



**Gusuzuma ibyago byo kwibasirwa n'inkangu  
n'Ingamba zo kugabanya ubukana bwazo mu  
byogogo bine by'ahari imijyi mu Rwanda**

## 1. INTANGIRIRO

---

Ibyago byo kwibasirwa n'inkangu byiganje mu duce tw'imisozi miremire n'udusozi tugufi ku mubumbe w'isi, ubusanze bigaragara mu Rwanda. Ijambo Inkangu bisobanura gukukumuka kw'ibigize ubuhaname bw'ahantu runaka bigizwemo uruhare n'imbaraga rukuruzi (Cruden na Varnes, 1996). Inkangu ni kimwe mu bintu biherereye ahantu henshi zikanagira uruhare mu guha isi ishusho tubona.

Hamwe n'terambere n'ivuka ry'imijyi ku mpinga z'udusozi tugufi n'imisozi miremire ku mubumbe w'isi, kubaho kw'inkangu nabyo akensi bijyana n'ibikorwa bya muntu n'ibice byiganjemo inyubako, inshuro nyinshi biba bifite ingaruka ziteza ibago (Sidle na Ochiai, 2006; Lu na Godt, 2013; Froude na Petley, 2018; Haque n'abandi., 2019).

N'ubwo mu buryo busanzwe inkangu zibasira ahantu hari udusozi tugufi n'imisozi miremire ku isi, ibikorwa bya muntu (Urugero., Imihanda, kubaka ibigega, gutema amashyamba, kwaguka kw'imijyi, n'ibindi) bishobora nabyo gutiza umurindi ukubaho kw' inkangu, ukwiyyongera kwazo n'igihe zimara (Sidle na Ochiai, 2006; Lacroix n'abandi, 2020).

Biranga inkangu bigaragaza imiterere itandukanye y'ubutaka, ubutumburuke n'ubuhaname, ibidukikije n'ikirere inkangu zishobora kubarizwamo, bikanatuma habaho uwoko butandukanye bw'inkangu n'uburyo zibaho butandukanye(Lu na Godt, 2013; Hungr n'abandi., 2014).

U Rwanda ni igihugu cy'imisozi, gituwe n'abaturage 10,515,973 (Ibarura rusange ry'abaturage n'imiturire rya 2012 mu Rwanda), kikaba gifite ubuso bwa 26,338 Km<sup>2</sup>.

Hashingiwe ku miterere y'ubutaka, ubutumburuke n'ikirere, igihugu kigabanyijemo ibice 3 by'ahabereye ubuhinzi (AEZs), bizwi nk'ibice bishingiye ku butumburuke ariyo: ibice by'Imisozi miremire, imibande n'ibibaya bigize uko bikurikirana 17, 32 na 38% by'ubutaka.

Igice gisigaye kingana na 13% cy'igihugu kigizwe imanga, ibishanga, ibirwa n'ibiyaga (Verdoodt na Van Ranst, 2003a). Ubutaka bw' U Rwanda bukomoka ku ishwanyangurika n'isaza ry'utubuye dutandunkanye tugize ubuso bw'igihugu harimo nk'amakoro bitewe n'ingufu zitandukanye n'ibindi binyabutabire.

Bitewe n'uruvangitirane rw'ubutumburuke n'inkomoko y'ubutaka, uduce tw' U Rwanda tugenda tugira imiterere inyuranye n'iyo utundi ku ntera nto cyane.(Birasa n'abandi., 1990; Steiner, 1998).

Intara y'Amajyaruguru y'u Rwanda, igizwe n'ahantu hafite ubutumburuke bwo hejuru kandi hahanamye, ikaba inakunze kugira imvura nyinshi, ibi bituma inakunze kwibasirwa n'inkangu bya hato na hato.

Nanone, inkangu ndetse n'isuri byatijwe umurindi no gutema amashyamba kubera ubwinshi bw'abaturage. (Mbonigaba na Culot, 2010).

Nko mu mwaka wa 2020 gusa, abantu 232 bahitanywe n'inkangu ndetse n'umwuzure, inzu 7,769 zirasenyuka, hegitari 4,437 z'ibihingwa zirangirika, ibiraro 103 birasenyuka (Raporor y'ingaruka z'ibiza buri mwaka, GoR, 2020).

Na none, byagaragajwe ko u Rwanda rutakaza buri mwaka impuzandengo ya toni 62 kuri hegitari kandi igice cy'ubu butaka buzimira giterwa n'inkangu (Rwanda NCA, 2019).

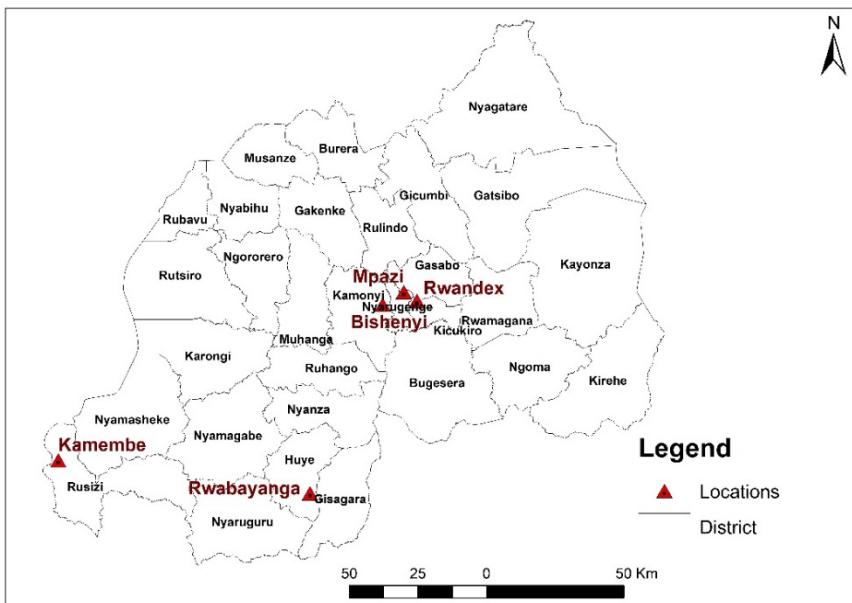
Mu ntumbero yo Kubaka Ubushobozi bwo guhangana n'imihindagurikire y'ikirere, Ikgi Mpuzamahanga Giharanira iterambere ritangiza Ibidukikije (GGGI) muri gahunda yacyo mu Rwanda, ku bufatanye n'Ikgi cy'Igihugu gishinzwe kubungabunga Ibibukikije, mu bubasha bwacyo nk'Urwego rw'Ubuyobozi ku rwego rw'Igihungu (NDA) rwashyiriwe gukorana n'ikigega mpuzamahanga cyo guhangana n'Imihindagurikire y'ikirere (GCF), cyagaragarije GCF umushinga wo kongera ubushobozi bw'igihugu mu guhangana no gukumira ibiza hibandwa ku bushobozi bwo guhangana n'imyuzure mu Rwanda, bijyanye n'amabwiriza, ingamba n'intumbero za Guverinoma, no kongera ubushobozi bw'U Rwanda mu gukemura ibibazo by'imihindagurikire y'ikirere mu duce dufite ibyago byinshi byo kugerwaho n'ibiza hashyirwa mubikorwa igenamigambi ryimbise ryo guhangana n'imyuzure no gukumira inkangu mu duce tw'imijyi.

