questionnaire survey:

Questionnaire were developed to get the people's responses on those created objective, sub-objective and attributes. See the Annex III. Household survey was carried out by questioning a member of every household which almost took one hour for each house.



Inspection of Conventional Toilets with User



Interaction with Urine user in vegetables



Picture: Interaction wit CHASC/VWASHCC member on Eco-san and Demonstration of Eco-san model

To collect the data relevant to the GMAA model, i have used question regarding Yes/No type question, ranking the intensity of people´s responses in the form of 1 to 5, and general knowledge concerning the different sanitation alternatives. I have also collected and manipulated the statistical data from the analytical responses.

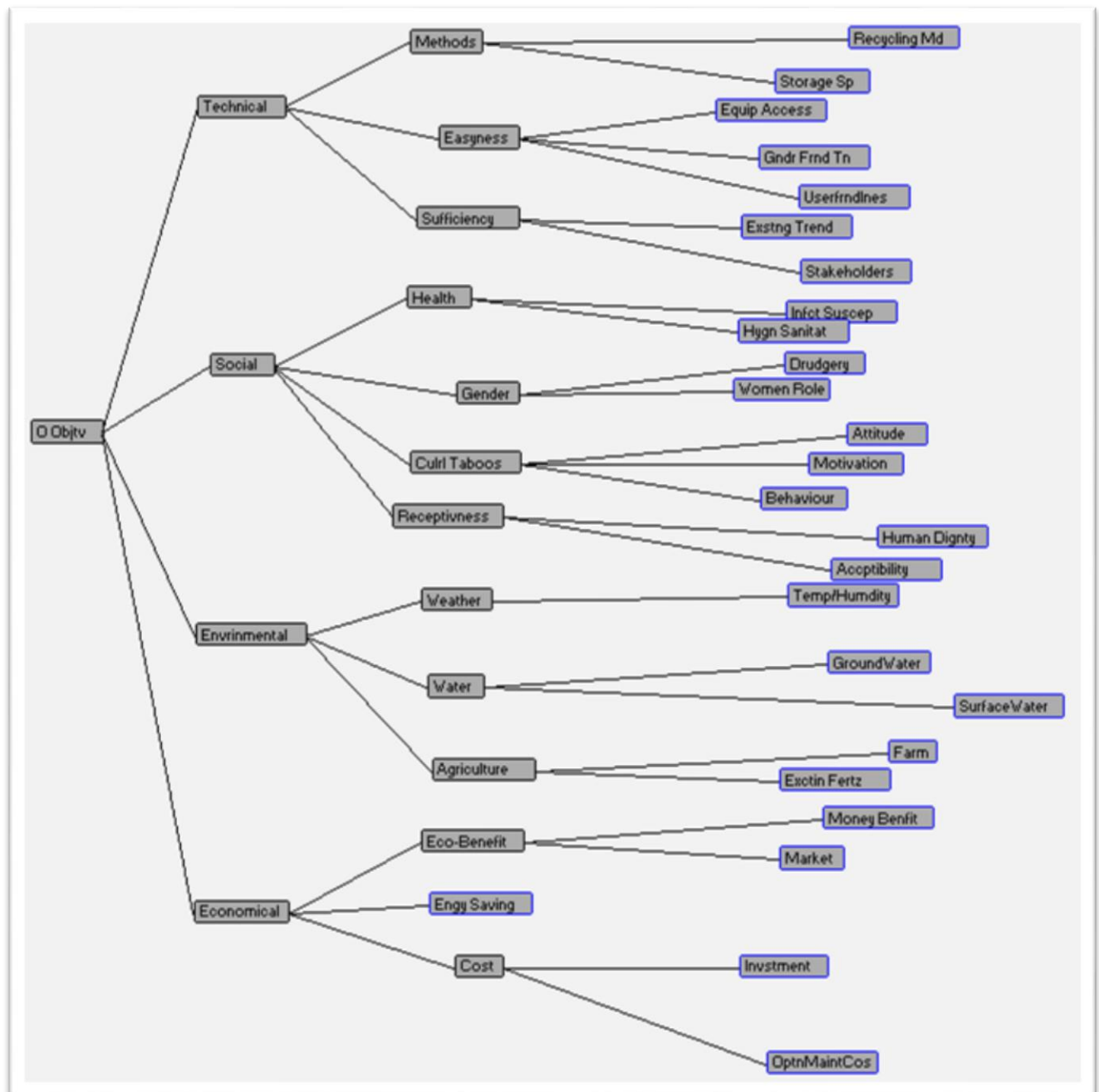


Figure 1: GMAA model

Interesting Survey Findings from Kapilbastu

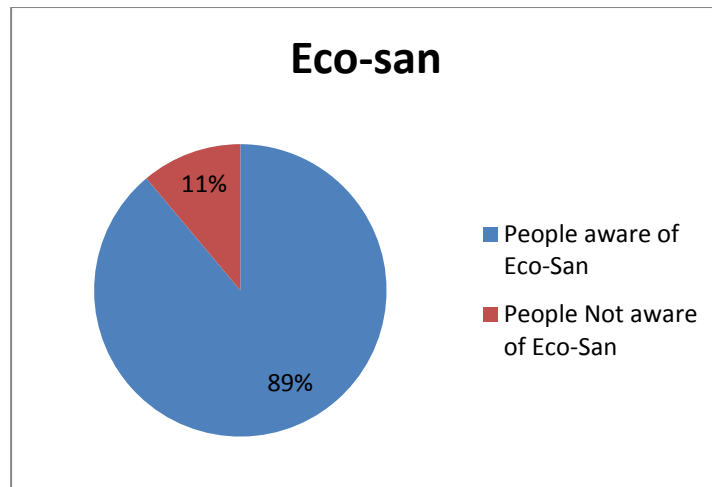


Figure 2.1: percentage of people aware of eco-san

40% of the respondents were from the VWASHCC/CHASC committee, therefore, above plot shows the biased results.

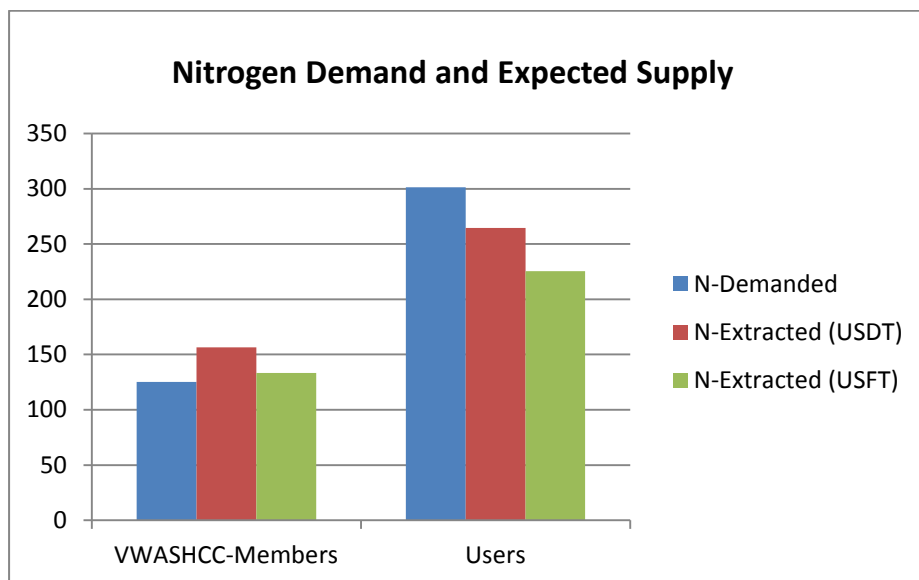


Figure2.2: Nitrogen Demand and Expected Supply from eco-san

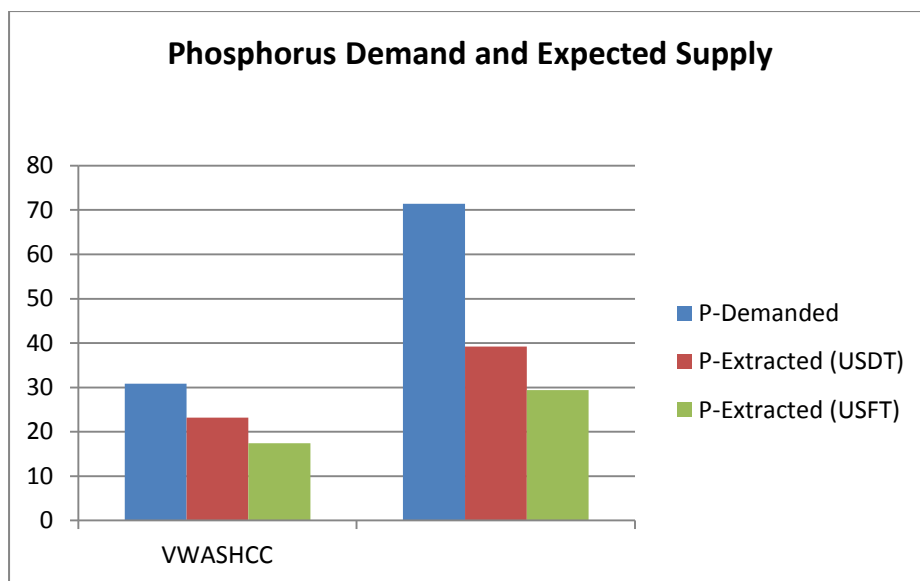


Figure 2.3: Phosphorus Demand and Expected Supply from Eco-san

- Since, more than 90% of respondents do not use Potash in their field, correlation was not done for Potash use.

Evaluation of the Alternatives

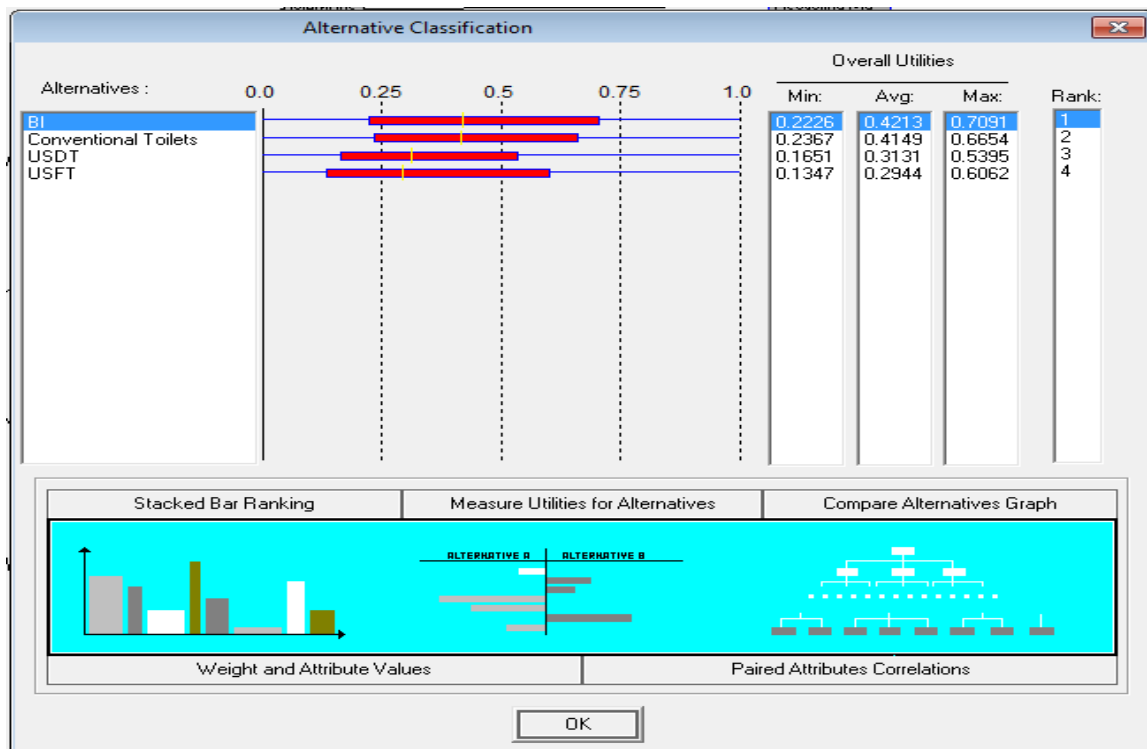


Figure 3.1: The ranked alternatives with their utilities

In Figure 5, given set of alternatives are evaluated including overall utilities and ranked automatically. The yellow vertical lines represents the average utilities, while the rectangles are bounded by the minimum and maximum utilities for that specific alternative. Biogas integrated sanitation came as the optimal alternative with highest ranking with average utilities. Since, the first two alternatives in above graph are overlapped, the evaluation may not be taken as accurate. USFT and USDT are also overlapped but comparatively both have very low average utility values.

