

# 3HMRXP SURGXFW LQ ZDMZ DMU DQG WKHU SURSHUHV

(YHQ 9DQHLK\$ONHY DQG2QD9DQCRQD%NLQD

ORVFRV BWHYHRILWOLQHHUHQJR VODVKNVAMFRZ 5XVVL D

\$EVWUDFW: HURGH DUSRO OEW HURGH SHWU SORGHURPV  
YDULRXV UFKH YULP DRX UFDYND YLJ DW ERGR QKLSV  
DQGRD VUDHQDQG XZDV WCHGD WFKU/ XUIDF MWHZDWHU  
IURPHW WODHQDQV SRURWDMZDWEHRG I5HHG XFLQJ  
WFKRQVRHRQSU R GIXE DWEHRG L D Q P SR UWDVQD W XUH  
SURWHW WLRQV KGHYHORS FCHZMHFWRNW KRGV  
ZDVWHVZDWDWRPISORRG \$FWWHHPSSVLEFDRSRVHG  
WRROWKSVUREQDFOXDQDQRVLRVQLMVBQW HZDWHU  
IRUPDWLRKSKDVH GERBBBVRMSBQXVQKMLU  
SKIVDFQHPISURCS HDVQCHDVRB RWVZLVWUHDWPHQW  
PHWKRGFRUWRQRUPDFRLRQLWLRQDWWHEZDWHU  
GLYLGLGRPHVZDLVFWHZDXVH DUFHQ RDQGGGXVULDQ  
ZDVWHZB SHHQGLQWKHRUPDWRGLRLBQRGKQWV  
ZDVWHZDWHQGLH UHSHKDVH GLWASBZVWVGLH UHQW  
VHGLPHQDQDWRURQDWD EYDQXMS DUBWWRKGRV  
PRVWHFWRYHHGLPHQWS HQVSDRGRKFWBEQUH  
VXILFLHQWSDQGHOLDEGLPHHQW/DVQDVRHSNWUROHXP  
SURGXEDWQHUVHS UHOLPGRDWDQKQDWFHGLBYHG  
DGGIDQNDQFLQHQHEFDQXCRQDQDQSRQ\HOHFWURO\WHV  
: D V W H Z B W H D F W H D U L J U H S J D W D V W R P S H W U R O H X P  
S U R G K B W N U H B V G H G U D G D W W I K R Q F K R J R Q D R U L R Q  
V R U S W L R Q  
. H \ Z R U G V S U R G Z D W W H S B D V H I W G L W S A N U B L P H Q W D W L R Q  
V W D E L Q J U M W D W L E Z B D L W H V Z D W D W P H Q W

## , QWURGXFWLRQ

7KH SUIP DJ VRXUFRIR ZDMJERG SROWRQ E RLOSURGXFW DJHQDJDQRP HPHJHQF  
VSOY GXUQJ WQSRUWRQ E ZDMU WQSRUW GLVKDJH RI LQXILFHQD WFDNG  
ZDMZDMUJURP LQWWDHQMSULHV XUDFHZDMZDMUJURP FROWDQVWPHQV DQG  
WQSRUWVRUMLQJVR ZDMJERGHV

3HURXP SURGXFW DJH FQWILHG DV KQDGRXV DQMSRQHJF SROWDQV > @) RU  
HJDP SDI WH V D FQDQJ SURFWRI GP RI RLOSURGXFW LQ D ZDMJERG FRQXP HV  
GLVROHGR \JHQ LQPRUHQD P RI ZDMU6SLO WQR RLOSURGXFWFRYHU\XSR  
NP RI ZDMU XUDFHZLW RLOLD \$WVHFRHQDQRP RI RLOSURGXFWLQZDMU

&RUUHVSRQVHQ: [skrbunvhhhy@pjjvx.ux](mailto:skrbunvhhhy@pjjvx.ux)

P J GP R U J D Q R O S M F L G G F D A U / D U H G L V M U E H G Z K L F K D U H G R V H O P L Q D A N G E \ W D G W R Q D O Z D M U W H D A / H Q / P H K R G /

3 H A R O X P S U R G X F W H Q M U I Q J D Z D M U E R G D V S D V R I Z D M A Z D M U K D Y H Y D U R X V I R U P V R I S R O X M D Q / V P S D F W @

7 K H I L O P R I R O S U R G X F W R Q V H Z D M U M U I D F H V L J Q U L F D Q O U H G X F H / G L I X V R Q S U R F W H V / D V W H I L Q M U I D F H 3 D U Z D M U G L U X S M Q J D V H J F K D Q J H S U R F W H V / L Q W H U H H Y R L U \$ V D U H X O W M H R \ J H Q G H I L F H Q L Q W H Z D M U L Q F U H D V Z K L O H D W M H V O P H W P H W H K G U R J H Q X O L G H F D U E R Q G R L G H D O G P H M D Q H F R O M Q V I C F U H D V /