### **Bimwe mu biteganijwe kugerwaho muri uno Mushinga:**

- a. Imbaraga mu guhuza ibikorwa n'ubushobozi
- b. Umurongo uhamye wo gutera inkunga Umushinga n'Ingamba zo kubungabunga Ikirere, hamwe no guhitamo no kugaragaza inyigo zihariye,
- c. Imbaraga mu mikoranire, mu guhanahana amakuru no gusangizanya Ubumenyi ku bijyanye no guhangana n'ibiza.
- d. Ubyo bwo gutanga raporan, gukurikirana no gusuzuma ishyirwaho ry'Ingamba zo kongera ubudahangarwa bw'ibidukikije no guhangana n'ibiza.

Mu miterere remezo y'uyu mushinga, hahiswemo Ibyogogo bitanu mu mujyi wa Kigali n'imijyi yunganira Kigali (Huye na Rusizi) kimwe n'agace k'umujiyi w'Akarere ka Kamonyi kugira ngo hakorerwe inyigo y'imbitse y'ahashobora guhura n'ibiza by'inkangu n'ingamba zo kubikumira, mu rwego rwo guha amakuru ikorwa ry'imishinga ikenera inkunga y'ikigega mpuzamahanga cyo kubungabunga ibidukikije.

Ikarita Ikurikira igaragaza aho ibyogogo byatoranjwe biherereye mu Rwanda.

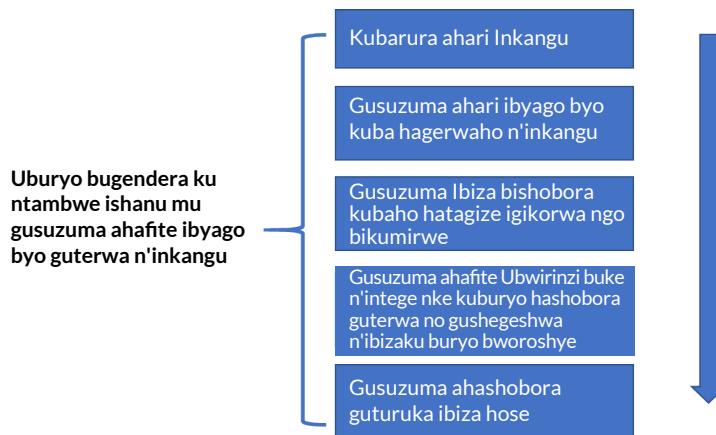


Ishusho ya 1: Ikarita agaragaza ahaherereye ibyogogo byatoranijwe.

## 2. METHODOLOGY

Muri iyi Nyigo, Isuzumwa ry'ahafite ibyago byo guterwa n'inkangu ryagezweho mu ntambwe eshanu (Ishusho ya 2). Ubu buryo bwashingiye ku buryo busanzwe busabwa kugira ngo hasuzumwe ahashobora guhura n'ibyago by'inkangu mu Karere (Corominas n'abandi., 2014).

Ibarurwa ry'Inkangu (Intambwe ya 1) ni ryo ryari intambwe nyamukuru y'uburyo. Ibyavuye mu Isuzumwa ry'ahari ibyago byo guterwa n'inkangu, nti bishingiye gusa ku inkangu zabaruwe ahubwo binashingiye ku miterere y'izo nkangu n'ingano y'inshuro zigaragara mu gace runaka.



Ishusho 2: Uburyo bwo gusuzuma ahashobora kwibasirwa n'inkangu

### 2.1 Kubarura ahari inkangu (Intambwe ya 1)

Ibarurwa ry'inkangu ryakozwe hashingiwe ku bisobanuro byavuye mu busesenguzi bwakozwe ku buryo bwitonewe kandi bwimbitse bw'amashusho y'ibyogajuru yo muri porogaramu izwi nka google earth mururimi rw'icyongereza, harebwa uburebure, ubugari n'ubujyakuzimu bwa (3D) buri kintu kiri ku isi nk'uko ayo mashusho abigaragaza.

Amashusho yose yakoreshejwe muri ubu busesenguzi yagaragazaga buri kintu cyose kiri muri byibura hagati ya sentimetero 30 na sentimetoro 60 z'ahantu runaka.

mashusho yo muri ino porogaramu yitwa google earth yaturutse mu ikigo cy'ubucuruzi cyo muri Amerika gicuruza amashusho afatirwa mu kirere hifashishijwe icyogajuru (kizwi nka © DigitalGlobe), cyangwa Ikigo cy'Ubufaransa gishinzwe iby'

ikirere (Kizwi nka © CNES) kimwe n' ikigo nyaburayi gishinzwe iby'ikirere (Kizwi nka © Airbus), ayo mashusho akaba yarafashwe hagati y'umwaka wa 2000 na 2021.

Byagaragaye ko ubusesenguzi bw'amashusho yo muri porogaramu ya google earth ari uburyo butanga igisubizo kandi bwizewe mu gutunganya ikarita y'ahari inkangu (Fisher, n'abandi., 2012).

Ubwizerwe bw'ubu buryo bwerekanwe na Depicker. (2020a; 2020b) ku gace k'ikiyaga cya Kivu, harimo igice cy'u Burengerazuba bw'u Rwanda.

Amashusho y'icyogajuru n'amafoto yafatiwe ahakorewe inyigo, yasesenguriwe hamwe mu buryo bubangikanye.

## **2.2. Gusuzuma ahari ibyago byo kuba hagerwaho n'inkangu (Intambwe ya 2)**

Intego y'iyi ntambwe ni uguuzuma ahashobora kugera inkangu mu gice gikorwamo inyigo, no gutunganya ikarita igaragaza ahari ibyago byo kuba hagerwaho n'inkangu mu byogogo bine. Aya makarita yashyizwe mu byiciro bigendanye n'ahakunda kwibasirwa, hakoreshejwe uburyo bw'ibarurishamibare ku kugenekereza ibishobora kubaho (The logistic regression model) bworoshye gusobanukirwa.

Ubu buryo kandi nibwo bwakoreshejwe ndetse butanga umusaruro mu gace Ikiyaga cya Kivu giherereyemo. (Depicker n'abandi., 2020).

Uburyo bw'ibarurishamibare ryo kugenekereza ibishobora kubaho bukoreshwa mu guteganya imboneko cyangwa ibura ry'inkangu (1/0). Ubu buryo buraboneye mu gutanga amakuru y'ibantu bitandukanye kugirango uteganye ibikorwa bibiri bishobora kubaho (Hosmer and Lemeshow, 2000). Ubu buryo kandi burakoreshwa kurenza ubundi bwose ku bijyanye no guteganya ibiza by'inkangu (Reichenbach n'abandi., 2018). Impinduka zibaho zikomeza kurira igereranya riri hagati ya 0 na 1.

