

vy uhuk nf{k.kh nkyu& ,d leh{k**fourk ,l gcyh* ,o fpe; dek l kg**—f'k foKku foHkx] le fgfxuc,ve —f'k fo'fo[ky;] çk|kfxdh vkj foKku] ç;kxjkt& 211 007] mÜkj çn'k] Hkkjr
iklr fl rEcj 2020 Lohdr vDrcj 2020**lkjk'k**

,y uhuk dh ?kVuk, cMh tyok; xMcMh g tk Hke/;j[kh; ç'kkr d Hkhrj mRiUu gkrh g] vkj gj 2 l 8 o'kk e gkrh gA ,y uhuk d fodflr pj.k e i : vkj bDokMkj d rV k l Hke/;j[kh; ç'kkr d e/; rd leæ dh lrg ij v lkekU; xe ikuh dh fo'k'krk gA ;g ?kVuk if'pe dh vkj cgu okyh 0; k i kfjd gokvk d v thc detkj gku d dkj.k gkrh g] tk xe lrg d ikuh dk viuh fn'kk io dh vkj myVu dh vuefr nrh gA ,y uhuk d tyok; çHkko ij xg ij c< jg g tk {k=h; ekle ij db çHkko fn[kk l dr gA ;g tyok; ç.kkyh d Hkhrj 0; k id ifjoru l lcf/kr g vkj cfu;knh <kp] —f'k] LokLF; vkj Åtk {k=k dk çHkfor dju oky çe[k lkekftd&vkfFkd çHkko dk dkj.k cu l drk gA ;|fi ,y uhuk m".kdfvc/kh; ç'kkr {k= d Hkhrj fn[kkb nrk gA ;g nfu; k Hkj e tyok; vkj ekle dh ?kVukvk t l l[k@ck< vkj m".kdfvc/kh; rQku ij çHkko Mkyrk gA Hke/;j[kh; ç'kkr d Hkhrj ikjifjd fLFkr dk xhugm l x l k e of) d dkj.k l 'krf/kr fd;k x;k g tk cny e ,y uhuk nf{k.kh nkyu %ENSO½ ifjoruk dh vkj tkrk gA ge ;g vk'oklu nu e l {ke g fd ENSO fofo/krk, vku oky n'kdk vkj 'krkfcn;k d Hkhrj nfu; k Hkj dh tyok; dk lgu vkj çHkfor djxhA blfy,] ENSO ifjLFkr; k dk iokueku vkj 0; k [; k djuk nku oKkfudk vkj turk d fy, vko'; d gA bl i= d nkjku] ,y uhuk dh ?kVuk vkj of'od tyok; vkj lkekftd&vkfFkd fLFkr ij bl d çHkko dk v/; ;u vkj lfgr; l leh{k dh xb gA

'kn dth ENSO] 0;kikj gok,] l [kk] tyok;A

Bhartiya Krishi Anushandhan Patrika, 35(3): 119-127

ENSO - A review**Vinuta S Hubballi* and Chinmaya Kumar Sahu**Department of Agrometeorology, Sam Higginbottom University of Agriculture, Technology and
Sciences, Prayagraj- 211 007, Uttar Pradesh, India.

Received: September 2020

Accepted: October 2020

ABSTRACT

El Niño events are large climate disturbances which are originated within the equatorial Pacific, and occur in every 2 to eight years. The developed phase of El Niño is characterized by unusual warm waters at the ocean surface, from the coasts of Peru and Ecuador to the middle of the equatorial Pacific. This phenomenon is caused by strange weakening of the trade winds blowing westward, which allows warm surface waters to reverse their direction eastward. The climatic impacts of El Niño are amplifying throughout the planet which may show several effects on regional weather. it's related with wide-ranging changes within the climate system and may cause prominent socio-economic impacts affecting infrastructure, agriculture, health and energy sectors. albeit El Niño appears within the region of tropical Pacific; it's impact on the worldwide climate and weather phenomena like drought/flooding and tropical storms. the traditional status within the equatorial Pacific is modified due to the raise in greenhouse gases which in turn leads to El Niño Southern Oscillation (ENSO) changes. we are able to assure that ENSO variations will endure and influence the worldwide climate within the coming decades and centuries. Hence, forecasting and interpreting ENSO conditions are essential to both the scientists and therefore

*Corresponding author's E-mail: vinutahubballi26@gmail.com

the public. during this paper, the occurrence of El Niño and its impact on global climate and socio-economic status has been studied and reviewed from literature.

Key words: ENSO, Trade winds, Drought, Climate

iLrkouk

l kfgR; e] ,y uhuk dk fofHkUu y[kdk }kjk 0;kid :i l ifjHkkf'kr fd;k x;k g] ftldh dkb lkoHkkfed ifjHkkf'kk ugh gA cgr igy] i: d eNvkj u bl ,y uhuk dgk Fkk] tk fd ^ØkbLV pkbYM d fy, Lifu'k okD;k'k g %Dijkstra, 2006%A gycV ,V vy i: vkj bDokMkj %Hurlburt et al., 1976% d rVh; {k= e xe ikuh d ,d fo'kky çokg d :i e ,y uhuk leæ d :i e ifjHkkf'kr fd;k x;k gA fQyMj u vy uhuk ?kVuk dk ifjHkkf'kr fd;k] tk lkekU; :i l nf{k.k dh vkj rVh; leæ dh ryuk e vf/kd xe leæ d rkieku d l kFk & l kFk] mÜkj i: %Philander, 1990% dh ryuk e bDokMkj e mPp o'kk vkj ck< dk etcr djrk gA

nf{k.kh nkyu if'peh vkj ioh ç'kkr d chp m".kdfVc/kh; ty Lrj d nco e n[k x, ,d okf'kd -'; dh fo'k'krk g] tk m".kdfVc/kh; ç'kkr ij iorh 0;kikfjd gokvk dk detkj dju vkj etcr dju l feydj curk gA vy uhuk vkj nf{k.kh nkyu] lcl çl) ;f'xer egk l xjh; ok; eMy ?kVuk gA Bjerkne u i kLV fd;k fd ENSO e ldkjRed egk l xj&ok; eMy çfrfØ; k 'kkfey gA ENSO dk ekU; rk nh tkrh g D;kfd fo'o0; kih tyok; ç.kkyh dh vrj okf'kd ifjoru'khyrk dk lcl cMk l kku; iujkofÜk vof/k d l kFk 2&8 o'k cM %Santos, 1999%A

