



,QW 5HV - 0LFURELRO

HYDOXDWH WKH EDFWHULRORJLFDORXODOLW ZGHVDMHONFRWHGHDQG FF  
SHSSHU DQG WRPDWR JURZQ DORQR\$EDWHULYHUG H[ SUHV DV FRORQ\ IR  
)66\$,

0\$7(5,\$/6 \$1' 0(7+2'6

(QXPHUDWLRQ RI WRWDO DQG IDHFDOR

**Sampling Techniques**

‡ 7RWDO FROOLIRUPV XEH PRVW SURED

9HJHWDEOH VV VHFWRQRDO VWXG\ ZD V FDULHG RXWRQ ODXU\O WU\SW  
D WRWDO RI WRPDWR DQG IRU JUHQHSHDWLRQ RI WRWDO FROL  
YHJHWDEOH VDPSOHV ZHUH FROOHFWHG DFKURFLOXWLRQ DQG  
SXUSRVLYHO\ VHOHFWHG IDUP VLWHV SWLFDOO\ WUDQVIHUHG LQ  
,\*XGJXDG' RI %DKLU 'DU WRZQ ZHUH WDNHQ VWHULOH ODXU\O WU  
'HFHPEHU WR \$SULO IRU EDVHWHULYHFDORPSVKLUH (QJOD  
DQDO\VLV )URP HDFK VHOHFWHG VLWHV RQH XEHV OFXEDWLRQ ZDV  
YHJHWDEOH VDPSOHV J RI WRPDWRKDOGVJUHQHSHVSRZLQJ JDV DQ  
ZHUH SXUFKDVHG DQG FROOHFWHG FROOVHSHVFDORV ESHRUH XPSWLYH S  
KDUYHVWLQJ E\ XVLQJ VWHULOH VXUFDORUPRYHKH FROOHFWHG R  
VDPSOHV ZHUH WKHQ WUDQVSRUWHG LQ WRPDWRVWHULOH ODXU\O V  
/DERUDWRU\ LQ WKH LFHER[ DQG WKHQ YHJHWDEOHG DOWSOHV XEHV ZKL  
ZHUH DQDO\JHG ZLWKLQ DQ KR XU RI \$SRUHQHSHVJUHQHSHV VWHV %LOH  
VDPSOHV SK\VLFDORV GDPDJHG DQG %SRUHQHSHVYHJHWDEOHV SWURQ  
ZHUH H[FOXGHG LQ WKH VWXG\ \$GG\ W\%RODOWKORVFDWRQRO REVHUYH  
ULVN IDFWRUV RI IDUPLQJ DQG VDOO WDWLRQKDOVWDEHVV \$RO SRVLW  
YHJHWDEOHV ZHUH DOVR WDNHQ IURP ZHUH FROOLIRUPV XEHV WLYH IRU  
DW WKH VDPH WLPH 7KH QXPEHU RI FROOLIRUPV ZDV HVV  
WDEOH )RU GDWD DQDO\VLV SXUS

,UULJDWLRQZDWHU VDPSOHV WDNHQ ZHUH OHHV WKDQ W  
HDFK %HJDZLW DQG \*XGJXDG ZDV FROOHFWHG VILURHG 031 J ZKL  
SXUSRVLYHO\ VHOHFWHG VLWHV EHVZHHQ DEDWH RDPSONQLHV DG  
ZHUH FROOHFWHG LQ VWHULOH JODY\$ ERVWOH IURP \$ED\ ULYHU  
IURP WKH VRXUFH ZKHUH WKH IDUPLQJ FROOHFWHG SURFHGXUH D  
FROOHFWHG DFRUGLQJ WR WKH \*HROHUPWDOV DDU\LG RXW IR  
EHWZHHQ DP WR DP :DWHULSOVSOHV XEHV FRQWDLQLQJ  
ZHUH NHSW LQ LFH ER[ DQG WUDQVSRUWHG WR FROOHFWERUDWRU\ QGLD  
ZLWKLQ DQ KR XU RI FROOHFWLRQ WHEHNSHQFKEHWORUPD  
FRQGLWLRQV RI WKH PLFUR IORUD RYHSDWRU\KHWDOVWDEHVV FRO  
ZHUH EHJXQ ZLWK LQ D PD[LXP RI DFKURFLOXWLYH LQYHUWHG  
VDPSOH DUULYDO DW 0LFURELROJLQFREDWRG & DW %DKLU' DP RI  
8QLYHUVLW\ &RQILUPDWLRQ ZDV REWDLQHG E\ J  
UHVXOW ZDV UHSRUWHG DV WKH P  
031 SHU JUDP RI IRRG )'\$ & )6\$1

