Rwanda Integrated Water Security Program (RIWSP)

CRITERIA AND PROCESS FOR WATERSHED SELECTION

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Contents

ACRONYMS

CBO:	Citizen Based Organization
CFSVA:	Comprehensive Food Security and Vulnerability Assessment
DHS:	Rwanda Demographic and Health Survey
DDP:	District Development Plan
EICV:	Enquête Intégrale des conditions de vie des ménages
FEWSNET	Famine Early Warning Systems Network
GoR	Government of Rwanda
IWRM	Integrated Water Resources Management
JAF:	Joint Action Forum
MINAGRI:	Ministry of Agriculture
MININFRA:	Ministry of Infrastructure
MINIRENA:	Ministry of Natural Resources
MINISANTE:	Ministry of Health
MUS	Multiple Use Services
NGO:	Non- Governmental organization
NISR:	National Institute of Statistics of Rwanda
REMA:	Rwanda Environmental Management Authority
RNRA:	Rwanda Natural ResourcesAuthority
PGNRE :	Projet de Gestion Nationale des Ressources en Eau
RIWSP	Rwanda Integrated Water Resources Program
USAID	United States Agency for International Development
TWG:	Technical Working Group
UNICEF:	United Nations Children's Fund
WASH	Water, Sanitation and Hygiene
WHO:	World Health Organization
WR	Water Resources

CRITERIA AND PROCESS DOCUMENT FOR WATERSHED SELECTION

1. INTRODUCTION

The Rwanda Integrated Water Security Program (RIWSP) is a USAID funded program to lend support to Rwanda's development through the improvement of the sustainable management of water quantity and quality with actions at national and decentralized levels with the primary aim to benefit vulnerable populations in target watersheds in the country. USAID in collaboration with the Government of Rwanda (GoR) identified the sub-basins of Akanyaru and Akagera where these target areas would be located. The selection of target watersheds, up to two per sub-basin, is one of the major initial activities of the program.

This document includes an overview of RIWSP and contains a description of the conceptual framework of the criteria and the proposed approach to identify the target watersheds. It characterizes the criteria and indicates how the criteria will be applied.

The methodology developed has incorporated various concepts into an original framework specifically applicable to the case of RIWSP; this notwithstanding, we believe the approach retains a number of general features which should it make attractive for adaptation to other programs that involve the selection of target areas where integrated field approaches require to be tested. As is described below, RIWSP seeks to develop replicable model programs at watershed level in order that may be applied in, and benefit, further decentralized areas in Rwanda.

2. THE RWANDA INTEGRATED WATER SECURITY PROGRAM (RIWSP)

2.1 The scope of the Program

The primary goal of RIWSP is to improve the sustainable management of water quantity and quality to positively impact human health, food security, and resiliency to climate change for vulnerable populations in targeted catchments in Rwanda. The program will accomplish this by: (i) increasing sustainable and resilient access to water and Water, Sanitation and Hygiene (WASH) related infrastructure and services for domestic and productive use; (ii) strengthening governance of water-related resources at the national, watershed, and community scale to increase sustainability and resiliency of the resource for all users; and (iii) Improving technical practices and approaches to optimize the use and resiliency of available water resources for multiple uses. While the program is expected to contribute to health, food security and climate change-related development objectives, the overall focus of RIWSP is on water as a unifying theme. In this context, the overall strategy of the Program is rooted on an IWRM (Integrated Water Resources Management) approach.

The conceptual approach guiding RIWSP involves a carefully coordinated set of simultaneous and sequential activities nested at multiple spatial scales, particularly at the community and central government levels. At the community level, through implementing practical and innovative technical activities, the program aims to improve the livelihoods of vulnerable rural populations, while building capacities at the local level to ensure the long-term benefits of these activities. At the district and national levels, RIWSP will contribute to institutional strengthening through capacity building of human resources and support to the development and implementation of national policies and strategies related to the three sector areas (water, food security, and adaptation to climate change) addressed by RIWSP.

The initial stage of the program will include a preliminary assessment and scoping activities after which the project implementation sites will be defined. Two to four watersheds will be selected in total. These will be sub-catchments of the Akanyaru (south) and Akagera (east) sub-basins and are to represent the realities and challenges across the water resources, WASH, food security, and climate change related sectors. The activities proposed for the RIWSP Program will, from beginning to end, engage stakeholders (civil society, government, local NGOs, CBOs) at multiple levels, build capacity, and transfer knowledge. A significant proportion of RIWSP's effort will be invested to effectively implement and integrate a wide range of low-cost and innovative technologies for water supply, sanitation, and agriculture, with a strong focus on the behavioral change at the community level, needed to ensure real and sustainable transformations in the country. The Program will aim at creating an enabling environment as a means to promote long-term improvements in water and sanitation service delivery and capacity to adapt to climate changes.

RIWSP will implement activities related to Multiple Use Water Services (MUS), sanitation marketing and product/supply chain development, as well as on-farm water use efficiency schemes. Actions related to community climate change adaptation and disaster risk reduction, together with climate resilient water management will also be targeted. In the health sector, importance will be given to scaling up community hygiene behavior change and the integration of improved WASH into facility based care. Lessons learned during these ground-level interventions, coupled with the results of national policy and institutional assessments, will be the basis for cooperation with national authorities to influence existing policy and institutional frameworks and create better enabling conditions for the replication of ground-level interventions in other parts of the country. RIWSP contemplates providing support and guidance to the Rwandan Government in the adoption and implementation of "adaptive" Integrated Water Resources Management (IWRM) strategies. The role of decentralized governance will be addressed at all levels as a means to attain sustainable water resources management, WASH services and agricultural water use in the context of the social, economic, and environmental realities of Rwanda.

2.2 Basins, sub-basins and watersheds in Rwanda

Rwanda hydrographically gives rise to the headwaters of two of the great rives of the world: the Nile and the Congo, thus Rwanda's territory corresponds to two principal basins, one for each of these rivers; a basin comprises the land areas that drain toward to the water courses that form the river. The basins may be divided into sub-basins that is, the drainage areas of smaller order water courses. Figure 1 illustrates the sub-basins that drain towards the Congo River (in yellow) and the ones that go to the River Nile (all the rest).

It must be pointed out that only the part of the sub-basins within Rwandan territory are represented in the figure; for instance, rivers Akanyaru and Akagera run along the border and receive water from affluents flowing in the neighboring countries (not pictured); these are referred to as transboundary basins. The two designated sub-basins that contain the potential target watersheds of RIWSP are the Akanyaru sub-basin (orange, to the South) and Akagera (blue, to the East), and are among the Nile sub-basins. A watershed, as used here, is a still smaller subdivision of the sub-basin; another commonly used word to denote a watershed is “catchment”. The boundaries of a watershed (or a sub-basin or basin for that matter) are given by water divides of the drainage leading water into that watershed or towards another one as defined by nature (topography), such as the crests of ridges. These boundaries normally do not coincide with administrative boundaries – say districts or sectors in Rwanda; this has implications with respect to the data to be used in the assessment of the watersheds.