Stacked bar Ranking

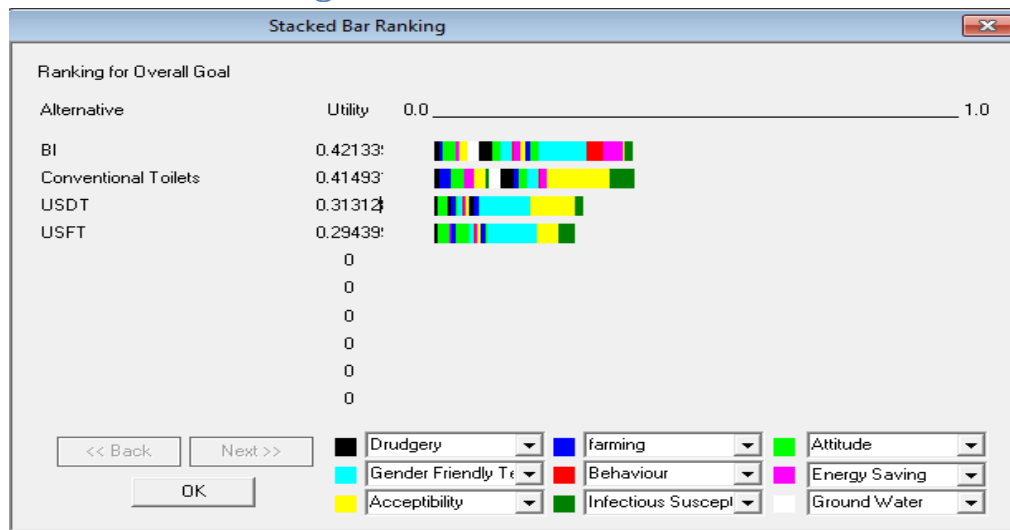
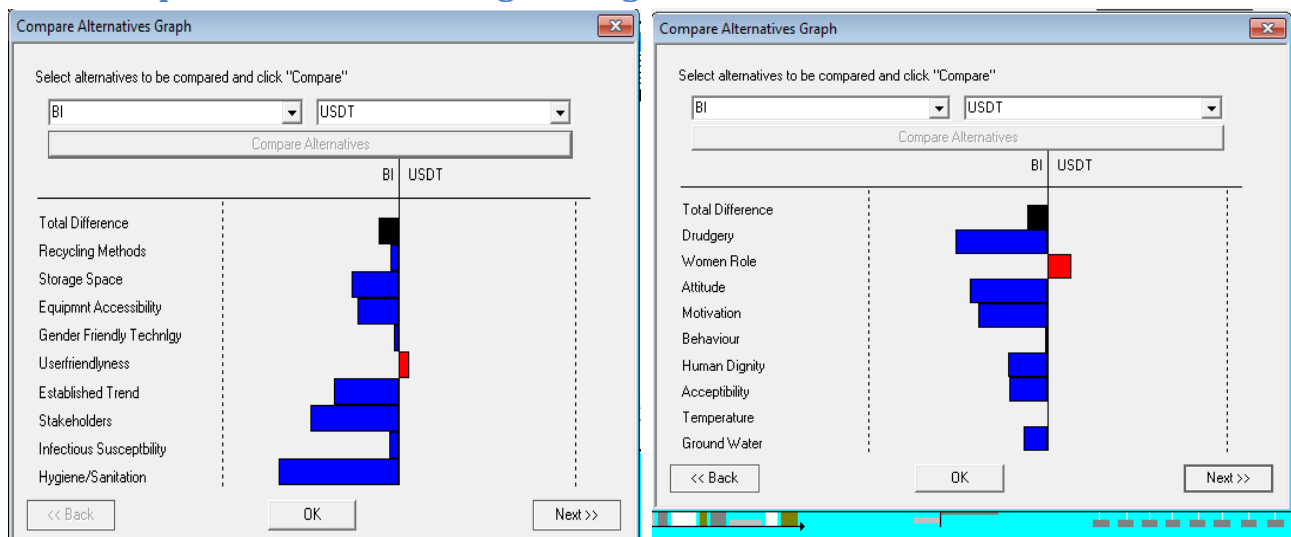


Figure 3.2 : Stacked bar ranking

In Figure 3.2, each alternative are composed of various bar with different colors showing the attributes utility value which results the alternatives to be ranked. Because of the high number of attributes in the model and reoccurrence of the same color representing different attributes, examination of alternatives and attributes was not easy with stacked bar ranking.

Result Analysis

Comparison between Biogas Integrated Toilet and USDT



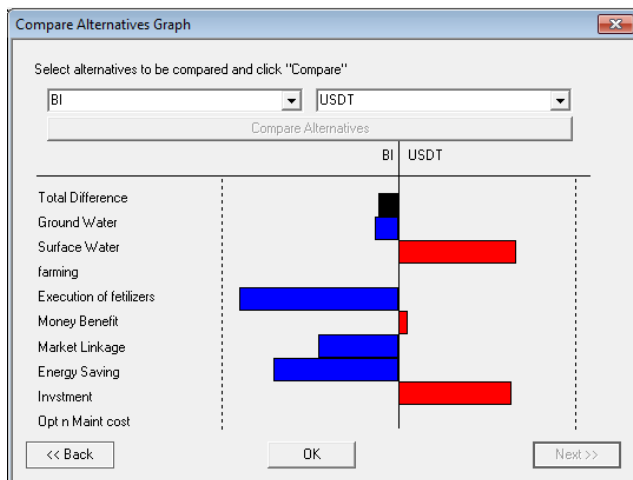


Figure 3.3: Compared alternative graph

BI and USDT

Bars for each attribute in above figure represent measures that favor one alternative over the other taking into account average utilities. Longer bars indicate more influence on the over all ranking.

While comparing biogas integrated and USDT alternatives, USDT utilities for most of the attributes was dominated by the BI alternative except for few attributes; userfriendliness, women role, investment, money benefit, surface water.

recycling method	People prefer BI in recycling method.. But the difference is very low, can be just overcome by giving practical knowledge on recycling methods related to the eco-san
storage space	Since people have no idea on storing urine and faeces in eco-san, they preferred and still go for the BI despite its high value of storage spare requirement.
equipment accessibility	Equipments for the BI is easily available compared to the Eco-san, that is why, BI has higher utilities for equipment accessibility than for eco-san.
gender friendly technology	Since they are not aware of the term genderfriendly and have been using the toilet in conventional way, utility for the BI is naturally high. And even eco-san has to be incorporated with gender friendly technolgy.

established trend	Nothing can be done here in order to promote eco-san. Established trend would naturally continue people to follow as the social norm.
stakeholders	big difference was seen here and the truth is of course the presence of various stakeholders working in biogas business.
infectious susceptibility	This attribute shows very less amount of utility differences and might not need to focus more on it to promote eco-san.
hygiene sanitation	preferably, biogas seemed more hygiene and the people actually have no idea of the hygiene value in eco-san alternatives. Until a practical demonstration by some users able to influence more people with more hygiene practice of eco-san, this belief system would continue to exist in people perception.
drudgery	Monotonous hard work, which is of course high in BI but people's lack of knowledge on it made them think that BI has less drudgery than in other sanitation.
attitude	Big gap was seen in this attribute also because participants believe that faeces and urine are more threatening in handling, attitude need to be changed by proper knowledge that it's not threatening until the faeces are mixed with urine or water.
motivation	Questionnaire for this attribute was made so as to know the motivation behind choosing a specific sanitation alternative, motivation that is required to choose eco-san would be increased by making them known to the nutrients flow concepts and helping in making environment more sustainable within a HH boundary which would make them feel proud.
behaviour	This is something that people's behaviour that has been accustomed in their thinking. Based on the questionnaire, it was found that, participants are neither used to with BI nor to eco-san. Probably, that signifies the participants are receptive to new alternatives.

human dignity	Dignity was found more in BI because its benefits were already pervasive in community, for example, BI toilet's use in cooking consequently saving the fuel wood, and the fertilizer use in the end.
acceptability	BI toilets are more accepted than eco-san, this is the existing status quo, therefore, by only changing other attribute would make people accept the eco-san.
temperature	NA
ground water	NA
Surface water	Eco-san has considerable amount of utility in surface water attribute.
farming	Equal utility was seen for both BI and eco-san. And interestingly, participants know already that the use of human waste is good in farming.
execution of fertilizers	May be because of the lacking knowledge in use of human waste, they preferred BI, therefore, large gap was seen here and eco-san utility was dominated by BI. Information on the technical way of using of human waste is needed in order to minimize the gap.
benefit	Though the benefit from eco-san was not common in the communities and the people's dissatisfaction on the quality of end product from BI, they know littler more on benefit from ecosan.
market linkage	The end product of BI can be sold in the communities level, however its not in the market level. Therefore, the utility is higher for BI and it can be overcome by creating a market where human waste fertilizer from eco-san can be sold and bought.
energy saving	Difference is bigger, and NA in order to promote eco-san because in either way, eco-san can not save any energy.
investment	NA

opt and maintenance

Low difference represents that there is no need to think on it since, both alternative seems equal utility for this attribute.

Comparison of USFT and USDT

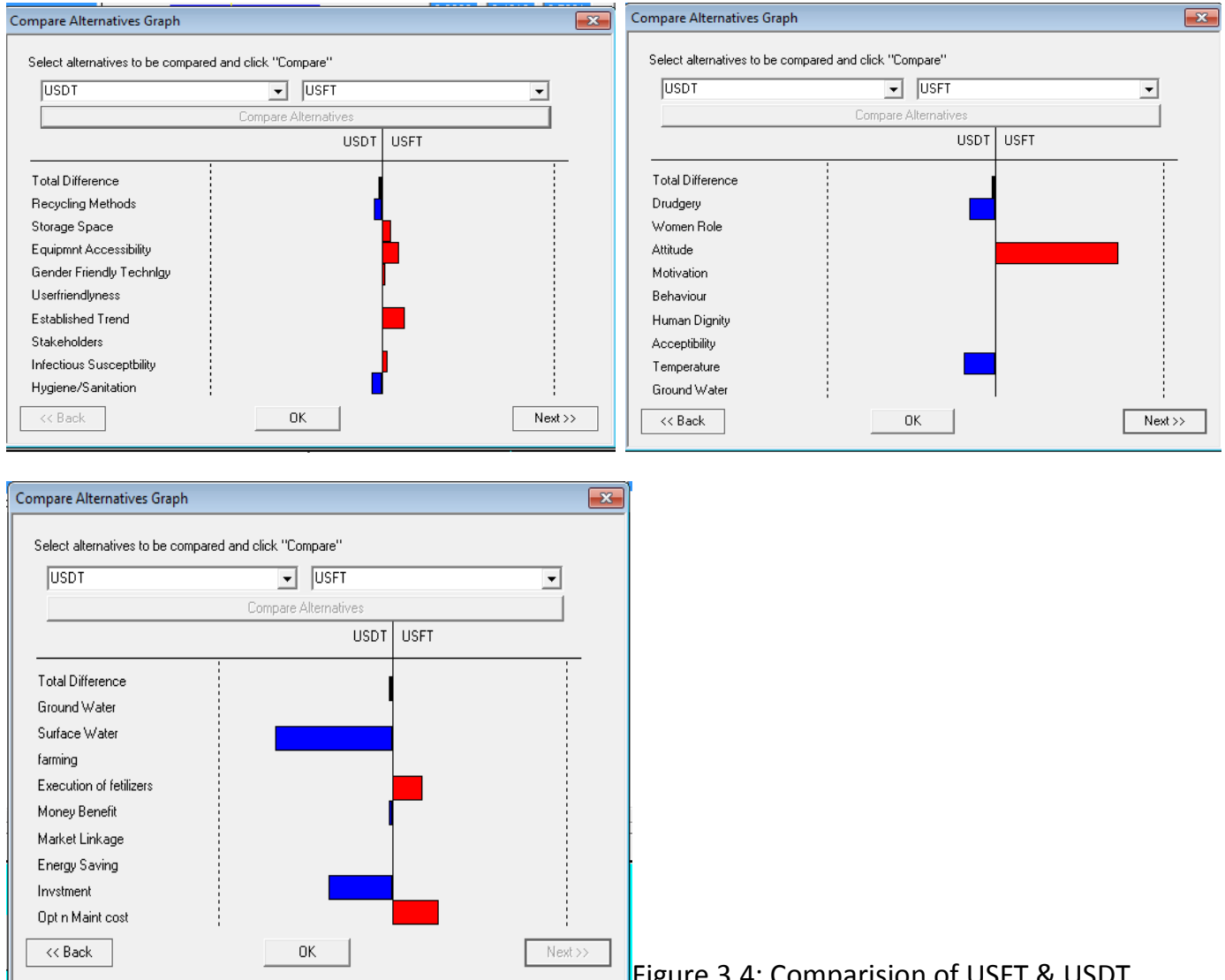


Figure 3.4: Comparison of USFT & USDT

Optimal solution for different objective aspects

Economic aspects

Viewing figure 3.5 below, eco-san came as the optimal alternative but only in economic aspects. Biogas integrated alternative is still one step ahead of the USFT because of the good utility value in energy saving. Since the total difference of average utility between USFT and

USDT was very low which can be seen in figure 3.4, there seems a large difference in utility while considering economic aspects which is shown in figure below. However, eco-san as a sanitation alternative is facing the barrier from the existing socio-economic status and present belief of the population as cultural behaviour, differences and gaps need to be measured with BI or Conventional toilets.

In economic aspects, eco-san has the good utility and has become the best alternative; therefore, there is no need to apply any measure in economic aspects in promoting eco-san.

