भाकृअनुप
ICAR

वार्षिक प्रतिवेदन

Annual Report
2016-17

भा.कृ.अनु.प.–भारतीय कृषि प्रणाली अनुसंधान संस्थान
मोदीपुरम, मेरठ–250 110 (यू.पी.)

ICAR-Indian Institute of Farming Systems Research
Modipuram, Meerut - 250 110 (U.P.)

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PREFACE

Scientifically designed integrated farming systems play significant role in providing sustainable livelihood to marginal and small households as the existing naturally systems do not provide sufficient round the year production and income to meet the requirement of relatively larger family size of these households. It is evident from the on-farm farming systems study that although 38 farming systems are present, three systems namely crop + dairy (49.2 % marginal households), crop + dairy + goat (12.8 %) and crop + dairy + poultry (8.2 %) are predominantly adopted by marginal households in the country. The number of components integrated is observed to be up to 5 depending upon the location, resources and social acceptability. These households are also having mean family size of 4 to 5 indicating availability of at least 900 man days per year for the farm work. Crop and dairy are the most obvious components across the agro climatic regions except Eastern Himalayas where a dairy component is lacking in the dominant farming system. Existing farming systems productivity and profitability is hampered by increased market dependency and declining factor productivity.

Institute has undertaken various research activities under institute programmes, AICRP and NPOF network with an aim to improve the productivity of existing systems and profitability. In this endeavour, established 38 region specific on station integrated farming systems modelsin 14 agro climatic regions for research, extension, education and business (bankable projects). Around 8860 farmers have visited these models and adopted the successful modules for enhancing their income. Similarly, 63existing farming systems were refined through on-farm farmer participatory research.

Under diversification, low chilling apple has been evaluated at Meerut which is giving scope for increasing the income of farmers. Organic production packages for 42 cropping systems suitable for 11 states were also developed. Two integrated organic farming systems models for Tamil Nadu and Meghalaya were developed besides identification varieties suitable for organic farming in 12 states. Policy for promotion of organic farming was also formulated based on the results of NPOF project by involving Ministry of Agriculture, Cooperation and Farmers Welfare.More than 225 FLDs on oilseeds in farming systems perspective was conducted.Farmer FIRST programme was initiated in 3 villages during the year besides adopting 50 villages under *Mera Gaon Mera Gaurav* for penetrating the modern and suitable technologies to the farms for higher productivity with least uncertainties in Western Plain zone of Uttar Pradesh. The research activities and programmes of the institute, AICRP and network works with the aim to double the real farm income through farming systems approach by 2022.

Capacity building of scientists have been made by deputing them to national (08 no's) and international training (04 no's). The Institute organized a three days Northern Regional Agriculture Fair "*Krishi Kumbh*-2016, two field schools, three trainings, one national seminar, two field days one on mustard and one on mango, several *kisan gosthies* on management practices of crops and livestock. Infrastructure facilities such as data repository cell (DRC) and fishpond were developed. Publications (09 no's) having NAAS rating of >6 was also made by the institute.In future, efforts are being made to initiate studies on Carbon crediting and GHG emission in IFS models and Preparation of Bankable IFS project using available data bank by involving AICRP network.

I express my gratitude to Dr.TrilochanMahapatra, Secretary, DARE and Director General, ICAR, New Delhi and Dr. K. Alagusundaram, Acting Deputy Director General (NRM), ICAR, New Delhi for their constant guidance, encouragement and support. My appreciation is also due to Dr. S. Bhaskar, ADG (AAFCC), ICAR, New Delhi and to other staff members of NRM division for cooperation and support. The help of the PME Cell and Editorial Committee in compiling and timely publication of the report is highly appreciated.