## **2.3. Gusuzuma ibiza bishobora kubaho hatagize igikorwa (Intambwe 3)**

Intego y'iyi ntambwe ni uguuzuma inkangu Igagara mu gihe n'agace runaka (kimwe n'ubukana bwayo). Gusuzuma ahari ibyago byo kuba hagerwaho n'inkangu (Intambwe 2) byasanishijwe n'ikiza cy'inkangu hifashishijwe gusuzuma ikigereranyo cy'ibiza biherereye mu duce tunyuranye twagenwe hashingiwe ku byago byatwo byo kuba twagerwaho n'ibiza.

Agace ka mbere gakubiyemo ahantu hose hafite ibyago byo kuba hagerwaho n'inkangu ku kigero cyiri hagati ya 0 na 0.2,

Igice cya kabiri nacyo kigizwe n'ahantu hose hafite ibyago byo kuba hagerwaho n'inkangu kukigero cyiri hagati ya 0.1 na 0.2, no gukomeza ukageza kuri 1.

Ku bisobanuro birambuye kuri buri cyiciro cy'ahantu hashobora kwibasirwa n'inkangu, Ubuso bw'ahantu hose hagezweho n'ingaruka zikomoka ku nkangu zagaragaye mu

gihe cyose cyakoreweho ubushakashatsi bushingiye ku kwitegereza ibiri ku butaka (Hafi imyaka 20 - Bijyanye n'intambwe ya 1 yavuzwe haruguru), bwashyizwe ku mpuzandengo ya buri mwaka.

Imibare ivuye muri iyi mpuzandengo igaragaza ubuso bw'ahagezweho n'ingaruka z'inkangu ku kigero cya metero kare ku mwaka no kuri buri kilometero kare ( $m^2$  umwaka-1 km<sup>-2</sup>), Ni ukuvuga Igipimo cy'Inkangu.

Guhuza ahafite ibyago byo guterwa n'inkangu (Ahaba Inkangu) n'igipimo cy'inkangu (Inshuro inkangu ibaho n'ubukana bwayo) biranga imiterere y'ikiza. (Guzzetti n'abandi., 1999; Glade n'abandi., 2006).

## 2.4. Gusuzuma ahafite ubwirinzi buke n'intege nke kuburyo hashobora guterwa no gushegeshwu n'ibiza kuburyo bworoshye (Intambwe ya 4)

Intego yo gusuzuma ahafite ubwirinzi buke n'intege nke kuburyo hashobora guterwa no gushegeshwu n'ibiza kuburyo bworoshye ni ukubaka ububikoshingiro bw'ahafite ubwirinzi bucyo no gusuzuma intege nke z'ibantu byose bishobora kwibasirwa n'inkangu.

Isesengura ryakozwe hasanishwa uduce duherereyemo ibiza hamwe n'ibindi bintu byose bishobora kwibasirwa n'inkangu muri buri cyogogo.

Byavuye mu isesengurwa byatunganirijwe muri mudasobwa hifashishijwe umwitoto wo gusanisha uduce tw'ibiza biboneka ahantu hatandukanye (Igipimo cy'Inkangu) Ibyavuyemo bigaragazwa mu buryo bubiri bushoboka ari bwo:

- Ibantu bishobora kwibasirwa n'inkangu hakurikijwe uko imikoreshereze y'ubutaka imeze uyu munsi;
- Ibantu bishobora kwibasirwa n'inkangu hakurikijwe imikoreshereze y'ubutaka iteganwa n'igishushanyombonera cy'imikoreshereze z'ubutaka cyo kugeza muri 2050.

Urutonde rugendeye kugusakara kw'ahantu hafite ubwirinzi buke n'intege nke muguhangana n'inkangu rwashyizwe mu byiciro bine bigaragara mu mbonerahamwe ikurikira:

Igipimo cy'inkangu ( $m^2$ / Umwaka /km <sup>2</sup> )
1
18
90
365

## **2.5. Ingamba zo kugabanya ubukana bw'ibishobora gutera inkangu**

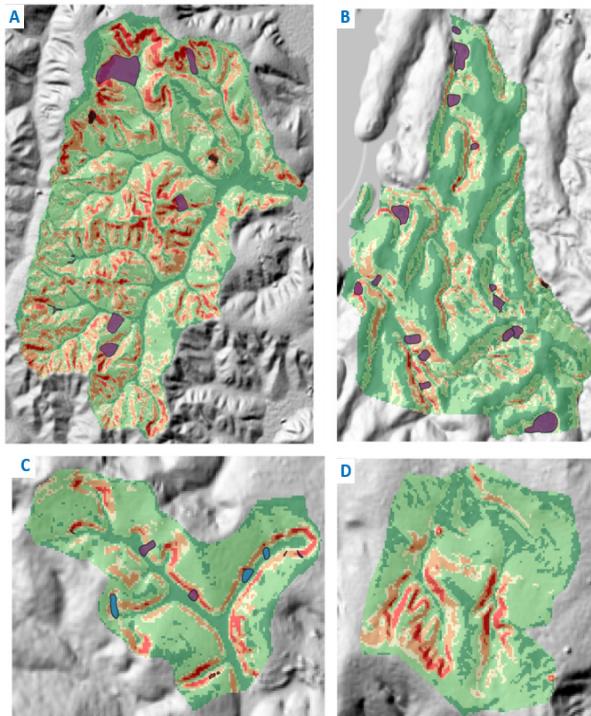
Intego y'iyi ntambwe kwari ugutanga icyifuzo (ibishushanyo mbonera hamwe n' ibisobanuro bya tekiniki) ku ngamba zifite ubushobozzi bwo kugabanya ubukana bw'inkangu zikaba zanageragezwa ku hantu hagaragajwe ku ntambwe ya 1 ukageza kuya 4 nk'ahantu hafite intäge nke n'ibyago byo guterwa n'inkangu.

Uburyo bushobora kugeragezwa no gutangwaho umurongo mugushyiraho ingamba zo kugabanya ubukana bw'inkangu harimo porogaramu ya mudasobwa izwi nka CROM DSS ihuza siyanse/Ubumenyi n'imyanzuro iva mu bushakashatsi, nka bumwe mu bundi buryo bushobora gukoreshwa. Ibi bizuzuzanya n'isesengura ry'inyandiko zivuga ku nkangu ndetse no kurwanya isuri.

### 3. IBYAGARAGAYE

#### 3.1 Ibarurwa ry'inkangu n'ikorwa ry'amakarita agaragaza ahafite intege nke muguhangana n' inkangu

Ishusho ya 3 ikurikira igaragaza Ibisubizo byavuye mu ibarurwa ry'inkangu ryakozwe hashingiwe ku bisobanuro byagaragaye ku mashusho yo muri porogaramu ya mudasobwa yitwa google earth mu byogogo bine kimwe n'isesengurwa ry'ahafite intege nke muguhangana n'inkangu ryakozwe hifashishijwe uburyo bw'isesengura bukoreshwa mu ibarurishamibare mu kugerageza kureba igisubizo cy'ukuri gishobora kuva mu bisubizo bibiri biri kwigwaho, aribwo buryo bita logic regression model mu rurimi rw'icyongereza.



A - Bishyenyi  
B - Rusizi  
C - Rwabayanga  
D - Rwandex Magerwa

Isesengura ryakozwe hasanishwa uduce duherereyemo ibiza hamwe n'ibindi bintu byose bishobora kwibasirwa n'inkangu muri buri cyogogo.