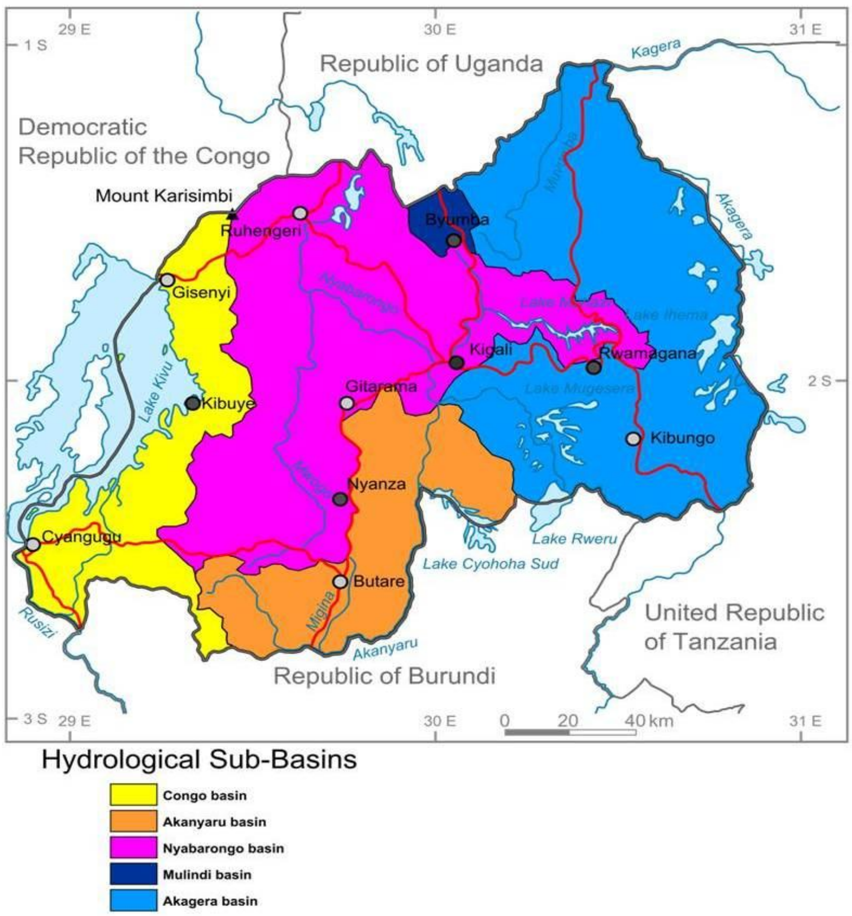


Figure 1. Principal hydrographic division of sub-basins in Rwanda

3. CONCEPTUAL FRAMEWORK

RIWSP seeks to first identify candidate watersheds in the two sub-basins and then to assess them in a logical sequence in order to select the target watersheds. The conceptual framework based on multi-criteria basis designed for this purpose is illustrated in Figure 2. It includes the following steps: (1) a set of clearly defined initial criteria used to identify and demarcate the candidate watersheds within the two sub-basins; (2) assessment of the identified candidate watersheds as to the potential integrated impact and effectiveness of the program; (3) rating of the candidate watersheds based on two sets of objective and subjective screening factors on the potential for successful implementation of the program in each watershed; and (4) joint, composite, rating of the potential of integrated impact of the program and for the successful implementation. This analysis will yield the numerical results of the rating process; this will be complemented by a possible rapid field verification phase and a consultation process.

The evaluation of the integrated impact factors and the objective factors will be based on the application of available relevant data. Some issues on data and information need to be understood from the outset. For instance, as already mentioned, the sub-basins and watersheds do not follow the administrative boundaries (District Boundaries). As a result, aggregate data available which covers areas crossing administrative boundaries may not be directly applicable, though data at Sector and lower levels will most likely be.

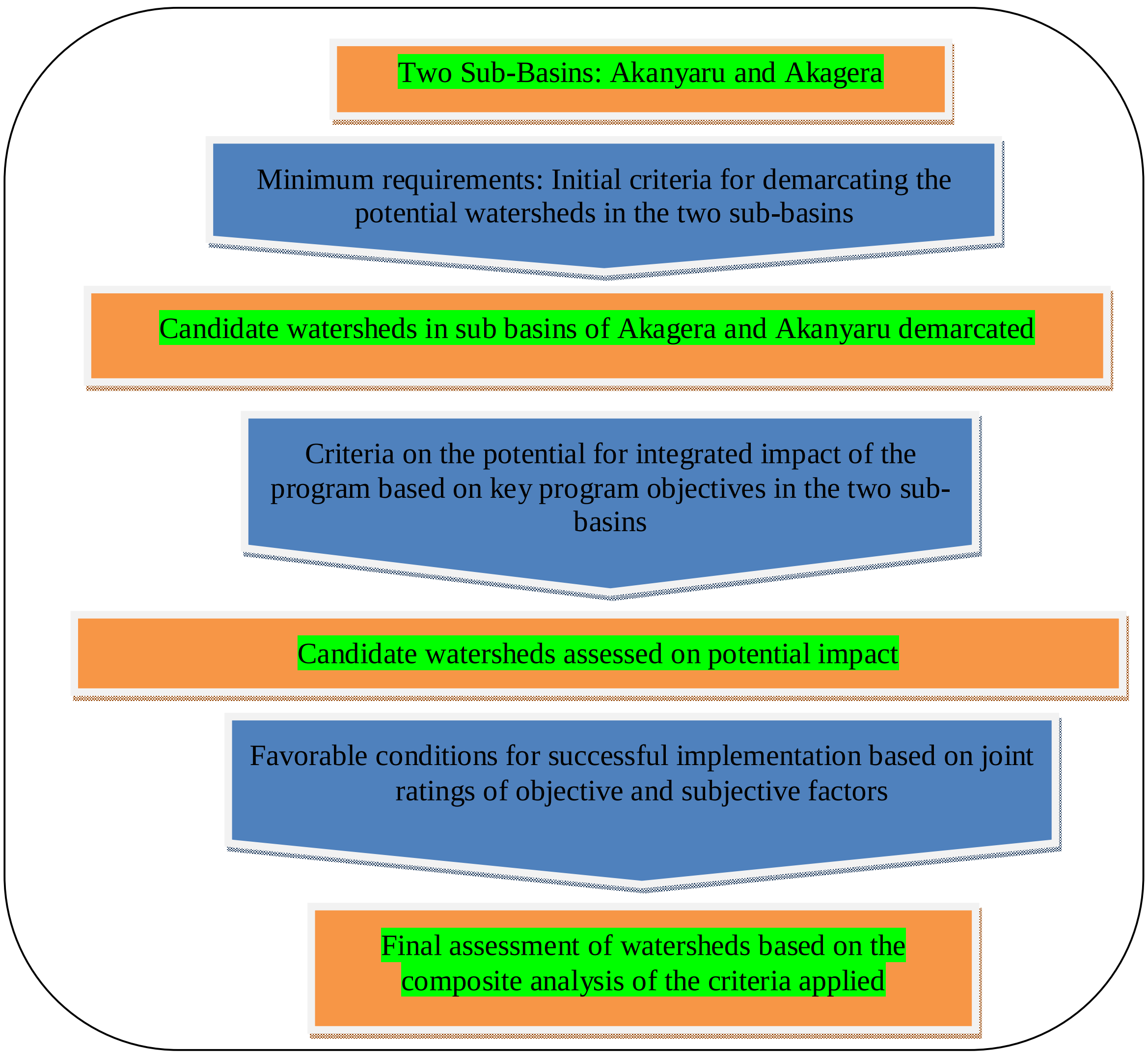


Figure 2. Conceptual framework for watershed selection

In the preparatory discussions within the program and with the stakeholders it was proposed to evaluate various watershed options based on multi-criteria analysis. The adopted criteria are applied sequentially in three parts:

a) The minimum requirements which basically serve to set the boundaries of the watersheds;
b) According to the potential for the integrated impact on the basic objectives of the program related to human health, food security and resiliency to climate change based on precise indicators evaluated suing available data; this will allow to identify the most promising watersheds with respect to the impact of the program; and finally
c) According to a predetermined set of objective factors whose evaluation will be based on the application of relevant data to each watershed and to a set of significant subjective factors which include issues like socio-economic, and whose application will allow producing the short-list of candidate watersheds;

These criteria will be applied on the demarcated watersheds in the two sub-basins of Akanyaru and Akagera. These demarcated watersheds are a result of the application of the minimum requirements described below.

The central concept of this exercise is that it has the objective of selecting promising watersheds that will allow performing an integrated set of field activities at the community level; the approaches to be developed there,having proved successful may thus be replicated elsewhere in Rwanda. This means that the selected watersheds, in addition to benefiting directly from RIWSP activities, will also constitute experimental settings to test and to fine-tune integrated water resources management activities involving WASH, multiple water uses, community climate change adaptation, sanitation marketing, etc., so that the procedures developed may be exported. This constitutes a very significant difference with decisions concerning the final location of unique projects, such as significant investment projects, where these may pre-empt other watersheds and communities from enjoying the same opportunities.

In the case of RIWSP, the experience to be gleaned from activities in the selected watersheds will be used to be able to launch more targeted and successful interventions in other locations in the country; that is, instead of pre-empting opportunities for other watersheds, RIWSP will create the means for expanding these activities; it is a process of inclusion, not exclusion. Thus the choice of watersheds is meant to operationalize the objectives of RIWSP within some initial target areas with an ultimate goal of general inclusion – the fact that watersheds either from the Akagera and Akanyaru sub-basins may not be selected at this juncture is simply circumstantial. The goals for RIWSP mid- and long-term impacts are much more ample than what will be achieved initially in the target areas.