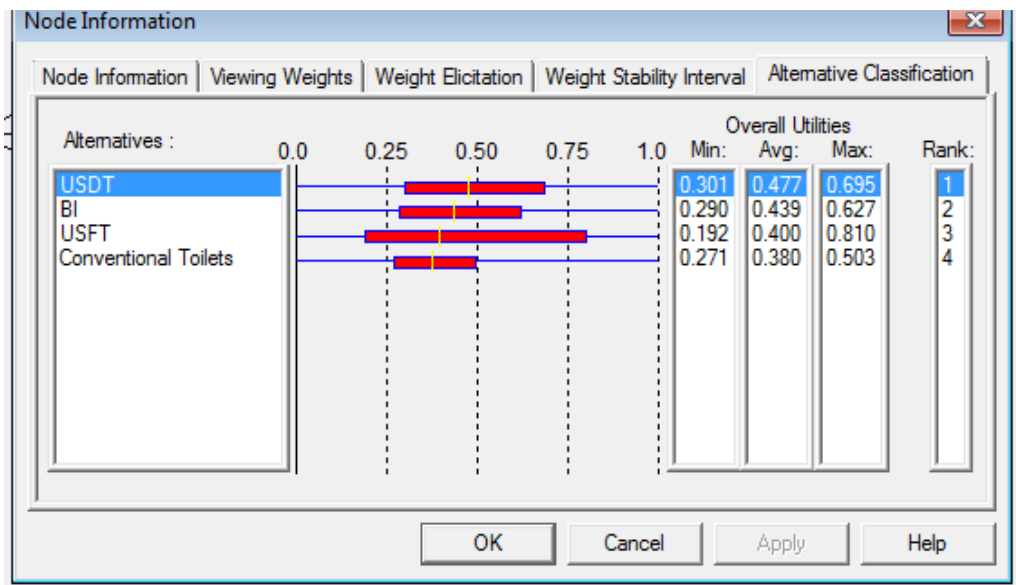


Figure 3.5. Ranking for Economical Aspects

Environmental Aspects

Similarly, when the alternative classification was viewed considering only environmental aspects of the objective, eco-san alternatives came as the second and third optimal alternatives after Biogas integrated toilet.

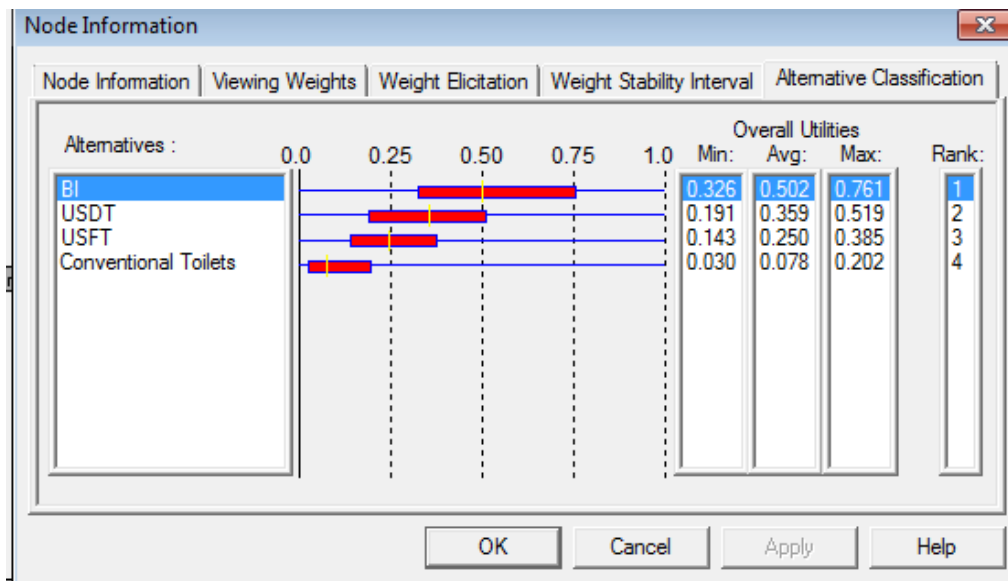


Figure 3.6. Ranking for Environmental Aspects

Since, the average utility for USDT is largely behind the average utility for BI, planning and implementation of the possible measures must be focused here in order to gain the average utility for the eco-san. Comparison between the BI and USDT in environmental aspects would give a more clear and concise differences between these two alternatives which is shown below in Figure 3.7.

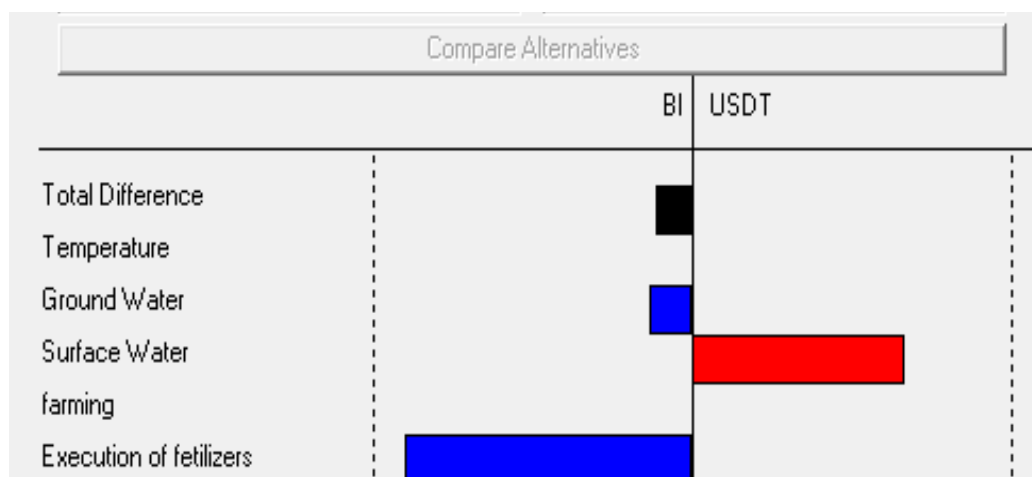


Figure 3.7. Compared Alternative graph of BI and USDT for environment

Certainly the belief which those participants had for ground water was inclined to BI and they were so confident that with the BI sanitation practice, ground water was not being polluted. In contrast, participants had positive belief that supported USDT. In addition, BI possessed large number of utility value for attribute execution of fertilizer. This belief was supported by the fact that they have had the knowledge on BI and its methods. If the knowledge for the use of

urine and faeces is provided to the participants, that could bring USDT with a higher utility value for execution of fertilizer attribute and put USDT as optimal alternative environmentally as well.

When the subjective scale for execution method was increased 0 to 0.5-0.6, USDT came as the optimal sanitation alternative. Hence, the knowledge on the execution methods of urine and faeces should be provided so as to promote the eco-san.

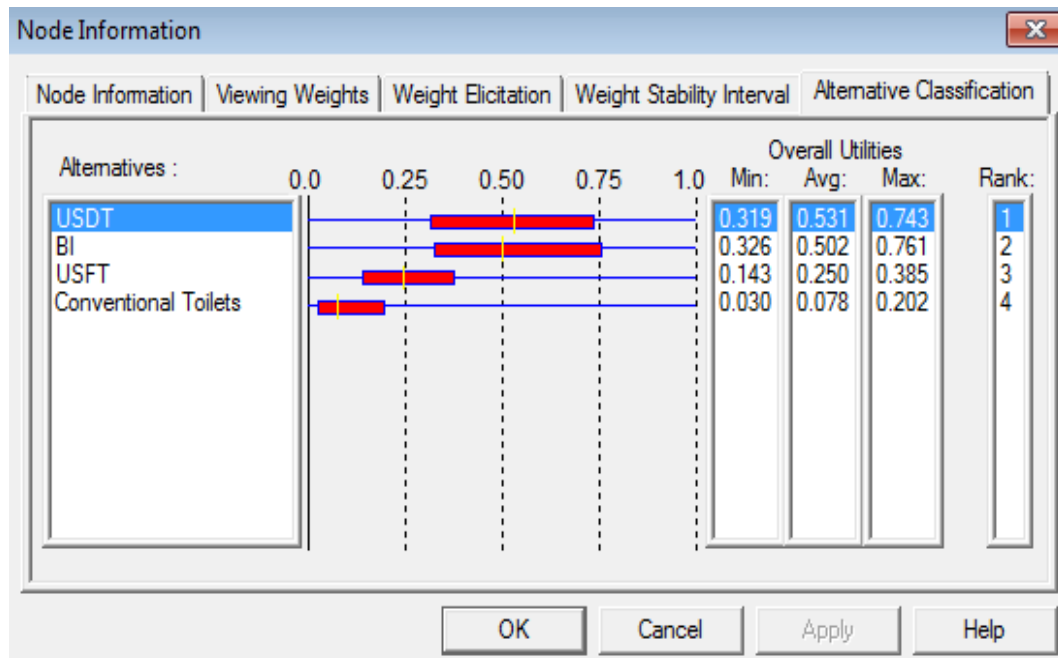


Figure 3.8. Ranking of alternative for environment aspect.

Comparison between the USDT and Conventional toilet with environmental aspects:

When the comparison was done between USDT and Conventional toilet, differences in utility value was seen for all the environmental attributes and higher in values for conventional toilets as shown in figure below, which meant respondents answers supported the conventional toilet despite the fact that environmentally USDT is sound alternative. Proper knowledge on ground water and surface water pollution from the use of conventional toilet need to be provided in promoting eco-san. This analysis is just to check out what differences lies between USDT and Conventional toilet because most of the users have conventional toilets in Kapilbastu.

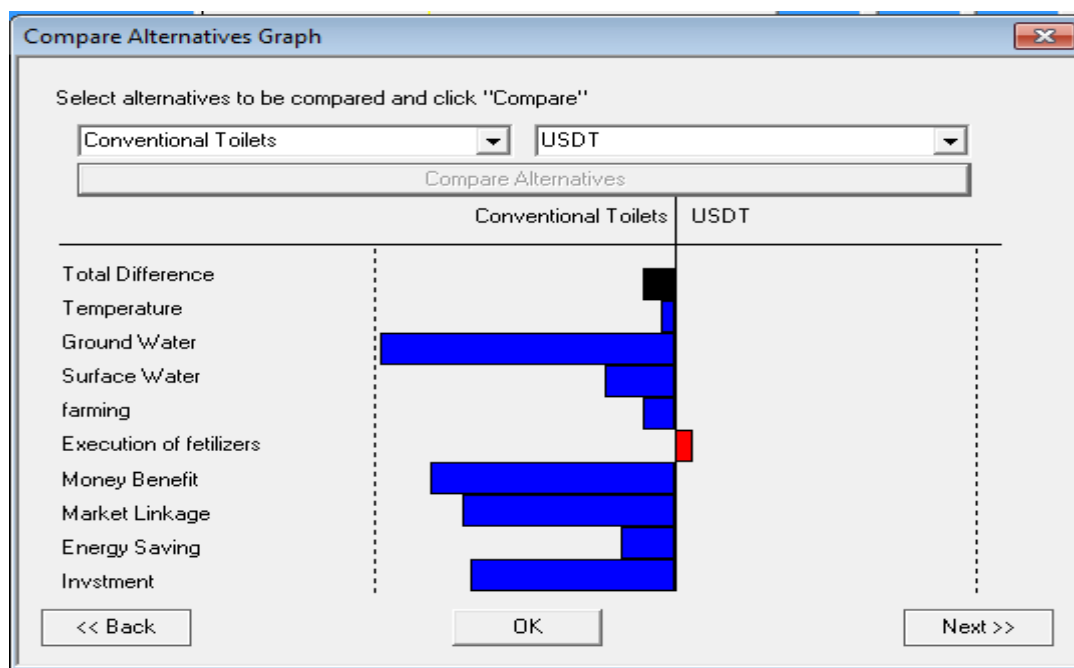


Figure 3.9. Compare Alternative graph for Conventional and USDT.

Social Aspects

Conventional toilets are socially accepted and optimal sanitation alternative which is followed by the BI, USFT and USDT as shown in figure below. USDT comprises of very low utility value socially therefore, the promotion plan for ecosan has to be dealt socially.

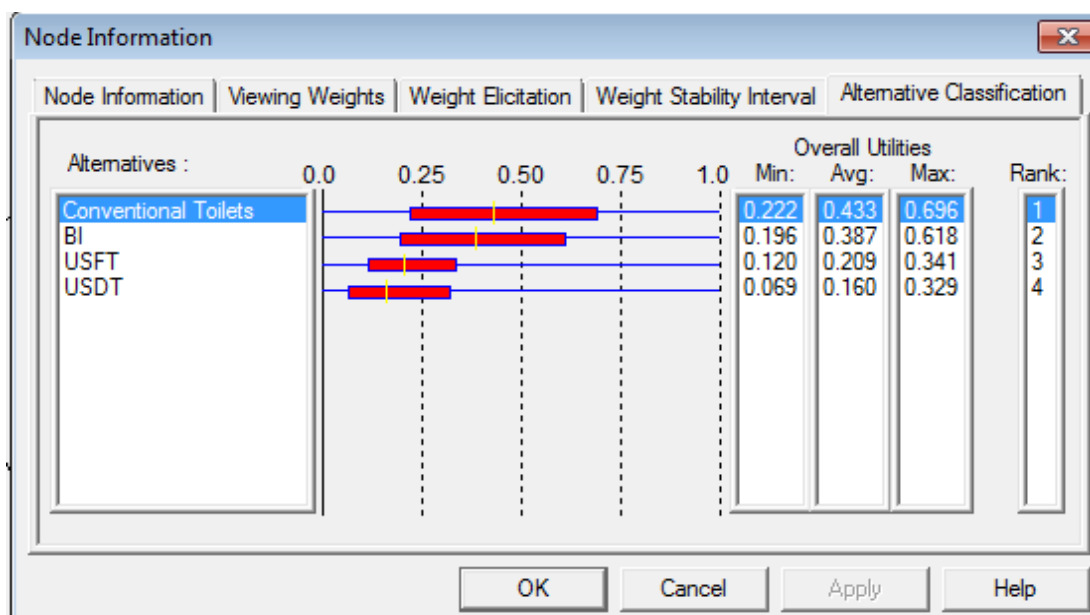


Figure 3.10. Ranking alternative for Social Aspects

Comparison of conventional toilet and USDT with social attribute:

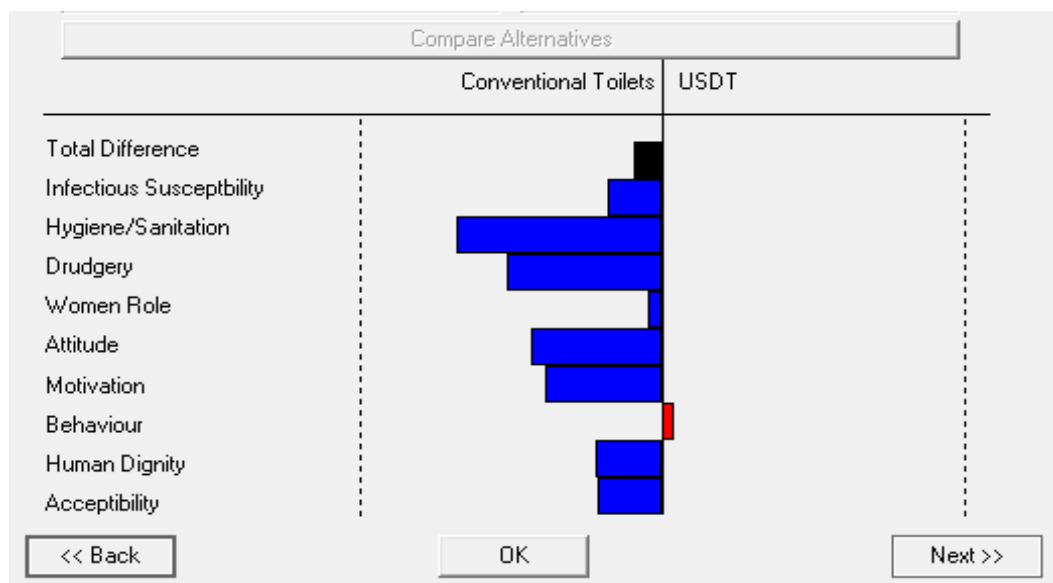


Figure 3.11. Compare Alternate Graph for Conventional Toilet & USDT

Only the behaviour attribute is supporting USDT, this is also because few users are not used to with their current sanitation practice which in turn supports the eco-san promotion. Otherwise, almost all attribute has dominance value over the USDT utility value.

Current people's perception showed that the conventional toilet is not infectious compared to USDT, that might be the cause of unawareness in the cleanliness and flylessness qualities of USDT. Similarly, hygiene sanitation was also perceived as the existing sanitation practice BI or Conventional one, and while asking on the hygieneness of their current sanitation practice, no one dare to say that their unhygieneness of the current sanitation practice. That unawareness is actually supported by the fact that, they have no idea how hygene and clean eco-san would be.

To promote the eco-san, it first has to be accepted socially for which, proper implementation plan should be taken. If we can only change 20% of people perception towards the ecosan and make them feel ecosan as socially accepted, it will not only change 20% people rather lower the 20% of people's wrong perception on conventional toilet and BI. Which will consequently help in promoting eco-san. Figure below shows that, how 20% changes in people perception make the ecosan socially accepted.

USDT is now optimal alternative when certain percentage of people's perception was changed which is shown in figure 3.12.

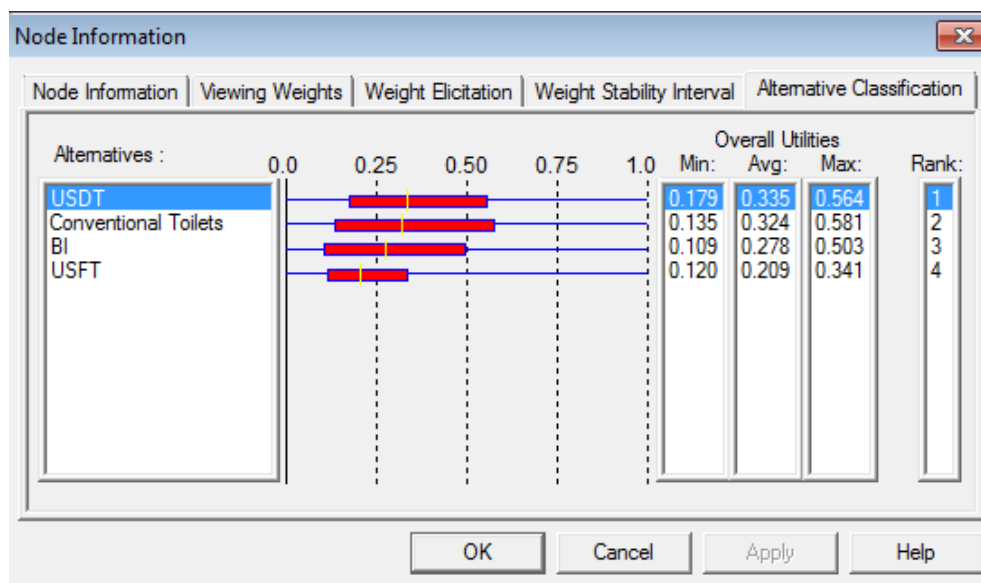


Figure 3.12. Ranking Alternative for Social Aspect

Technological Aspects

At last, Conventional toilets came as the optimal alternative for technological aspects, and USDT is at last choice as for social aspects which is shown in figure below. Difference in utility value between conventional toilet and USDT is even large here than in social aspects.

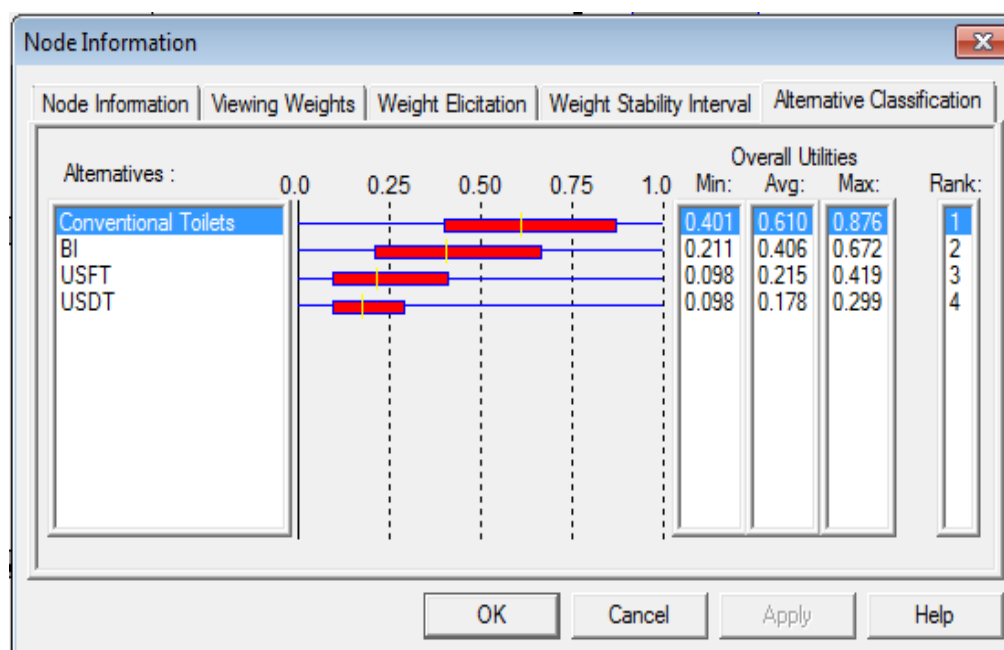


Figure 3.13. Ranked Alternative for Technological Aspects.

Compare alternative graph between conventional and USDT gives a concise graphical representation of attribute and its utility value. When ecosan as the commode system was introduced in the community during the questionnaire survey, people preferred USDT as

userfriendly for all ages of people. However, dominance over the USDT utility value for storage space, equipment accessibility, established trend and stakeholders has made conventional toilet strongly optimal alternative as shown in figure 3.14.

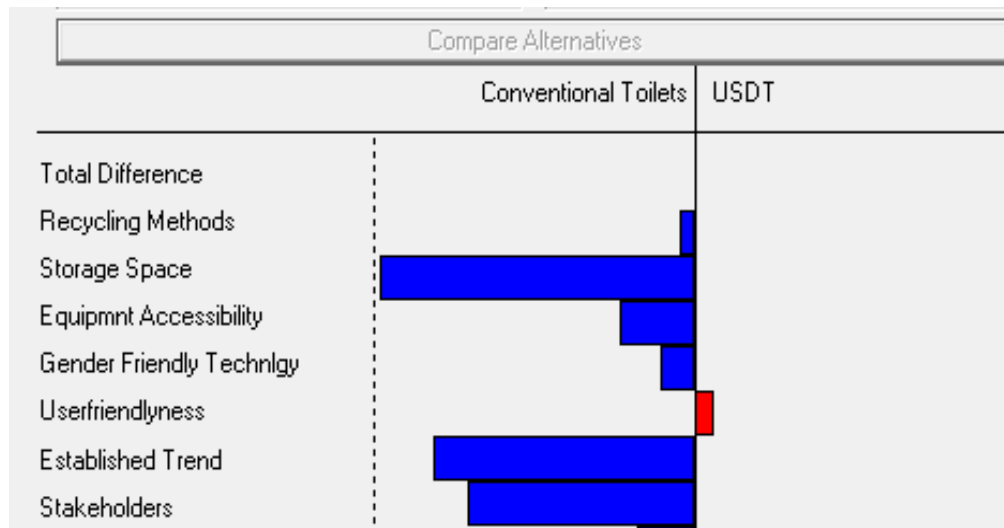


Figure 3.14. Compare Alternatives Graph

What remedies would be to make eco-san technologically viable and optimal among all alternative? Storage space is more problematic in ecosan practice compared to conventional toilet until the pithole gets full and alternative is looked for. However, the people perception on the problem of storing urine and faeces could be made better by furnishing their knowledge. Likewise, the utility value for established trend is also not changeable. In contrast, equipments required for the conventional toilet is easily available in market but not for ecosan; however, the utility value for equipment accessibility can be improved by the addition of few market for ecosan equipments near by the community. Likewise, the utility value of ecosan for genderfriendly technology could also be ameliorated with proper knowledge. For stakeholder attribute, currently, conventional toilet are being promoted and there exists few stakeholders like VWASHCC, CHASC, VDC, etc for conventional toilets. Organizing such stakeholders to promote ecosan and reducing those stakeholders working for conventional toilets would ultimately increase the utility value for USDT.

Changes in the values given for those above potentially changeable attributes made the USDT as optimal alternative technologically as shown in figure below. For example, increased in number of people believing that recycling urine and faeces is not tough, making more people believe that commode system ecosan is more userfriendly has subsequently

increased the utility value for USDT among all other alternative and finally as the optimal alternative in technological aspects as well.

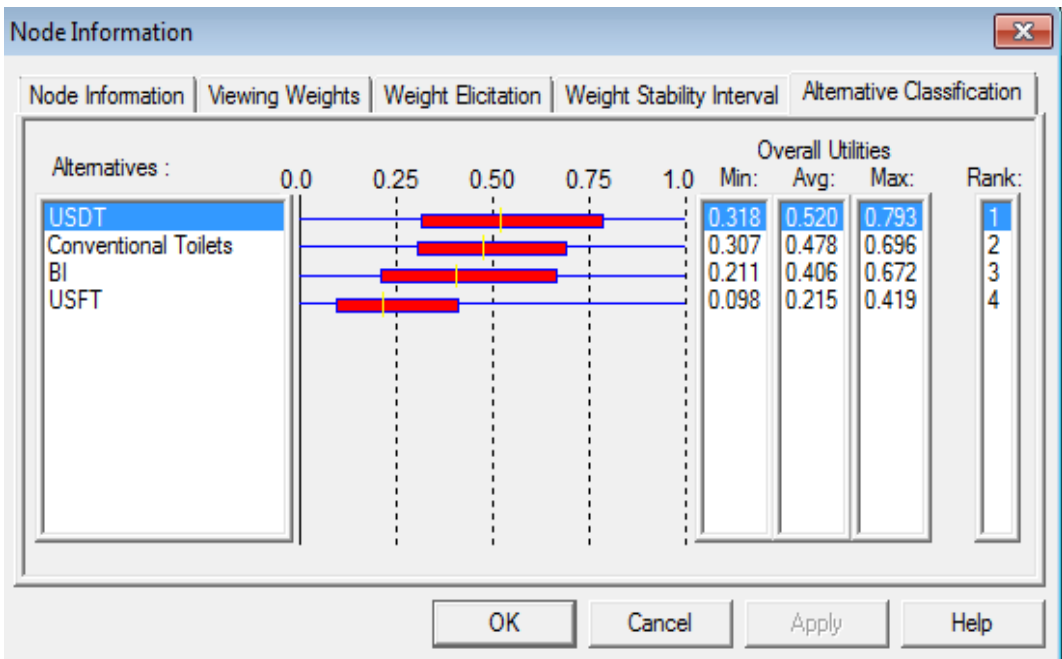


Figure 3.15. Ranking for Social Aspect

Below figure 3.16. is the final alternative ranked after all the changes and measurement done to make the eco-san optimal sanitation alternative among people.