(A S Panwar)
Director

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- i'kvk d fy, o"k Hkj gjk pkjk mRiknu e,MÎy d vrxr eDdk&eVj&Tokj Qly pØ l lokf/kd Tokj lerY; mit ¼171-46 Vu çfr g0 çfr o"k çkIr gvkA tcfd ij o"k mxkb tkuh okyh neu ?kkl l lcl de Tokj lerY; mit ¼84-94 Vu@g0@o"k½ çkIr gbA
- ve:n d rMkb d mijkr vyx&vyx eY; lo/ku mipkj i)fr;k d ijh{k.k l irk pyk dh ve:n dh x.koÙkk cuk, j[ku rFkk bldh HkMkj.k vof/k dk 10&12 fnu c<ku gr] ,Ldkfcd ,flM ¼0-3%½] dfY'k;e DykjkbM ¼0-3%½ ,o dfY'k;e yDVV ¼0-4%½ dk mipkj lcl vPNk ik;k x;kA
- fcØh ;kX; vf/k'k"k cp e'k:e dk eY; lo/ku gr vkpkj cuku ij vkpkj dh cukoV] Lokn] lx/k ,o dy Lohdk;rk Øe'kh 8-2] 8-4] 8-2 vkj 8-3 gMkfud Ldy ¼uk vdk½ ik;h x;hA
- Åtk mRiknu d vkdyu d fy, v/;;u fd, x; uk Qly ç.kkfy;k e lcl vf/kd Åtk mRiknu ¼858165 exk ty@g0½ xUuk& iMh&xg pØ l çkIr gvk tcfd lcl de Åtk mRiknu ¼34922-3 exk ty@g0½ ykdh &Qy xkHkh&VekVj Qly ç.kkyh l nt gvkA
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ij rkykc d rVk ij uhc ,o djkn d ik/k¨ dk jki.k fd;k x;k lkFk&lkFk eNyh mRiknu e of) gr cgrj oKkfud çc/ku i)fr;k dk viuk;k x;kA çkjfEHkd ifj.kke d vulkj cgrj çc/ku l eNyh mRiknu e mYy[kuh; of) nt dh x;hA eNyh vk/kkfjr —f"k ç.kkyh e,My ¼0-9 g0½ ftle eNyh ikyu ¼0-5 g0½ rFkk Qly mRiknu ¼0-4 g0½ l # 63462 dk dy ykHk nt fd;k x;k ftle eNyh ikyu dk ;kxnku 63-85% jgkA

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- xtjkr d ljUnuxj fty e 180 fdlku ifjokjk d lo d ckn ik;k x;k dh bl fty e vklr tkr dk vkdkj 3-66 gDV;j g tk dh jk"Vh; Lrj dh ryuk e vf/kd gA ifj.kke Lo:Ik bl fty e e/;e ,o cM fdlkuk dk ifr'kr ¼65-6%½ lhekUr ,o y?k fdlkuk l vf/kd gA Lko e Ikk;k x;k fd 78 ifr'kr fdlkuk dh e[; —f"k i.kkyh Qly rFkk Ik'kikyu 0;olk; g vkj ek= 22 ifr'kr fdlku viuh vkenuh doy Qly mRiknu l ikIr djr gA

- to l?ku ijd Qly ç.kkfy;k d eY;kdu e eDdk ¼Hkêk½&vky& fHkMh Qly pØ l lokf/kd xg lerY; mRikndrk 21-17 Vu@g0 @o"k rFkk 'k) ykHk # 644@g0@fnu ik;k x;k tcfd Tokj&Xokj ¼pkjk½&eDdk ¼Hkêk½& mMn ¼1½1½& eFkh& ykfc;k ¼lCth$ vo'k"k½ ç.kkfy l lcl de xg lerY; mRikndrk ¼10-22 Vu@g0@o"k½ nt dh x;hA