4. THE CRITERIA

4.1 The Minimum Requirements

These will basically define the watershed boundaries and are based on three elements:

- ✓ Being located entirely within Rwandan territory on the basis of available topographic and hydrographic maps; this ensures that the governance within the watershed at the various levels lies entirely within Rwanda for the implementation of RIWSP.

- ✓ Draining a minimum area of 75 km^2 up to the main Akanyaru or Akagera rivers, giving a minimum size that would be effective in showing the impact and replicability of the integrated field approaches of RIWP; and

- ✓ Being located only within Akanyaru and/or Akagera Sub-Basins, which is a necessary pre-condition developed by USAID in collaboration with the GoR for location of the watersheds.

The application of these requirements will take into consideration the hydrography and physical geography maps and data currently available for the two sub-basins of Akanyaru and Akagera in Rwandan territory.

The resulting list of watersheds in the two sub-basins will be the object of the selection process using the criteria developed in this document. The watersheds demarcated as a result of the application of these minimal criteria are show in the schematic map in Figure 3. The candidate watersheds are a total of 20.

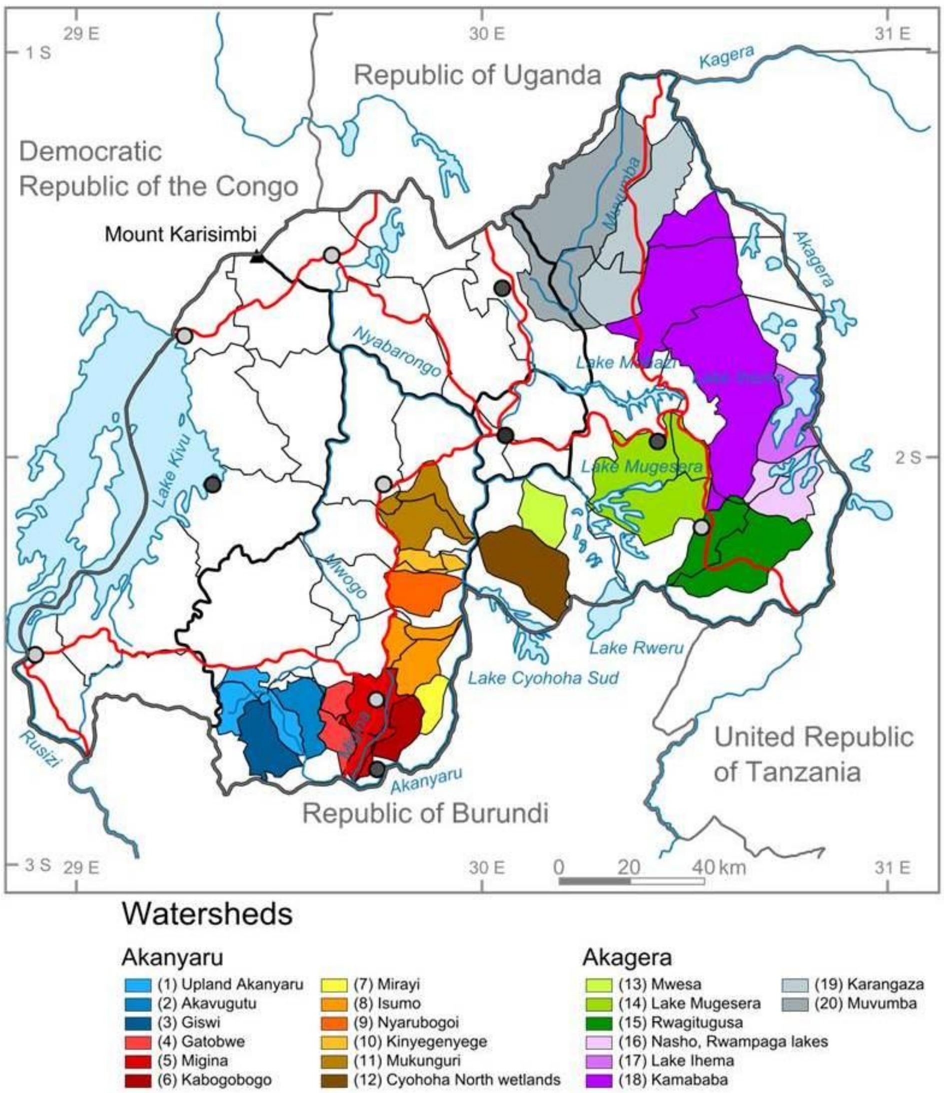


Figure 3. Location of potential watersheds considered in the selection procedure, with superimposed administrative boundaries.

Table 1 presents the major topographic characteristics of the watersheds and indicates their classification into sub-basin regions (adapted from PGNRE, 2005a) in order to facilitate its characterization. The naming of the watersheds generally obeys to that of the major tributaries. Further details may be found in Annex 3(a).

Table 1: Identified potential watersheds within the Akanyaru and Akagera sub-basins

Sub-basin	Sub-basin region	Watershed	Area (km^2)	Elevation (m)
Akanyaru (~3550 km^2)	Upper Akanyaru	Upland Akanyaru	264	1,760 - 2,765
		Akavuguto	155	1,760 - 2,380
		Giswi	237	1,750 - 2,645
		Gatobwe	159	1,480 - 2,275
		Migina	260	1,450 - 2,250
		Kabogobogo	126	1,420 - 1,810
		Mirayi	83	1,400 - 1,810
	Middle-Lower Akanyaru (west)	Isumo	304	1,375 - 1,830
		Nyarubogo	174	1,370 - 1,850
		Kinyegenyege	101	1,360 - 1,850
		Mukunguri	329	1,355 - 1,830
	Lower Akanyaru (east)	Cyohoha North wetlands	392	1,355 - 1,550
Akagera (~8900 km^2)	Upper Akagera	Mwesa	174	1,345 - 1,670
		Lake Mugesera	798	1,330 - 1,750
	Upper-middle Akagera	Rwagitugusa	647	1,325 - 1,900
	Central Akagera	Nasho, Rwampanga lakes	298	1,285 - 1,900
		Lake Ihema	341	1,285 - 1,735
		Kamababa	1,773	1,280 - 1,820
		Karangaza	736	1,280 - 1,880
	Kagitumba	Muvumba	679	1,320 - 2,270

4.2 The Integrated Impact of the Program

4.2.1 Impact criteria and assessment

The potential for achieving the full effect of the integrated impact of the program will be evaluated as a key element for the selection of watersheds. In consonance with RIWSP's principal objectives, it may be assumed that the program will have its greatest impact on areas where there is the greatest lack or gap in water related services related to food security, health, and climate change resiliency, pointing to a high degree of vulnerability to the resulting risks. This assessment is aimed at obtaining a measure on how well the program would perform as an integrated platform addressing these issues in each watershed.

The methodology proposed is to use objective verifiable data in the public domain that can give direct or indirect information on each of the following components:

a. Vulnerable populations and vulnerability related to and/or adverse effects of climate change and variability
b. Food security of vulnerable population

c. Health of vulnerable populations, related in broad sense to water, hygiene and sanitations, nutrition.

The criteria selected must be focused on aspects that the actions of the program will measurably affect. For instance the impact on longevity will not be measurable, but the impact on the health of 1-2 year olds may be.

For each component the same number of specific criteria will be adopted. The choice of three criteria for each component seems reasonable. This results in 9 criteria in total for the three components to be quantified for estimating the combined integrated impact of the program on the watershed. The data to be used must be readily available at least District level. The data for the watershed can be estimated from district or sector level data.