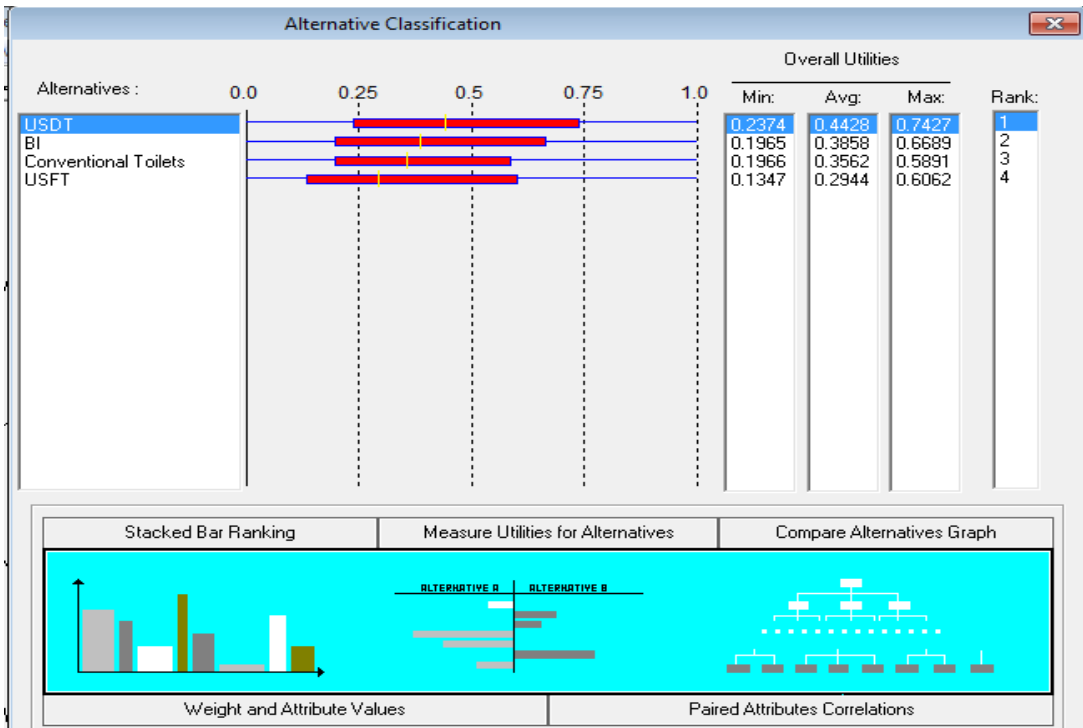


Figure 3.16. Final Ranked alternatives after the promotion plans and initiatives.

Conclusion

Current government plan to cover the all nation with well organized hygiene sanitation practice withing few years and the problem lying in the current sanitation practices are well known to us. Pollution of ground water to surface water, linear flow of nutrients that ends up in the pit hole causing farmers to look for alternative such as chemical fertilizers are just few problems which should be addressed in time and those old trend praticce would be replaced by new way of sanitation practice known as eco-san.

Implementing such new practice in a community where other practices has already been ingrained in their culture, would be a challenge for eco-san. Therefore, the use of DSS seemed practical way to measure the gap that lies between the community and eco-san.

On the basis of the GMAA analysis, it has been proved that; ecosan are optimal solution chosen by the community but socially, technologically, and environmentally they lack plenty of value in community. However, the attribute related to those parts where ecosan are not accepted as optimal, proper plan and activities would enhance their knowledge on ecosan and it would be otpimal sanitation alternative. Among all, eco-san first has to be accepted socially since the big deficiency in utility value for ecosan could be seen from the GMAA result.

Limitations

- More survey would have provided the better result and analysis yet time constraints made the project limit number of participants to 30.
- One third of respondants were from the CHASC/VWASHCC who had already participated in eco-san programme that made the report a little biased.
- Utility for all the attribute was drawn on the personal assumption and the weight given to the attributes also presumed with personal assumption.

Annex I

Attribute Weights on Decision

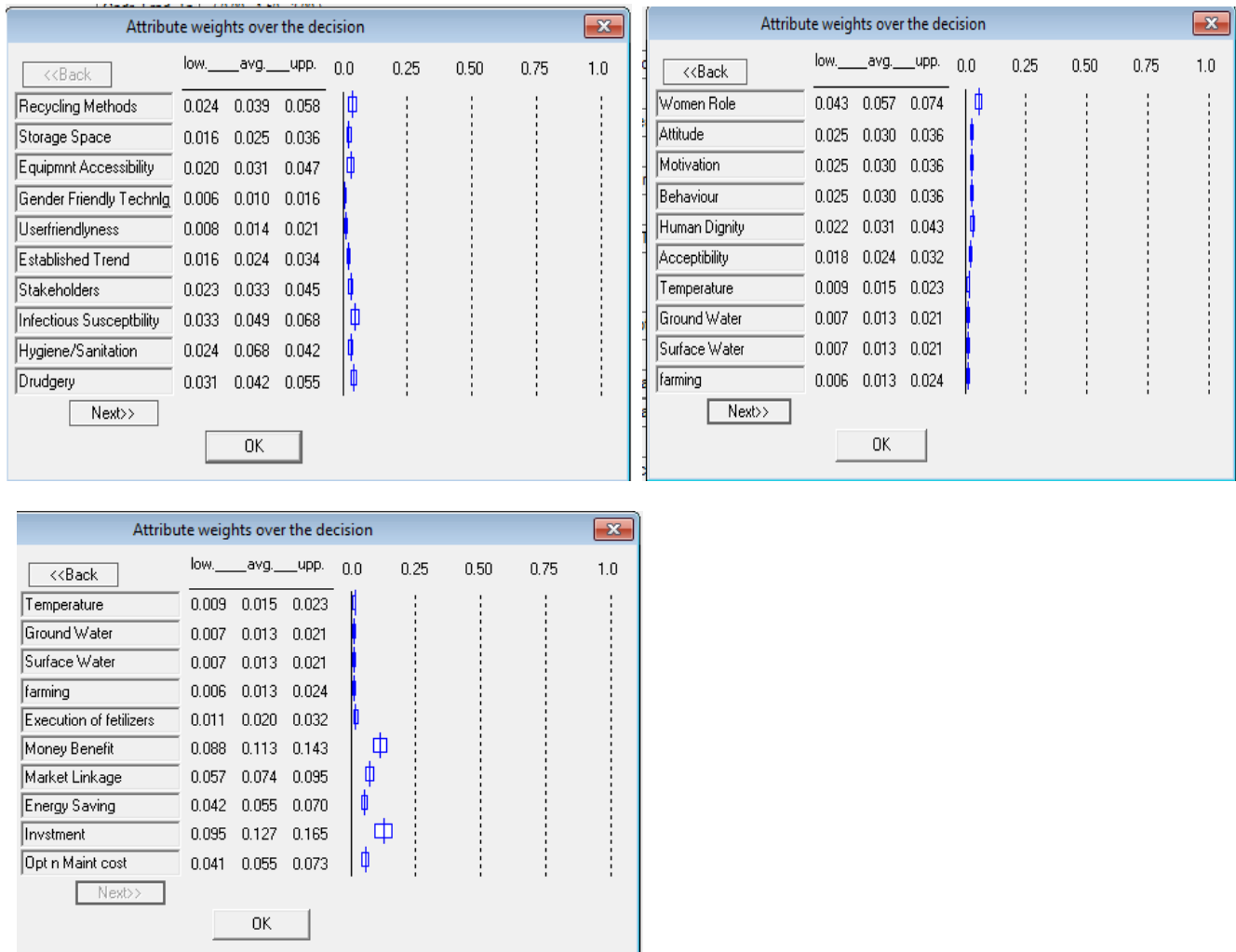


Figure: Overall Attribute's Weights on the Decision

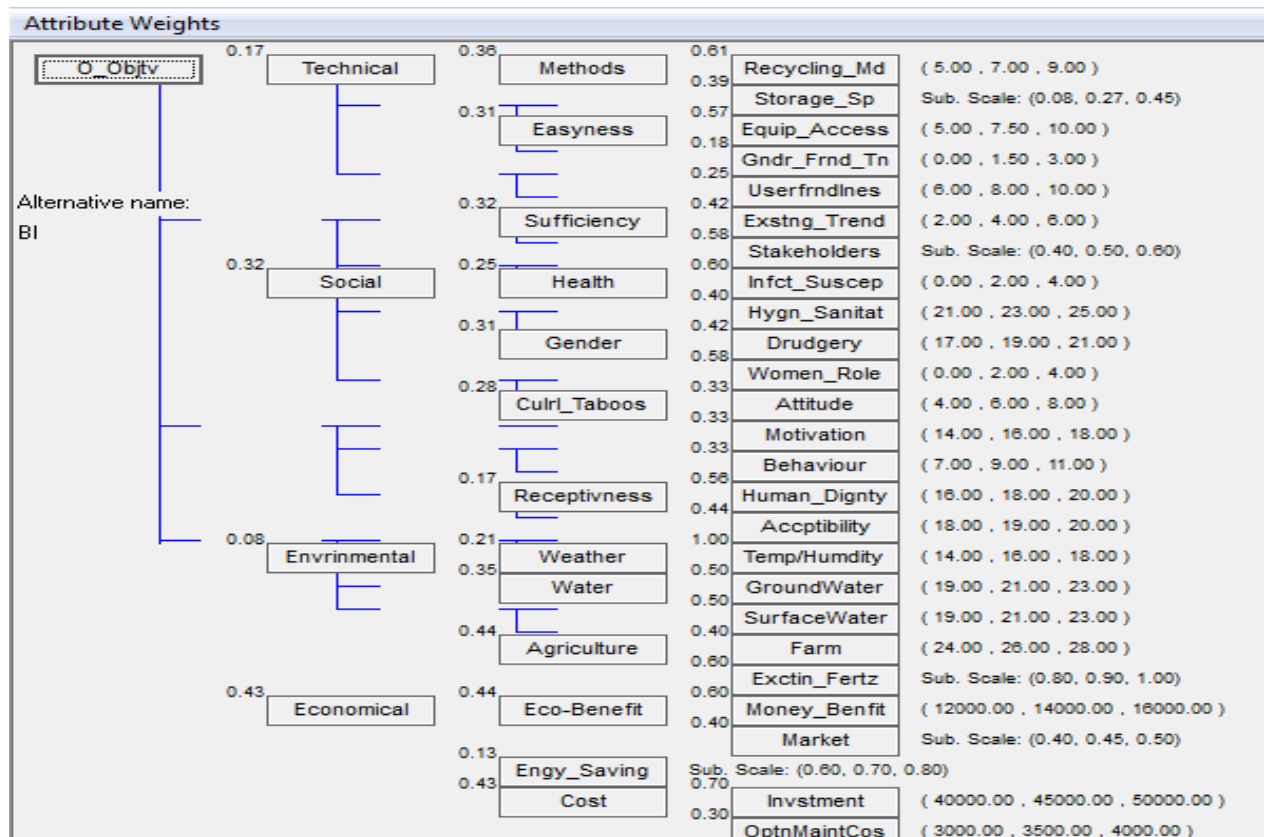


Figure: Attribute weights

Weights were given on the personal assumption as decision maker that economical and social aspects are more important than the environmental and technical for rural people. Given weights can be seen in above figure.

Annex II

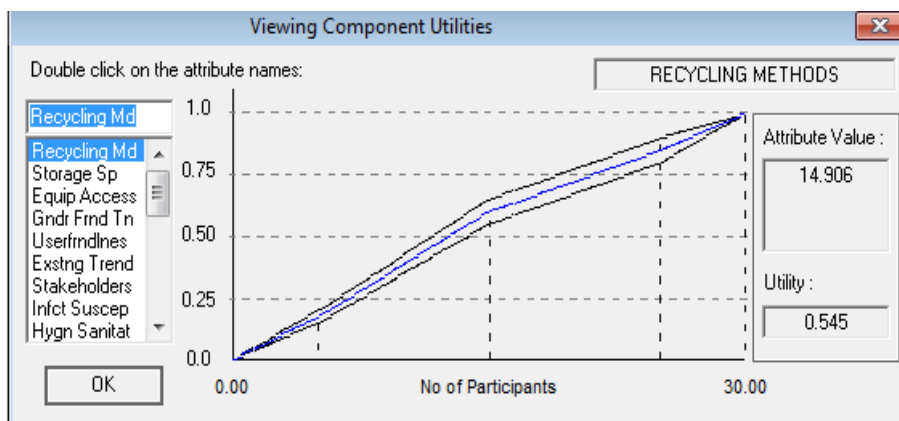
Attribute and its Utility function:

Gender friendly technology	Approval from the lower number of people would not show that the alternative is gender friendly, therefore until the large number of people admit that the alternative is gender friendly, the utility will not be high.
Userfriendliness	The utility for this attribute is also drawn with the same concept as of gender friendly technology. Unless the large number of participant admit that the alternative is userfriendly, it wont be granted as the userfriendly.
Existing trend	Utility for this is made on the basis of linear utility. Since, it seems that if half of the population use a sanitation alternative, that will have a half utility.
Stakeholders	Subjective scale will be assigned here, since the number of organization are fixed in the study area working for the different alternatives.
Infectious susceptibility	Until it reaches more than half of the population's belief that the one sanitation practice is not infectious, than the utility will be high for that specific alternative.
Hygiene sanitation	More than half of the population must admit that the one is hygiene inorder to have the high value of utility. Therefore the utility for it is drawn very low for low number of respondent and high only for the maximum number of respondent.
Drudgery	Since, fetching water might be problematic for some household leaving other in ease. Therefore the utility is drawn very wide on that concept.
Women Role	This is such a crucial matter now a days which include gender equality in each and every step of life, therefore maximum utility will only be achievable for the maximum number of respondents.
Attitude	I expect it as the low utility if more than 5 people has the wrong concept about the faeces and urine. Therefore the utility was drawn with high value of utility for less than 5 people and lower utility for more than 5 people.
Motivation	More than 65% of motivated people only give a sufficient utility for a sanitation alternative. Otherwise it will have the similar but lower utility for the number of respondent.
Behaviour	More than 60% of people's positive behaviour towards the alternative would only bring the good utility for that specific alternative. Which is similar to the above utilities for the psychic attributes.
Human Dignity	I expect the population will only have a rigid dignity with high value of utility on any alternative only if more than half of the population admits it as the
Acceptability	Will have gradual increase utility for more than half of the population's acceptance.
Temperature/Weather	Since, it is very crucial in fertilizing the faeces and urine during any season, because temperature, humidity plays a very important role in processing the human waste. More the high temperature, fast the fertilization of

	faeces take place. Therefore, maximum number of people's validity on this truth need to have a good utility.
Ground water Table	Until more people responds with the belief that certain alternative would or would help not to pollute the ground water, therefore the utility was drawn gradually increasing only with more than of 22 respondents.
Surface water	This is something like the utility for ground water table but in monotonically decreasing order.
Farming	Utility for farming is higher even for few household since, the alternatives are supposed to be measured in giving the beneficial support to the farming.
Execution of fertilizer in fields (Subjective)	Utility for this attribute will be higher in value if the alternatives could provide maximum number of HH a easy execution of the fertilizers in fields. Which depends on the methods and rules in execution of fertilizers from the alternatives.
Money Benefit	If a household economize more than 2000, it is probably a good benefit for a HH in rural area. And the utility is expected to increase with saving more than 2000 up to 10000.
Market for the output	Subjective scale was constructed for this.
Energy savings (Fuelwood)	<p>Probably yes answers are the biased answer because during the questionnaire survey, i had to explain them about the energy aspects of sanitation alternatives. Generally, people use biogas as alternative because it allow people not to depend on fuelwood which needs very hardwork to fetch it from forests.</p> <p>Utility was drawn and it gets higher utility if the alternatives would provide more than 6 months the energy as alternative for the fuel wood. Since, the villages with biogas integrated sanitation, they still have to use fuelwood every day because of the insufficient gas for all the cooking purpose. And it is not even easily measurable in terms of months, therefore, it should be subjective on personal assumption.</p>
Investment	Investment cost was first calculated based on the cost respondents paid for their sanitation alternative. And then based on the general overview for the cost of BI, utility was drawn for the low cost conventional toilets to BI with increasing utility trend.