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- /kku yxku d fofHkUu rjhdk d ryukRed çn'ku dk v/;;u dju d fy, yc le; rd ç;kx fd, x;(euVkLlykVj ¼eV½] cMjki.k ¼chih½] 'kU; rd fMfyx ¼tMVh½] fMfyx ¼,lVh½ rdiêh] fMfyx rd jkVjh ¼vkjVh½ l VkllykfVx] Lo&pkfyr VkllykVj ¼,eVh½ }kjk çR;kjkfir dju okyk gkFk VkllykfVx ¼,pVh½ pkoy mit ¼okb½] ykHkh ykxr vuikr ¼chh½ vkj Åtk mRiknuh buiV vuikr ¼bb½ d lc/k e] chl ¼ch,l½ Me chflx vkj vdfjr çlkj.k ¼ch,l½A ,pVh,l d vH;kl u Qly d vo'k"kk d rgr cokb d dkj.k Mhty ¼70%½] le; ¼80%½ vkj Åtk ¼65%½ cpkbA ,pVh ¼0-41 g,pvkj&1½

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- tfod vkj vtfod ifjfLFkfr;k e xUuk&iMh&xg Qly if)r gr xUuk vkj xg dh itkfr;k dk eY;kdu fd;k x;k ftld vrxr xUu dh 9 vxrh itkfr;k dk eY;kdu fd;k x;kA xfe;k dh cokb l dk-ih-d- 05191 itkfr e lof/kd fijkb oky xUu ¼,u-,e-lh½ ikIr g,A vf/kdre phuh dh ek=k ¼fcDl ifr'kr½ dk- 3234 e n[kk x;k rFkk xUu dh mit ¼90-27 Vu@g0½ dk-ih-d- 05191 itkfr l vU; dh ryuk e vf/kd ikIr gbA

- df"k i.kkyh e fryguk dh fofo/krk ln< dju dh nf"V l o"k 2016 dh [kjhQ _r e 14 lk;kchu itkfr;k dk ryukRed eY;kdu fd;k x;kA eY;kfdr 14 itkfr;k e l Mh-,l- 2705 itkfr dk in'ku lcl mRre jgk tcfd ,l-,y- 982 ,o t-,l- 20&71 dh mRikndrk Øe'kh nlj ,o rhlj LFkku ij jghA mi;Dr itkfr;k e fo"kk.k tfur ihyk ektd jkx nkuk gh ifjfLFkfr;k e ugh yxkA itkfr t-,l- 20&71 e ijEijkxr ifjfLFkfr o tfod i)fr e ihyk ektd dk idki jgkA tfod o ijkEijkxr ifjfLFkfr;k d rYukRed v/;;u e ik;k x;k fd] tfod ifjfLFkfr e lHkh itkfr;k e ihyk ektd dk vklr idki de jgk rFkk ijEijkxr ifjfLFkfr e ;g idki vf/kd jgkA

- o"k 2016 d vrjk"Vh; nygu o"k d miy{; ij lLFkku }kjk {k= dh df"k i.kkyh e nyguh Qlyk dh mRikndrk vkj mRiknu c<ku gr dk;Øe cuk;k x;k ftle mn dh nk ¼ir mn&31 vkj ek'k&1008½ ,o ex dh ikp itkfr;k ¼ir ex&4] vkbih,e 2&3] vkbih,e 2&14] egk vkj lekV½ dk lLFkku d i{k= ij jkxjkf/krk ,o mRikndrk gr eY;kdu fd;k x;kA lHkh itkfr;k dk nk ifjfLFkfr;k e ,dhdr lefdr uk'kh tho ic/ku ¼vkbih,e½ o fu;f=r e yxk;k x;kA mn itkfr;k e ir mn 31 lcl mRre ikb x;h ftle ihy ektd dk idki U;ure ¼0-04% vkbih,e e rFkk 0-86% fu;f=r e½ o nku dh vf/kdre mit ¼1141 fd-xk- çfr g0 vkbih,e e o 1038 fd-xk- çfr g0 fu;f=r e½ jghA ex itkfr;k e vkbih,e 2&14 lcl mRre ik;h x;h ftle lefdr ic/ku oky Hk[k.M e doy 3-33% ektd o fu;f=r Hkkx e 6-67% ihyk ektd dk idki jgkA bl itkfr e lefdr ic/ku d vUrxr 680 fd-xk- çfr g0 o fu;f=r [kM e 549 fd-xk- çfr g0 dh mit ikIr gbA