l j fxYcV okdj u ty&Lrj d nco] lrg d ok; rkieku vkj o'kk e o'k&nj&o'k d mrkj&p<ko dk o.ku fd;k] tk xkyk/k e Qy ,d fo'k'k of'od&ieku d VYduu'ku iVu dk çn'ku djrk g vkj mÜkj dh ,d fgL l k gA xkyk/k %o,dj 1923] 1924] 1928% o,dj vkj fcy l %1932] 1937%A Bjerkne %1966% okLVj vkj xbyu %1974% u ,y uhuk dh fLFkr; k dk ml fcn ij ikjifjd ekleh detkj l ij xkyk/k 0;kikj ç.kkyh d ,d cM ieku ij detkj d :i e of.kr fd;k] i: vkj bDokMkj d rVh d l kFk & l kFk vifo= gku dh lekflr] vpkud dh mifLFkr rV l yxHkx 1000 fdeh nj de yo.krk okyk vleku :i l xe lrg dk ikuh] vkj blfy, bl ikuh dk nf{k.k dh vkj foLrkj bldh lkekU; xfe;k dh lhek l ij gA

,y uhuk d pj.k d nkju if'peh nf{k.k vefjdk d rV d fdukj BM ikuh dk viokg vuifLFkr gA Å'ek dh çfØ;k dh otg l if'peh ç'kkr dh ryuk e ioh ç'kkr e Fkekdykbu dh xgjb mFkyh gA ,y uhuk dh ?kVuk, 1897] 1891] 1911] 1925] 1940 l 1941] 1957] 1965] 1972 l 1973 vkj 1976] 1982&83] 1986&87] 1991&92] vkj 1993] 1994 vkj 1997 %efluj% e gb gA] 2000%A ;g n[kk x;k g fd 20 oh 'krkCnh dh lcl etcr ,y uhuk ?kVuk, 1982&1983 vkj in 1997&1998 e gb FkhA

ENSO Hkkfrdh xe vrjky tk vfu;fer vrjky ij gkrk g vkj vkerkj ij ,d l 2 lky rd jgrk g] ckn d ok; eMyh; }kjk fo'k'krk gkrh gh

1% nf{k.k&ioh ç'kkr d Hkhrj mi&m".kdfVc/kh; mPp d detkj gku d l kFk & l kFk v, LVfy; k bMkuf'k; k xr {k= d Åij&lkekU; ty Lrj ncoA ; fLFkr; k nf{k.kh v,fly'ku d udkjRed pj.k d vu: i g] tlk fd o,dj %Bjerknes 1969] Quinn, 1974(tfy; u vkj pfju] 1978] okx vkj ikbdV] 2004% }kjk ifjHkkf'kr fd;k x;k gA 2% fo'korh; e/; ç'kkr d Hkhrj xjtu okyh gokvk dk detkj ;k myV gkuk] tk bl {k= d nkju tyok; l c/kh ek/; & if'pe lpyu ly d fo?kVu dk xBu djrh g (Ichiye and Peterson, 1963; Wyrski, 1975)

3% 160°E %MkcfVt] 1968(fDou ,M cV] 1972(flykgu vkj fly; j] 1975% d io e fo'korh; LV'kuk ij rth l o'kk dk c<k; kA

4% gMyh ifj l pj.k e of) ç'kkr {k= %jbVj] 1978 ,%A 5% vfrfj ä m".kdfVc/kh; v{kk'kk d fy, dVko ft le gfeIQ; j lfn; k d ek le d nkju vymfr; u d xgj vkj nf{k.k.ke[kh foLFkku 'kkfey g %Bjerknes, 1966, 1969, 1972, Rowntree, 1972; White and Walker, 1973; Namias, 1976)A

dkj.kk leæ'kkL=h; v/; ;u %Wyrski, 1975(gycV ,V vy-]1976] edØjh] 1976(fQyMj] 1981% crkr g fd ENSO d nkju 0;kikj gokvk d detkj iMu l Åijh egk l xj d Hkhrj xeh dk ,d {kfrt iuforj.k gkrk g vkj bld ifj.kkeLo: i folxfri.k xeh dk vkhk l gkrk gA e/; vkj ioh m".kdfVc/kh; ç'kkr d Hkhrj lrg dk ikuh vke rkj ij] Hke/; j[kk d l kFk io l cgu okyh

0; kifikjd gok, m".kdfVc/kh; ç'kkr d fduj ij lrg dh lrg d ikuh dk bdëk djrh gA bl chp] ik"kd rRok l Hkjij BMk xgjk ikuh xe lrg d ikuh dh txg lrg ij igpk; k tkrk g] tk nf{k.k vefjdk d rV l nj rd cgrk g] ft l viofyx dgk tkrk gA ;g BMk ikuh igyh mRikndrk dk c<ku d fy, vkd"kd g tk eRL; ikyu dk leFku djrk gA bl çdkj if'peh o"kk d dkj.k if'peh m".k dFVc/kh; ç'kkr ij Hkkjh o"kk vkj volkn ik; k tkrk g] tcf d io e BM ikuh d Åij dh gok ryukRed : i l 'k'd gkrh gA e/; vkj if'peh ç'kkr {k= e 0; kifik gokvk dk vkjke vy uhuk çxfr dk çjfhkd l dr gA ;g if'peh ç'kkr {k= e io dh vkj cgko d fy, xe ikuh dk l {ke cukrk gA bl çdkj if'pe ç'kkr d Hkhrj ncko c< tkrk g vkj vf/kdre ncko d l kFk io e de gk tkrk g vkj dæh; ç'kkr ij VV tkrk gA Hke/; j[kh; mFky&iFky d detkj gku l] lrg dk ikuh nf{k.k vefjdk d rV d l kFk xe gk tkrk g] io&if'pe leæh lrg <ky e vkj fxjkoV vk,xh vkj 0; kifikjd gok, vkj Hkh detkj gk tk,xhA