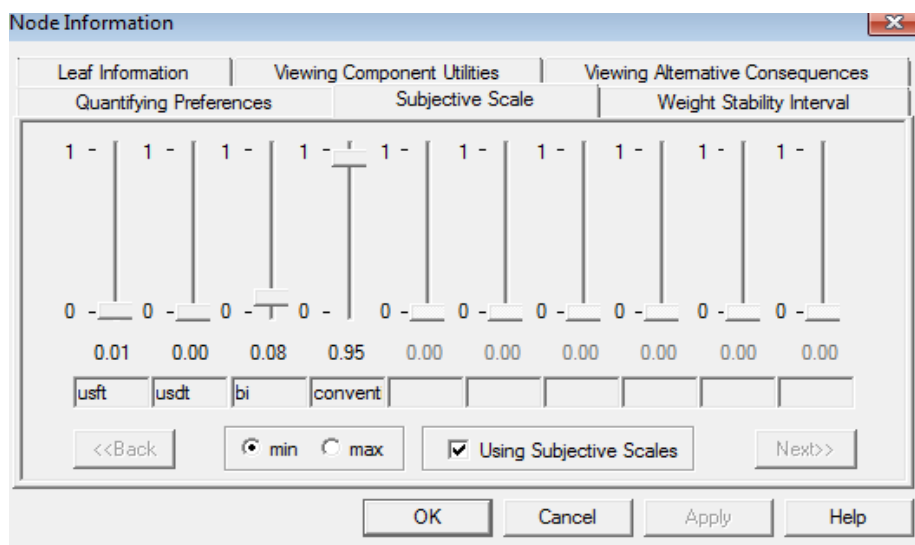
Recycling Method

Every sanitation alternatives has its own unique methods of recycling and managing waste. Here, utility of recycling method was created such a way that more the people think easy recycling waste in certain way that belongs to the specific alternative, more utility that alternative possesses. data for this attribute were put on the people's perception.



Storage Spare

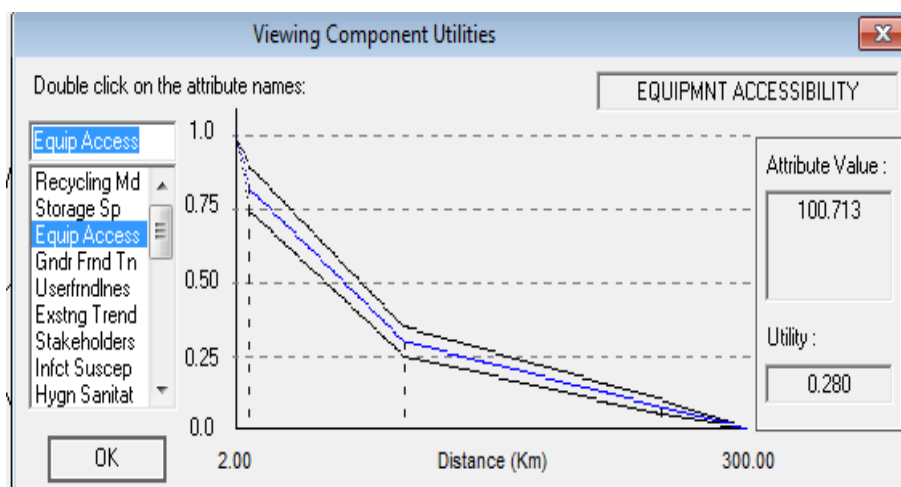
Despite the fact that the space problem is more for Biogas integrated sanitaiton and then comes to other sanitation as problem because of its high land requirement. However, the subjective scale of utility was drawn on the basis of people's responses.



Equipment Accessibility

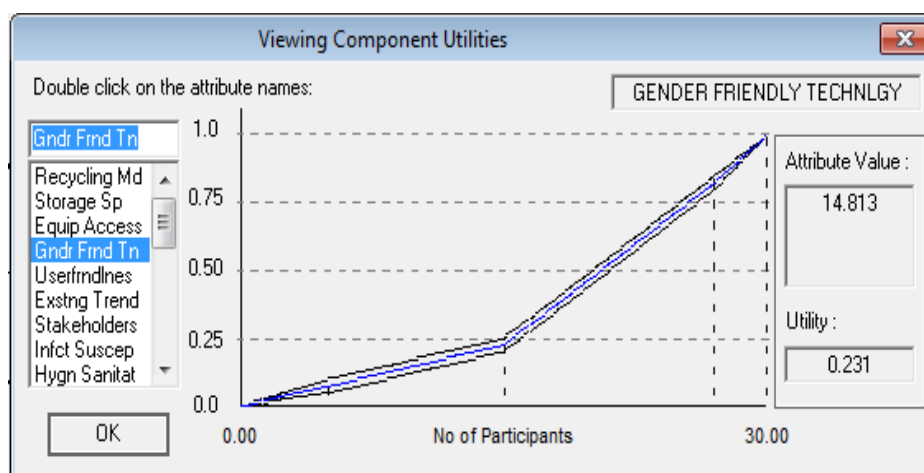
Equipment required for the sanitation alternatives depends on complexity of the parts and its uses by the people so the business market would grow near to the people market. Since, the conventional toilets are more used by the people, more parts of those alternative is available in the nearest market otherwise the equipments for other alternatives has to buy from district market or few more kilometers far from the community market.

Utility was drawn based on the economic status of the people so the utility is high if the equipments are available near them.



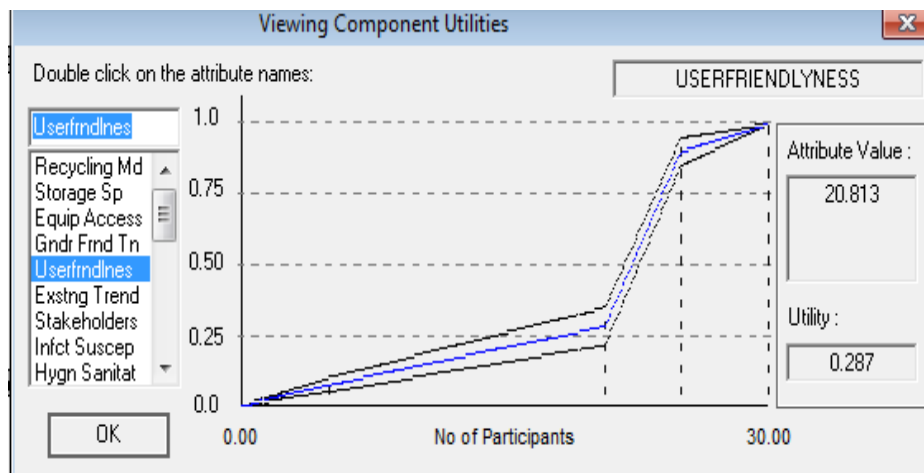
Gender Friendly Technology

Most of the people are unaware of the term gender friendly technology, though the utility was drawn thinking that unless more than half of the population agree an alternative as the gender friendly, it will not have more than 20% of utility and only after in increasing utility trend as shown in figure.



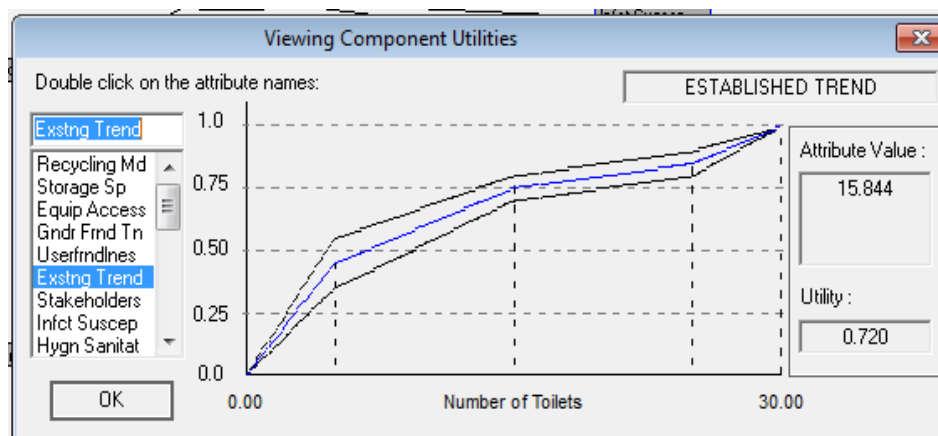
Userfriendliness

Until and unless one third of the population admits that any sanitation alternative is user friendly for people of all age, the utility will not surpass 25%.



Existing Trend

Based on the truth that any new ideas is actualize by inagurating with a few start, therefore the utility is getting high even for the one third of population and increasing in trend.



Stakeholders

Promotion of certain alternative depends certainly on the stakeholders working for it.

However, that would not have been the case unless the study area is urbanized area.

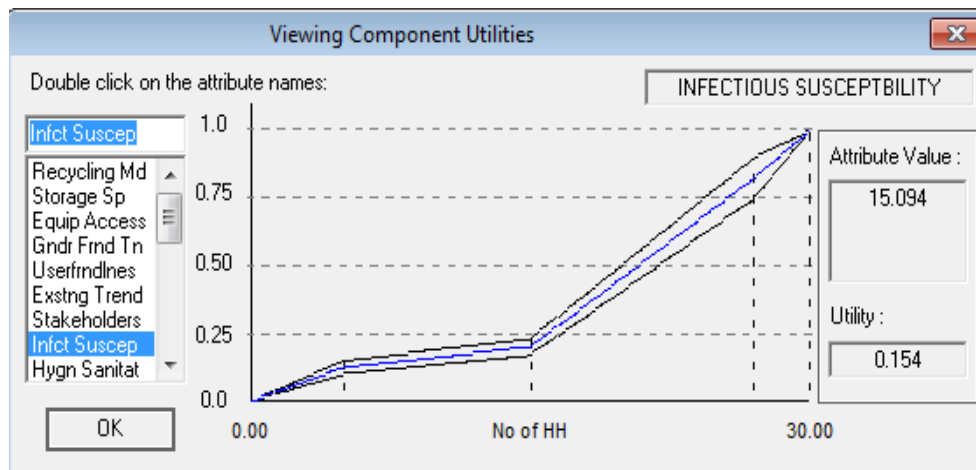
Therefore, subjective scale was drawn based on the number of organization related to specific alternative would probaly promote more rapidly than other with less stakeholders.