- —f"k ik|kfxdh m|ku e fofHkUu df"k i.kkyh ekM;y tl fd lCth vk/kkfjr] rduhfd i)fr] mUur'khy itkfr;k ,o Qly fofo/khdj.k rduhfd i)fr;k dk yxk;k x;k ftle /kku dh l?kurk i)fr ¼SRI½] mUufr'khy itkfr;k] e'khu }kjk /kku dk jki.k] /kku]xg ,o ljlk e ik"kd rRo icU/ku]xg e 'kU; d"k.k] gjh [kkn] mBh gb D;kjh fof/k] Qly vo'k"k icU/ku] ,o d"kd i)fr dk inf'kr fd;k x;k rFkk /kku lerY; mRiknu eY; ifr g0] dy vkenuh] 'k) vkenuh ,o vkenuh ifr fnu ifr g0 dh x.kuk dju ij ;g ik;k x;k fd /kku&vky ¼dQjh [;kfr½&eDdk ¼lCth vk/kkfjr ekM;y½½] /kku&xUuk $ vky ¼'kjn dkyhu½&iMh ¼Qly fofo/khdj.k½] /kku ¼ihñchñ 1509½&xg ¼,ñMhñ 3086½&<pk ¼itkfr vk/kkfjr½ rFkk /kku&xg ¼ik"kd icU/ku½&<pk ¼rduhdh vk/kkfjr½ e lokf/kd /kku lerY; mRiknu ¼de'kh 19-0] 18-76] 11-