iHkko% gkykfd] ,y uhuk dh mRifUk m".kdfVc/kh; ç'kkr {k= e gkrh g] ;g nfu; k Hkj e ek le ek le vkj tyok; ikfjLFkfrd] lkekftd vkj i; koj.kh; {k=k ij çHkko Mkyrk gA lfn; k d nkjku ¼tu l vxLr½ e 30° vkj 35°s v{k'k d chp vk l r l vf/kd o"kk dk =>ku ,y d nkjku n[kk tkrk gA uhuk boV l] tcf d yk&uhuk boV l ¼e,UVfduk vkj ,f lVuk] 2003½ d nkjku uhp&vk l r o"kk dh çofUk fof'kV gA vy uhuk dh ?kVuk, leæ dh lrg d rkieku dk c<krh g tk ok; eMyh; gok vkj ncko iVu ij xHkhj çHkko fn[kkrh gA gok] ncko d rkieku vkj o"kk d iVu e bu vrjk dk —f'k] okfudh] ifjogu cfu; knh <kp vkfn ij çHkko iMrk gA fy l k xkMkM ,V vyA] b,u, l vk dh ?kVukvk u lkekftd : i l mRiUu lkekftd vkfFkd vkinvk dk vjck M,yj d nfl ; k of'od vkfFkd ud l ku e ; kxnku fn; k ¼fy l k xkMkM ,V vy-] 2005½A bl dMh e eyfj; k] Mx vkj ?kVh c[kkj t l dN oDVj tfur jxck d rho [krj l lcf/kr LokLF; {k= ij Hkh egRoi.k çHkko iMk gA

of'od ekle ij% m".kdfVc/kh; ekle vkj tyok; e leæh vkj ok; eMyh; ifj l pj.k d vrj d dkj.k db ifjoru gkr gA ENSO d çHkko dk vD l j m".kdfVc/kh; tyok; d ckn l l h/k n[kk tkrk gA ENSO boV fo'o dh fupyh v{k'k ij tyok; e o"k nj o"k ifjoru'khyrk d lcl egRoi.k lkr g ¼cFkyh ,V vy-] 2006½A vrfjå

m".kdfVc/kh; {k=k ¼XyVt ,V vy-] 1991½ d Hkhrj db VyhdudV l dk o.ku fd; k x; k FkA jkiyOLdh ,V vy-] u le>k; k fd nfu; k d db m".kdfVc/kh; Hkfe {k=k e l [k dh ?kVuk] vy&uhuk ?kVuk dk ,d : i g tk voykdu&vk/kkfjr fo'y" k.kk l v/; ;u fd; k x; k g ¼jkiyOLdh vkj gYiV] 1987(elu vkj xkMkM] 2001½A lcf/kr {k= d Hkhrj jgu oky ekuo dk , l l [k d dBkj ifj.kkek dk lkeuk djuk iMrk g] dHkh&dHkh ;g xHkhj Hkh gk ldrk g ¼Y; ku ch] 2006½A ENSO dk ,d xHkhj ifj.kke ;g g fd LFkyh; cuke leæh lkrk d lki{k ; kxnku dk blyj [kk] tky ¼LVi ,V vy-] 1999½ e fhkUu fd; k tk ldrk gA

nf{k.k vefjdk% ENSO dh ?kVukvk] nf{k.k vefjdk e nk rjhd l vuHko fd; k tkrk g] ,½ bl d çHkko l nuk leæ ç.kkfy; k vkj ok; eMy ij] vkj ch½ çk—frd ikfjLFkfrd r= ¼leæh vkj LFkyh; nukuk½ vkj —f'k ¼t l —f'k½ ij bl d çHkko d ek/; e l eRL; ikyu] LokLF; ¼ lVkl t- ,y] 2006½A vy uhuk ?kVuk dk v l j nf{k.k vefjdk d dN {k=k t l fd ckthy d iokUkj] vekt kfu; k] ckthy d nf{k.k vkj m#Xo ¼dM l k , - vk ,V vy-] 2006½ ij gk ldrk gA bDokMkj vkj mUkj h i : d nf{k.kh rV d Hkhrj fo'ke o"kk vkj unh dh ck< dh ek=k vy uhuk ?kVukvk ¼v,fVyc] 2000½ dh rkdr dk lcl egRoi.k l drd cuh gb gA nf{k.k vefjdk e ENSO }kj k o"kk dk çHkko bl tyok; dh ryuk e fem&gkyk l hu d Hkhrj de Fkk] tk ENSO çHkko dk LFkfkud forj.k theto vof/k; k ¼t t êh-] ,V vy] 2006½ d Hkhrj dkQh fhkUu gA nf{k.k vefjd h gkbMk&DykbeVky, th l dkjRed ¼, y uhuk½ vkj fofhUu rjhd l ,y uhuk nf{k.kh vk l ou dh udkjRed ¼yk uhuk½ ?kVukvk ¼jkiyOLdh vkj gYiV ¼1987½] f lVuk ¼1988½ oby ¼1999½ oyu }kj k cgr =Lr gA vkj ikonk ¼2002½A v/; ;uk l irk pyk fd ENSO vkj lcl egRoi.k nf{k.k vefjd h ufn; k d unh fuogu d chp Hkh lglc/k ektn gA vetu vkj ijuk ¼fjph ,V vyA ¼1989½ vej l dj k ,V vy- ¼1997½A mUkj&e/; fpyh ¼fofnyk ,V vy] 1999] vkfyokj l vkj f l dk] 1999] gkYexu ,V vy-] 2006½ e rVh; jfxLrkuh ikfjLFkfrd r=k d fy, cj l kr vy uhuk o"kk d nkjku l ;= mRikndrk e of) dk l fpr fd; k x; k gA ,ub ckthy e] ,y uhuk dk ykdfç; : i l xHkhj l [k d dkj.k tkuk tkrk g ¼du] 2006½A

mUkj h vefjdk% ,y uhuk dukMk d fy, prj ych njh dh lfn; k d iokueku cuku dk lcl vPNk ekdk çnku

djrk g ¼ "kCc j ,.] 2006½A gkykfd] mÜkj h vefjdk e ,y uhuk d çHkko detkj vkj vf/kd ijLij g ¼>km okx ,V vy-] 2007½A 20 oh 'krkCnh dh lcl etcr ,y uhuk ?kVuk, 1982&83 vkj in 1997&98 e gb d ifj.kke 1982&83 e ij nf{k.k if'pe e egRoi.k rQku vkj v,LVfy;k e lnh d lcl [kjkc l[k e l ,d 'kkfey FkA