0 L F U R G L V S H U R Q / D O G H P X O L R Q / R I S H A R O X P S U R G X F W L Q Z D M U K D Y H D Q H J D M Y H I P S D F W R Q W H E L R D R I W H U H H Y R L U

F R Y H U I Q W H X U D F H R I I L V K J I O Z L W D W L Q I L O G L U X S W J D V H J F K D Q J H D O G O D G / V R W H G D A K R I I L V

H P X O L L H G P I Q M U H / D O G Z D M U V R O X E H F R P S R X Q G / U H D G O S H Q H D M W H E R G H / R I I L V K D O G R M H U D P S K L E D Q /

K H D X I U D F W R Q / V H M O J R Q W H E R W P G L V M U E W H I R R G E D V H R I Z D M U E R G H / G L V R O Y G F R P S R Q O W R I R O D O G S H A R O X P S U R G X F W R I W Q F R O M L Q W H P R W W A Q L F V E V M D Q F H /

7 K L V O D G / V R G L V M U E D Q F H R I W H J H Q U D H F R O J I L F D F R Q G W R Q R I Z D M U E R G H / & R Q H T X H Q O E L S U R G X F W L W G F U H D V F K P L F D O S K I V L F D O D O G R U J D Q R O S M F S U R S H W H V R I Z D M U F K D Q J H D O G W H E L F Q R V L R I Z D M U E R G H V L Q F O G L Q J W H F R P S R V M R Q R I K U J K H U D X O M F Y H J H O M R Q L V G L V M U E H G

\$ V D U H X O V R I W H D F W R Q R I W H H S U R F W H V W H Z D M U E R G E H F R P H V D V R X U H R I W I L F V E V M D Q F H / R K X P D Q / M U R X J K I R X U Z D M U W S K L F F K D Q / > @

Z D M U : K X P D Q

Z D M U : D Q P D O Y : K X P D Q

Z D M U : V R O : S O Q V : K X P D Q

Z D M U : V R O : S O Q V : D Q P D O Y : K X P D Q

5 H G F L Q J W H F R O M Q R I R O S U R G X F W L Q Z D M U E R G H / L V F X U J H Q O R C H R I W H V O J H W M D V R I Q M U H S U R M F W R Q 7 K H U H D Y D Q F H R I W L V L V X H G H M U P L Q H V W H V D U F K I R U G Z G L U F W R Q / I R U L W R O X M R Q

7 K H V O J H V G L U F W R Q R I U H H D U F K L V I P S U R Y L Q J Z D M A Z D M U W H D A / H Q / W M F K R O B \ D O G G H Y H O S L O J Q Z P R U H H I L F L H Q / F R W H I H F W H P H M R G / R I Z D M A Z D M U W H D A / H Q / U R P R O S U R G X F W

0 D W H U L O O H W K R G V

7 K H U H D Q D M R Q R I W H V O J H V G L U F W R Q R I U H H D U F K I P S O H V D V W M P D M F D S S U R O F K E D V H G R Q W H V M G R I W H F X U J H Q W M D M R I W H S U R E O P D O G S U R P L V L Q J Z D V R I L W V R O X M R Q 5 H H D U F K R E M F W H V L Q F O X G G D O D V L V D O G V W M P D M F D M R Q R I Z D M A Z D M U I R U P D M R Q F R O G W R Q / F R O M L Q J R O S U R G X F W D O D O V L V R I S K D H G L V S H U H F R P S R V M R Q R I S R O X M D Q W D O G W H L U S K I V L F D O D O G F K P L F D O S U R S H W H V D O G D O D O V L V R I S R W L E O Z D M U W H D A / H Q / P H K R G / I U R P R O S U R G X F W

5 H V X O V G L V F X V V L R Q

\$ F F R U G L Q J V R W H I R U P D M R Q F R O G W R Q / Z D M A Z D M U F R O M L Q J R O S U R G X F W F D Q E H G L Y L G H L Q R W U H W S H V

' R P H M F Z D M A Z D M U L V J H Q U D A N G E \ S U R F W H V W D V W X S S R U W K X P D Q D F W Y L W L Q U H L G Q M D O D O P L Q M D M Y H R I L F H F R P P H U L D O D O G L O G W M D O E X L O B Q J V 7 K H F R Q F Q M D M R Q R I S H A R O X P S U R G X F W L Q W L V W S H R I Z D M A Z D M U L V O Z L Q W H U D Q H R I P J O > @

' RP HMF Z DVNZ DMU LV GLVKDJHG VR VNH P XQFLSDO WHD/HQV/DFLQWV SURYLGQJ  
GRUP DNYH LGGFDRLV/RQ VNH FRP SRVLRQ RI SROXNDQV \$ I WU VNH WHD/HQV/SURFHW VNH  
Z DMULV/GLVKDJHGLQR/DZ DMJERG