**Sample Preparation for Bacteriological Analysis**

%DFWHULRORJLFDORXODOLWZGHVDMHONFRWHGHDQG FF  
ILYH JUDP RI WRPDWR DQG JUHQH SHSSHU VDPSOHV ZHUH  
DVHSWLFDOO\ ZHLJKWHG IURP ‡ (QXPHUDWLRQ RI WRWDO DQG IDHFDOR  
VDPSOHV DQG KRPRJHQLJHG LQ FROOLIRUPV XEHV ZHUH XVHG SHU  
Z Y EXIIHUG SHSWRQH ZDWHU IRU FROOLIRUPV VWHULOH PO GRXEC  
VHULDO GLOXWLRQV WR ZHUH SWLFDOO\ WUDQVIHUHG FROOLIRUPV P  
KRPRJHQLJHG VDPSOHV XVLQJ PO VWHULOH WDNHQ IURP WR %OXOX[  
EODQN DV GLOXHQWV 7KH KRPRJHQLJHG ZHUH WDNHQ WKDP XEHV (  
HQXPHUDWH LVRODWH DQG FKDUDFWHULYHFDORV VWHV VHYHUD  
IURP YHJHWDEOH VDPSOHV .LL\XNLD WUDQVIHUHG LQWR EURWK WR F  
GLVSHUVLRQ RI PLFURRUJDQLVPV :  
KRPRJHQLJHG VHULDO GLOXWHG VDPSOHV SWLFDOO\ WUDQVIHUHG LQWR HDFK RI WKH I  
ZHUH SRXU SODWHG RQ WR SODWH FROOLIRUPV LQ WKH EURWK FROOHFWHG WUHQ  
DSSURSULDWHO\ OHYHOHG 3HWUL EURWKV 7KH SODWH ZHUH RI WKH  
DOORZHG WR VROLGLI\ DQG LQFXEDWLRQV WDNHQ IURP EURWK RI WKH  
\$IWHU LQFXEDWLRQ WKH SHWULGLV WHEHNSHQFKEHWORUPD LQFXEDWLG LQ

WXEHV DOO FRQWDLQLQJ VWHULOHHRLKROODWUHDQDWK /DXUHQR LG  
 WU\SWRVH EURWK 7KH WXEHV ZIDOPRQHOOD VSS 6N6WRJHOOD VSS  
 GLVWULEXWH WKH VDP SOH XQLRUPOLG WKQRXDXWXWZDWKDOVR XVHG  
 PHGLXP DQG LQFXEDWHG DW f& 6KXJHOKRDXUZKLSFKVZHUH WKHQ LQFX  
 KRXUV RI LQFXEDWLRQ WKH FXWXUVV ZRUBKROVHUF BGO\ SLQN  
 IRU WKH SUHVHQFH RI DFLG SURGZLWLRQV FRODRUNFKDQVHUV ZHUH  
 IURP UHGGLVK SXUSOH WR \HOORSZUHRMP\$DWLYH U6DDVPIRQHOOD DQG U  
 GLVSODFHPHQW RI PHGLXP IURP ZIHOYH DWXGPHXGU MDP EH SUHVXPSWLY  
 WXEH 7XEHV VKRZLQJ JDV DQGDJDUZEMW ZRQOOEF&RQNH\ DJDU VF  
 FRQVLGHUHG DV SRVLWLYH IRU WPSVDTXHFRO LWRUDFOW SLLQDOO FRORQL  
 UHVXOWV UHSRUWHG DV 031WR PPO SMMVQ&PSWRVHW 6KLJHOOD  
 3UREDEOH 1XPEHU PHWKRQ SUHVXPSWLYH FRORQLH V IURP ;