Ibyavuye mu isesengurwa ry'ahafite intege nke muguhangana n'inkangu hifashishijwe uburyo bw'isesengura bukoreshwa mu ibarurishamibare mu kugergeza kureba igisubizo cy'ukuri gishobora kuva mu bisubizo bibiri biri kwigwaho (bwitwa logic regression model mu rurimi rw'icyongereza) bitanga imibare idafite ibisobanuro bihitabigaragarira amaso ahari gukorerwa inyigo kuko ubu buryo buba bugamije gutanda amakuru ngenderwaho muri rusange. Kugira ngo haboneke ibisobanuro bifatika by'amakuru ajyanye n'ahashobora guterwa n'inkangu byoroshye, ibisobanuro biba bikeneye gushyirwa mu byiciro. (Corominas n'abandi., 2014; Reichenbach n'abandi., 2018).

Muri urwo rwego, amakuru arambuye agize uburyo bwo gusobanura byoroshye ahashobora guterwa n'inkangu yashyizwe mu byiciro bitanu bitandukaniye ku byago bya buri kiciro byo kuba cyakwibasirwa n'inkangu. (Ishusho ya 3):

Icyiciro cya [0.80 – 1.0], mu Ibara ry'umutuku wijimye mu ifoto ya 3, igaragaza icyiciro kirusha ibindi kwibasirwa n'inkangu cyané.

Icyiciro gihabanye nacyo ni [ $\leq 0.2$ ] mu ibara ry'icyatsi. Icyiciro cya [0.45-0.55] kigaragaza igice gifite guhindagurika kw'ibikiranga kuri hejuru kuri hejuru (Rossi n'abandi., 2010). Ubu buryo bwo gushyira mu byiciro ahakunze kwibasirwa n'inkangu butuma kugereranya imiterere y'ibyogogo bitandukanye byoroha.(e.g.,Jacobs n'abandi., 2018).

Hashingiwe kuri iki kigereranyo, Hakarebwa ku mpuzandengo z'imibare igaragaza ahafite ibyago byo kwibasirwa n'inkangu kurusha ahandi, ubonako muri rusange icyogogo cya RWANDEX-MAGERWA ari cyo kiri ahantu hafite ibyago byo hakwibasirwa hato na hato n'inkangu ifite ubukana, mu gihe Rwabayanga ari cyo cyogogo giherereye ahantu hafite ibyago bike byo kuba hakwibasirwa n'inkangu. Ariko, ntabisobanuro izi mpuzandengo zaba zaba zifite hadasesenguwe uduce ziherereyemo.

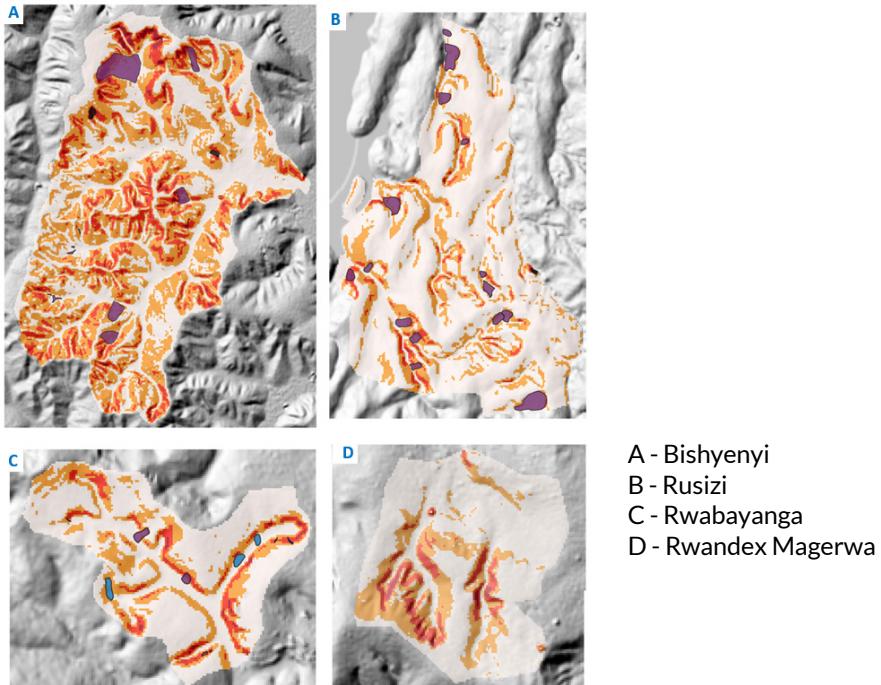
Imbonerahamwe ikurikira igaragaza ubuso buri mpuzandengo iherereyeho kuri buri kiciro cy'ahafite ibyago byo kwibasirwa n'inkangu muri buri cyogogo.

*Imbonerahamwe ya 1: Ubuso bwa buri kiciro cy'ahashobora kwibasirwa n'inkangu muri buri gace kakoreweho inyigo*

Ikiciro cy'ahafite ibyago byo kwibasirwa n'inkangu	Bishenyi		Rwabayanga		Rusizi		Rwandex-Magerwa	
	Ubuso (km <sup>2</sup> )	Ijanisha ry'ubuso bwose						
<= 0.2	9.87	20.9%	2.54	32.5%	9.50	45.1%	4.45	45.8%
0.2 - 0.45	14.85	31.4%	3.06	39.1%	6.55	31.1%	2.83	29.1%
0.45 - 0.55	12.47	26.4%	1.20	15.3%	3.31	15.7%	1.29	13.3%
0.55 - 0.8	7.45	15.8%	0.67	8.6%	1.45	6.9%	0.73	7.5%
0.8 - 1.0	2.62	5.5%	0.35	4.5%	0.25	1.2%	0.41	4.2%

## 3.2 Gusuzuma ibiza by'inkangu

Nk'uko byasobanwe muri make mu gice cya 2, ishusho ya 3 ikurikira igaragaza ibavuye mu isuzumwa ry'ibiza by'inkangu mu byogogo bine.



Ishusho ya 3: Amakarita y'ahari ibiza by'inkangu (Ahari ubuso bw'ibara "ry'lhuki/risa n'imbuto z'igitu cy'umuhengeri" n'ubururu ni ahabaruwe inkangu)

Amabara atandukanye ari mu makarita ari ku ishusho ya 3 agaragaza ikigero cy' ahari uwirinzi buke n'intege nke mu guhangana n'inkangu nk'uko bigaragara mu mbonerahamwe ikurikira:

Igipimo cy'inkangu (m <sup>2</sup> /year/km <sup>2</sup> )
1
18
90
365

Imbonerahamwe ya 2: Ibyiciro bishingiye ku bipimo by'inkangu

Imbonerahamwe ikurikira irerekana ubuso buherereyeho buri kiciro gishingiye ku gipimo cy'ibiza by'inkangu muri buri cyogogo

*Imbonerahamwe ya 3: Ubuso kuri buri kiciro gishingiye ku gipimo cy'ibiza by'inkangu kuri buri gace k'ahakorewe inyigo*

Ikiciro gishingiye ku gipimo cy'icyiza (m <sup>2</sup> /year/km <sup>2</sup> )	Bishenyi		Rwabayanga		Rusizi		Rwandex-Magerwa	
	Ubuso (km <sup>2</sup> )	Ijanisha ry'ubuso bwose						
1	21.06	44.6%	5.34	68.3%	15.98	75.9%	6.77	69.7%
18	19.54	41.3%	1.84	23.5%	4.40	20.9%	2.19	22.5%
90	5.96	12.6%	0.59	7.5%	0.66	3.1%	0.68	7.0%
365	0.71	1.5%	0.05	0.6%	0.02	0.1%	0.08	0.8%

### 3.3 Landslide Exposure and Vulnerability Assessment

Intego yo gusuzuma ahafite ubwirinzi buke n'intege nke kuburyo hashobora guterwa no gushegeshwa n'ibiza kuburyo bworoshye ni ukubaka ububikoshingiro bw'ahafite ubwirinzi bucye no gusuzuma intege nke z'ibintu byose bishobora kwibasirwa n'inkangu.