6XUDFHZ DVNZ DMU RI UHMGQNDODUHV RI VHWOP HQV/LVJHQUDNGIURP SUHLSVWRQ  
PHQZ DMU DGG LUULJDNQZ Z DMU' ULDQJHZ DMU GLVKDJHGIURP EXUHG SDUV RI EXLQJIV  
DQG VVKFAMUH/LV RIVQ UHUIHG VR DV VNH FDMURV RI VXUDFH Z DVNZ DMU > @ 7KH  
FRQFQNDNRQ RI SHWRXP SURGFW/LQ VXUDFH Z DVNZ DMU FDQEHVJ QILFDQW KJ KLVMDQ  
LQ GRP HMF Z DVNZ DMU DGG P DQD GSHQGR/RQ VNH Z DMU FRQFQNDNRQ DUH 7KH FRQFQNDNRQ  
RI SHWRXP SURGFW/LQ VNH FRP SRVLRQ RI D/RVSKHUF Z DVNZ DMU IURP UHMGQNDODUHV  
FDQ YDU LQ VNH UDUJH RI P J OGSHQGRQ RQ VNH QDMUH DQG GQWV RI EXLQJIV  
VNH SUHMFH RI P DQ WUHV Z LK KDA WDLF VNH UP RINQW RI VNH WUULRV IURP  
LGGWMDHQMSULHV/> @\$VDUXD VXUDFHZ DVNZ DMULV/GLSRVHGR D WUWHDF/HQVQRD  
Z DMJERG

\$ SURPLQJ GLUFWRQIRU VNH SUYHQNRQ RI RLOSURGFWVQOZ Z LK VXUDFH XQRI LQR  
Z DMJERGH/LV/RXHLVZ LKQVNH WUULRV RI IRUP DNQ

: DVNZ DMU RI LGGWMDHQMSULHV/LV IRUP HG GX VR VNH UHQJ DNQ RI SURGFWRQ  
R FQVDFRP SDQHG E WFKQRJLFDOSURFHWV/XLQJ RLRLOSURGFW DGGZ DMU 7 KLV/WSH  
RI Z DVNZ DMULCQGHV

Z DVNZ DMU IURP UH LQV SURGFWRQ SURFHWV  
Z DVNZ DMU IURP VALDJH DQG WDO SRVWRQ HQMSULHV DGG RLOSURGFW RQGSRW  
SXP SLOJ VDMRQ/ DGG QDQJ SRLQ

RLO DQG RQG Z DVNZ DMU IURP VHP DQSRZ HU SDQW RSHUDNRQ RI IXORLOI DUP V  
VUEHQ RLOX VAP V QEUFDNRQ RI E-DUJVR URDMQJ PHKQJVP V IQVKLQ IURP IQRV RI  
VUEHQ DQGERLQURPV

Z DVNZ DMU IURP PDKHEXLQJ HQMSULHV Z DMU IRFRQJ SDUV SUHSDUDNRQ RI  
DTXRXV RQNRQ/ FRP SUHWRUFRQJ V VAP V

Z DVNZ DMU IURP P RRUWQ SRVW DGG FDUHSDUHQMSULHV HJ WQDOZ DKLQJ RI FDV  
DGG SDUV EDWUJ Z DKLQJ

RQFRQJLQJ Z DVNZ DMU IURP SURGFWRQ SURFHWV/RI PHQJLFDOSQW FRQJ  
RI PHQJLFDQW Z DKLQJ RI SURGFW

Z DVNZ DMU IURP SURGFWRQ SURFHWV/RI VJ WDHQMSULHV  
7KH HP DQ FDMURV/RI Z DVNZ DMU DUH IRUP HG D VGGWMDHQMSULHV/ WDVXVH RQRU  
SHWRXP SURGFW/LQ VNH SURGFWRQ WFKQRJ VFK DV RLOJ LQJHV UH LQJHV > @

FRQFQNDNG LGGWMDQZ DVNZ DMU± GLUFW IURP WFKQRJLFDOSURFHWV/ Z LK KJ K  
FRQVQRI RLOSURGFW XS VR JO> @

P RGHUAD SROXNGZ DVNZ DMU IURP DQ LQDU LGGWUHV XS VR PJO> @  
VXUDFHZ DVNZ DMU PJO> @

\$ VNH VOP HVP H VXUDFH XQRI GLVKDJHGIURP VNH SURGFWRQ VAP/RI SURFHWV/ Z LK  
VNH XH RI RLOSURGFW IRUH DP SH VXUDFH LGGWMDQXQRI GLIHU/VJ QILFDQW LQ VNH  
TXDQW DGG FRP SRVLRQ RI SROXNDQV IURP VNH VXUDFH XQRI IURP VNH VMDGNVHQV VNH  
WUULRV RI VNH DGP LQVADYHEXLQJ RI VNH VOP HQMSULHV \$ FFRLEQJ LQVAVI QZ VNH  
RLOSURGFWFRQVQZ LQEH FORH LQ P DJQVXG VR VNH VXUDFH Z DMU GLVKDJHGIURP VNH  
UHMGQNDODUHV