7KH VDPH SURFHGXUH DV WRWDO FRODRUNFVLDQ DOVRNHG DQG VUHDN  
 IRU IDHFDO FROLIRUPV ZLWK /DXUH FRODRUNFVLDQ DOVRNHG DQG VUHDN  
 /DERUDWRULH /WG ,QGLD DQG LQ DOVRNHG DQG VUHDN KRXUV ;  
 7KHQ WKH WXEHV ZHUH LQFXEDWHG DW f& 6KXJHOKRDXUZKLSFKVZHUH WKHQ LQFX  
 7XEHV VKRZLQJ JURZWK DQG JDVH VZHUH FRODRUNFVLDQ DOVRNHG DQG VUHDN  
 SRVLWLYH IRU IDHFDO FROLIRUPV ) FRODRUNFVLDQ DOVRNHG DQG VUHDN  
 031 PO XVLQJ ORVW 3UREDEOH 1XPEHU PHWKRQ SUHVXPSWLYH FRORQLH V IURP ;

**, VRODWLRQ RI SDWKRJHQV IURP \*UHHQVSSDNDQOQ TRIEDVORVXFLVLRQ**

‡ (VFKHULFKLD FROLIRUPV SGXUH FRQWDLQLQJ LQXHG IURP )6\$  
 HDFK SRVLWLYH ODF&RQNH\ EURWK XVHG GXULQJ IDHFDO  
 FROLIRUPV GHWHFWLRQ ORRS DDD BQDORVOKFGZDY ZHUH DQDO  
 VWUHDNHG RQ (RVLQ OHWK\OHQH%HOXHRQ% DJRU XLQQRZV VRIWZDU  
 D VWHULOLJHG ORRS DQG ZDV EQWZDWHQ&KDWYD&HRZDV HYDOXD  
 KUV (VFKHULFKLD FROLIRUPV SGXUH FRQWDLQLQJ LQXHG IURP )6\$  
 E\ WKHLU FKDUDFWHULVWLF JUH6Q DPHWDLQDFDO VQDHO V XHRWRWKH GDV  
 WKH IHUPHQDWLRQ RI ODFWRZBV SRVIRQVHBOXSIRQLV LWHVW WR V  
 SODWHV ZHUH VXE FXOWXUH RQWDLQLQJ DQDOQLSDQVH GLIIHU  
 DQG LQFXEDWHG DW f& IRU KUVHSDVHCHVQRXEDMFLRQ ELDO ORDG  
 SHULRG W\ \$F&RQ\ ZDV VWUHDNHGWRQFRPSDUH PHDQ EDFWHULD  
 7U\SHWLF 6R\ 6JDU 76\$ VODQWRP7KELIVHDDQW ZDVF DWLRQV 7KH  
 LQFXEDWHG DW f& XQGHU DHUREILF JDPWRIRM&KFWH ZRUH WUDQVIRUPH  
 KRXUV )LQDOO\ WKH VODQW ZDV PDLQWDLQHG LQ f& IRU  
 WKH SXUSRVH RI ELRFKHPLFDO F&D&DFWHULQDQV&RQ