Ibi byakozwe hasanishwa uduce duherereyemo ibiza hamwe n'ibindi bintu byose bishobora kwibasirwa n'ibiza.

Ibyavuye mu isesengurwa byatunganirijwe muri mudasobwa hifashishijwe umwitoto wo gusanisha uduce tw'ibiza biboneka ahantu hatandukanye (Ibipimo by'inkangu) byakozwe mu ntamwe ya 3 (Ifoto ya 3) ndetse n'ibyiciro bitandukanye by' imikoreshereze y'ubutaka. Ibyavuyemo bigaragazwa mu buryo bubiri bushoboka ari bwo:

- Ibintu bishobora kwibasirwa n'inkangu hakurikijwe uko imikoreshereze y'ubutaka imeze muri iki gihe (Ikarita y'imikoreshereze y'ubutaka yo muri 2018);
- Ibintu bishobora kwibasirwa n'inkangu hakurikijwe imikoreshereze y'ubutaka iteganwa n'igishushanyombonera cy'imikoreshereze z'ubutaka cyo kugeza muri 2050.

Igipimo cy'inkangu (m <sup>2</sup> /year/km <sup>2</sup> )
1
18
90
365

*Imbonerahamwe ya 4: Ibantu bishobora kwibasirwa n'inkangu hakurikijwe uko imikoreshereze y'ubutaka imeze muri iki gihe hakurikijwe Ikarita y'imikoreshereze y'ubutaka yo muri 2018;*

<b>Ahakorewe inyigo</b>				
<b>Ubuso bwo lgice cy'imiturire / cy'ubucuruzi [ha]</b>				
Bishenyi	539.47	341.15	41.55	0.26
Rusizi	363.79	46.62	2.01	0.04
Rwabayanga	154.65	17.48	0.40	-
Magerwa	480.88	113.58	17.95	0.56
<b>Ubutaka bwo guhinga [ha]</b>				
Bishenyi	1,222.54	1,401.11	366.36	19.56
Rusizi	658.87	177.01	17.68	0.25
Rwabayanga	263.06	98.74	24.05	1.28
Magerwa	69.51	33.58	12.24	1.20
<b>Igishanga [ha]</b>				
Bishenyi	261.44	3.48	0.50	0.27
Rusizi	97.57	2.52	0.41	-
Rwabayanga	54.56	1.99	0.50	0.14
Magerwa	22.62	0.25	-	-
<b>Imihanda yo ku rwego rw'Igihugu (Km)</b>				
Bishenyi	5.86	2.06	-	-
Rusizi	7.00	2.40	0.39	0.04
Rwabayanga	2.82	0.71	-	-
Rwandex-Magerwa	2.14	-	-	-
<b>Imihanda yo ku rwego rw'Akarere (km)</b>				
Bishenyi	-	-	-	-
Rusizi	6.54	0.92	0.25	-
Rwabayanga	0.28	0.64	0.30	-
Rwandex-Magerwa	-	-	-	-
<b>Indi mihanda (km)</b>				
Bishenyi	35.44	17.15	2.91	0.37
Rusizi	61.85	10.91	1.40	-
Rwabayanga	29.10	7.27	1.32	0.12
Rwandex-Magerwa	62.86	13.43	1.15	0.10

Imbonerahamwe ya 5: Ibantu bishobora kwibasirwa n'inkangu hakurikijwe imikoreshereze y'ubutaka iteganwa n'igishushanyombonera cy'imikoreshereze z'ubutaka cyo kugeza muri 2050.

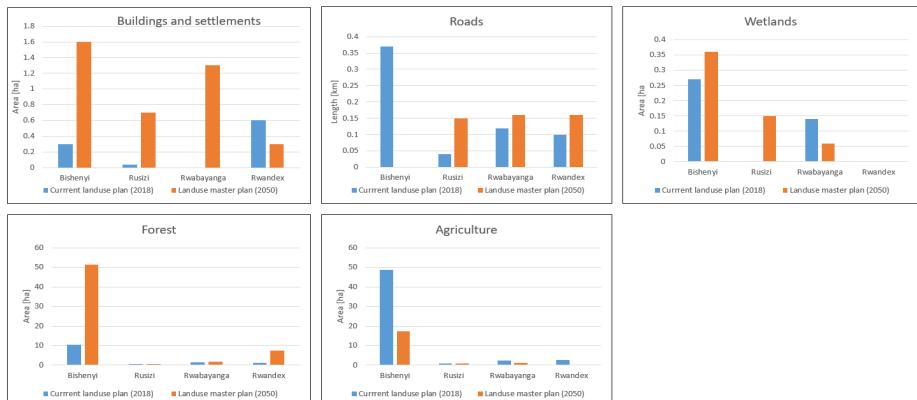
Ahakorewe inyigo	Ubuhinzi [muri Hegitar]			
Bishenyi	976.10	1,256.68	384.20	17.29
Rusizi	154.09	99.73	19.64	0.81
Rwabayanga	80.97	56.61	20.21	1.27
Rwandex-Magerwa	0.56	6.57	0.29	-
Amashyamba [ha]				
Bishenyi	53.39	157.98	140.74	51.39
Rusizi	223.46	106.28	20.10	0.56
Rwabayanga	19.09	27.89	20.80	1.67
Rwandex-Magerwa	4.61	13.34	25.12	7.46
Parike n'ibyanya by'ubukerarugendo [ha]				
Bishenyi	12.84	6.69	1.44	0.00
Rusizi	54.35	15.36	1.18	0.01
Rwabayanga	1.26	0.26	0.10	-
Rwandex-Magerwa	13.39	3.18	-	-
Leta/ubucuruzi/inganda [ha]				
Bishenyi	112.41	56.16	7.56	0.46
Rusizi	245.20	39.53	4.83	0.26
Rwabayanga	135.11	33.07	10.35	1.17
Rwandex-Magerwa	190.70	27.70	2.76	0.13
Imihanda [km]				
Bishenyi	-	-	-	-
Rusizi	111.14	21.80	3.29	0.15
Rwabayanga	45.08	17.45	2.79	0.16
Rwandex-Magerwa	48.75	15.48	1.89	0.16
Imiturire y'Icyaro [ha]				
Bishenyi	86.71	77.33	15.35	0.17
Rusizi	64.47	20.15	1.08	-
Rwabayanga	25.12	5.07	-	-
Rwandex-Magerwa	-	-	-	-