30] 10-96 Vu ifr g0½ d"kd i)fr dh ryuk e vf/kd ik;h x;hA

- xg e lUrfyr mojd ,o l{e rRok d mi;kx ij —"kd [kr ijh{k.k d rgr xg dh itkfr;k ij lUrfyr mojd ,o l{e rRok d icU/ku ij 34 —"kdk d yxk; x;A iR;d ijh{k.k e 3 icU/k j[k x;] Vh&1½ fdlku fof/k ¼,u-Ikh-d- nj 120½60½0 fd-xk- çfr g0½] Vh&2½ mUur fof/k ¼,u-Ikh-d-dh nj 120½60½60 fd-xk- çfr g0½ ,o Vh&3½ mUur fof/k] ¼Vh&2 $lYQj nj 25 fd-xk- çfr g0½A iR;d icU/k dk 800 ox ehVj {k= e fdlkuk d ;gk fdlkuk }kjk yxk; x;gA bu ijh{k.kk e fdlku fof/k ,o mUur fof/k dh ryuk dh xb rFkk ik;k x;k fd mUur fof/k e lrfyr ek=k e xg dh Qly e ,u-Ikh-d- io/ku l mijkÙk itkfr;k e de'kh 7-8] 7-1] 6-9] 7-14 ,o 7-57% ifr g0 inkokj e of) gbA rFkk lrfyr ek=k e ,u-Ikh-d- ,o lYQj d i;kx l mijkÙk itkfr;k e de'kh 9-1] 8-3] 8] 8-82 ,o 8-97% ifr gDV;j inkokj e of) fdlku fof/k dh vi{kk vf/kd nt gbA
- fofHkUu ifjfLFkfr;k d fy, tyok;&vu:i mRiknu i.kkyh d igpku gr rhu ic/ku i}fr;k] tfod ¼tfod lkrk d ek/;e l 100% ik"kd rRok dh vkifr vkj ,uihvk,Q d vulkj i.k tfod ic/ku½] tfod dh vkj vxlj ¼50% tfod ic/ku d lkFk 50% vtfod ek/;e l ik"kd rRok dh vkifr½ vkj 100% vtfod ic/ku d rgr m".k dfVcf/k; {k= e 11 o"kk ¼2004&05 l 2014&15½ fd, tk jg vul/kku ftle rhu Qly i.kkfy;k vFkkr lk;kchu&xg] lk;kchu &ljlk ,o lk;kchu&puk gA bu rhuk Qly i.kfy;k e bDdB fd, x; vkdMk dk fn?kdkfyd ¼1951 l 2015½ ekle lc/kh vkdMk vFkkr o"kk] d lkFk tyok; vu:i mRiknu i.kkyh vkj Qlyk dk igpkuu gr v/;;u fd;k x;kA vf/kd o"kk ,o de o"kk fd fLFkrh e tohd i}fr d vrxr lk;kchu dk mRiknu vtohd i}fr dh rYkuk e de'kh 17-3 ,oe 18-4% v/khd nt dh x;hA tfod mRiknu i.kkfy;k d rgr mxkb xb ljlk e Øe'kh vf/kd o"kk vkj de o"kk dh fLFkfr e 6-3 vkj 12-1% vtfod dh ryuk e vf/kd mit feyhA vtfod dh ryuk e tfod mRiknu i.kkyh d rgr pu e 22-2% vf/kd mit nt dh xbA bl v/;;u l ;g fu"d"k fudkyk tk ldrk gfd tfod ic/ku d rgr lk;kchu&puk Qly i.kkyh v/k&'k"d m".k dfVc/kh; {k= e/;çn'k d fo/; iBkj —f"k&tyok; {k=½ e lkekU; l vf/kd ;k de o"kk dh fLFkfr d rgr cgrj tyok;&vu:i mRiknu i.kkyh gA
- ,dhdr df"k i}fr ij vf[ky Hkkjrh; lEfUor ifj;ktuk 2010&11 l 'k: dh xbA ;g ;ktuk oreku e 75 dUnk ¼25 e[; dUnk] 12 midUnk] 32 d"kdk d [krk rFkk 6 Hkk-d-vu-i- lLFkku d LofPNd dUnk½ ij py jgh gA tk lHkh 15 df"k tyok; {k=k e Qyk gvk gA ;g ;ktuk 34 df"k fo'ofo|ky;k] 2 lkekU; fo'ofo|ky;k vkj 6 Hkk-d-vu-i- lLFkkuk e lpkfyr gA vkj ble 23 jkT;k vkj 2 l?kh; {k= 'kkfey gA fjikV d vUrxr o"k d nkjku] pkj i;kxk l lEcf/kr {k=k e fof'k"V ,dhdr [krh i.kkyh ekMy ¼32 LFkkuk½ dk fodkl] fofHkUu df"k &ikfjfLFkfrd r=k ¼37 LFkkuk½ d fy, t:jr vk/kkfjr Qly i.kkyh dh igpku] vukt vk/kkfjr Qly e nh?kdkfyd ik"kd ic/ku ij LFkk;h Hk[kM i;kx i.kkyh ¼13 LFkkuk½ vkj i.kkyh vk/kkfjr mPp eY; Qlyk ¼8 LFkkuk½ d fy,

tfod [krh idt dk fodkl] vul/kku i{k= ,o LofPNd dUnk ij fd;k tk jgk gA tcfd 3 e[; i;kx yxk; x; tkfd ik/kk e ik"kd rRok d ifr tokcngh tk io l iHkkoh df"k i.kyh i) ¼768 ifjokjk 21 jkT;k d 32 ftyk d 64 Cykdk e 192 xkok e½ ii) ektnk ifjokjk dh lhekUr ?kjy ifjfLFkfr;k e fofo/kh dj.k ¼21 jkT;k d 32 ftyk d 64 Cykdk e 192 xkok e 768 ifjokjk½ iii) [krh i.kyh ekM;y d [kr eY;kdu NkV vkj lhekUr fdlkuk dh ykHkinrk vkj vkthfodk e l/kkj ¼21 ftyk d 64 Cykdk e 192 xkok e 384 ifjokjk vkj frygu ¼125 LFkkuk½ l tMh [krh i.kfy;k ij iFke ifDr in'ku vul/kku dUnk d ek/;e l fd; x;A