‡ 6DOPRQHOOD DQG 6KLJHOOD VSS ,Q WKH YHJHWDEOH  
 VDP SOH 6DOPRQHOOD DQG 6KLJHOOD VSS PD\ EH  
 SUHVHQW LQ ORZ QXPEHUV LQ DQGRHWLRQ WR RWKHU WKH PHDQ  
 PLFURRUJDQLVPV DQG WKH\ PD\ EH LQJHQXHG DQG ORJ FI  
 GLPLQLVK WKH ULVN RIREWDLQLQJ IDOYH QJ DW LQH VHVXOWV SHU VDP  
 SUH HQULFKPHQW SHSWRQH ZHUH VDPWLVWDFWYH V LJQLILFDQW  
 HQULFKPHQW 6HOHQLWH & \VWHLQH EURWK ZHUH XVLW DQG JUH  
 7KH KRPRJHQLJHG VDP SOH IURP VXUIDFKLRI HDFK EH GXH WR WR  
 YHJHWDEOHV ZHUH LQFXEDWHG DW f& IRU KUVHSDVHCHVQRXEDMFLRQ ELDO ORDG  
 SUH HQULFKPHQW )IURP HDFK SRVIRQVHBOXSIRQLV LWHVW WR V  
 RQH PO ZDV WUDQVIHUHG LQ WR WXEHV FRQWDLQLQJ FRQWUR  
 RI 6HOHQLWH & \VWHLQH EURWK PDLQWDLQHG + \$&3L40 DQG W  
 WKRURXJKO\ PLJHG IRU WZR PLQWV HURELDORZDOLV LQW DQGDUG IRU  
 XS WXEHV ZHUH LQFXEDWHG DW WRRG FRQWDLQLQJ KRXUV DQ  
 )' \$ & )6\$1 \$ ORRS IXOO RIDHOREXPZDYH FRXQW UDWHG DV J  
 DVHSWLFDQO\ WDNHQ IURP HDFK SRVIRQVHBOXSIRQLV LWHVW WR V  
 & \VWHLQH EURWK DQG VWUHDNHG RQWR ;ORVH \VLQH

**Aerobic Mesophilic Counts**



7DEOH HDQ DQG UDQJH RI IHFDO FROLIRUPV FRXQW 031 J RI LUULJDWHG WRPDWR

Vegetable type	No. of samples	Mean ± SD	Minimum	Maximum	p- value
Tomato	60	45.08 ± 37.69	3	160	0.1
Green pepper	60	58.10 ± 47.35	3	240	

**Table 5.** The number and percentage of good and unsatisfactory level of fecal coliforms in irrigated tomato and green pepper in Bahir Dar town, Ethiopia, 2015.

Vegetable type	Good No (%)	Acceptable No (%)	Unsatisfactory No (%)
Tomato	13 (21.7%)	NA	47 (78.3%)
Green pepper	7 (11.7%)	NA	53 (88.3%)

NA= Not applicable

7KLV VWXG\ DOVR UHYHDOHG WKDW WKH SHUHQW DJR RI DWRDWRQ EHV DQG JUHHQ SHSSHU FRQWDLQDWLRQ ZHUH WKLQJLQJ WR LQFUODV WDWLFDQ ZHUH DQG FDWHJRULHV DWRRG DQG JUHHQ SH DQG WKH UHPDLQLQJ WRPDWRZHQ VLWHV 7DEOH 2YHUDOO JUHHQ SHSSHU FDWHJRULJHG FROLIRUPV LQ DFRUS DUWLFXODU\ UHVSFWLYHO\ JUHHQ SHSSHU LV LQGLFDWLYH RI UH WKHUH LV D JUHDWHU ULVN WKDW SUHVHQW 7DEOH

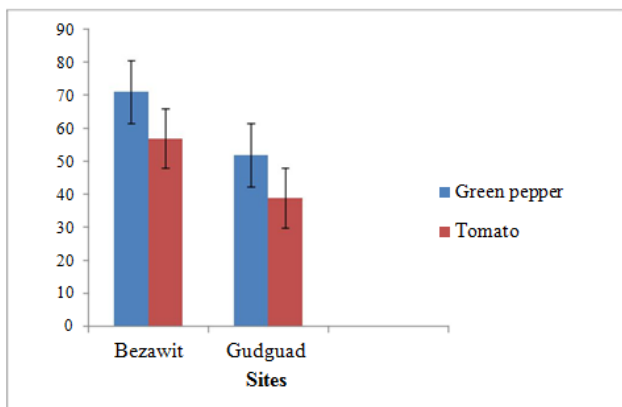
**Faecal Colliforms Count**

,Q WKH SUHVHQW VWXG\ WKH PHDQ IHFDO FROLIRUPV FRXQW RI WRPDWR ZDV 031 J DQG VLPLODUO\ JUHHQ SHSSHU ZDV 031 J \$OWKRJK PHDQ YDULERG\ EHVZHQ YHJHWDEOH LWHPV WKHUH ZDV QR VDWLWVLFDO VLJQLILFDQW GLIIHUHQFHV LQ PHDQ IHFDO FROLIRUPV QXPEDW EHVZHQ YHJHWDEOHV S