,GGWMDQ Z DVNZ DMU I QZ V DUH GLVKDJHG WURXJK VSDUDM Z DVNZ DMU GLSRDQ  
QHJZ RUN VR WHD/HQV/DFLQWV/DGG VHQ D WUWHDF/HQV/DUJ UHMLQHG VR VNH WFKQRJLFDQ  
SURFHW Z KHU VNH DUJ UHVGRUGLVKDJHGLQR VNH FUMV/FQNDQJ HG Z DVNZ DMU GLSRDQ  
V VAP 6XUDFHZ DVNZ DMU FRQFQNDQ IURP VNH WUULRV/DGG VAP/RI LGGWMDHQMSULHV/  
WURXJK VNH GUDQJHQHJZ RUN HQMV/VNH VXUDFH XQRI WHD/HQV/DFLQWV/DGG VHQ D WU  
WHD/HQV/GLVKDJHGLQR/DZ DMJERG

\$QDOLV/RI VHSKDVH GLVSHUHFPP SRVLRQRI RLOSURGFWLQZ DVNZ DMULVQHFWDY VR GHMUP LQH VHFRCQVLRQ/IRU VHFHIFVYH DSSOFDNRQ RI PHMRG/RI Z DMUWHDF/HQVDCG UFRYHV RI XWQJ HGRP SRQOV

2 LODCG RLOSURGFWLQZ DMU DUH D KHMVSKDVH SROGLVSHUHV VWP ,QZ DVNZ DMU SHAROKP SURGFWP D EHLQGLIHUQVSKDVH GLVSHUFGVDMV

6HGP HQDMRQVDELDV/RI FROVDH GLVSHUFGSDUWFOV/RI SHAROKP SURGFWGHSHQG/RQ VHLUGQWV UHDMYHV VHZ DMUGQW : KHQVHGQWV RI VHSUWFOV/LQVWVNDQV VHZ DMUGQW VHS DSHUDV/DILP VOFN RQ VHXUDH +HDA IUDFNRQ/RI VROG DCG YLFRV FRP SRQOV VHMV RXVDSUWFOV GQWV/JUHDVNDQ VHZ DMUGQW ,Q VHSVSHQGVDV IGDVQ LQVHZ DMUFROP Q UHMGDORLORLQJUHJDM/P D EHVREHGRQ RMHUP LFUR GLVSHUFGIP SXUWV

0 LFURGLVSHUFG SDUWFOV/IRUP LQ HPXOLRQ/RI GLUFWVSH<sup>3</sup>RLOSURGFWLQZ DMU KDYH KJK DJUHJDMV VDELDV 0 LFURGLVSHUFG SDUWFOV/RI <sup>3</sup>QJWVSHAROKP SURGFWUHSUHVQV VHVRFDCG<sup>3</sup>VROEVI SHAROKP SURGFV> @

7KHFRFHRI PHMRG/RI Z DVNZ DMUWHDF/HQVURP RLOSURGFWLQVFRQVLRQGEA D QP EHU RI DSHW 7KH PDLQ RQH/LQFOXGH VHP DP RXQ/RI Z DVNZ DMU VHFRCQVARI RLOSURGFWLQV/VHHSKDVH GLVSHUHVDMVRI SROVDQV VHLQMGCG SXLSRVHRI VHDNGZ DMU DCGVHIFVDELDV/RI XLQJ VSHUDMGRLOSURGFV> @

7KH SKDVH GLVSHUHVDMVRI RLOSURGFWLQZ DMU/LV VHFEDV/IRU VHFREHRI Z DMU WHDF/HQVPHMRG/ DCG VHFVFKRBJLFDVHTXQFHRI VHLU DSSOFDNRQ> @7KH PRWV ZLGHSHUDG VFKRBJA RI RLO Z DVNZ DMUWHDF/HQV/VSHUDNRQPHMRG/ \$VDUHXQVRI VHLUDSSOFDNRQ SROVDQV DUH VDFWVIRP Z DMU DCGVHIF VDFWV SURGFVWP D KDYHD UH FDECI SRMVDQD 7KH VSHUDNRQ PHMRG/ FXUHQD XVG IRU VGLPHQDMRQXQVDECI SHAROKP SURGFVW VWP V DUH VLP SOI DCG UHDECI 7KHV LQFOXGH JUDYLV VHMVQ XLQJ VLP PHV/VR FDSMUHRLQ V VOFN ILODMRQVURXJK JUDQXQV DCGV DGIQDMRQ