The components and the proposed significant Impact Factors are thus:

- Health
  - Lack of access to safe water and sanitation as percentage of population
  - Diarrheal disease per 1000 population
  - Percentage of malnourished children

- Food security
  - Percentage of people living under poverty norm /vulnerable
  - Percentage of population with no recourse to crop diversity,
  - Risk to food security vulnerability

- Climate change resiliency
  - Frequency of unusual event affecting households ability to provide food (shocks)
  - Increased erosion, and deforestation
  - Frequency of drought, irregular rains, dry spells

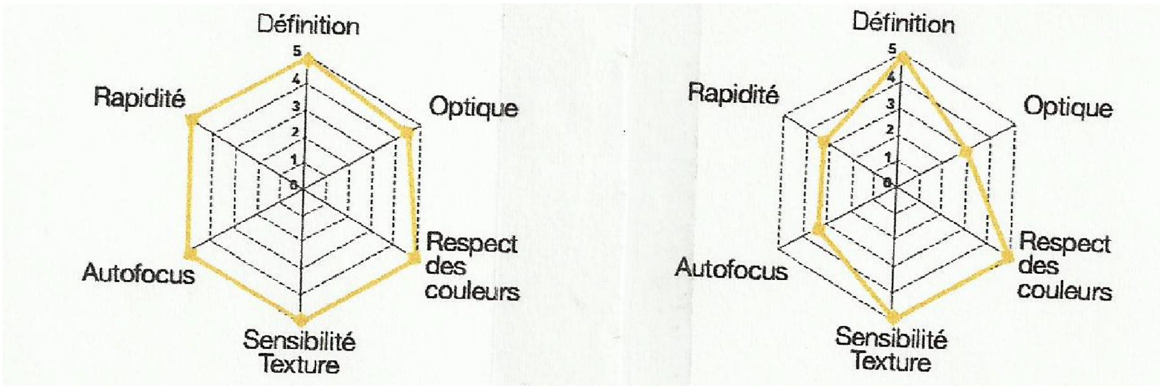
A scale of 1 through 5 points will be adopted for each one of the nine factors listed (three per objective), assigning five for the most critical value (i.e. for the lowest range of population having access to clean water). The comparative ratings scale for each factor will be assigned a score for each watershed as follows:

- 1 for extremely low or no presence of impact factor;
- 2 for limited presence of impact factors;
- 3 for presence of impact factors within the normal range for sub-basins;
- 4 for an evident presence and effect of the corresponding impact factor; and
- 5 for full presence and manifestation of the impact factor.

For each one of the objectives, the score will be summation of the points of the three factors; consequently the maximum score per objective for each watershed will be 15 points.

4.2.2 Measuring Performance in a Multi-objective Setting

The evaluation of an integrated impact of a set of action over several dimensions is a complex exercise. Involved analytical methods, say nonlinear optimization, have been developed to deal with this type of problems. However the applicability of these techniques is only as good as the premises employed, such as the validity and certainty over time of the functions adopted to represent interactions between the variables, and of the data utilized. Other techniques, simpler and more direct, may prove effective and satisfying. One such technique with recourse to graphics is to represent the identified critical objectives or attributes by means of uniformly distributed radii (one per objective) around a central origin where the respective lengths of the radii represent the performance for each objective. The polygon resulting from joining the tips of the radii and its areal coverage yields a representation of the composite, multi-objective performance. One common way of designating this representation is the "radar screen" method. An example of application to rating an electronic product is shown in Figure 4.



(a) (b)

Figure 4. Example of the representation of the multi-objective performance of two electronic devices. Device (a) shows a better overall performance than (b), with a fuller areal coverage.

4.2.3 Application to Integrated Impact Assessment in RIWSP

While the generic description of the technique above may be applied to any number of objectives, implying an equal number of radii or axes, for the case at hand it would involve only three objectives: health, climate change and food security. As indicated in Section 4.21, for each of these three main objectives a maximum of 15 points can be applied. For example a particular watershed may have scored:

Health:	15
Climate change:	12
Food security:	10

The graphical representation of the combined integrated impact is shown in Figure 5.

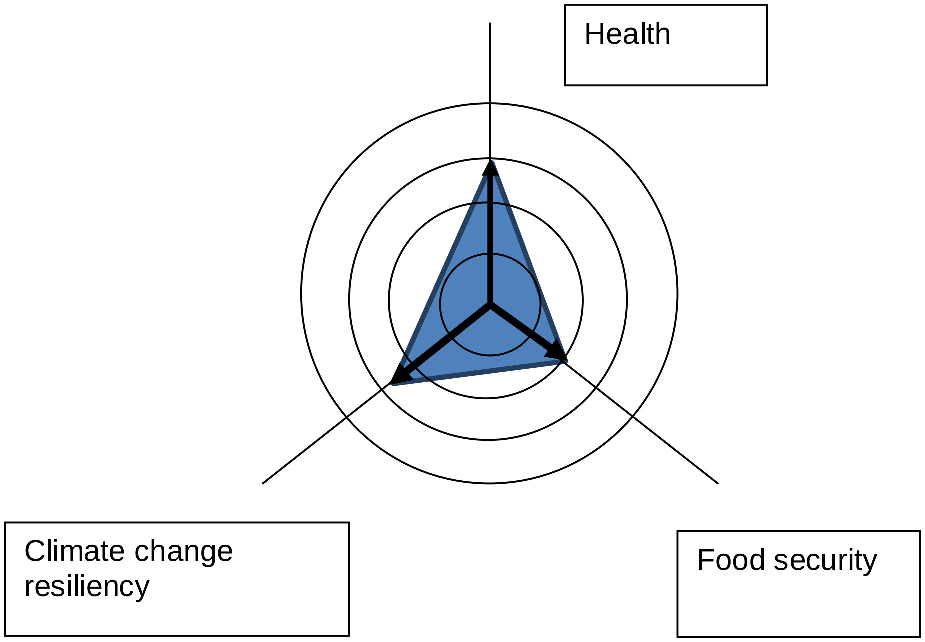


Figure 5. Combined integrated impact of the program

The combined impact will be measured for each watershed as proportional to the area of the triangle defined by the tips of the arrows. The larger and more balanced the effect on each of the three axes, the greater the integrated impact. The largest score possible would be for a watershed having received 15 points for each of the three components (axes)[1]. The score for each watershed will be normalized, dividing the resulting area by the maximum potential area, adopting the value of 1 for this maximum potential area (combined impact) or a fraction thereof. This normalized score for watershed "i" will be denominated $\mathbf{A_i}$. Annex 3(c) illustrates some of the particularities involved.

4.3 Potential for successful implementation - Application of Objective and Subjective Factors

A number of factors with significant implications for the successful implementation of this program will be used to rate the potential target watersheds in the two sub-basins. The factors that constitute this matrix include, but are not limited to, the locations where the partners are already working and hence have a work advantage and acquaintance with the socio-economics of the watershed. The factors being considered are in two groups: the Objective Factors and the Subjective Factors and are fully described in Annex 1.

4.3.1 Objective Factors

A total of four objective factors will be evaluated on each of the 20 candidate watersheds using the relevant data available for each of the watersheds.

[1] When there are more than 3 objectives (or axes) the order in which they are placed around the "radar screen" may affect the computed value of the area within the polygon, but for three axes the order in which they are place does not affect the result, which is unique, thus this is a methodological advantage.

The objective factors identified based on key characteristics are:

- Concentration of needs/population. The rating will consider:
  - Population density
  - Poverty index
  - Degree of lack of access to safe water of population

- Potential for complementary/synergistic relationships with other entities or programs working in the watershed. It will consider:
  - Number of partners present working in the watershed in RIWSP compatible activities at district and sector level
  - Presence of competing programs in the same fields of activity as RIWSP (may include WASH, irrigation infrastructure) - if this presence is of important magnitude and the potential for collaboration is nil or almost nil, the watershed may be ruled out.

- Existence of information.
  - Sources of relevant data at district level on health, climate change adaptation, food security; water quantity and quality, hydrometeorology, water use

- Favorable conditions for the introduction of water supply technologies and for productive water uses.
  - Demonstrated favorable outlook/openness by stakeholders towards new technologies and/or concrete steps already taken towards their adoption
  - Accessible local water sources in sufficient quantity; if not available watershed ruled out.
  - Agricultural potential: farming, cattle, commercial -not just subsistence- crops

4.3.2 Subjective Factors Matrix

A total of three significant factors primarily of a subjective nature have been identified. They will be judged drawing on the work experience of the partners in Rwanda and elsewhere. Detailed definitions of these factors are given in Annex 1.

The following factors have been identified:

- Entrepreneurial capabilities and initiative

- Willingness to cooperate – district, sector, village

- Watersheds with potential for replicability and wider applicability

4.3.3. Evaluation of Objective and Subjective Factors

Scale: The evaluation involves assigning quantified scores to the factors in each watershed to be able to reach a ranking. Based on the information available and/or judgment elements and on an appropriately designed weight and rating scale each factor will be assigned a score for each watershed as follows:

- 1 for absence of the element being rated or not being applicable in this watershed at all;

- 2 for limited presence or merit;
- 3 for partial presence or merit.
- 4 for a high degree of presence or merit.
- 5 for full presence or extremely meritorious assessment.