- {k= fof'"V ,dhdr df"k i.kyh vul/kku] foLrkj] f'k{kk vkj 0;kikj ¼cddkjh ifj;ktukvk½ d fy, 14 df"k&tyok; {k=k e 38 dUnk ij ,dhdr df"k i.kyh ekMy fodflr fd; x;A blh rjg fdlkuk d [krk ij 'kk/k dUnk d ek/;e l 14 df"k tyok; {k=k e fdlkuk dh lgHkkfxrk l 63 ektnk ,dhdr [krh i.kfy;k dk ifj"dr fd;k x;kA tkfd ektnk df"k i.kyh l 2&3 x.kk vf/kd vk; rFkk ifjokjk dk [kkn] Hkktu] pkjk] b/ku rFkk diMk dk 65&80% rd vkirh djr gA

- vukt&vukt Qly i.kfy;k e nh?kdkfyd ik"kd rRo ic/ku l irk pyk g fd /kku&xg i.kyh e xkcj dh [kkn ;k gjh [kkn d lkFk 25&50 ifr'kr u=tu d ifrLFkkiu l 4 ifr'kr dh of} gbA /kku&/kku i.kyh e gjh [kkn l mit e 3-6% of} nt dh x;hA

- fofHkUu ,u-,-vkj-ih- {k= e yxk, x, Qly i.kfy;k e n[kk x;k fd de mRiknu dk e[; dkj.k u=tu] QkLQkjl] ikVk'k ,o l{e ik"kd rRok dk de'k 29] 25] 71 rFkk 100% de i;kx djuk g tcfd fdlku dh rduhd ,o oKkfud rduhdh d e/; [krh e mRiknu dk vUrj 1192] 2059] 2636] 3575 rFkk 1622 fd-xk- ifr g0 ¼de'k /kku&/kku] /kku&xg] eDdk&xg] lk;kchu&l;kt rFkk /kku&ex Qly i.kyh½ e ik;k x;kA enk ijh{k.k d vulkj l{e ik"kd rRok d i;kx l mi;Dr i.kfy;k e de'k 805] 7896] 341] 877] rFkk 246 fd-xk- dh vfrfjDr mit ikIr gbA lHkh ,u-,-vkj-ih-{k=k o Qly i.kfy;k e l>k; x; u=tu] QkLQkjl rFkk ikVk'k d i;kx ;k mi;Dr d lkFk l{e ik"kd rRok d i;kx l vf/kd mit rFkk ik'kd rRo mi;kx n{krk e l/kkj n[kk x;kA

- fofHkUu LFkkuk ,o df"k i.kfy;k e] oreku df"k i.kyh e Qly i'k/ku] mRikn fofo/kh dj.k rFkk {kerk fodkl d }kjk l/kkj l mRiknu ¼yxHkx 2 xuh rd½ vfrfjDr fcdh mRikn e of) ¼1&2 xuh½] Qly i.kfy }kjk ykxr e deh ¼20%½ rFkk ykHk e of) ¼2 xuh rd½ n[ku dk feyhA iR;d ftyk d fy, loJ"B df"k i.kyh dk p;u fd;k x;k ftll Hkfo"; e lEHkkfor l;kX; ?kVdk ,o fofo/kh dj.k rjhdk l lhekUr d"kdk dh vkthfodk dk l/kkjk tk ldA

- y?k d"kdk dh df"k i.kyh e l/kkj d vUrxr fofHkUu ftyk e 1 ¼lEck] vEcMdjuxj] fljlk] verlj] ikdj vkj x<x½ l 8 ¼Jhdkdye½ df"k i.kfy;k ik;h xbA uuhrky dkykj rFkk ipegy ftyk e 5 rFkk dUnikjk e 7 df"k i.kfy;k ik;h xbA 20 ftyk d d"kdk d vkdMk d vk/kkj ij Qly $i'kikyu df"k i.kyh e[; ik;h x;h tkfd dy v/;;u fd; x; ftyk dh 68% FkhA lkekU;r;k lHkh LFkkuk

ij dfe;k d vk/kkj ij Qly] i'k/ku] ilLdj.k rFkk vU; ekM;y ¼?kVdk½ e fd; x; i;klk l mRiknu e of) ¼1&2 xuh½ gbA ckt kj e vf/kdrk ¼1&2 xuk½ rFkk Hkko e of) ¼12-3 x.kk½ ikb x;hA