\* UDYVNRQDO VSHUDNRQ 7HFKQFDQ VLP SOI DCG HFRQPLFDQ Z DMU SXULFDNRQ PHMRG/IRUP RLOSURGFW DUHEDVGRQ JUDYLV VSHUDNRQ> @2 LOSURGFW DV QJKMLQ VHF RLOZ DMU P LQ VHU IGDV VHF RSHQ VHXUDH RI VHV VXFVUH Z KHU VSHFDQGHYHV FROFVWV \* UDYLV VSHUDNRQ DQZ V VHF VDFWVRI SUDFVDDQ DDFRDUH GLVSHUFG SDUWFOV RI RLOSURGFW IRUP RLO Z DMU : KHQ RLOSURGFW DCG KHDMO GLVSHUFG IP SXUWV DUH SUHVQ/VRUHVHULQZ DVNZ DMU VHFDMHUP D EFRP HFRDNGZ LVKRLQ V UHXQVQ LQ QXNDQV DQVDELDV 7KHV ILEHCF RI JUDYLV VSHUDNRQLV UGXFGLQVLFVDFH ,Q DCGVLRQ VFK DJQPHDM/RVHDS ILOMUDP HQV SRUHVDFH VJQLFDQ UGXFQJ VHLU RSHUDNRQ GUDNRQ &XUHQD JUDYLV VGLPHQDMRQ DCG VSHUDNRQ LQ VHF ILEGS RI FQWLVXDO IRUHV DUH XVG DV VHF ILYVWVUH RI VHF VFKRBJLFDQ SURFV RI Z DMU SXULFDNRQ> @

) QDMRQ 7KH I QDMRQ PHMRG/LV EDVGRQ VHF IGDVQ RI IGDVNRQ FRP SOI H/IRUP HG GXH VHF DGKHLRQ RI RLOSURGFVSDUWFOV Z LVK DUJURVHUJ DV EXEEDV 0 HFKQFDQ K GUDXCF SQXP DMF FRP SUVLRQ DCG HOFVRFKPLFDQ IGDVNRQ DUH GLVWQXVKG DFRUGLQ VHF PHMRG RI REMQLQJ GLVSHUFG JDV SKDVH LQ Z DMU> @7KH I QZ RI VHXUDQV IGDVNRQ FRP SOI H/IRUP VDJUDGHQV VSHUDNRQ RI RLOSURGFVFRQVLRQV VHF KHJKVARI VHF IGDVNRQ FKP EHV FCFQNDM IGDVNRQ VOJH IRDP RQ VHXSSHUHXUDH DCG SXULHG Z DMU LQ VZ HU SDUW\* UDYLV VGLPHQDMRQ DCG IGDVNRQ DUH XVG VHF VHDV Z DVNZ DMU FRQVLRQV DUH DP RXQVRI SHAROKP SURGFWLQVH IRUP RI VGLPHQDMRQ XQVDECI VWP V

,I VHF RLOSURGFWLQZ DMU IRUP DVGLPHQVDECI V VWP GLUFWO DSSO LQ VHF PHMRG/ EFRP HV LQHIFVYH ,Q VLV FVH Z DMU SUHVDF/HQV/LV QHFVWV VR GLVXSVH VGLPHQDMRQVDELDVRI VHV VWP RI SHAROKP SURGFWLQZ DMU

7KH PRVWFRP RQ VFKRBJA LQ RLO Z DVNZ DMUWHDF/HQV/VFKPLFDQDQVH/VNDV UGXFH VHF VGLPHQDMRQVDELDVRI VHV VWP DVUZ KFK VHEFRP HV SRVLECI VR DSSO VHF VSHUDNRQPHMRG/RI Z DMUWHDF/HQV/VXVHG DERYHIFVYH 7KHDFNRQRI VFK

DGGVYH/LV EDVHG RQ GHWR LQJ VNHEDUJHUP RQRD HUDVMH<sup>3</sup> SDUWFOI Z DMU LQAUJDFHGK  
VR VNH VVKFAMUJ RI VNH HOFANIF GRXEOI OD HURUVMH SUHVFQFRI DGRLSARQ VKHOVZ LK KJK  
VVKFAMUJDFVFRVW , QVNH ILLVWFDJH VNH YLRDWRQ RI VHGEP HQDWRQ WDELQW LVDFKLYHGE  
VNH DGGWRQ RI DFLGRUDDO FKOJLQ VHS+ YDQH LQVMHVFRQGFVH± E VNH DGGWRQ RI  
P LQHJDFRDXOQARU RJJDF SROHDFWROVM FKOJLQ VNH DGRLSARQ HTXLOEUXP DVMH  
LQAUJDFH