,f'k;k] ;jki vkj v,LVfy;k tc ,y uhuk ?kVuk gkrh g] rk if'peh ç'kkr {k= d Hkhrj o"kk dh io dh vkj cnyko gkrk g] tk v,LVfy;k] fQyhih l] bMkuf'k;k vkj Hkkjr t l if'peh ç'kkr {k= e o"kk dh deh dk dkj.k curk g tk xHkhj l[k dk vuHko djxk] tcf d dæh; ç'kkr }hi leg vf/k'k'k o"kk ¼fedh ,V vy-] 2011½ dk vuHko djr g A Hkkjr d yxHkx vk/k l[k bl ?kVuk ¼—iykuh vkj vf'ouh dyd.kh 1998½ l tM gA Hkkjr dh ikjLifjd ifjoru'khyrk d fy, mÜkjnk;h ckjgh dkj d e l ,d Hkkjrh; xh"edkyhu ekulu o"kk ¼f lrcj d ek/;e l tu½ ;g g fd ,y uhuk ?kVukA ;|fi tyok; lc/kh 'k#vkr dh rkjh[k {k=k d l kFk fHkUu gkrh g] yfdu ,f'k;k d vf/kd'k fg l k e {k=h; ekulu dh 'k#vkr dh okf"kd ifjoru'khyrk vkf"kd : i l ENSO ¼tk l Q ,V vy 1994] ykm vkj ;kx 1997] o vkj okx 2000] >kx ,V 2002] ekvk vkj o 2007½ l ihfMr gA ;jkih; egk}hi m".kdfVc/kh; ç'kkr egk l xj l nj ik;k tkrk g] gkykfd] ENSO d tyok; lc/kh ifjoruk dk vHkh Hkh eg l l fd;k tk l drk g (Wilby, 1993; Fraedrich,1994; Van Olden borgh *et al.*, 2000)A ,d fof'k"V ,y uhuk d nkjku] ,f'k;k; kb ekulu vkerkj ij detkj gk tkrk g vkj Hke/; j[kk dh vkj /kdy fn;k tkrk g] tk vD l j Hkkjr d mÜkj&if'pe vkj e/; {k=k e xeh dk l[kk yrk g vkj mÜkj&io d Hkhrj Hkkjh o"kk gkrh gA

Hkkjrh Hkkjr d vf/kd'k Hk;dj l[k ,y uhuk ?kVukvk ¼jkt ho vkj ikb] 2006½ d lg;kx l g,A 1950 d ckn l] 23 vy uhuk lky gk x, g vkj doy 13 l[k lky vkj mue l rhu l[k xj&,y uhuk lky e FkA gkykfd] 1980 d ckn l] l Hkh Hkkjrh; l[k ,y uhuk d o"kk d Hkhrj g,] yfdu l Hkh ,y uhuk o"kk l[k ¼'ork luh vkj v'kkd] 2003½ e leklr ugh g,A ,y uhuk l lcf/kr VyhdK'D'k l fgn egk l xj l ¼Dyu ,V vy-] 1999] erxM vkj c l kykph] 1999] th ,V vy-] 2009½ d lex okfex e leklr gkr g] D;kfd cnyr ckny vkj gok d iVu d dkj.k tk c<r g, ifjoru l lcf/kr gA okdj lpyu dh vojkg h 'kk[kk, ¼Mî ,V vy-] 2009] dkj.k ,V vy-]

2000] ot d ,V vy-] 2000½A pje 1997 i,ftfVo IOD / vy uhuk ?kVuk dk io h bDoVkfj;y fgn egk l xj d Hkhrj ,d etcr QkbVklkydVu f[kyu dh fo'k"rk FkA ,d iMkl tk vkerkj ij de mRikndrk ¼erxM ,V vy-] 1999] l lkrk vkj ekj] 2005½ }kjk fo'k"rk gA 1997 dh ?kVuk d vU; çyf[kr çHkko e vjc l xj l l jek] 2006½ d Hkhrj lrg Dykj k fQy dh deh 'kkfey Fkh] tk bl {k= d nkjku ,deku l ,deu ifix d dkj.k] cxy dh nf{k.k io h [kkMh d Hkhrj ,d f[kyu okyh fo"ke mÜkj h gokvk d dkj.k Fkh ¼fouk;pæu vkj eF;] 2003½A v'kkd oxjg ¼2001½ u fn[kk;k g fd IOD vkj ENSO u fiNy pkj n'kdk d nkjku Hkkjrh; xh"edkyhu ekulu o"kk dk ijd : i l çHkfor fd;k gA lkeu vkj flyxk ¼1997½ u fn[kk;k g fd bMkuf'k;k d Åij m".kdfVc/kh; logu vkj blfy, olr d ek le ¼ekp l eb½ d nkjku if'peh ç'kkr Hkkjr e e,ulu dh 'k#vkr e egRoi.k Hkfedk fuHkkrk gA

LokLF; ij½ v/; ;uk dh c<rh l[;k l irk pyk g fd vy uhuk pØ dk ePNjk eyfj;k vkj Mx vkj vU; arboviruses (Sari Kovats *et al.*, 2009½ t l ePNjk l Qyu okyh chekfj;k d tkf[ke e ifjoru d l kFk dgk tkrk gA ePNjk vkj —Urdr l Qyu oky jkx pje ?kVukvk d ckn etcr gk l dr g] fo'k"rk : i l ENSO ?kVukvk ¼, iLVhu ,V vy] 1995½ d l kFk feydj ck<(vkj eyfj;k dh bDoMkj vkj i : egkekjh e ,y uhuk ?kVuk ¼edfedv vkj gu l] 1997½ d l kFk ck< l lcf/kr fn[kkb nr gA bMkuf'k;k d if'pe dkyheru e NkV xkok e l[k d çHkko ij fd, x, ,d v/; ;u e ik; k x;k; fd —f" k vFk0; oLFkk (Salafsky, 1994½ d dkj.k LokLF; l eL;k, c< jgh gA ckfyfo;k ¼Vyfj;k] 1986½ vkj i : ¼x,jh ,V vy-] 1986½ e rho Mk;fj;k jkxk vkj xHkhj 'o l u jkxk dh vkofÜk d Hkhrj of) n[kh xb FkA oDVj tfur jkx l pj.k vkj ,y uhuk d chp tMko d ckj e l keU;hdj.k vk l ku ugh g] D;kfd LFkkuh; l pj.k LFkkuh; oDVj çtkfr;k dh ikfjLFkfrdh ij fuHkj djrk g] ftud le; vkj o"kk dh ek=k e fHkUurk gk l drh gA