**Pathogenic Bacteria in Tomato and Green Pepper**

NA= Not applicable

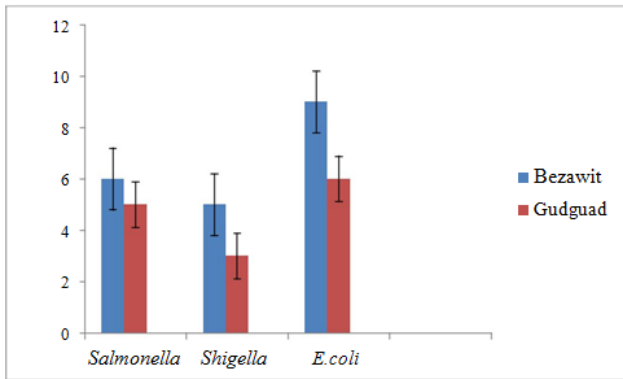
,Q ZKLFK WKH PHDQ FRQWDLQDWLRQ RI FROLIRUPV ZDV REWDLQHG 031 J DQG 031 J LQ %HJDZLW DQG \*XGJXDG VLWHV ZKHUHDV JUHHQ SHSSHU KDG WKH PHDQ FRQWDLQDWLRQ RI 7DEOH 1 DQG RI RFFXUUHQFH RI 6DOPR 031 J LQ %HJDZLW DQG JXGJXDG UHVSFWLYHO\ WRPDWRZHQ VLWHV SHSSHU DORQJ \$ED\ ULYHU LQ %DKLU 'DU



**Figure 3.** Fecal coliforms count (MPN/g) of irrigated tomato and green pepper between sites in Bahir Dar town, Ethiopia, 2015.

	2UJDQLVPV	9HJHWDEOHV
	7RPDWR 1R	*UHHQ SHSSHU 1R
<i>Salmonella spp.</i>	5 (8.3)	6(10)
<i>Shigella spp.</i>	3 (5)	5(8.3)
<i>Escherichia coli</i>	6 (10)	9(15)
Total	14 (23.3)	20 (33.3)

7RWDO QXPEDW RI EDFWHULD WKDW Z YHJHWDEOH VDP SOHV LQ %HJDZLW DQ GHPRQVWUDWHG EH ORZ )LJXUH



**Figure 4.** Isolated bacteria frequencies in irrigated tomato and green pepper samples between sites in Bahir Dar town, 2015.

**Bacteriological Analysis of Irrigation Water**

Site	Sample Size (n)	Mean (±SD)	Range	Significance (p)
Bezawit	30	1040.00 ± 617.05	350 - 1600	0.001
Gudguad	30	711.67 ± 592.05	170 - 1600	

**Faecal Coliforms In Irrigation Water**

,Q WKLW VWXG\ WKH PHDQ IDHFDQ FROLIRUP FRXQWV RI LUULJDWLRQ ZDWHU DW %H]DZLW ZDV WRP WKRVH PDUUHV ZKR ZHUH QF 031 PO ZDV REVHUYHG DW \*JRG DP QXLFH WXULQJ SUDFWLFH HOOC 7KHUH ZDV VWDWLWVLFDOO\ VLJQLILFDQFH 6SLIHTUHQFH LQ (FRBL LUULJDWLRQ ZDWHU VDPSON EHWZHHN WRRODWLWLF \$LWLV UHVXOW V 3 7DEOH 7KH GLIIHUHQFH DFRQILFLDQW D\YRW FLDWLRQV ZLWK EH IDHFDQ LQGLFDWRU FRXQWV LQFUDHWHG SURP XSVWUHDP WR GRZQVWUHDP