&RP SUHWLQI QDWRQ Z LK SUHOP LQJ Z DVNZ DMUFRDXOQWRQLV DQJ DP SØRI VFK D  
VFKQRJLDFOP HMRG + HMRSKDVI QDWRQFRP SØI HVI RUP HG LQVWLV SURFHWFRQVEXMVR  
VNH HJ WDFWRQ RI RLOSURGFVW DQG RWHU GLVSHUHG SROXQDQ IURP Z DMU LQ DGGWRQ VR  
P LFURSDUWFOV

: DVNZ DMU FKOJFAMUJ HG E VNH DJJUHJDIYH WDEOH WDM RI SHARØP SURGFVW LQ  
Z DMU SUHVFQVNH JUHDMVGLI LFXQVH/LQLWVHDFR HQV\$ JUJHJDIYH WDEOH V VMP VDUHRI WQ  
FKOJFAMUJ HG E Z DVNZ DMUFRQDQJLQJ VP DODP RXQVRI SHARØP SURGFVW 7KHP HMRG/  
RI FRODMFQFH VRLSARQ DGGFKP LFDOGHJUDGWRQDUHXVHGVR WHDVXFK Z DMU/

&RDMFQFH 7KH FRODMFQFH P HMRG LV EDVHG RQ VNH HQDUJHP HQV DGG I XVRQ RI RLO  
SURGFVSDUWFOV LQ FRODMFVZ LK VNH GHYHØSHG VUJDFH RI KI GURSKREL P DAMJDO : KHQ  
Z DMU SDVH VURXJK VNH FRODMFQJ GHYLFH VNH HOFARWDMF LQAUJDFWRQ RI SHARØP  
SURGFVSDUWFOV DQG VNHUFRQRODWRQ RFXU/ ) XVMHU VNH FRQRODWRQ SDUWFOV RI RLO  
SURGFVW DUHVSDUJGE JUDVW VSDUWRQ DGG GLVFKDJHG VR VNH RLOFRODMFV > @

7KHU DUHV VNH WSHVRI FRODMFQFH  
SRUJ Z KHQVH DJJUHJDIYH RI SHARØP SURGFVSDUWFOV RFXU/LQDSRURXVP DAMJDO  
VUJDFH Z KHQ FRODMFQFH RFXU/RQVNH VUJDFHRI VNH FRODMFQJ P DAMJDO  
YROP HMF Z KHQVH I XVRQ RI RLOSURGFVW LFUR SDUWFOV RFXU/Z KHQVH FROGH  
6) QMHV ILEHU SROSURS GCH SROXUHMOGH JUDQDUSRO VVUJQH I RDP SROXUHMOGH  
I RDP QDMJDO: VON DGGZ RROFDQEHXVGDV FRODMFQJ P DAMJDO

\$GRLSARQ 7KH P HMRG LV EDVHG RQ VNH DEVRLSARQ RI SROXQDQ E VNH GHYHØSHG  
VUJDFHRI DGRLSARQ P DAMJDO VRIE-QV 1 DAMJDO DUWV LDO DGG V QMHV P DAMJDO DVZ HD  
DVRP H VSHVRI LGGVWDOZ DVMV FDQEHXVGDV VRIE-QV 7KHP DQ UHTXUHP HQV RUVNH  
VRIE-QV XVG I RUJ DMUSXU LFDWRQ IURP RLOSURGFVW LV KI GURSKREL V DGG GHYHØSHG SRUJ  
VUJDFH 7KH EHVW VRIE-QV DUH GLIHUHQW UDG V RI DVMYH FDUERQ/ > @6DMF DGG  
G QP LF VRLSARQ SURFHWV FDQ EH XVG I RUJ Z DVNZ DMU WHDV HQV' \ QP LF VRLSARQ  
SURFHWV/SURYGHZ DMU WHDV HQV/JUHDMV WDELQW DGG TXDQV > @

: DVNZ DMU FKOJFAMUJ HG E DJJUHJDIYH WDEOH V VMP VRI RLOSURGFVW Z LK UHDMYH  
ØZ RLOFRQMQV FDQ EH WHDG Z LK GHVVKFAMUJ HIHFV 7KH H P HMRG/LCFOGH RJ RQDWRQ  
DGGXONDYLRQV UJGDWRQ 7KHP RWHYLVDMH LV VNH RJ RQDWRQ P HMRG