leah thou ij½ ,y uhuk dh otg l if'peh nf{k.k vefjdk d rV l tfod mRikndrk de gk xb g] tk BM ikuh d cgko dk de djrk gA jh tuy LVMh t ck;ky,t h ,M fQ'kjh t] ¼ykyj l] 1989½ d b,u, l vk d ifj.kkek ij 'kk/kdrkvk }kjk {k=h; v/; ;u fd, x, gY l ,V vyA fjikv fd, x, fl xkjV k eNyh d tgj dh okf"kd ?kVuk d chp ,d lc/k ik;k x;k vkj blfy, nf{k.k ç'kkr d Hkhrj dN }hik e ,l vkvb tgg ,y uhuk mPp , l , l Vh

gYl ,V vy-] 1999 ch½ l lcf/kr gA dN lcrk l irk
pyrk g fd gkfudkj d rVh; 'koky f[kyu dk vflrRo
vkj çl kj vy uhuk ¼VLVj] 1994] gYyxk,Q] 1993-] gn]
1998½ dgk tkrk gA b,u,lvk o"kk l lcf/kr çkFkfed
mRikndrk e vk'p; tud of) e ouLifr çtkfr;k d
cht d vkj vkj cht mRiknu e rth l of) 'kkfey
g xfrjt ,V vy] 1999½A ç'kk {k= d ikfjLFkfrdh r=
ij ,y uhuk dk çHkko [ky leæ l ydj mÜkj vkj nf{k.k
vefjdk d if'pe rVr rd gkrk g vkj ble n;uh;
lenk; ¼,y- yfou ,V vy] 2002½ Hkh 'kkfey gA vy
uhuk d nkjku] ioh vkj e/; ç'kk d Hkhrj Hke/;j[kh;
mFky&iFky dk nck fn;k tkrk g] bl çdkj lrg ij vkj
2 dh miy/krk de gk tkrh g ¼vkj- ,yh ,yh vy-] 2006½A
1982&1983 d ,y uhuk l igy ;g lkpuk vke Fkk fd
ENSO ?kVukvk dk doy udkjRed çHkko FkkA vul/kku]
fo'k" : i l leæh mFky xgjk b e ldkjRed çHkko Hkh
fn[kk;k g ¼Vkj tkuk ,V vy-] 2001½A

m".kdfVc/kh; pØokrk ij ,y uhuk dh ?kVukvk d
ifj.kkeLo: i nfu;k Hkj e ek le d iVu e cnyko gkr
g vkj vVykfVd rQku xfrfof/k e deh vkj if'peh
ç'kk pØokrk xfrfof/k dh ,d ioorh ikjh lfrg
m".kdfVc/kh; pØokrk xfrfof/k dh ?kVuk vkj rhork dk
çHkfor djr gA bl çdkj] VkbQu] ,y uhuk ¼LiMeu
vkj ek l dj] 1995½ d nkjku ek'ky }hi] ç'kk d ik l
gku dh ryuk e 2-6 xuk vf/kd g] D;kfd ,y uhuk dh
?kVuk, rQku dk ç'kk d Hkhrj if'pe e LFkkukrfjr
djr gA ;g dkQh vPNh rjg l le>k tkrk g fd
m".kdfVc/kh; pØokrk ENSO ¼yMI;] 1999(Saunders
et al., 1999½ l d l ifMr gA

fopkj&foe' ,y uhuk leæ dh lrg d chp ckrphr
l ,d çk—frd folxfr ifj.kke gk ldrk g vkj blfy,
og okrkoy.k ft l d lFk ge ekiuk pkgr gA ; [fi] ;g
?kVuk çR;d dN o"kk d fy, gkrh g] fudV Hkfo"; e
bl d çHkko egRoi.k gkr gA

• ,y uhuk d çHkko ij xg ij eg l l fd, tkr g] tgk
l keU; ek le dh #dkoV d n[kn lkekftd&vkfFd
ifj.kke gk ldr gA t l gh xe ikuh io dh vkj c<r
g] c<h gb xeh vkj ueh ok;eMy e c< tkrh g] ok;eMyh;
ifjLFkfr;k dk l'kkf/kr djrk g tk Øfed : i l nfu;k
Hkj e ek le ç.kkyh dk çHkfor dj ldrk gA

• nf{k.k&io ,f'k;k vkj if'peh ç'kk {k= e xHkhj çHkko
fn[kku oky of'od ek le ij bldk 0;kid çl kj çHkko

gA ;g nf{k.k io ,f'k;k e ekulu d ek le d nkjku
vl kekU; : i l de o"kk dk dkj.k curk gA

• ,y uhuk ,fi l kM dk {k=h; ek le vkj Qly dh inkokj
ij xHkhj çHkko iMrk g ft l d vkfFd ifj.kke gkr gA
Hkkr e] ,y uhuk dk vkerkj ij l [k dk dkj.k ekuk tkrk
gA i : vkj fpyh e ck< bl ?kVuk d çHkko d dkj.k gA
• db m".kdfVc/kh; {k=k e l [k dk fodk l vy uhuk d
çHkko d fy, /kU;okn gA ,y uhuk ?kVuk d nkjku if'pe
ç'kk {k= d Hkhrj o"kk dh ioorh ikjh if'peh ç'kk {k=
e o"kk dh deh dk dkj.k curk g tk xHkhj l [k dk vuHko
djxh tcf d e/; ç'kk }hik e vf/kd o"kk dk vuHko
gkrk gA

• ;g vR;f/kd ek le d [krj dk c<krk g yfdu ekuo
LokLF; ij Hkh vf/kd l {e çHkko Mkyrk gA ;g gkfudkj d
rVh; vYxy f[kyu d vflrRo vkj çl kj l Hkh tMk gvk
gA

• ;g ioh ç'kk d Hkhrj tfod mRikndrk vkj eRL;
ikyu dk Hkh çHkfor djrk gA ,d ,y uhuk ,fi l kM d
nkjku] xe ikuh dk jx Åij mBu dh fof/k l VV tkrk
g blfy, QkbVkykdVu dh fo/kku l Hk cgr de gk
tkrh g vkj blfy, eNyh BM {k=k e pyh tkrh gA

fu"d"k

• ,y uhuk ?kVuk, cMh tyok; xMcMh g tk Hke/;j[kh;
ç'kk egk l xj d Hkhrj mRiUu gkrh gA vkerkj ij gj 2
l 8 lky e iujkofÜk gkrh gA