The aim is being as transparent as possible with the awareness of the need to address specific issues and achieve the program objectives. The GLOWS consortium collectively and consensually will assign a rating. As described further ahead, there will be a consultation with stakeholders on the application and results of the overall exercise of selection of watersheds.

Border condition: If any watershed obtains a "1" score for any of the four objective or three subjective factors, it would be discarded as it would denote the absence of one of the basic characteristics required to have the potential for successful implementation of RIWSP

Weights: The joint evaluation of the implementation potential aspect using the two sets of objectives and subjective criteria will be a function of the scores accumulated by each watershed on the four Objective Factors and three Subjective factors. The weights assigned to each factor must be given due consideration. As the chosen factors respond to their particular relevance for the selection of watersheds and they already constitute a small select number extracted from the many possibilities examined, they should in principle be considered to be of comparable weight. Nevertheless, given the special emphasis of the program improving the lot of the vulnerable population of Rwanda, it was judged that***the first objective factor "Concentration of needs/population" should be given a weight of two, while the other six other objective and subjective factors would maintain a weight of one each****.*

Computational procedure: The corresponding tabulation is illustrated in Table 2 for the 7 factors (4 Objective and e Subjective factors). The rating of the Objective Factors shows a summation of points for each watershed; the same for the Subjective Factors. The combined total is placed at the bottom. The double weight for the first Objective factor would be reflected in the corresponding score. The maximum score for any one watershed would be 40 (a maximum of 5 per factor, including a double weight for objective factor 1. The minimum combined score is theoretically 8, but it should be recalled that the score of 1 for any individual objective or subjective factor would already mean that that particular watershed would be eliminated. One convenient way of having a final dimensionless score is to normalize the results for each of the watersheds so that it shows a value between 0 and 1; this is achieved by dividing the individual scores by the maximum potential score of 40. This normalized score for the potential for successful implementation using the objective and subjective factors will be denominated $\mathbf{B_i}$.

4.4 Sources of Information

The assessment of the Integrated Impact Factors and of the Objective Factors relies on accessible and reliable data. The specific parameters used to assign the scores to each factor were chosen because they provide a firm basis to rate the factor and at the same time the availability and reliability of the data to rate these have been confirmed. Annex 2 indicates the sources of data and information for these two types of factors whose rating are based on data.These data and sources identified provide a firm basis for the exercise; applicable additional sources that may be identified during the process will be incorporated.

This data is mainly at district level, which is highest administrative unit that can yield appropriate data for the selection of watersheds. Sector level information, where available, should be used. One main source for this level data is the district development plans (DDP) which are often available on-line; not all of them are complete or are of the same quality. In addition to the databases at the applicable ministries (MINIRENA, MINAGRI, MININFRA, MINISANTE), there are very valuable publications such a EICV 3 (Third Integrated Household Living Conditions Survey - Enquête Intégrale sur les Conditions de Vie des Ménages), DHS 10 (2010 Rwanda Demographic and Health Survey), CFVSA (Rwanda Comprehensive Food Security and Vulnerability Analysis and Nutrition Survey, 2009) which address many of the aspects that need to be considered in the selection of watersheds.Famine Early Warning Systems Network (FEWSNET) is likewise a potential source.

Table 2: Evaluation using Objective and Subjective Factors

(1 lowest & 5 highest per factor; except for objective factor 1 that has double weight)

CANDIDATE WATERSHEDS =>																				
OBJECTIVE FACTORS																				
1.Concentration of need/population (double weight – max score of 10)																				
2. Existence of information																				
3 Potential for complementary/ synergistic relationships with other entities or programs working in the watershed																				
4. Favorable water availability for water supply technologies and for productive water uses																				
Sub-Total for Objective Factors																				
SUBJECTIVE FACTORS																				
5. Entrepreneurial capabilities and initiative																				
6. Willingness to cooperate - district, sector, village.																				
7. Watersheds with potential for replicability and wider applicability																				
Sub-Total for Subjective Factors																				
TOTAL SCORE (up to 40)																				
NORMALIZED SCORES (between 0 and 1)																				

4.5 Final composite score of watersheds.

The analysis thus far described yields two normalized scores for the selection of watersheds: one representing the potential integrated impact of the program considering the combined effect of the program on health, resiliency to climate change and food security, denominated $\mathbf{A_i}$, and another representingthe implementation potential based on the joint consideration of the sets of Objective and Subjective Factors, denominated $\mathbf{B_i}$.

It is conceptually satisfying to postulate that the combined evaluation of the two types of scores is not a simple summation of these two scores, but rather a compounded effect that can be represented by the product of the scores. Thus we propose that the final overall score be represented by:

$$\textbf{Final Score of Watershed i} = 100\ (A_i * B_i)$$

where A_i represents the Integrated Impact score of the potential in a given watershed “i”, and B_i is the normalized score for Implementation Potential in the same watershed.

The constant value of 100 was introduced to give scores that would not fall just between 0 and 1, but more manageable numbers maintaining the proportionality of the scores. This final score will allow the watersheds to be ranked overall and per each of the two sub-basins.

The numerical results and implied ranking will be the subject of a report that will have annotations to give conceptual depth with regard to the process, the sensitivity of the results (consequences of possible variations of ratings), inherent uncertainties and degree of reliability.

5. CULMINATION OF SELECTION PROCESS

5.1 Consultation with Government of Rwanda and other Stakeholders

The above process undertaken by the RIWSP team collectively will yield a listing of scores per watershed per sub-basin and a tentative ranking. This list, along with the criteria and data employed, the methodology used for the application of the criteria and the computational procedure followed will be shared with the IWRM Department of RNRA and other stakeholders with the objective of keeping that office updated on the ongoing developments and to take due account of their views concerning the designation of candidate watersheds.

In this consultation there will be an in-depth discussion with the aim that the purpose and utility of the process of selection is clearly understood and that a common understanding arises. As indicated earlier, the central concept that must borne in mind is that this exercise has the objective of selecting promising watersheds that will allow performing an integrated set of field activities at the community level; the approaches developed having proved successful may thus be replicated elsewhere in Rwanda. Thus its ultimate goal is that of inclusion and of benefitting the whole country.

In this review of the selection process, the criteria will be discussed and any variants, sensitivity analyses, or verifications and additional analyses that may be judged necessary will be agreed upon and will be executed by RIWSP to be shared likewise within a an expeditious timeline and reported back to the group. The emerging consensus should indicate the recommended watersheds per sub-basin.

5.2 Field Verification Step

If judged necessary, a limited number of targeted fact-finding or verification field visits will be carried out to the leading candidate watersheds that will allow reaching a formal recommendation within a rapid time-frame. Consequently, the objective of these field visits would be to corroborate and qualify further the existence of those attributes used in the selection criteria of watersheds in order to validate and/or adjust the ranking and recommendations of watersheds. Thus the number of watersheds and / or aspects to be examined at this point would be kept to the essential minimum. This on-site corroboration process may provide an additional opportunity to consult and interact with stakeholders, both at the level of the community(ies) and local GoR entities, and to gain further understanding of the baseline conditions of the respective watershed in perspective for future potential RIWSP activities implementation. One important element to keep in mind while carrying out these field visits and entering in contact with the various local actors is not to give ground to unfounded expectation, since the final selection of the RIWSP watersheds will be carried out in the last stage of the final selection process.

5.2 Presentation of the results

The program is planning a *RIWSP Watersheds Presentation Session*of the results of this selection process of watersheds aimed at :

- presenting the set of potential RIWSP watersheds / areas to stakeholders
- discussingthe suggested options and receiving feedback from stakeholders
- discussing suggested adjustments in the list of recommended watersheds/areas to carry out RIWSP interventions.

The results of the presentation would be part of the report of the RIWSP Watershed Selection. This report will be prepared by the RIWSP coordination team with the collaboration of all partners.