7KH Z DMU RJ RQDWRQ P HMRG LV EDVHG RQ VNH KJK RJ LGJ LQJ SRZ HUR RI RJ RQH 2] RQH  
GHWR V P DQ RJJDF VXEWDQFV LQ Z DVNZ DMU RYHU YDUJRV VMP SHUDMUH DGG FROMQV  
' XUIQJ VNH SURFHW RI Z DMU RJ RQDWRQ VNHU LV D VJQILFDQ LP SURYHP HQV LQ VNH Z DMU  
TXDQV LQ P DQ UHSFW 7KH GHJUDGWRQ RI RJJDF SROXQDQ UHXOV LQ GLVFRUDWRQ  
GHFRUJ DWRQ GLVQHWRQ DGG Z DMU RJ \ JHQDWRQ 7KH XH RI RJ RQH DV D GHVVKFAMUJ RI  
RJJDF SROXQDQ XVDG GRHV GRVUHTXUJH VNH DGGWRQ RI RWHU UHJHQV VR VNH WHDG  
Z DMU + RZHYU LVMKXG EH FRQVGHUHG VDMV RJ RQH LV D UDMHU VRI LF JDV LVP DQ LP XP  
SHUP LWIEH FRQFQDWRQLQ VNH DUJRI VNH VHYLFH DUJH V KXG GRVH FHG P J ORI DUJ

7KH VFRSH RI DSSOFDWRQ RI VLV RU WDMV HMRG LQ DGGWRQ VR VNH HFRQP LF DGG  
HQVURQP HQVDFRP SRQH V DGG VNH UHTXUHP HQV I RUJ GLVFKDJH LQR D Z DMU ERG RU VNH  
FRQWRQ/ I RU UHTXUHP WHDG HIØHQVE VNH FRQXP HU P D EH GHMUP LQHG E VNH  
IHDMJELQW RI FRODMFQJ DGG UHFRYHUJQ SHARØP SURGFVW > @, QVNH SUHVFQFRI KJKO  
FRQHQDWRQ RLO Z DVNZ DMU LVLV DGYLWDEOH VR XH P HFKQDFD DGG SKI VFDOKP LFDO  
WHDV HQV P HMRG/

' HMKFVYH P HARG/ DUH XVFG VR UFGFH VH FRCH QNDNRQ RI SHWRDP SURGFW LQ  
 Z DVAZ DAM \$ V D UXOI VHM DUH X VAP V LQNDNRQ/IRUDGGVNRQDOZ DVAZ DAM WHDA/ HQV  
 WDVKDV/SWVGHDLUHMVH/RI P HFKDQFDODGSK VFDOPK-P LFDONHDA/ HQV  
 7KV VHF RP SRVNRQ RI RLO Z DVAZ DAM WHDA/ HQVDFLQVH/ G-SHQG/RQ VHWSH DGG  
 TXDQV RI SROVDQV DGG VHUHTXUHP HQVIRU VHTXDDV RI WHDAGZ DAM I RUH DP SBI I RU  
 D SURFHV Z LK UHXH RU UFA FQJ RI Z DAM RU UHXDAN UHTXUHP HQV I RU Z DAM VR EH  
 GLVKDJHGLQRZ DAMJRGH/

### & R Q F O X V L R Q

3HWRDP SURGFW DUH DP RQJ VHP RVKQUP IXOFK-P LFDOSROVDQV LQZ DAMJRGH/ DGG  
 RFDQ/  
 : DVAZ DAMFRQMLQJ RLOSURGFW FDQ EHFDMILHGE VHFRCGVNRQ/RI IRUP DNRQ DGG  
 EI VHSKDVH GLSHUHVDMRI VHRLOSURGFWVH FRQMLQ  
 : DVAZ DAM WHDA/ HQVURP RLOSURGFW LV DQ XUHQMDAN RI CDVUH SURVNRQ DGG  
 UHTXUHV/VHGHYHDSF HQVRI QZ HIFVYH DGGHFRCP LFDQ IDYRDEHP HARG/  
 7KHFRLEHRI Z DVAZ DAM WHDA/ HQV HARG/IRUP RLOSURGFW/G-SHQG/RQVHDP RXQV  
 FRQMLQ/DGG SKDVH GLSHUHVDMRI SROVDQV DVZ HODV/VH LQAGGSGXSRVRI WHDAG  
 Z DAM DGG XMD DNRQRI VSDUDNGRLOSURGFW  
 3HWRDP SURGFW LQ Z DVAZ DAM FDQ EH LQ FRDUH GLSHUHG PIFUR GLSHUHG DGG  
 KLJKO GLSHUHG VDM/  
 7KHJUHDNVGILFXOV LQVH VFKGRU\ RI RLO Z DVAZ DAM WHDA/ HQV/VH HJ WDFWRQRI  
 HPXQILHG PIFUR GLSHUHQ/ RI SHWRDP SURGFW Z LK KLK VGP HQDNRQ DGG  
 DJUHDNRQ VDELDV  
 O HARG/ RI Z DVAZ DAM WHDA/ HQVIRUP RLO SURGFW VFXG EH IREXVHG RQ VH  
 SFXODUHV/RI VHSKDVH GLSHUHVDMRI RLOSURGFW LQZ DAM DGG VHLVHGP HQDNRQ DGG  
 DJUHDNVH VDELDV ' HMKFVYH Z DVAZ DAM WHDA/ HQV HARG/DUHJ SHGHQVWR DSSO LQ  
 VHF FDH RI KLJKO GLSHUHG DJUHDNVH VDECH IRUP V RI SHWRDP SURGFW LQ VP DQ  
 FRCH QNDNRQ/