• ,y uhuk ,fi l kM e/; vkj ioh m".kdfVc/kh; ç'kk
{k= e fofp= xe ikuh d yxu l lcf/kr g tk xg d cM
fg l l ij xHkhj çHkko Mkyrk gA

• vy uhuk dk 0;kikj lpyu d l kekU; iVu e cnyko
d dkj.k ekuk tkrk gA

• ,y uhuk d çe[k çHkko rkieku folxfr;k g] ij xg
e o"kk ifjoru'khyrk] ck< vkj l [k e ifjoruA

• ;g oDVj tfur jkxk d c<r [krj l lcf/kr gA

• vf/kdk'k ?kkfV;k e m".kdfVc/kh; pØokrk dh vkofÜk
Hkh ,y uhuk ij fuHkj djrk gA

l nHk

Aceituno, P. (1988) On the functioning of the Southern
Oscillation in the South American sector, part
I: surface climate, Mon. Wea. Rev., 116, 505–
524, .

Amarasekera, K. N., Lee, R. F., Williams, E. R., and
Eltahir, E. A.B. (1997) ENSO and the natural
variability in the flow of tropical rivers, J.
Hydrol., 200, 24–39, .

- Ashok, K., Guan Z, Yamagata T: Impact of the Indian Ocean Dipole on the relationship between the Indian monsoon rainfall and ENSO, *Geophys. Res. Lett.*, 28, 4499–4502, doi: 0.1029/2001GL01329, 2001.
- Bartholy, J. and Pongracz, R. (2006). Regional effects of ENSO in Central/Eastern Europe, *Advances in Geosciences*, 6, 133–137.
- Bjerknes, J. (1966). A possible response of the atmospheric Hadley circulation to equatorial anomalies of ocean temperature. *Tellus*, 18, 820829.
- Bjerknes, J. (1972). Large-scale atmospheric response to the 1964-65 Pacific equatorial warming. *J. Phys. Oceanography*, 2, 212-217.
- Bjerknes, J. (1969). Atmospheric teleconnections from the equatorial Pacific. *Mon. Wea. Rev.* 97, 163-172.
- Block, M. A. and Richter, M. (2000). Impacts of heavy rainfall in El Niño 1997/98 on the vegetation of Sechura Desert in Northern Peru, *Phytocoenologia*, 30, 491–517.
- Cardoso, A. O., and Silva Dias P. L. (2006). The relationship between ENSO and Paraná River flow. *Advances in Geosciences*, 6, 189–193.
- Dijkstra, H. A (2006). The ENSO phenomenon: theory and mechanisms. *Advances in Geosciences*, 6, 3–15.
- Dillon, M. O. and Rundel, P.W. (1990). The botanical response of the Atacama and Peruvian desert floras to the 1982–83 El Niño event, in *Global Ecological Consequences of the 1982–83 El Niño Southern Oscillation*, edited by: Glynn, P. W., Elsevier Oceanographic Series 52, p. 487–504, Amsterdam, .
- Doberitz, R. (1968). Cross-spectrum analysis of rainfall and sea temperature at the equatorial Pacific Ocean. *Bonner Meteor. Abhand.*, 8, 61 pp. .
- Du, Y., Xie, S.-P., Huang, G., and Hu, K. (2009). Role of air–sea interaction in the long persistence of El Niño–induced north Indian Ocean warming, *J. Climate*, 22, 2023–2038, doi:10.1175/2008JCLI2590.1.
- Epstein, P., Penna, O., and Racedo, J. (1995). Climate and disease in Colombia, *Lancet*, 346, 1243.
- Feely, R.A. et al., (2006) *J. Geophys. Res.* 111, C08S90, doi: 10.1029/2005JC003129.
- Flohn, H., and Fleer, H. (1975). Climate teleconnections with the equatorial Pacific and the role of ocean /atmosphere coupling. *Atmosphere*, 13, 96-107.
- Flores, M. J. (1989). Incidencia de los Fenomenos “El Niño” en la Extracción de Recursos Pesqueros Marinos de la Pesquería Peruana en el Periodo 1950–1987, *Memorias del Simposium Internacional de los Recursos Vivos en las Pesquerías del Pacífico Sudeste*. Comisión Permanente del Pacífico Sur., 467–476,
- Fraedrich, K. (1994). An ENSO impact on Europe – A Review, *Tellus*, 46A, 541–552.
- Glantz, M. H., Katz, R. W., and Nicholls, N. (Eds.) (1991). *Teleconnections Linking Worldwide Climate Anomalies*, Cambridge University Press, New York, NJ.
- Gueri M, Gonzalez C and Morin V (1986): The effect of the floods caused by “El Niño” on health. *Disasters*, 10, 118–124.
- Gutierrez, J. R., Vidiella, P. E., Armesto, J. J. (1999). Vegetation change and sequential flowering after rain in the southern Atacama Desert, *J. Arid Environ.*, 43, 449–458.
- Hales S, Weinstein P and Woodward, A.(1999b). Ciguatera fish poisoning, El Niño and Pacific sea surface temperatures. *Ecosystem Health*, 5, 20–25 .
- Hallegraeff, G.M. (1993). A review of harmful algal blooms and their apparent increase. *Phycologica*, 32, 79–99.
- Hamman, O. (1985). The El Niño influence on the Galapagos vegetation, in: *El Niño en las Islas Galápagos: el evento de 1982–1983*, edited by Robinson, G. and Del Pino, E. M. Fundación Charles Darwin para las Islas Galápagos, Quito, p. 299–330.
- Heed, Marine Ecosystems (1998). *Emerging Diseases as Indicators of Change. Year of the Ocean Special Report: Health of the Oceans from Labrador to Venezuela. Health and Ecological Dimensions of Global Change Program.*
- Holmgren, M., Stapp P., Dickman, C.R., Gracia, C., Graham, S., Gutiérrez, J. R., Hice, C., Jaksic, F., Kelt, D. A., Letnic, M., Lima, M., Lopez, B.C. Meserve, P. L., Milstead, W. B., Polis, G. A., Previtali, M. A., Richter, M., Sabaté, S., and Squeo, F. (2006). A synthesis of ENSO effects on drylands in Australia, North America and South America, *Adv. Geosci.*, 6, 69–72.
- Hurlburt, H.E. John C. Kindle., and James J. O’Brien (1976). A numerical simulation of the onset of El Niño. *Journal of Physical Oceanography*, Vol. 6, NO. 5 .
- Ichiye, T., and Petersen (1975). The anomalous rainfall of the 1957-58 winters in the equatorial central