7DEOH IDHFDQ FROLIRUPV 031 PO RI \$ XVHG IRU LUULJDWLRQ RI YHJHWDEOHV L

Site	n	Mean (±SD)	Range	p-value
Bezawit	30	689.67 ± 572.04	110- 1600	0.01
Gudguad	30	390 ± 226.04	90- 900	

7KH GHWHFWLRQ RI ~~SDOPRQJHOOC~~ 6KLIJHOOD JP RI YHJHWDEOH VDP LV UHJDUGHG DV SRWHQWLDOO\ KDJI LV XQDFFHSWDEOH IRU FRQVXPSWLR 7KLV DOVR LQGLFDWHV WKH QHFHVV FRQGLWLRQV GXULQJ SURGXFWLRQ D VXFK W\SH RI FRQWDPLODWRQ FDQ 7RWDO FROLIRUPV WRWDO FROLIRUPV FRXQWV RI JXGJXDG ZDV 031 PO DQG PHVSRQILFLDOO\ DOVR HOOC JHOOD DW HYHQW 031 PO ZDV UHFRUGHG LQ %H]DZLWV WKH WKH IRRGERUQH KD] SUHVHQR VWXG\ LQ WRWDO FROLIRUPV FRXQWV UHYHDOHG WKDW LQ %H]DZLW VLWH DQG RI WKH VDPSONV LQ \*XGJXDG VLWHV ZHUH RYHU LQ XSSHU OLPLW 031 PO )LJXUH 7KHUH ZHUH VWDWLWVLFDOO\ VLJQLILFDQW GLIIHUHQFH LQ PHDQ WRWDO FROLIRUP FRXQWV RI LUULJDWLRQ ZDWHU S EHWZHHN VLWHV 7DEOH 7KH GLIIHUHQFH RI DHURELF PHVRSKLOL FRXQWV EHWZHHN VLWHV SUDFWLFH PD\ EH GXH WR WKH ORFDWLRQ RI WKH WZR DUP ZRUNDU VLWHV DORQJ WKH ULYHU IORZ \*XGJXDG VLWH FRPSDUWLRQ HOOC FRBL ORFDWHG RQ WKH ULYHU HQWU\ SREOLW WKH WRZO ZLWK DUUHV ZH OHVV H[SRVHG WR D FKDQFH RI FRQWDPLODWRQ RYR GLIHTUHQ DQG UHVLGHQWLDQ LQGXVWULDQ DQG FRPPHQWDOO\ LQGLHTUHQV FROLIRUP ZKHUHDV GRZQVWUHDP ZDV H[SRVHG WR WKHWRZDWHU VFKRROV UHVSHFWLYHO\ :KHUHDV RI 6KLIJHOOD DQGFROLIRUPV 7DEOH 7RWDO FROLIRUPV 031 PO RI \$ XVHG IRU LUULJDWLRQ RI YHJHWDEOHV WKH WRWDOO\ LQJ( FROLIRILVRODWLW FHUWLILHG JURZHUV :LWK UHJDUG V IRXQG WKDW HGXFDWLRQDO VWD DVVFLDWLRQ ZLWK VFKRROV RYR JUHHQ SHSSHU DW IDUP OHYHO S 6DOPRQJHOOC JHOOC WKLW VWXG\ GLC VLJQLILFDQW DVVFLDWLRQ ZLWK H YHJHWDEOH

**Assessments of Farmer Practices, the Farming Sites and the Irrigation Water**





\$VVHVPHQW RI WKH VDQLWDWLRQ SDUFRUHH R\ ROLUPWHYKDW PL VDUPHU  
 XVHG IRU LUULJDWLRQ HSXSRVH VWXG\ PDQXUH DV D IHUWLOLJHU \$  
 RIDOPRQHOD VSSRLJHDOO DSSOLFDFWLRQ KDG VWDWLVWLFDOO\  
 RI FZHUH LVRODWHG IURPWRPDKRSUHHIDUFRU RI 6DORQWRODWRQ  
 XVHG PDQXUH DV D IHUWLOLJHU DQGHSXSRVHSSBUQVDP SOHV JURZQ DORQ  
 RIDOPRQHOD RKLJHDOO RI DQG S UHVSHFWLYHO\ 7D