ANNEX 1

OBJECTIVE AND SUBJECTIVE WATERSHED SELECTION FACTORS

(Factors 1 to 4 are objective while 5 to 7 are subjective)

Objective Factors

Factor	1.Concentration of need / population
Extended definition	A target watershed having higher water related needs and or a higher population is more desirable
Importance to RIWSP	This provides a fertile area to work in and impacts can be easily seen and appreciated. This is also important when relating to potential for replicability and sustainability. It also provides potential for achieving the targets.
Potential negative Condition	Demand may turn out to be higher than what the program may be able to deliver especially in terms of water quantity and quality for multiple uses
Mechanism(s) to reduce potential negative condition	Work closely with the local leadership in selecting the final specific community where the program will implement activities so that the target needs and or population is clearly defined.

Factor	2.Potential for complementary/synergistic relationships with other entities or programs working in the watershed
Extended definition	Existence of ongoing programs implemented by one or more of the RIWSP partner organizations or by other agencies or donors that are complementary and that can reinforce the impact of RIWSP's actions.
Importance to RIWSP	The advantage of developing activities in watershed/areas/communities where one or more of the RIWSP partner organizations or other doors or agencies are already working in complementary or compatible provides a series of potential advantages. The may include the existence of baseline information, knowledge of the site and the various stakeholders characteristics, established relationship with local GoR entities and authorities. RIWSP may build on ongoing programs and/or establish synergies with these programs, among other options.
Potential negative Condition	(1) At the initial stages of the program in the site, local stakeholders may not perceive a sharp distinction between RIWSP activities to the other previous or ongoing program(s) of the partner(s); (2) One extremely negative condition may be that another donor or organization may be already carrying out a program along the same lines as RIWSP that may conceivably preempt RIWSP, particularly if the local governments feel this is the case.

Mechanism(s) to reduce potential negative condition	(1) Clear introduction from the very beginning, working together as a team and continuous flow of information to the local stakeholders on the role of partners in this integrated program;(2) In case another donor is perceived to be carrying out essentially what would be RIWSP activities there is the possibility to detect and propose a complementary RIWSP activity that may benefit from the worked done by the other donor and at the same time strengthen the other donors' effort to the benefit of the population.

Factor	3.Existence of information
Extended definition	Adequate availability of information of diverse nature, e.g. data at district level on health, climate change adaptation, food security; water quantity and quality, hydrometeorology, water use, socioeconomic factors, etc.
Importance to RIWSP	The existence of adequate and accessible information of various categories for a particular watershed will facilitate the RIWSP team the definition of the corresponding baseline conditions for planning and implementation purposes
Potential negative Condition	Utilization of unreliable or superseded information.
Mechanism(s) to reduce potential negative condition	Filtering/checking mechanisms for quality control.

Factor	4.Favorable conditions for the introduction of water supply technologies and for productive water uses
Extended definition	The watershed should have basic conditions that encourage the use of new technologies, for example a population which appreciates introduction of new ideas, issues and technologies, and accessible sources of water within the watershed (e.g. groundwater table not very deep) that enable the use of new and cost-effective technologies. This last condition is critical for the feasibility of the schemes. Since RIWSP obeys an IWRM approach, the target watershed should ideally have opportunity for multiple water uses. For example, apart from domestic uses there should be potential for productive uses such as community cattle raising or irrigation, hence needs water for these productive activities; and having enough land for farming.
Importance to RIWSP	Enhanced conditions for successful and replicable experiences in the watershed. Sufficient water availability within economic margins enables the introduction of new water supply technologies. The existence of this potential will enable RIWSP to show readily and effectively the integrated aspects of the IWRM approach.

Potential negative Condition	Built up expectations from local stakeholders on what the program will bring may be let down if one or more components do not perform. If it turns out that there is no or insufficient water availability, the new technologies will not succeed.
Mechanism(s) to reduce potential negative condition	Avoid initiating activities on new water technologies in unfavorable locations with no adequate water resources. If there is a negative or indifferent attitude from the locals, either at the authorities or the general population level intensive communication and awareness-raising activities should be undertaken.

Subjective Factors

Factor	5. Entrepreneurial capabilities and initiative
Extended definition	A potential watershed should have entrepreneurial potential and some ongoing business activities, such sales of crops and other produce plus places for buying household essentials by the local community. This is of particular importance in relation to the grants program of RIWSP.
Importance to RIWSP	This factor is significant for RIWSP because there would be a demonstration of the potential entrepreneurship and community dynamism along with a pool of business entities to work with in private – public partnership and also in choosing who to support in terms of the grants project.
Potential negative Condition	The population may not readily respond to the opportunities given by the grants program and other RIWSP community initiatives not having grasped their potential. Also, most private business entrepreneurs are busy with their undertakings and tend not to be easily available for other activities unless they see increased profit ton their incomes.
Mechanism(s) to reduce potential negative condition	The grants program is evaluating prospective beneficiaries and adopting a manual. The approach to business entrepreneurs will be business like showing them the potential for growth and economic opportunities as opposed to traditional local community approaches for example during meetings, trainings, etc.

Factor	6. Willingness to cooperate - district, sector, village.
Extended definition	This is the willingness of the community and the local leaders to collaborate and work with the program on its activities. This also encompasses the concepts of social cohesion of the communities and of village readiness.

Importance to RIWSP	This is important to RIWSP because without political support of the local leadership community mobilization and work cannot be effectively carried out.
Potential negative Condition	The lack of cooperation of the communities would result in a lack of ownership by them of the proposed way forward.
Mechanism(s) to reduce potential negative condition	Clear communication with the community from the beginning so they can see and identify with the potential benefits of RIWSP.

Factor	7. Watersheds with potential for replicability and wider applicability
Extended definition	Watersheds having a wider cross section of water related challenges would be more representative of Rwanda's realities and this can result in a wider applicability and replicability of the approaches and solutions found by the program. The potential for replicability is one of the main drivers of RIWSP.
Importance to RIWSP	For RIWSP this provides it with a good show case when activities have been implemented along with the potential to make the program sustainable and able to be copied all over the country
Potential negative Condition	Reduced cooperation of communities if program does not visibly address their concerns. Raised expectations among the target local stake holders
Mechanism(s) to reduce potential negative condition	Important from the very beginning to record all lessons learnt and success stories and to maintain communications channels permanently open.

ANNEX 2

SOURCES OF INFORMATION

Basic listing - not limitative

I. OBJECTIVE FACTORS

Factors	Variables	Source of information
1. Concentration of need/ population	Population density	District Baseline surveys (NISR), DDP
	Poverty index	CFVSA, DDP
	% of population with access to water	DDP, EICV, MININFRA
2. Potential for complementarity/synergistic relationships with other entities/programs	Number of partners present working in the watershed in RIWSP compatible activities at district and sector level	District JAF
	Presence of competing programs in the same field of activity (WASH, Irrigation, infrastructure)	District JAF, Immigration Office
3. Existence of information	Health	DDP, MINISANTE
	Climate Change adaptation	DDP
	Food security	DDP, CFVSA
	Water quantity and quality	DDP, MNIRENA/RNRA
	Hydrometeorology	DDPs, REMA
	Water use	DDP, MINISANTE
4. Favorable conditions for r the introduction of water supply technologies and for productive water uses	Demonstrated favorable openness to new technologies	DDP, MININFRA,
	Accessible water sources and availability (springs, streams, rivers)	DDP, MINIRENA, MININFRA
	Agriculture potential	DDP, MINAGRI

II. IMPACT FACTORS

Factors	Variables	Source of information
1. Health	Access to safe water and sanitation as percentage of population	MININFRA, MINISANTE, UNICEF, WHO, DDP
	Diarrheal diseases per 1000	MINISANTE, DDP
	Percentage of malnourished children	MINISANTE, DDP
2. Food Security	% of people living under poverty norm/vulnerable	DDP, EICV
	Percentage of population practicing diversity of crops	DDP, CFSVA
	Risk to food security vulnerability	DDP, CFSVA
3. Climate change resiliency	Unusual event affecting HH ability to provide food (Shocks)	CFSVA
	Increased erosion and deforestation	CFSVA
	Drought, irregular rains, dry spell	CFSVA

ANNEX 3

ELEMENTS FOR THE COMPUTATIONAL PROCEDURES

Annex 3 – Elements for the Computational Procedure illustrates several aspects required for carrying out the rating of watersheds for the Impact Factors as well as for the Objective Factors.