	Imiturire y'umujiyi [ha]			
Bishenyi	437.13	292.74	29.70	1.00
Rusizi	585.43	129.56	14.97	0.39
Rwabayanga	146.46	31.38	3.39	0.12
Rwandex-Magerwa	392.22	128.50	19.50	0.16
	Ibishanga [ha]			
Bishenyi	295.37	10.12	2.53	0.36
Rusizi	128.60	5.01	0.95	-
Rwabayanga	72.64	4.87	1.16	0.06
Rwandex-Magerwa	21.11	0.14	-	-

Ishusho nyamirongo ikurikira igaragaza ikigereranyo cy'isuzumwa ryakozwe ku ngaruka z'inkangu ku mikoreshereze y'ubutaka iriho ubu n'iteganijwe kugeza muri 2050. Izi mbonerahamwe zigaragaza ahari ikiciro kigizwe n'igipimo cy'ibiza by'inkangu cya 365 m<sup>2</sup> /year/km<sup>2</sup>, ari nacyo cyiciro cyonyine cyijyanye n'ahari ibyago byinshi.

Uburyo Ibyiciro by'imikoreshereze y'ubutaka bikoze mu gishushanyo mbonera cy'imikoreshereze y'ubutaka cyo kugeza muri 2050 si kimwe n'ubwo mu gishushanyo cy'imikoreshereze y'ubutaka gisanzwe cyo 2018.

Bimaze kugaragara ko nta buryo bubangutse bwo kugereranya amakuru yabonetse ku mikoreshereze y'ubutaka, Hafashwe umwanzuro wo guhitamo amakuro yo mu byiciro by'igishushanyo mbonera cy'imikoreshereze y'ubukaka cyo kugeza muri 2050 asa n'ayo mu byiciro by'igishushanyo mbonera cy'ikoreshereze y'ubutaka gisanzwe cyo muri 2018, noneho ashirwa hamwe mu rwego rwo kugerageza kubona amakuru ashobora kugereranwa. Amakuru yabonetse agaragara hano hasi ku byiciro by'inyubako n'imiturire, imihanda, ibishanga, amashyamba n'ubuhinzi.



Ishusho ya 4: Isesengura rigereranya ingaruka ku byiciro by'imikoreshereze y'ubutaka - Hakurikijwe Igishushanyo mbonera cy'imikoreshereze y'ubutaka ari uko iri ubu n'uko biteganyijwe mugije kizaza.

## **4. INGAMBA ZIHAMYE ZO KUGABANYA IBYAGO BYO KWIBASIRWA N'INKANGU**

Bitewe n'inzira zinyuranye ziturukaho inkangu, hari mo imiterere y'igice cy'ubutaka gitwikiriye urutare shingiro ubutaka ka buteretseho ari narwo ubutaka bukomokaho buri uko rugenda rusaza kimwe n'ibindi bintu byose bikikije urwo rutare kugeza ku gice cy'ubutaka turebesha amaso, bituma usanga buri mbogamizi ziba zihariye mu kugaragaza ibyago bishingiye ku ubuhaname bw'ahantu byagabanuka.

Kugaragaza icyakorwa kugira ngo Ubuhaname bw'ahantu bube bushikame hamwe, bisaba iperereza kuri aho hantu, ibizamini byo muri laboratwari, gusesengura ubuta-jegajega bw'aho hantu, n'ubugenuzi bw'inyubako zihakwiriye. Bitewe nuko amakuru yose ajyanye n'uyu mukoro aba ashobora kudafatwa nk'amahame, imyanzuro myiza y'ubuhanga, ubunraribonye, n'inyurabwenge bigomba guhirizwa hamwe n'uburyo bugezwaho mugukusanya amakuru no kuyasesengura igisubizo kidasaba ubushozi bw'amafaranga buhambaye kandi cyizewe kigerweho mu gushimangira ko ubuhaname bw'ahantu runaka butajegajega. (Turner and Schuster, 1996).

Intego y'iki gice ni ugutanga ishusho rusange kungamba zishobora kugeragezwa ahantu hagaragara ko hashobora kwibasirwa n'inkangu.

Ingaruka zijiyanie n'inkangu zishobora kugabanuka hakozwe ibi bikurikira:

- Ibiza \_ H (Hazard) ( Ni Ukuvuga: Amahirwe yo kuba habaho Igihe cy'inkubiri imwe cyangwa nyinshi zidasanzwe)
- Intege nke zo guhangana n'Ikiza \_ V (Vulnerability) : (Ni Ukuvuga: Ikigero cy'ibangirika ku bintu bifite ibyago byo kwibasirwa n'inkangu.
- Ibantu bifite ibyago byo kwibasirwa\_E (Ni Ukuvuga: Umubare wabyo cyangwa n'agaciro kabyo kihariye).\_ E (Imibare yabyo cyangwa agaciro kabyo).

Imbonerahamwe ya 6 ishyiraho itandukaniro hagati y'ingamba zo kugabanya ibyago byo kubaho kw'inkangu mu rwego rw'emyubakire no mu buryo butari ubwo imyubakire igaragarira amaso.

Muri rusange, bivuze ko:

- Ingamba zo kugabanya ibyago byo kubaho kw'inkangu mu rwego rw'emyubakire, nka zimwe muri zo hari mo za ruhurura, imirwanyasuri, imiyoboro, ibimera, kongererera ubutaka ubushozi, inzitiro nk'inkike zikozwe mu butaka n'amabuye, ibikunda, ikirundo cy'itaka cyakozwe n'abantu, uburyo bwo kuzirika no gutega inyubako, inyubako zabugenewe kandi zigashyirwa aho zibasha kwihanganira ubukana z'ingaruka z'inkanguno guha abaturage aho kuba hatekanye n'inzira zo guhunga igihe bibaye ngombwa.
- Ingamba zo kugabanya ibyago byo kubaho kw'inkangu mu bundi buryo butari ubwo imyubakire "cyangwa muri rusange "Ingamba zo kugabanya ingaruka" nka zimwe muri zo hari mo kwimuka burundi ahari ibiza, igenamigambi ry'imikoreshereze y'ubutaka, kuburira abantu hakiri kare, Uburyo bwo guhora abaturage biteguye (inzira zo guhunda igihe bibaye ngombwa, n'ibindi) n'ubutabazi bwihiuse.

Uburyo buboneye bwo kugabanya izi ngaruka harimo gukoresha ubutaka icyo bwateganyirijwe, gutanga integuza hakiri kare, kumenyesha abantu kwitegura ibiza, gутегура uburyo bwo guhangana nabyo n'ibindi.