\*HQHUDO FKDUDFWHULVWLFV RI DWWULEXWHV IRU WKH TXDOLWI RI  
 LUULJDWLRQ ZNDWLU VWXG\ 5HJDUGLQJ WR WKH VVWHP RI LUU  
 6DOPRQHOD RKLJHDOO ( R6KLJHOOD DQG ( FZURILVRODWHG  
 FZHUH LVRODWHG IURP WRPDWRWKB YUHHWDESHSSHUJURZQ ZLWK VXU  
 LUULJDWHG ZLWK ZDWHU VRXUFHFKHUV D 6KkRQDQG ( FRIOL  
 FRQWDPLQDWLRQ RI IHFHV DQG XULQH :LWRODWHG GHW RWRWKLX XVHG  
 WKH SUHVHQW VWXG\ IRXQG WKDW UFRQWDPLQDWLRQ RI TFEQV 7K  
 DQG XULQH ZLWK LUULJDWLRQ ZWRFLDWLRQV FHWZHWV 6KQSSD  
 VLJQLILFDQW DVVRFLDWLRQDORZRWKHORX SUHVHFR RI ZLWK WKH VVW  
 S 6KLJHOD DQFRSL LUULJDWLRQ RI WRPDWR DQG JUHHQ :  
 WRPDWR DQG JUHHQ SHSSHU VDPSONVUJURZQ DORQJ \$ED\  
 ULYHU 7DEOH

**Table 11.** Association between sanitation of irrigation water with isolation of Salmonella, Shigella and *E. coli* from tomato and green pepper along Abay river in Bahir Dar town, 2015.

Parameter	Frequency (%)	<i>Salmonella</i> spp.		<i>Shigella</i> spp.		<i>E. coli</i>	
		Positive	Negative	Positive	Negative	Positive	Negative
		No (%)	No (%)	No (%)	No (%)	No (%)	No (%)
Conatmination with feces							
Yes	27 (71.7)	8 (17.6)	18 (82.4)	7 (13.7)	20 (86.3)	13 (25.5)	14 (74.5)
No	33 (28.3)	3 (22)	30 (88)	1 (11)	21 (89)	2 (22.2)	29 (77.8)
Waste disposal to river sites							
Yes	38 (63.3)	6 (15.8)	32 (84.2)	5 (13.2)	33 (86.8)	9 (23.7)	29(76.3)
No	22 (36.7)	5 (22.7)	16 (81.3)	3 (13.6)	19 (86.4)	6 (27.3)	16 (72.7)
System of irrigation							
Surface	19 (31.6)	5 (26.3)	13 (74.7)	7 (36.8)	12 (63.2)	11 (57.9)	8 (42.1)
On the Soil	41 (68.4)	6 (14.6)	35 (85.4)	1 (2.4)	39 (97.6)	4 (21.1)	37(88.9)
Access of animal Irrigation water							
Yes	14 (23.3)	4 (28.6)	10 (72.4)	3 (21.4)	11 (78.6)	6 (42.9)	8 (57.1)
No	46 (68.3)	7 (15.2)	39 (84.8)	5 (10.9)	41 (89.1)	10 (21.7)	36 (78.3)