Node Information

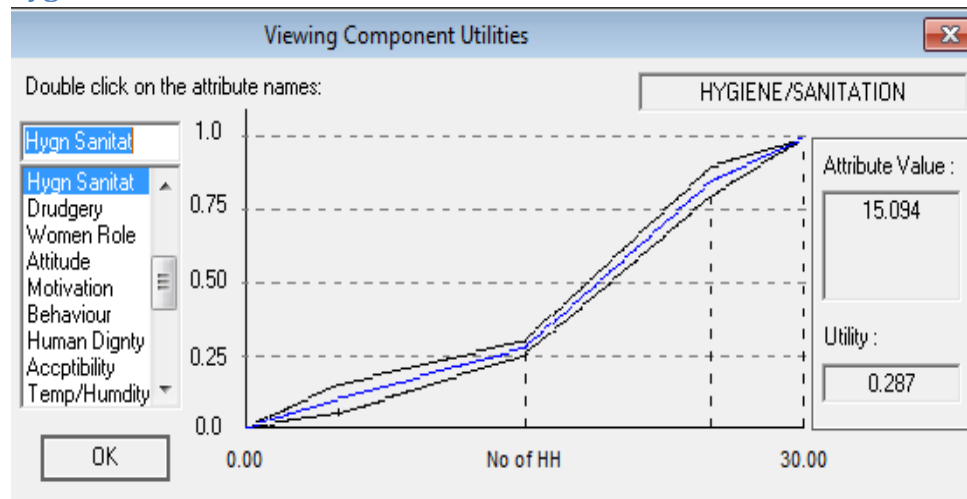
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Quantifying Preferences				Subjective Scale				Weight Stability Interval			
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0 -	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0 -
0.00	0.00	0.40	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
usft	usdt	bi	convent								
<<Back				<input checked="" type="radio"/> min <input type="radio"/> max		<input checked="" type="checkbox"/> Using Subjective Scales		Next>>			
OK				Cancel		Apply		Help			

Infectious susceptibility

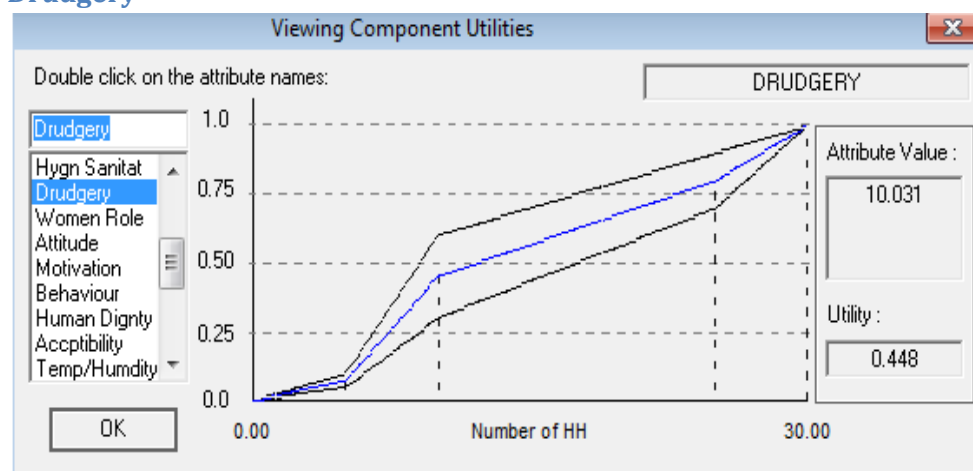
Utility for this attribute was also drawn completely based on the participants belief towards the alternatives as how susceptible the sanitation alternative is. Therefore, I assumed that it only gets more utility if more than half of the populations' perception support the one alternative not susceptible to infection.