- ,dh—r —f"k ç.kkyh ij vf[ky Hkkjrh; lefUor vuI/kku ifj;ktuk dh rgr 10 vk-,Q-vkj-;fuVl e ikp df"k tyok;q {k=k t l 'k"d] v/k 'k"d] mikn] vkn rFkk rfV; ij 10 jkT;k e frygu ;Dr Qly i.kkyh ij vk/kkfjr 125 iFke ifDr in'ku yxk, x; ftle l 39 exQyh] 38 ldj vj.Mh] 22 ljte[kh] 12 ljlk o 18 xkHkh ljlk ij fd; x;A ie[k Qly i.kkfy;k ftle fryguh ;ä Qly i.kkfy ij vk/kkfjr Qlyk dk ijh{k.k fd;k x;k gA

- txnku ¼xtjkr½ e frygu vk/kkfjr [krh ç.kkfy;k ij iFke ifDr in'ku d vrxr ldj vj-Mh dh mit e 136-54% dh of) nt dh xb] tcfd xnx e eDdk&ljte[kh Qly ç.kkyh e ljte[kh dh nk ifä;k d chp dh njh 20 lVhehVj j[ku ij fdlkuk }kjk ch tk dk fc[kj dj cku dh fo/kh dh rYkuk e inkokj e 36-30% dh of) n[kk x;kA vk/kçn'k d lhFkeiVk e exQyh dh mUur çtkrh ¼d&6½ d ç;kx l mit] ldy vkj 'k) ykHk e Øe'kh 25-28%, 25-3% vkj 32-3% dh of) nt dh x;hA dkxMk ¼fgekpy çn'k½ e dpu çtkrh dh txg ,p ih ,u&3 dk yxku l xkHkh&ljlk dh mit e 88-26% dh of) rFkk fr#oYyk e ,pvkboh fryd l dk;kdye&1 dk çfr LFkkiu dju l 32-06% vf/kd mit feyhA

- tfod [krh ij uVod ifj;ktuk ¼,uihvk,Q½ dh 'k:vkr o"k 2004&05 e 20 dæk d lkFk 10 —f"k&tyok;q {k=k dk 'kkfey djd dh xb FkhA oreku e ;g ;ktuk 11 —f"k fo'ofo|ky;] 7 Hkk-—-vu-i- d lLFkkuk vkj ,d MhEM fo'ofo|ky; d lkFk 16 jkT;k e dke dj jgh gA Qly ç.kkfy ifji{; e Qlyk d tfod mRiknu d fy, oKkfud idt çFkkvk dk fodkl fd;kA oKkfud fof/k }kjk QlykRiknu dk lEi.k idt fodflrfd;k x;k Tk¨ 11 jkT;k d 42 Qly ç.kkfy;k d fy, mi;ä gA

- lgk;d vkdMk d lkFk&lkFk l;ä LFkkfud midj.kk d bLreky djd 7 jkT;k d 8 p;fur ftyk dh ektnk —f"k i)fr dh lEi.k tkudkjh dj 8 ,u,vkjih {k=k t l mÙkj xtjkr {k= ¼xtjkr½ ioh vkj nf{k.k ioh rVh; [kkMh {k= ¼vkfM'kk½ rVh; lkxjh {k= ¼if'pe cxky½ e/; enkuh {k= ¼mÙkj çn'k½] mÙkj&if'peh {k= ¼rfeyukM½] mi vkn nf{k.kh enku {k= ¼jkt LFkku½] if'peh egkjk"V enkuh {k= egkjk"V½ vkj e/; egkjk"V iBkj tku ¼egkjk"V½ d fy; odfYid d'ky [krh ç.kkyh ftll vf/kd mRiknu rFkk le; vkj llk/ku dh cpr g¨ ldA