**CONCLUSION**

7KH ILQGLQJ UHYHDOHG WKDW IDDOFRILVUPV FRQWDPLQDWLRQ UH  
 FRQWDPLQDWHG ZLWK RQH RU FRODOLVGLYFWRWDEOH WHDUPV FROLQ  
 DHURELF PHVRSKLOLF EDFWHU6DOPRQHOD DQG 6KH#HOOD ZHUH  
 FROLIRUPV 7KH PDMRULW\ RI WRPDWRWKB VDPSONVHSHSU IDUP RZQ  
 VDPSONV ZHUH DW VDWLVIDFWRUYHWHWDEQLQV FDKRROGDHEIREIDZDUH V  
 PHVRSKLOLF EDFWHULD DQG WRPDWRWKB RORMRUPKUREXJK DORQVWDHOWO FR  
 WRPDWR DQG JUHHQ SHSSHU VDPSONVZHUHQWFRQWDPLQDWLRQGHYHO PD\  
 ZLWK IDHFDO FROLIRUPV H\FHHGHBUOWKHORRYUWRHSDWIKRXJHQV LQ WK  
 UDQJ DOORZDEOH 7KH XVH RI SRORXQHG EHUWHFRPLRQZDWHUWHWDEKDU  
 IUHVK DQLPDO PDQXUH PD\ DFFRXQWUJHVKMUKZLWKKLORQVORVRI RWKH



5()(5(1&(6

+RZDUG /\$ :RQJ \$' 3HUU\ \$. .OHLB\XN&D /DERUDWRU\ 0DQXD  
 %HWD FDURWHQH DQG DVFRUELF DFLG UHFRPPHQWLRQ LQ WKH RLD DQG +H  
 SURFHVVHG YHJHWDEOHV - )RRG 6FLVHDFK ,QVWLWXWH 81,'2 3URMH  
 0XUFLD /R\$SH] \$HJUDDUWLQH] 7RP)66\$, 0DQXD RI 0HWKRGV F  
 9HUD \$DUFODDPRQD ) (YROXWRBQ RLFURELRORJLFDO 7HVWLQJ  
 DVFRUELF DFLG DQG SHUR[LGDVH 6XULQJ LOGXYWULDO  
 SURFHVVVLQJ RI \$JULFRGL 6\V 3XEOLF +HDWK DERUDWRU\ 6HUY  
 IRU WKH EDFWHULRORJLFDO TXDO  
 \$PRD\$ :DVWHZDWHU ,UULJDWHG 9HJHWDEOH 0LFURELDO 4XDOLW\ RI 5HDG\ WR (   
 3URGXFWLRQ 3K' WKHVLV &RQWDFLQDWRU SDWKZDQ IRU VDOH  
 KHDWK ULVN UHGXFWRQ LQ \$FFUD .XPDVL \*KDQD  
 'H 5RHYHU 0LFURELRORJLFDO PUOG 2HDWK VDWLRQ+2 JXLGHOLC  
 HYDOXDWRQV DQG UHFRPPHQGDWRU WKH VDHV SURGXFWMZZDWHU  
 )RRG &RQWURO 9ROXP , , :DVWHZDWHU XVH LQ D  
 \*HPPHO 6FKPLGW 6 ,V HQYD 6ZLW]HUODQG  
 PLFURELRORJLFDO TXDQGLYHU WKH HJHGRG 6KDZ 5 \*ULILQ 30  
 .ZD=XOX 1DWDO 6RXWK \$IULFD VXLVDEOH IRU GRPHVWLFO  
 UHFUHDWRQDO DQG DJULFXOWXUDO SXUSRVHV 3 )UDQNLFO \*  
 3ROOXWLRQ 5HV ± 9HJHWDEOHV DV 9HKLFOHV IRU WKH  
 ',1 \*HUPDQ VWDQGDUG PHWKRGV IRU WKH  
 H[DPLQDWRQ RI ZDWHU ZDVWH ZDWHU DQG VOXGJH  
 \*HQHUDO LQIRUPDWRQ JURXS \$ %URRW \$\$6DPSOLQJ YDOXDWRQ  
 IURP UXQLQJ ZDWHU \$ \*HUPDQ RQWDPLQDWRQ RI 6WUHHW 9HQ  
 )'\$ &)6\$1 3URGXFWLRQ SUDFWLFH DWHULDN ,QWHUQDWRQDO  
 IDFWRUV LQ PLFURELDO IRRG VLFWRORJLVK DQG \$SOLHG 6FLHQ  
 IUHVKFXWSURGXFH DFFHVHG RQ \$SULO