*Imbonerahamwe 6: Ibyiciro rusange by'ingamba zo kugabanya ibyago byo kwibasirwa n'ibiza (SafeLand, 2012).*

Ibyiciro	Ibigize ibyago byizweho	Igisobanuro mu ncamaake	Inyandiko n'andi magambo akoreshwa
Kubaka ubutajegajejwa	Ibiza (H)	Ibikorwa by'ubuhanga mu kugabanya ibyago byo kwibashirwa n'inkangu	Gukumira, Umuti, bikomeye, byoroshye, Bishikamey birambye
Ubugenzuzi	Intege nke mu guhangana (V)	Ibikorwa by'ubwenge byo kurinda, kobyongerera imbaraga, kwegeza kure ibantu bigira ibyago byo kwibasirwa n'inkangu by'ihe gito cyangwa se no kugabanya bihoraho ibyago byo kwibasirwa n'ibiza binyuze: Mu buryo bwo kuburira abantu no kubatabara byihuse bakurwa ahilasiwe n'ibiza no gutuza ahatekanye, igejamigambi ry'imikoreshereze y'ubutaka, kimwe no kwimura ibikorwa remezo bishasanze	Gukumira, bikomeye, byoroshye, Bishikamey by'ihe gito  Kugabanya byihuse mu buryo bw'ihe gito cyangwa buhoraho ibantu biri aho bishobora kwibasirwa n'inkangu. Uburyo bwo kugenzura no kumenyesha cyangwa gutangwa imbuji kimwe n'uburyo bwa gisivili bujyanje no kwirinda, akenshi bufata nko kugabanya intege nke mu guhangana n'ibiza, mu buryo nyakuri bukoreshwa mu buryo bw'ihe gito, hari ikigomba kwirindwa runaka.
Ubwirinzi	Ibantu biri ku isi (E)	Kumenya amakuru, kwemera kimwe ndetse no gusangira ibyago	Uburyo butabangutse bwo kugabanya umubare cyangwa agaciro K'ibantu biri aho bifite ibyago byo kuba byakwibasirwa n'inkangu
Ubwihangane	Ibantu biri ku isi (E)		

Iyo Ubwirinzi budashoboka, izindi ngamba zo kugabanya ibyago byo kwibasirwa n'inkangu zingomba kuzirikanwa. Ingamba zigamije kugabanya ibiza, zigomba kugabanya ibishobora kuba imbarutso y'inkangu ari zo ingamba runaka ziba zigamije gukemura. Ubu bwoko bw'ingamba zo kugabanya ibyago byo kwibasirwa n'inkangu bukunze gufatwa nk'ingamaba zo "kubaka Ubutajegajejwa /Ubutanyeganejwa".

Mu rwego rwo kugabanya ibishobora kuba imbarutso y'inkangu, ingamba zo kugabanya ibiza by'inkangu zibasira ahantu zigomba gukorera kuri gahunda mu kerekezo kinyuranye n'icyo inkangu, hakorwa ibi bikurikira:

- A. Kongera imbaraga zo guhangana.
- B. Kugabanya Imbaraga z'ibitera ikiza cy'inkangu.

Imbonerahamwe ikurikira irerekana ingamba zo kugabanya ibyago byo kwibasirwa n'ibiza by'inkangu zihuye n'izivugwa na popescu & Sasahara.

*Imbonerahamwe ya 7: Ingamba zo kugabanya ibyago byo kwibasirwa n'ibyago by'inkangu  
 (Zihuye n'izivugwa na Popescu & Sasahara, 2009)*

Uburyo bugaragara bikorwamo	Ibisobanuro mu nciamake
<u>Kurinda ubuso bw'ahantu runaka: Kugenzura lsuri yo kubuso bw'ahantu runaka</u>	<ul style="list-style-type: none"> <li>• Ibimera(Gusasira ahateye ingemwe, Gutwikiriza ahace agace runaka ibyati bitye ku buryo bwegeranye cyane nk'isakaro, ibiti/Ibihuru)</li> <li>• Inzitiro z'amashami y'ibiti azirikanije zigamije gukumira itemba ry'ubutaka/ Gutera amashami y'ibiti ku murongo uhuzu ubutumburuke bwa buri buhaname</li> <li>• Kongera ibinyabutabire mu butaka hagamijwe kongera ubushobozi mu mwimerere wabwo</li> <li>• Gusimbza bimwe mubigize ahantu, Gukoresha ibifata amazi/nk'ibiritingi mu butaka akayoborwa aho atakwangiza</li> <li>• Gusibiza ubutaka bwo ku nkombie z'amazi umwimerere wabwo; Ikirundo cy'amabuye gishyirwaho n'abantu hagamijwe kurinda inkengero z'amazi atemba</li> <li>• Imyanya yo gufata amazi ishyirwa mu nzira z'amazi atemba hagamijwe kugabanya umuvuduko wayo</li> </ul>
<u>Gukora impinduka ku imiterere n'ibigize ahantu runaka</u>	<ul style="list-style-type: none"> <li>• Gukuraho ibintu by'ahari guturuka inkangu (aho bishoboka bigasimbuzwa kuhatsindagira ibitahemerera)</li> <li>• Kongeraha ibintu mu gace runaka bituma gakumeza kugumana ubutajegajezwa, haba hakoreshejwe cyangwa hadakoreshejwe imbaraga rukuruzi, ibaraza, inkuta kaz'ibyuma n'amabuze zo gutega ubutaka</li> <li>• Kugabanya imfuruka y'ubuhaname rusange</li> <li>• Kuringaniza (Gukuraho ibice by'amabuye adashikamye hamwe)</li> </ul>
<u>Gukora impinduka ngano y'amazi ku buso runaka -Ruhurura ku ubuso bw'ahantu runaka</u>	<ul style="list-style-type: none"> <li>• Imiyoboro ikwirakwiza amazi</li> <li>• Ingomero nto zo kugabanya umuvuduko w'amazi mu nzira yayo</li> <li>• Imiyoboro y'amazi atemba ku buso bw'ahantu runaka (Imiringoti, amatiyo) hagamijwe kuyobya amazi yatembaga agana ahashobora kwibasirwa n'inkangu</li> <li>• Gusanla Imikoke</li> <li>• Gufasha ubutaka buhanamye kudasoma amazi menshi</li> <li>• Gutera ibiti</li> </ul> <p>Icyitondera: Bifitanye isano no kugenzura isuri yo ku butaka</p>
<u>Gukora impinduka ku amazi yo munsi y'ubutaka -Ruhurura zifite ubujyakuzimu</u>	<ul style="list-style-type: none"> <li>• Gutaba imikoke migifi n'imiremire mu bujyakuzimu hakoreshejwe ubutaka n'ibibambo nk'amabuye kimwe n'ibinyabutabire bifite ububasha ko gusubiranya imikoke</li> <li>• Imiyoboro ikoreshwa mukwirinda ko imikingo miremire yakunduka cyane nk'ahakunda kuba amaninda</li> <li>• Utwobo ducukuye duhagaze mu bujyakuzimu kugira ngo amazi yo munsi y'ubutaka yinjiremo; Akiyobora (Aho dutanga inzira ku mazi aba ahaka kuva mu nsi y'ubutaka)</li> <li>• Utwobo duhagaze tw'umurambaro uringaniye twifitemo imbaraga rukuruzi yo kuyobora amazi yo mu nsi y'ubutaka tuyakuzanyiriza hamwe</li> <li>• Ibyumba by'amazi binini (Ibyobo bifite imirambaro minini), bikagira cyangwa ntibigire utuyoboro tubyunganira dutambitse cyangwa imiyoboro ishingiye ku mbaraga rukuruzi</li> <li>• Imiyoboro ica munsi y'ubutaka, inzira z'ingomero, ubuvu zunganirwa cyangwa zitunganirwa n'utuyoboro dutambitse cyangwa duhagaze mu butaka, cyangwa umuyoboro usohera amazi y'amariba acukurwa mu butaka hakoreshejwe imbaraga rukuruzi</li> </ul>
<u>Gukora impinduka ku bintu bishobora kunveganvezwa no gutwarwa byoroshye</u>	<ul style="list-style-type: none"> <li>• Gusimbza bimwe mu bihari</li> <li>• Gutsindagira ubutaka</li> <li>• Kuvanga ubutaka cyane n'ishwangara cyangwa sima</li> <li>• Gukoresha sima n'ibindi binyabutabire byongera ubutajegajezwa</li> <li>• Uburyo bwo kubaka bukomeye nka sima munsi y'ubutaka</li> <li>• Guhindura ibinyabutabire by'amazi yo munsi y'ubutaka</li> </ul>
<u>Kwimiruria ibitwarwa n'inkangu byoroshye ahizeweho ubushobozi bwo kutajegajezwa bitewe n'imikomerere y'urutare two munsi y'ubutaka muri ako gace runaka</u>	<ul style="list-style-type: none"> <li>• Kongererera imbaraga inkuta z'imikingo: Imbaraza z'inkuta, inkging zo mu butaka, imfatiro;</li> <li>• Ibfashi: injangwe zo mu bwoko bw'ibiti cyangwa ibyuma yinjizwa mu butaka kugira ngo zibufate ubutaka</li> <li>• Ibfashi by'inkutu (Guhaza ibifashi n'inkuta zo gutaka ubutaka)</li> </ul>