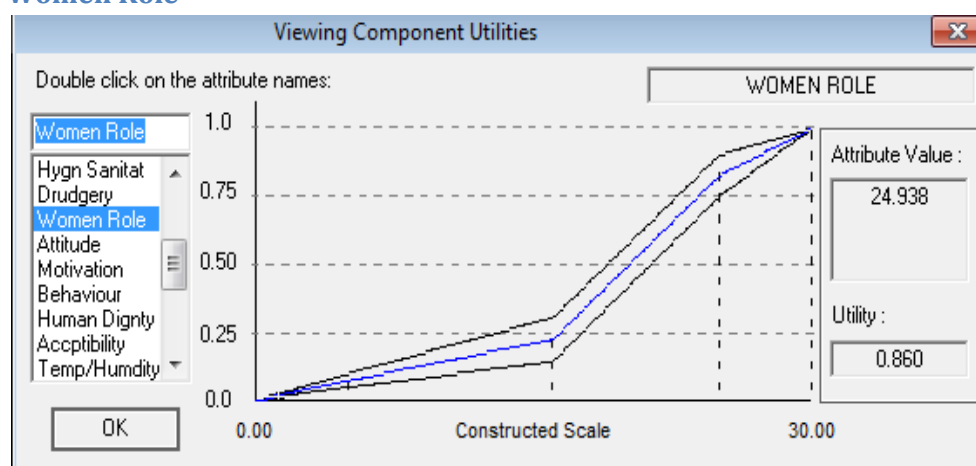
Hygiene Sanitation



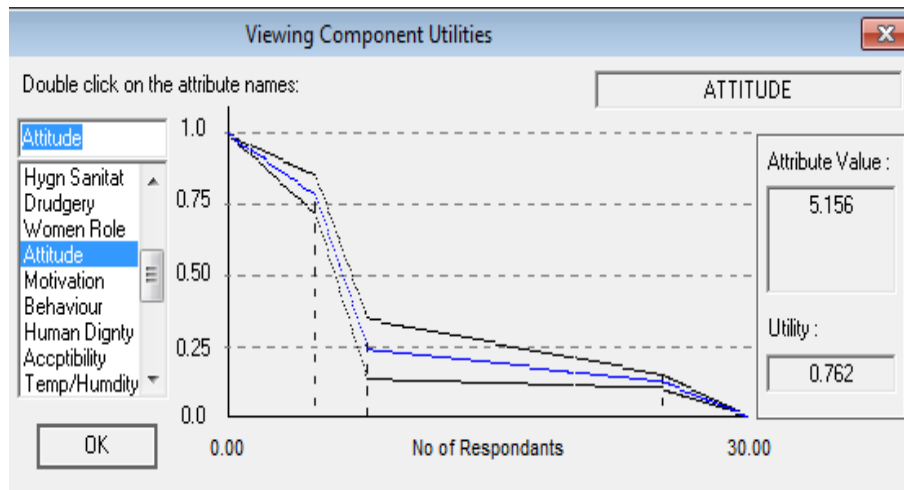
Drudgery



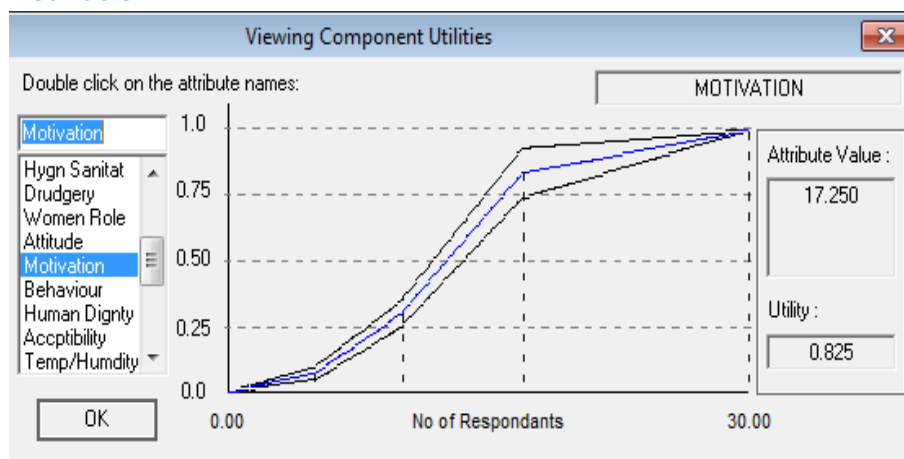
Women Role



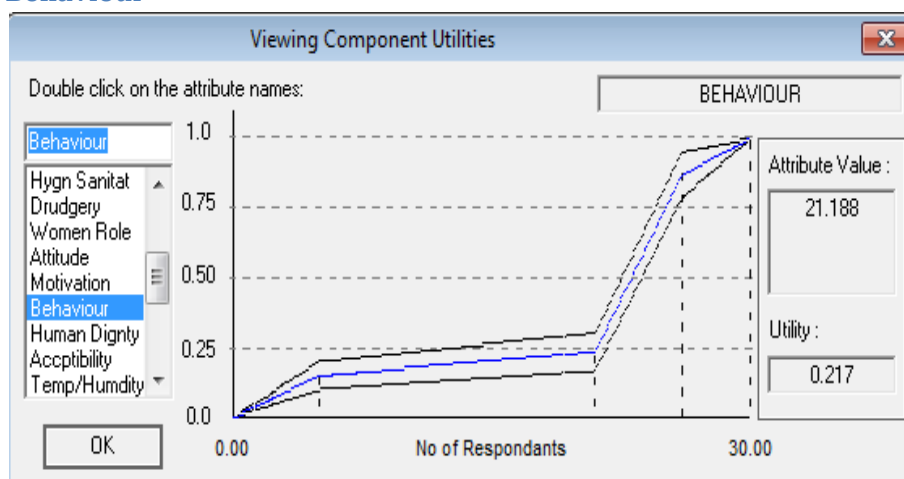
Attitude



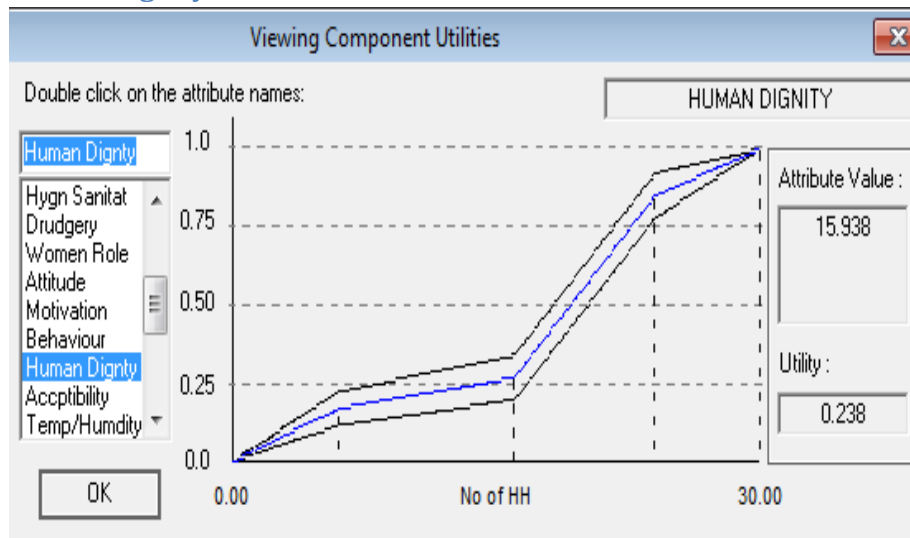
Motivation



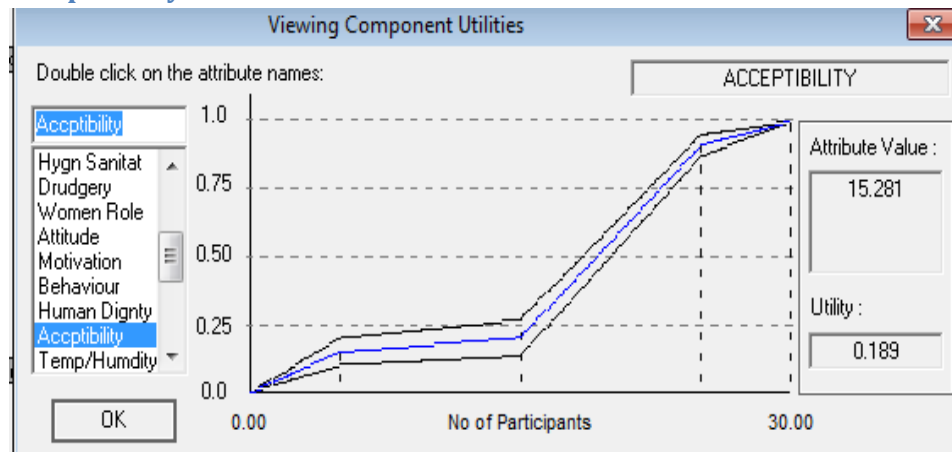
Behaviour



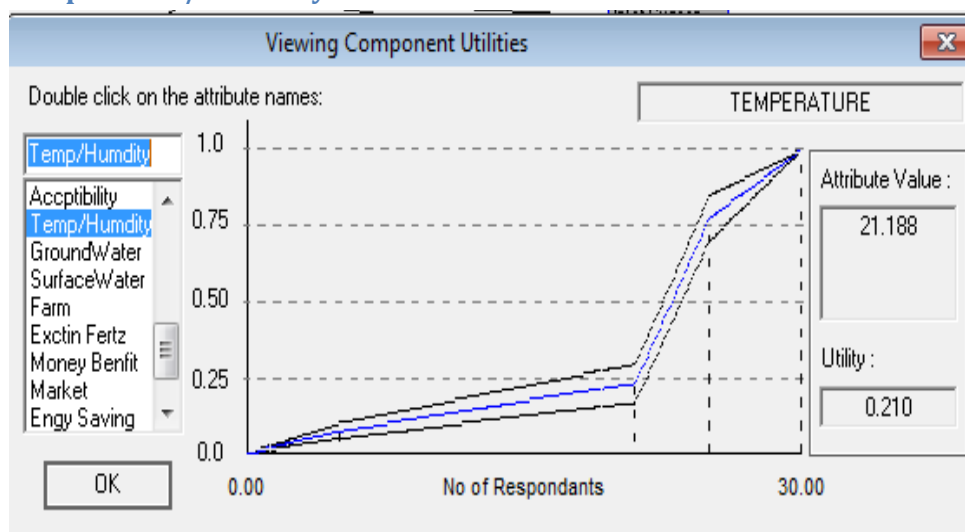
Human Dignity



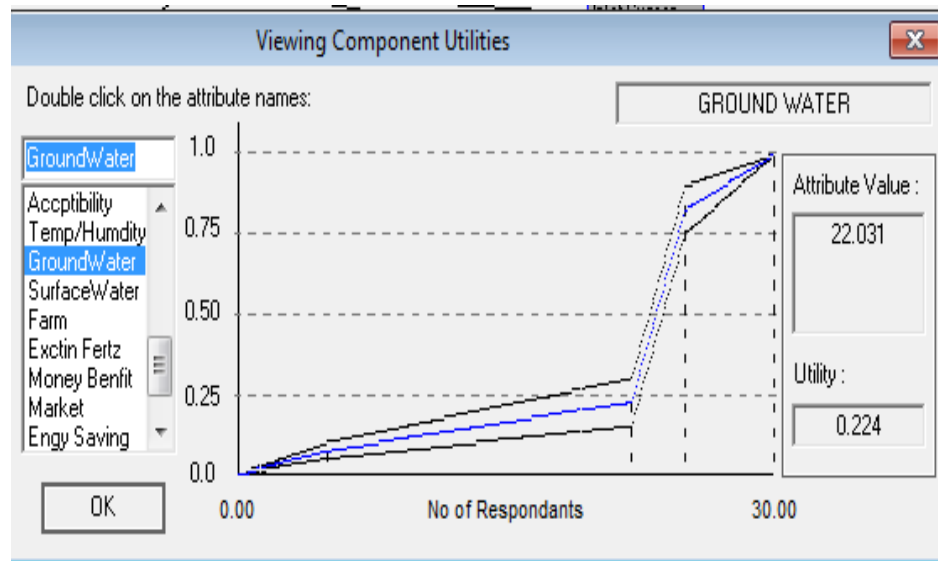
Acceptability



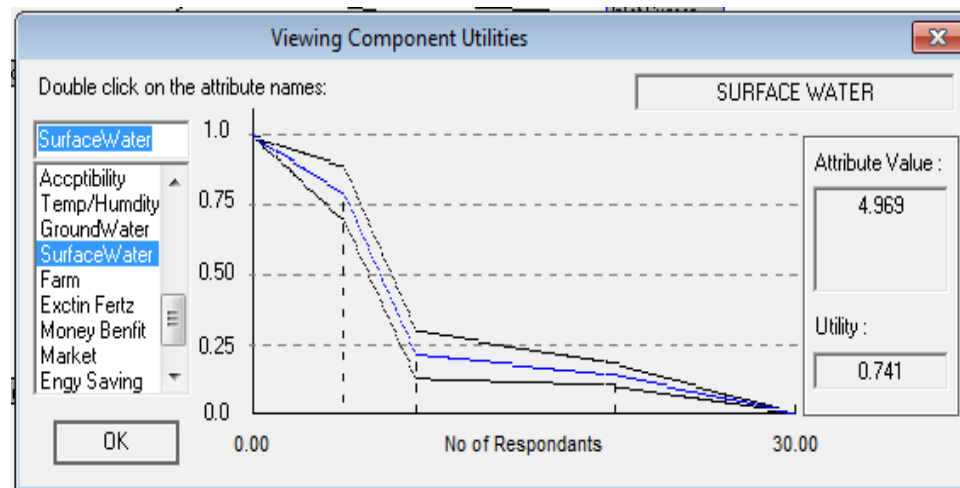
Temperature/Humidity



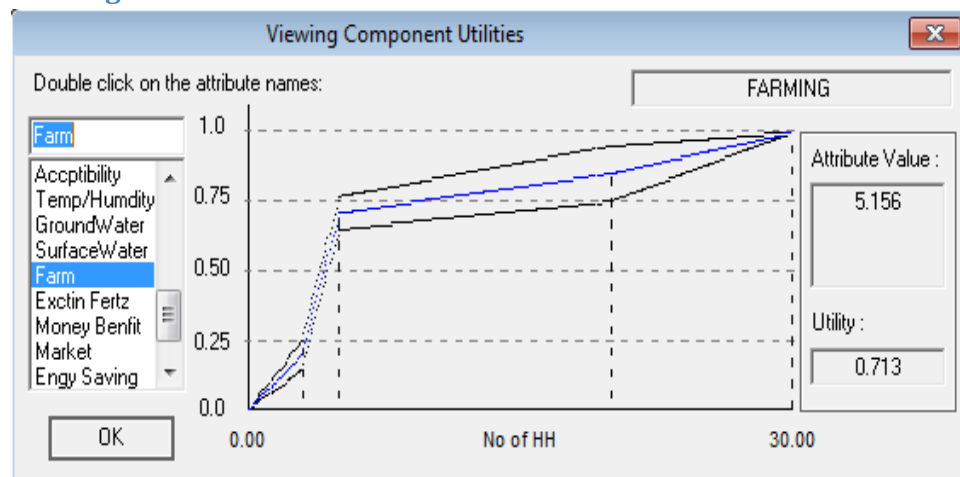
Ground Water



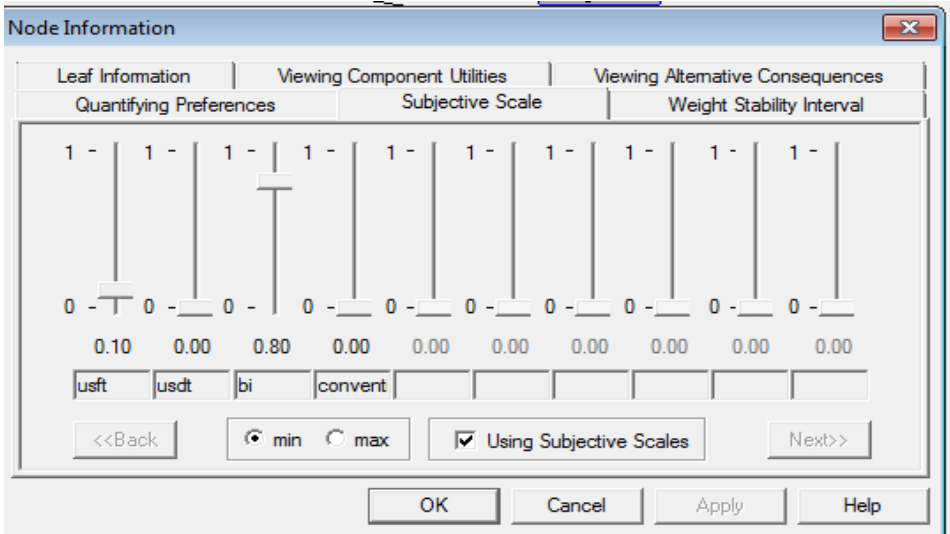
Surface Water



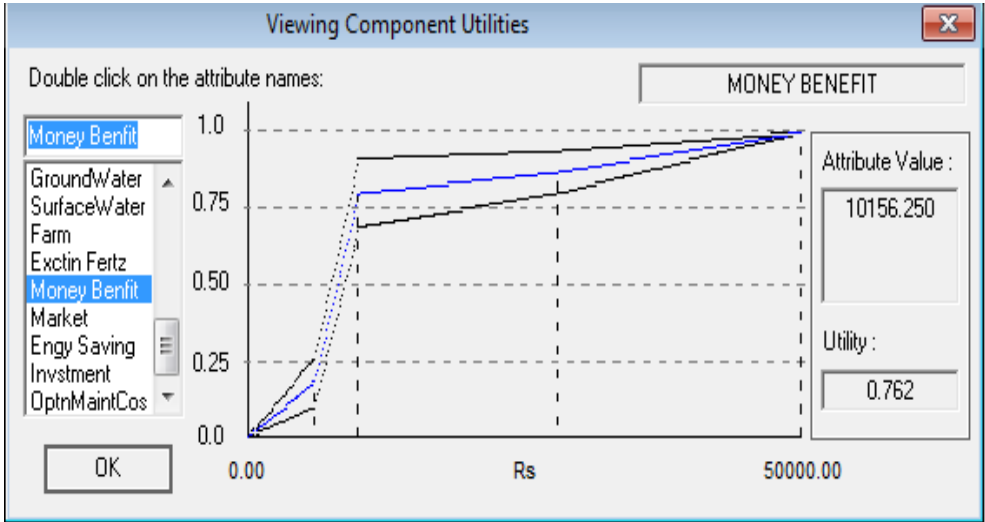
Farming



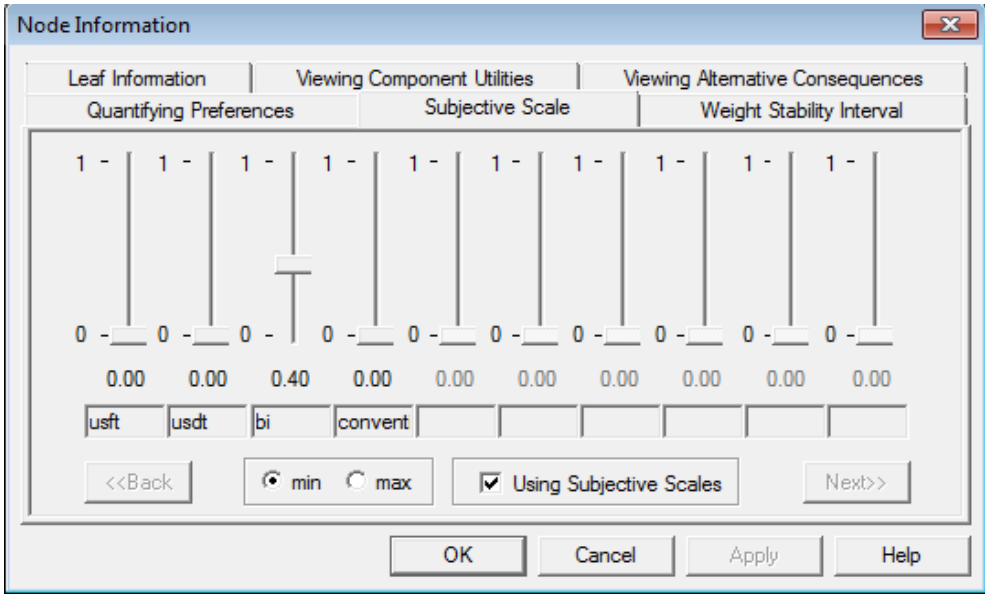
Execution of Fertilizer



Money Benefit



Market

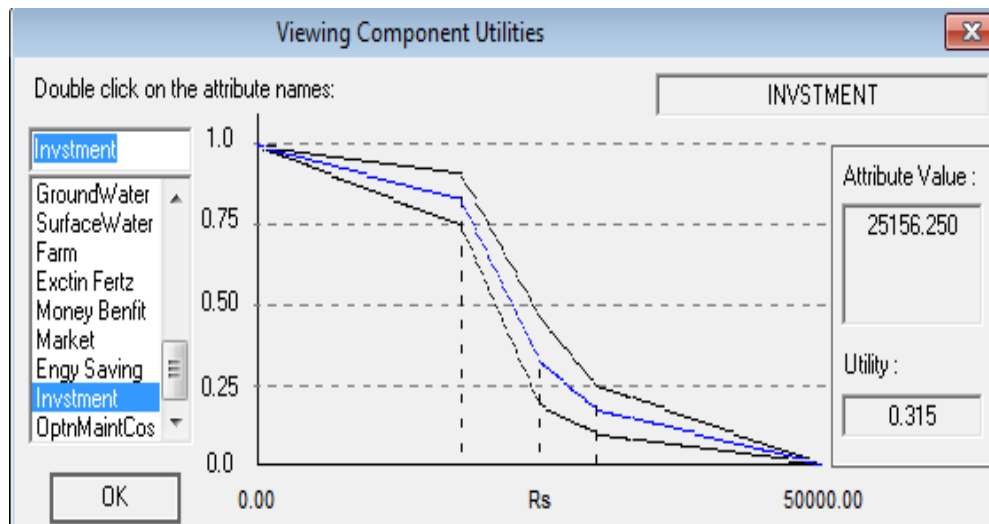


Energy Saving

Node Information

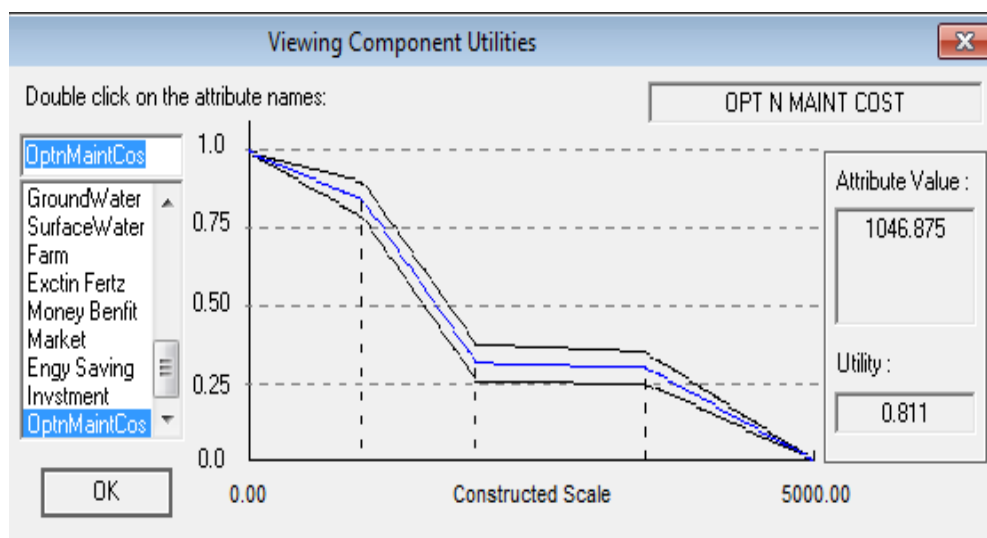
Leaf Information			Viewing Component Utilities			Viewing Alternative Consequences		
Quantifying Preferences			Subjective Scale			Weight Stability Interval		
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0 -	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0 -
0.00	0.00	0.60	0.00	0.00	0.00	0.00	0.00	0.00
usft	usdt	bi	convent					
<<Back			<input checked="" type="radio"/> min <input type="radio"/> max		<input checked="" type="checkbox"/> Using Subjective Scales		Next>>	
OK			Cancel			Apply		
						Help		

Investment



Operational and

Maintenance Cost



Annex III

Questionnaire