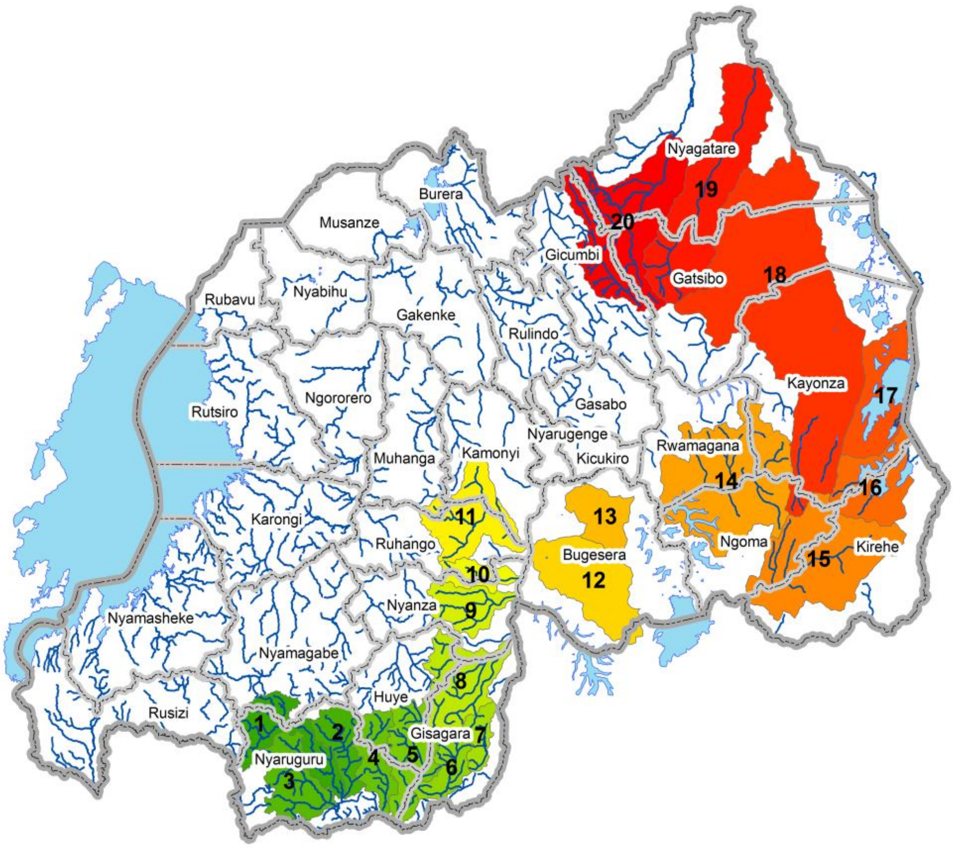
As has been explained, watershed boundaries do not coincide with administrative boundaries; data found at district level will need to be transposed to watersheds. This is not a straightforward procedure. For many of the parameters an approximate and practical way is to make it a direct proportion of the percentages of area of the watershed in the different districts; ***Annex 3(a)*** includes the necessary information to reduce district level information to watershed level by means of areal proportions as may be found in the tabulation of areal percentages. For estimates that are of a relative nature, such as densities, percentages of coverage, etc., which should be normally the case, the column showing the percentage of area of the watershed in the different districts will provide the necessary proportional figures. If absolute figures need to be computed – a rough approximation of total population of the watershed, number of latrines, hectares under cultivation, etc., then the applicable figures can be found in the last column showing the percentages of the district areas of the districts in which the watershed is present. If more precise information is available at sector level, this must be used.If there are clear reasons of why areal approximations would not apply – say, the presence of a town within a district, but outside the watershed; this would mean that for population estimation and other purposes a proportional approach would not apply.

Another matter which needs to be handled with great judgment is the setting of scales. As indicated in the foregoing text, for a given factor threshold values must be set to determine what rating within the five-step scale should be assigned to a watershed. Also, an Objective Factor may depend on several parameters; for instance, Concentration of needs/population needs to consider three parameters: (i) Population density, (ii) Poverty index and (iii) Degree of lack of access to safe water of population. A procedure to integrate the rating of these three parameters will need to be establishedin order to produce the score for that particular watershed. ***Annex 3(b)*** illustrates the setting of ratings for population density based on the statistics available for districts.

For the Impact Factors, in a given watershed there are three criteria (parameters) to be graded with score of 1 to 5 for each of the three objectives (health, climate change resiliency, and food security); the total score for an objective would be the summation of the three partial scores, giving a maximum of 15. From the scores for the each of the three principal objectives a triangle would be constructed within a “radar screen” depiction and the area enclosed by such triangle would represent the compounded Integrated Impact Score. ***Annex 3(c)*** gives a brief analytic background to the computation of these triangular areas.

Annex 3(a)

Watershed selection - District areas as % of each watershed



Watersheds; total (km²):

(1) Upland Akanyaru; 264 km^2
(2) Akavuguto; 155 km^2
(3) Giswi; 237 km^2
(4) Gatobwe; 159 km^2
(5) Migina; 260 km^2
(6) Kabogobogo; 126 km^2
(7) Mirayi; 83 km^2
(8) Isumo; 304 km^2
(9) Nyurabogo; 174 km^2
(10) Kinyegenyege; 101 km^2
(11) Mukunguri; 329 km^2
(12) Cyohoha North wetlands; 392 km^2
(13) Mwesa; 174 km^2
(14) Lake Mugesera; 798 km^2
(15) Rwagitugusa; 647 km^2
(16) Nasho Rwampaga lakes; 298 km^2
(17) Lake Ihema; 341 km^2
(18) Kamababa; 1773 km^2
(19) Karangaza; 736 km^2
(20) Muvumba; 679 km^2

Districts; total (km²):

(a) Nyaruguru; 1010 km^2
(b) Nyamagabe; 1090 km^2
(c) Huye; 582 km^2
(d) Gisagara; 679 km^2
(e) Nyanza; 672 km^2
(f) Ruhango; 627 km^2
(g) Muhanga; 648 km^2
(h) Kamonyi; 656 km^2
(i) Bugesera; 1291 km^2
(j) Ngoma; 868 km^2
(k) Rwamagana; 682 km^2
(l) Kayonza; 1935 km^2
(m) Kirehe; 1185 km^2
(n) Gatsibo; 1582 km^2
(o) Nyagatare; 1920 km^2
(p) Gicumbi; 830 km^2

Tabulation of Areal Percentages: Watersheds and Districts

NAME WATERSHED	GRID CODE	AREA WATER SHED [km2]	DISTRICT	AREA OF DISTRICT [km2]	AREA WATER SHED_IN DISTRICT [km2]	% AREA WATERSHED IN DISTRICT	% AREA OF DISTRICT OCCUPIED BY WATERSHED
Upland Akanyaru	1	264	Nyaruguru	1010	212	80%	21.0 %
Upland Akanyaru	1	264	Nyamagabe	1090	52	20%	4.8 %
Akavuguto	2	155	Huye	582	3	1%	0.5 %
Akavuguto	2	155	Nyaruguru	1010	153	99%	15.1 %
Giswi	3	237	Nyaruguru	1010	235	100%	23.2 %
Gatobwe	4	159	Huye	582	60	38%	10.3 %
Gatobwe	4	159	Nyaruguru	1010	99	62%	9.8 %
Migina	5	260	Huye	582	144	56%	24.7 %
Migina	5	260	Gisagara	679	60	23%	8.8 %
Migina	5	260	Nyaruguru	1010	55	21%	5.4 %
Kabogobogo	6	126	Gisagara	679	126	100%	18.6 %
Mirayi	7	83	Gisagara	679	83	100%	12.2 %
Isumo	8	304	Huye	582	72	24%	12.4 %
Isumo	8	304	Gisagara	679	202	66%	29.7 %
Isumo	8	304	Nyanza	672	31	10%	6.6 %
Nyurabogo	9	174	Huye	582	2	1%	0.3 %
Nyurabogo	9	174	Nyanza	672	171	99%	25.4 %
Kinyegenyege	10	101	Nyanza	672	49	49%	7.3 %
Kinyegenyege	10	101	Ruhango	627	52	51%	8.3 %
Mukunguri	11	329	Ruhango	627	209	63%	33.3 %
Mukunguri	11	329	Muhanga	648	19	6%	2.9 %
Mukunguri	11	329	Kamonyi	656	101	31%	15.4 %
Cyohoha North wetlands	12	392	outside RW			4%	
Cyohoha North wetlands	12	392	Bugesera	1291	378	96%	29.3 %
Mwesa	13	174	Bugesera	1291	174	100%	13.5 %
Lake Mugesera	14	798	Ngoma	868	353	44%	40.7 %
Lake Mugesera	14	798	Rwamagana	682	322	41%	47.2 %
Lake Mugesera	14	798	Kayonza	1935	122	15%	6.3 %
Rwagitugusa	15	647	Kirehe	1185	434	67%	36.6 %
Rwagitugusa	15	647	Ngoma	868	200	31%	23.0 %
Rwagitugusa	15	647	Kayonza	1935	13	2%	0.7 %
Nasho Rwampaga lakes	16	298	Kirehe	1185	178	60%	15.0 %
Nasho Rwampaga lakes	16	298	Kayonza	1935	120	40%	6.2 %
Lake Ihema	17	341	Kayonza	1935	338	100%	17.5 %
Kamababa	18	1773	Ngoma	868	32	2%	3.7 %
Kamababa	18	1773	Kayonza	1935	926	52%	47.9 %
Kamababa	18	1773	Gatsibo	1582	612	35%	38.7 %
Kamababa	18	1773	Nyagatare	1920	203	11%	10.5 %
Karangaza	19	736	Gatsibo	1582	241	33%	15.2 %
Karangaza	19	736	Nyagatare	1920	494	67%	25.7 %
Muvumba	20	679	Gicumbi	830	213	31%	25.7 %
Muvumba	20	679	Gatsibo	1582	153	23%	9.7 %
Muvumba	20	679	Nyagatare	1920	313	46%	16.3 %