- Pacific arid area .J. Meteor. Soc. Japan, 41, 172-182, .
- Jorgetti, T., Silva Dias, P.L., and P. Braconnot, P.,(2006). Review of: El Niño influence over South America during the mid-holocene. *Advances in Geosciences*, 6, 279–282.
- Joseph, P.V, Eischeid, J. K. and Pyle, R.J. (1994). Interannual variability of the onset of the Indian monsoon and its association with atmospheric features El Niño, and sea surface temperature anomalies J. Clim. 7 81–105.
- Julian, P.R., and Chervin, R.M. (1978). A study of the Southern Oscillation and Walker Circulation phenomena. *Mon. Wea. Rev.*, 106, 1433-1451.
- Kane, R.P (2006). El Niño effects on rainfall in South America: comparison with rainfalls in India and other parts of the world. *Advances in Geosciences*, 6, 35–41.
- Klein, S. A., Soden, B. J., and Lau, N. C.(1999). Remote sea surface temperature variations during ENSO: Evidence for a tropical atmospheric bridge, *J. Climate*, 12, 917-932, doi:10.1175/15200442011285–1327, 2<0917:RSSTVD>2.0.CO;2, 1999
- Kripalani, R.H. and Ashwini Kulkarni(1999). No Droughts over India Following Very Strong El Niño Episodes Vol. 10, No. 2, June .
- Levin L. et al., *Prog. Oceanogr.* 53, 1 (2002).
- Landsea CW: El Niño Southern Oscillation and the seasonal predictability of tropical cyclones. In: Diaz HF and Markgraf V (eds) *El Niño and the Southern Oscillation: Multiscale Variability and Global and Regional Impacts*. Cambridge, Cambridge University Press, 1999.
- Lau K.M and Yang, S.:Climatology and interannual variability of the Southeast Asian summer monsoon *Adv. Atmos. Sci.* 14 141–62, 1997.
- Lisa Goddard and Maxx Dilley: *El Niño: Catastrophe or Opportunity*. American Met. Society, . journal of climate, Vol 18, 2005.
- Lyon B. (2006). Robustness of the influence of El Niño on the spatial extent of tropical drought. *Advances in Geosciences*, 6, 207–209.
- Mao, J. and Wu, G. (2006). Interannual variability in the onset of the monsoon over the Eastern Bay of Bengal *Theor. Appl. Climatol.* 89 155–70.
- Mason, S. J. and Goddard, L.(2001). Probabilistic precipitation anomalies associated with ENSO, *Bull. Am. Meteor. Soc.*, 82, 619–638.
- McMichael, A. and Haines, A.(1997) Global climate change: the potential effects on health, *British Medical Journal*, 315, 805–809.
- Messiner, R. (2000). The impact of El Niño on water resources.Future challenges of providing highquality water. Vol-II.
- Mike Davey, Dr.Matt Huddleston, Dr.Anca Brook Shaw, (2011). Global impact of El Niño and La Niña 3 Implications for financial markets, May .
- Montecinos, A. and Aceituno, P. (2003). Seasonality of the ENSO-Related Rainfall Variability in Central Chile and Associated Circulation Anomalies, *J. Climate*, 16, 281–296.
- Murtugudde, R. and Busalacchi, A. J. (1999). Interannual variability of the dynamics and thermodynamics of the tropical Indian Ocean, *J. Climate*, 12, 2300– 2326, doi:10.1175/15200442.
- Namias, J.(1976). Some statistical and synoptic characteristics associated with El Niño .*J. Phys. Oceanogr.*, 6, 130-138.
- Olivares, S. and Squeo, F.A.(1999) Patrones fenológicos en especies arbustivas del desierto costero del norte-centro de Chile, *Revista Chilena de Historia Natural*, 72, 353–370.
- Ortlieb, L. (2000) The Documented Historical Record of El Niño Events in Peru: An Update of the Quinn Record (Sixteenth through Nineteenth Centuries), in: *El Niño and the Southern Oscillation*, Cambridge University.
- Philander S. G. H., Pacanowski, R. C. (1981). *Tellus* 33, 201-210 pp.
- Philander, G. (1990) *El Niño, La Nina, and the Southern Oscillation*, Academic Press, United States of America, 293p.
- Polis, G. A., Hurd, S.D., Jackson, C. T., and Sanchez Pinero, F. (1997). El Niño effects on the dynamics and control of an island ecosystem in the Gulf of California, *Ecology*, 78, 1884–1897.
- Quinn, and W. Burt,(1972). Use of the Southern Oscillation in weather prediction. *J. Appl. Meteor.*, 11, 616-628.
- Quinn, W. N. (1974) Monitoring and predicting El Niño invasions .*J. Appl. Meteor.*, 13, 825-830.
- Rajeevan, M. and Pai, D.S. (2006). On El Niño- Indian Summer Monsoon Predictive Relationships. Res. Rep. No 4/2006. National Climate Centre, India Meteorological. Department, Pune – 411 005. Pp-20.
- Reason, C. J. C., Allan, R. J., Lindesay, J. A., and Ansell, T. J.: ENSO and climatic signals across the Indian Ocean Basin in the global context: Part I, interannual composite patterns, *Int. J. Climatol.*, 20, doi:10.1002/10970088(200009)20:11<1285::AID-JOC536>3.0.CO;2-R, 2000