Izindi ngamba zo kugabanya ibyago byo kwibasirwa kw'ibantu biri mu kaga, zigizwe n'ibisubizo "byoroheje" bitagenewe gukumira ibishobora kuba imbarutso yo kubaho kw'inkangu ahubwo byagenewe kugabanya ikigero cy'ibihombo bishobora guturuka ku nkangu. Izi ngamba zindi zishobora kugabanywamo ibyiciro bibiri, bitewe n'uburyo bwakurikijwe kugira ngo iyi ntego yo kugabanya ikigero cy'ibihombo bishobora guturuka ku nkangu igerweho:

- Ingamba zo kongera ubudahangarwa bw'ibantu biherereye ahantu hashobora kwibasirwa n'ibiza (Kugabanya ibyago byo kwibasirwa n'ibiza) - Imiterere y'ibantu bisanzweho ishobora kongererwa imbaraga; naho ku miterere y'ibantu bishya haba hakwiriye kuzirikanwa hakiri kare ingaruka zose zishobora kubaho ziturutse ku nkanga. Mu busanzwe ubu buryo bukoreshwa gusa ku bijyanye n'inkangu zifte ubukana budakabije kuko mubyukuri bitashoboka kubaka inyubako iteye ku buryo yabasha guhangana n'ingaruka zituruka ku nkangu zifte ubukana bukabije.
- Ingamba zo guhagarika cyangwa guhindura icyerekezo cy'ibitwawa n'inkangu (Kugabanya ibyago byo kwibasirwa n'ibiza) - Hari ibishobora gukorwa mu kumire no guhagarika cyangwa byibura guhindura icyerekezo cyangwa kugabanya umuvuduko w'ibiri gukukumuka. Bene iyi mirimo yibanda by'ahanini ku igwa ry'ibibuye biremereye cyangwa ibitemba by'ubwoko bwose, mu gihe ahibusive hafite ubuhaname bukabije kandi kuhongerera ubutajegajeza bidashoboka kubera impamvu zishingiye ku imiterere y'ibihakikije cyangwa kubikora bihenze.

## 5. UMWANZURO

---

Ibyavuye mu nyigo byagaragaje ko, n'ubwo habaruwe inkangu nke mu byogogo bine; ibyavuye mu isuzumwa ry'ibiza by'inkangu bigaragaza ijanisha ryo kurwego rwo hejuru ry'ubuso bw'ahantu hari mu byiciro bibiri by'ahafite ibyago byinshi byo kwibasirwa n'ibiza by'inkangu (Reba imbonerahamwe ya 2).

Ibi byiciro bibiri by'ibipimo by'ibiza bigize 14.1%; 8.1%; 7.8% and 3.2 % mu byogogo bya Bishenyi, Rwabayanga, Rwandex-Magerwa and Rusizi nk'uko bikurikirana. Hazirikanwe ko ibi byogogo bine biherereye mu bice by'umuuyi n'inkengero zawo (Bishenyi), bivuze ko agiciro k'ibantu bishobora kwibasirwa n'inkangu gahita kiyongera cyane haba ku mikoreshereze y'ubutaka y'ubu (Ikarita y'imikoreshereze y'ubutaka 2018) n'iteganijwe kugera muri 2050 nk'uko bigaragara mu mbonerahamwe ya 4 n'iya 5.

Kubwibyo, Igitekerezo nyamukuru cyavuye muri ino nyigo ni ukumenya neza ko ingamba zikwiriye zo gukumira ibiza by'inkangu zafashwe mu gihe cyose hari gukorwa igikorwa runaka cy'iterambere mu gice cyashyizwe mu ciciro cy'ahafite ibyago byinshi byo kwibasirwa n'inkangu by'umwihariko mu bice by'umuuyi, no gukora ipere-reza ryimbitse kugira ngo hasuzumwe ikibazo, atari mu rwego rwo kumva uko inkangu zibaho gusa (Aho ziherereye, Uburyo zibaho, n'igipipo cy'ibyo ihindurira umwimere-re), ahubwo no mu rwego rw'intege nke mu guhangana n'ibiza n'ingaruka zabyo zaba iz'ako kanya cyanga izitinda kugaragara.

Iyi nyigo yagaragaje ingamba zo kugabanya ibyago byo kwibasirwa n'inkangu muri rusange zinashobora gusuzumwa mu duce twagaragajwe nk'uduherereye ahari ibyago kandi hashobora kwibasirwa n'inkangu nyuma y'iperereza ryimbitse rya buri mwihariko waho.

Hanyuma, Ubushishozi bwihariye bukeneye gushyirwa ku bikorwa bw'emicungire y'imyanda isukika n'amazi y'имвура byiganje mu duce tw'umuuyi bishobora gutiza umurindi ibyago byo kwibasirwa n'inkangu mu duce n'ubusanzwe tudafite ushobozи bwo guhangana n'ibiza.

To learn more about our work, please contact us.

**GGGI in Rwanda**

Mr Francois Xavier Tetero

GCF NAP- Green City Development Consultant

Email: tetero@gmail.com

Contact: +250 788 466 012

To learn more about us:

Global Green Growth Institute

**GGGI Headquarters**

Global Green Growth Institute

19F Jeongdong Bldg.,

21-15 Jeongdong-gil,

Jung-gu, Seoul 04518

Republic of Korea

Tel: +82-2-2096-9991

Fax: +82-2-2096-9990



[www.gghi.org](http://www.gghi.org)