### 5 H I H U H Q F H V

- 7 / 7DNU: ' %UJRV 3 3IRNRZ VL HVO ( QMU6FL 7HK ±  
 : DVAZ DAMSROVNRQ HQVURCP HQDOSUREOP V DGG VROVNRQ/ \$ FFWHGRQ O DJFK  
 ≥ QDCH@ \$ YDDECH  
 KMSV UFA FQCH/WVFKQ HYRG ]DUV D] QDQHNRQJLKHVNH SUREOP\ LSVMLK UHXH  
 Q\ D  
 5HROVNRQRI VH\* RYHQP HQVRI VH5 XVIDQ) HGHUHQRIURP 1R HG  
 IURP <sup>32</sup> QDSSURYDRI VH5 XQVRI FRGZ DAMVSSO DGGZ DAMUGVSRVDD  
 DGGDP HQP HQVVR VP HDPVRI VH\* RYHQP HQVRI VH5 XVIDQ) HGHUHQ \$ FFWHG  
 RQ ) HEUXDV ≥ QDCH@ \$ YDDECH  
 KMSV GRFVFGUX GRFP HQV "\ VFG QP KNF JF
- <X \$ ) HRIDRY %\* O LVKNRY : DAM ( FRO 3UREO6RQV
- \$ \* O HONKQ , 6 6KFXNQ %XO31538 &RQW \$ UFKLV ±  
 ,76 , QRUP DNRQ DGG VFKQFDODGGERNRQEHWDYDDECH VFKGRUJLHV 2 LO  
 UHLQJ DSSURYHG% VH2 LGURI 5RWDQDQVURP 1R \$ FFWHG  
 RQ ) HEUXDV ≥ QDCH@ \$ YDDECH  
 KMSV HFRQJ UK GRFVVO UUP 56PB) (\ 3+ S; - EIXQ

- 6 9 6 WSDRY \$ . 6 WDRY 9 1 6 KYHRY . 0 0 RUI RYD %LRU LFDOZ DVNZ DMU  
WDA/HQVURP RCUHLQHUV \$69 3XEQKQJ +RXVH 0 RVFRZ
8. 9 1 \$ QSRON 6 9 2 QHUKXN \$ 3 5 RP DQQR 6 2 .  
( 9 9 RURE HYD %XO7RP VN6VM8 QY \$ UFKLV&LYLO QJ  
/ \$ 0 RNI + . -DMP 1 \$ \$ EGXXVLO 0 DV7RQ 3URF  
KWSV GRLRJ MPDSU  
, \$ \$ GJRNH 2 2 \$ GPRD \$ SSO: DMU6FL  
KWSV GRLRJ V
12. ? < \$ QNHY 3K VFR FK-P LFOSURFWHVR Z DVNZ DMUWDA/HQV \$69 3XEQKQJ  
+RXVH 0 RVFRZ
13. ( 6 ' UPLFKHYD ( 9 6KDP VMLQRY : DMU( FRO 3UREO6RO
14. \$ 9 %XVHY , \* 6KHKHRYD , 1 7QPIHYD , JY . \* \$68
15. ? < \$ QNHY : DVNZ DMUWDA/HQV ( QVMRQ ) XGEP HQDVR WFKCRU\ DGG  
DSSQFMRQ \$69 3XEQKQJ +RXVH 0 RVFRZ
16. \$ 9 %XVHY \$ 6 HDXJLQ 1 6 8 UPLRYD ) ) . DXPY , JY . \* \$68  
±
17. 1 6 8 UPLRYD 5 1 \$ ELRY \$ . 1 UDPRYD / ' 6KJLHYD , JY . \* \$68  
±  
1 6 8 UPLRYD 5 1 \$ ELRY \$ . 1 UDPRYDHW,23 &RQ 6HU 0 DV6FL ( QJ  
KWSV GRLRJ ;
19. <X \$ ) HRIDRY 9RQD0 DJ ±  
( 6 0 DVKNQD ( , 9\ DRYD ( <X 2 VLSRYD %XO7RP VN6VM8 QY \$ UFKLV&LYLO  
( QJ KWSV GRLRJ  
( 6 ' UPLFKHYD %XO31538 &K-P 7FKQ %LRMFK ±
22. 7 : HL 7 5DQ : =KCR %' DL ,GG ( QJ &K-P 5H/