- Reiter, E.A., (1978a). Long-term wind variability in the tropical pacific; its possible causes and effects. *Mon. Wea. Rev.*, 106, 324-330.
- Richey, J. E., Nobre, C., and Deser, C. (1989). Amazon River discharge and climate variability: 1903–1985, *Science*, 246, 101–103.
- Ropelewski, C. F. and Halpert, M. S. (1987). Global and regional scale precipitation patterns associated with the El Niño/Southern Oscillation, *Mon. Wea. Rev.*, 115, 1606–1612.
- Rowntree, P.R., (1972). The influence of tropical east Pacific Ocean temperature on the atmosphere. *Quart. J. Roy. Meteor. Soc.*, 98, 290-321.
- Salafsky, N., (1994). Drought in the rain forest: effects of the 1991 El Niño/Southern Oscillation event on a rural economy in West Kalimantan, Indonesia. *Climatic Change*, 27, 373–396.
- Santos, J. L. (1999). El Niño and La Nina: A Climate Oscillation, on: El Niño Event in Ecuador: From Disaster to Prevention, Comitato Internazionale per lo Sviluppo dei Popoli, 205 pp.
- Santos, J.L. (2006). The Impact of El Niño – Southern Oscillation Events on South America. *Advances in Geosciences*, 6, 221–225.
- Sari Kovats, R., Menno J Bouma Andy Haines El Niño and Health (2009). Protection of the Human Environment Task Force on Climate and Health Geneva 1999, WORLD HEALTH ORGANIZATION WHO/SDE/PHE/99.4.
- Sarma, V. V. S. S. (2006). The influence of Indian Ocean Dipole (IOD) on biogeochemistry of carbon in the Arabian Sea during 1997–1998, *J. Earth Syst. Sci.*, 115, 433–450, doi:10.1007/BF02702872.
- Saunders, M.A., and Roberts, F. (1999). El Niño's impact on landfalling intense tropical cyclones. In: *Proceedings of the 23rd Conference on Hurricanes and Tropical Meteorology*, 10–15 January 1999, Dallas, Texas, pp. 274–275.
- Shabbar, A., (2006). The impact of El Niño-Southern Oscillation on the Canadian climate. *Advances in Geosciences*, 6, 149–153.
- Shweta Saini and Ashok Gulati: El Niño and Indian Droughts- A Scoping Exercise. Indian Council for Research on International Economic Relations.
- Soman MK, Slingo J (1997). Sensitivity of the Asian summer monsoon to aspects of sea surface temperature anomalies in the tropical Pacific Ocean. *Q J R. Meteorol. Soc.* 123:309-336.
- Spennemann, D.H.R., and Marschner, I.C., (1995). The association between El Niño/Southern Oscillation events and typhoons in the Marshall Islands. *Disasters*, 19, 194–197.
- Stapp, P., Polis, G. A., and Sanchez Pinero, F. (1999). Stable isotopes reveal strong marine and El Niño effects on island food webs, *Nature* 401, 467–469.
- Susanto, R. D. and Marra, J. (2005). Effects of the 1997/98 El Niño on chlorophyll a variability along the southern coasts of Java and Sumatra, *Oceanography*, 18, 124–127.
- Tarazona, J., Arntz, W., and Castillo, E. (Eds.): (2001). *El Niño in Latin America: Biological and Social Impacts*, Alfred Wegener Institute, ISBN 9972-50015-2, 423 pp.
- Telleria, A.V., (1986). Health consequences of floods in Bolivia in 1982. *Disasters*, 10, 88–106.
- Tester, P.A., (1994). Harmful marine phytoplankton and shellfish toxicity: potential consequences of climate change. *Annals of New York Academy of Sciences*, 740, 69–76.
- Van Oldenborgh, G. J., Burgers, G., and Klein Tank, A. (2000). On the El Niño teleconnection to spring precipitation in Europe, *Int. J. Climatol.*, 20, 565–574.
- Venzke, S., Latif, M., and Villwock, A. (2000). Coupled GCM ECHO-2. Part II: Indian Ocean response to ENSO, *J. Climate*, 13, 1371–1383.
- Vinayachandran, P. N. and Mathew, S. (2003). Phytoplankton bloom in the Bay of Bengal during the northeast monsoon and its intensification by cyclones, *Geophys. Res. Lett.*, 30, 1572, doi: 10.1029/2002GL016717.
- Vuille, M., (1999). Atmospheric circulation anomalies over the Bolivian Altiplano during dry and wet periods and extreme phases of the Southern Oscillation, *Int. J. Climatol.*, 19, 1579–1600.
- Walker, G.T., World Weather IX. Mem. Walker, G.T., and Bliss, E.W. (1932). World Weather. IV. *Mem. Roy. Meteor. Soc.*, 4, 119-139.
- Walker, G.T., and Bliss, E.W., (1937). World Weather. V. *Mem. Roy. Meteor. Soc.*, 4, 53-84.
- Walker, G.T., (1924). World weather IX, Mem., Meteor. Dept 24, 275-332, .
- Walker, G.T., (1928). World weather III, Mem Roy. Meteor. Soc., 17, 97-106.
- Walker, G.T., (1923). Correlation in seasonal variations of weather VIII. Mem. I. Meteor. Dep, 24, 75-131.
- Wang, and Picaut, J., (2004). Understanding ENSO Physics—A review. *Earth's Climate: The*

- Ocean– Atmosphere Interaction, C. Wang, S.-P. Xie, and J. A. Carton, Eds., Amer. Geophys. Union, 21–48, .
- Waylen, P. and Poveda, G. (2002). El Niño-Southern Oscillation and aspects of western South American hydro-climatology, *Hydrol Process.*, 16, 1247– 1260, .
- White, W.B. and Walker, A.E., (1973). Meridional atmospheric teleconnections over the North Pacific from 1950 to 1972. *Mon. Wea. Rev.*, 101, 817-822 .
- Wilby, R. (1993). Evidence of ENSO in the synoptic climate of the British Isles since 1880, *Weather*, 48, 234–239.
- Wooster, W.S., and O.Guillen, (1974). Characteristics of El Niño in 1972.*J.Marine Res.*,32,387-404.
- Wu, R., and Wang B., (2000). Interannual variability of monsoon onset over the western North Pacific and the underlying processes *J. Clim.* 13 2483–501, .
- Wyrtki, K., (1975). El Niño-the dynamic response of the equatorial Pacific Ocean to atmospheric forcing. *J. Phys. Oceanogr.*, 5, 572-584, .
- Xie, S. P., Hafner, J., Tokinaga, H., Du, Y., Sampe, T., and Hu KaiMing, H. G. (2009). Indian Ocean capacitor effect on Indo-western Pacific climate during the summer following El Niño, *J.Climate*,22,730–747,doi:10.1175/2008JCLI2544.1.
- Zhang, Y., Li, T., Wang, B., and Wu, G. (2002). Onset of the monsoon over the Indochina Peninsula: Climatology and inter annual variations *J. Clim.* 15 3206–21, .
- Zhuo Wang and C.-P. Chang Bin Wang (2007). Impacts of El Niño and La Niña on the U.S. Climate during Northern Summer, *Journal of Climate* Volume 20,.