Annex 3(b)

Setting Rating Scales: Illustration with Population density

The setting of scales for population density based on the statistics available for districts is illustrated here.

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District	Area (km2)	Population	Density (inhab/km2)
Akanyaru sub-basin:			
Nyamagabe	1,090	317,766	292
Nyaruguru	1,010	263,326	261
Huye	582	314,022	540
Gisagara	679	328,648	484
Nyanza	672	266,656	397
Ruhango	627	282,125	450
Bugesera	1,291	390,651	303
Muhango	648	309,266	471
Kamonyi	656	294,972	457
Akagera sub-basin:			
Rwamagana	682	318,474	467
Ngoma	868	322,906	372
Kirehe	1,185	328,856	278
Kayonza	1,935	332,032	172
Gatsibo	1,582	491,464	311
Nyagatare	1,920	424,161	221
Gicumbi	830	395,688	476

Range: 172 to 540

Possible rating scale for population density as measure of concentration with a 5 point scale:

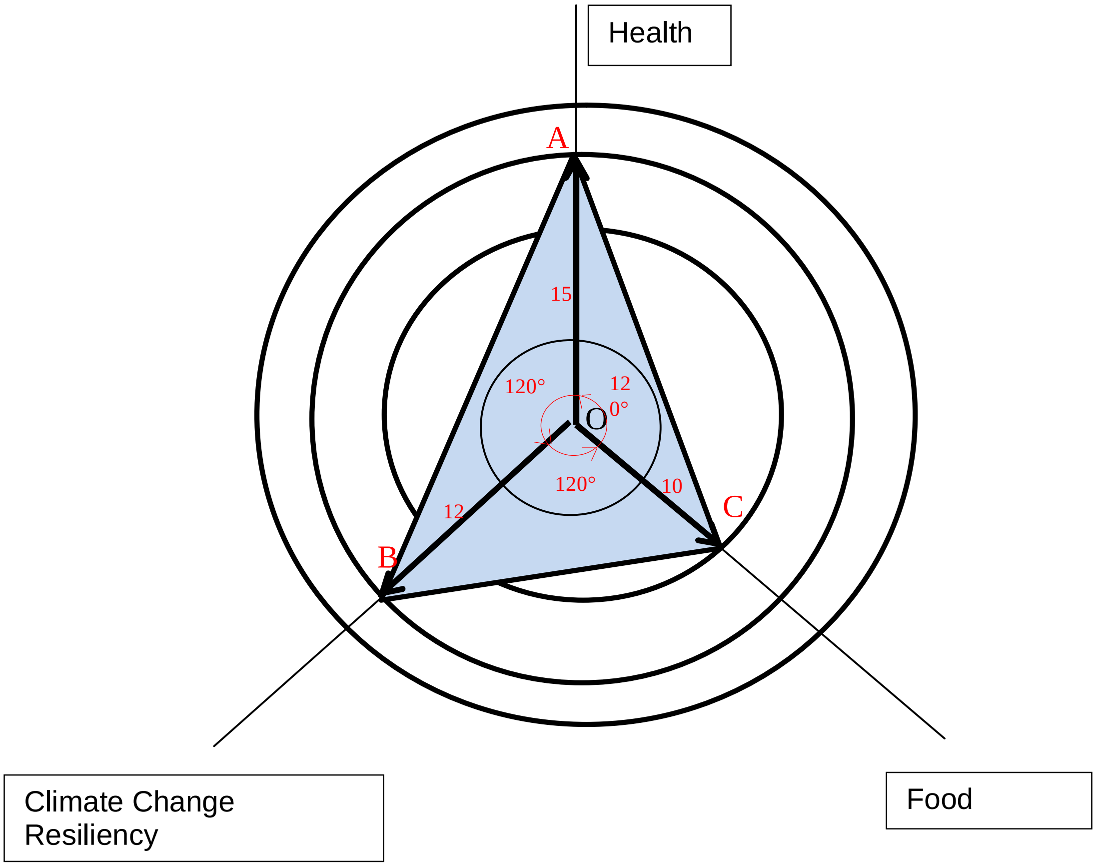
<200: 1 point (very low)
201-300: 2 points (medium low)
301-400: 3 points (medium range)
401- 500: 4 points (medium high)
>501: 5 points (high)

Notes:

- Metric will need to be computed at watershed level, which normally may lie in more than one district
- An objective factor may be the function of more than one metric; a compounding rule for the rating has to be defined as well (average or other options)
- This annex is an illustration, actual figures and scales may vary.

Annex 3(c)

Areal computation: Integrated Impact Triangles



Given an overall triangle ∆ABC as illustrated in the figure, it may be decomposed into the three triangles ∆AOB, ∆BOC and ∆COA, thus the total area of ∆ABC can be calculated as the summation of the three triangles that compose it.

Based on the fact that the area of a triangle is equal to one half the product of the length of the base times the height, it can be trigonometrically deduced that the area of triangle with two sides a and b of known length and the included angle θ can be calculated as

$$Area = \frac{a * b \sin \theta}{2}$$

That is to say, the area of a triangle is half the product of two sides times the sine of the included angle

In the case illustrated above we would have:

$$Area\ ABC = Area\ AOB + Area\ BOC + Area\ COA$$

As the sides of the smaller triangles form angles of 120^o with each other (a full circumference of 360^o), we obtain applying the trigonometric formula above:

$$Area\ ABC = \frac{(\mathrm{OA} * \mathrm{OB} + \mathrm{OB} * \mathrm{OC} + \mathrm{OC} * \mathrm{OA})\ sin\ 120^o}{2}$$

In the specific case illustrated we have OA=15, OB=12 and OC=10, thus:

$$Area\ ABC = \frac{(15 * 12 + 12 * 10 + 10 * 15)\ sin\ 120^o}{2}$$

$$Area\ ABC = \frac{(450)\ sin\ 120^o}{2}$$

The exact numerical value of the area can be calculated knowing that sin 120^o = √3/2 = 0.866025…, but in the actual rating process this will not be necessary as, as explained, the rating for Integrated Impact for a give watershed will be normalized, that is, the computed area of the triangle will be divided by the maximum potential area. This will occur when each of the three objectives assumes its maximum value, which is 15 by definition. Thus:

$$Max\ Area\ ABC = \frac{(15 * 15 + 15 * 15 + 15 * 15)\ sin\ 120^o}{2}$$

$$Max\ Area\ ABC = \frac{(675)\ sin\ 120^o}{2}$$

Hence, the normalized score would be

$$= \frac{Area\ ABC}{Max\ Area\ ABC}$$

$$= \frac{(450)\ sin\ 120^o/2}{(675)\ sin\ 120^o/2} = \frac{450}{675} = 0.667$$

Thus, in practice, it will only be necessary to compute the summation of the successive products of the three sides (scores assigned to each of the three impact objectives) and the resulting sum will be divided by 675, as in the case above, to obtain the normalized score.