- Xykcy ;hYM xi ,o ty mRikndrk ,Vyl ¼th- ;kb- th- ,-½ ifj;ktuk d vrxr itkc d verlj tyok;q cQj tku e ,ilhe e,My d mi;kx l /kku dh mit {kerk 8-48 Vu çfr g0 ik;k x;k vFkkr okLrfod mit 2-89 Vu çfr g0 jgkA bl tyok;q e lHkkfor mit l okLrfod mit e 5-59 Vu çfr g0 dk vrj nt dh x;h tk dh lHkkfor mit dk yxHkx 65-9% gA blh rjg if'pe cxky d dY;k.kh cQj {k= e lHkkfor mit 7-12 Vu çfr g0 ik;k x;k tcfd okLro e fiNy nl lkyk dk vklru mit 2-29 Vu çfr g0 FkkA lHkkfor mit ,o okLrfod mit e 4-83 Vu çfr g0 dk vrj nt fd;k x;k tk dh lHkkfor mit dk yxHkx 67-8% gA

- /kku e ijijkxr yok fof/k e uhe yfir ;fj;k d ç;kx l ehFku mRl tu e 23-8% dh fxjkoV nt dh x;h] tcfd x/kd yfir ;fj;k d ç;kx l ;gh fxjkoV 11-16% ik;h x;hA x/kd yfir ;fj;k d ç;kx l ,;jkfcd fof/k l cokb e ikjifjd fof/k dh ryuk e ehFku mRl tu e 21-76% dh fxjkoV nt dh x;hA

- o'ohd tyok; ifjoru d v/;;u d vrxr /kku dh ijijkxr [krh e lkekU; ;fj;k dh ç;kx l dkcu mRl tu 1252-61 fd-xk- dkcu Mkb&vkDlkbM lerY; çfr g0 nt fd;k x;k tcfd uhe yfir ;fj;k d ç;kx l ;gh mRl tu 932-34 fd-xk- dkcu Mkb&vkDlkbM lerY;@g0 jgkA

- of'od tyok; e,My ç,tD'ku }kjk jçtVfVo dkUlV'ku ikFkot ¼vkj-lh-ih-½ 4-5 d ifj–';e ektnk mRiknu ç.kkyh l [krh l feyu okyh 'k) ykHk e 2 l 8-5% fxjkoV dk vkdyu fd;k x;k g tcfd vkj-lh-ih- 8-5 d vkdyu d vulkj ;g fxjkoV 1 l 9% gku dk vueku yxk;k x;k gA nkuk e,My¼,ilhe ,o fM,llV½ vkj-lh-ih- 4-5 o 8-5 d vrxr] ifj–';,ilhe&,y dk NkMdj ckdh lHkh ifj–';e xg dh inkokj e 1 l 23% dk fxjkoV dk vkdyu fd;k x;kA

- lhthvkb,vkj vul/kku dk;Øe ^tyok; ifjoru d ifj–';e –f"k vkj [kk| lj{kk ¼lhlh,,Q,l½* d vrxr Hkkjrh; –f"k ç.kkyh vul/kku lLFkku eknhije vkj vrjjk"Vh; eDdk vkj xg l/kkj dæ¼lhvkb,e,evkbVh½ d lg;kx l nf{k.k ,f'k;k e tyok; LekV ikVQkfy;k fodflr vkj ifjHkkf"kr dju gr ,d ifj;ktuk 'k: fd;k x;kA bl ifj;ktuk d vrxr ^tyok;-LekV xko* dk fodflr dju d fy, et¶Qjuxj ftyk d [krkyh Cy,d e fLFkr xx/kkjh xko dk p;u fd;k x;kA bldk mí'; tyok; ifjoru l gku okyh tkf[kek dk çcf/kr djuk vkj mud çc/ku dk c<kok nuk rFkk fdlkuk dh vkthfodk vkj vkenuh e l/kkj ykuk gA bl ifj;ktuk d vrxr lo{k.k d ek/;e l xx/kkjh xko dh cpekd tkudkjh ,d= dh xb ,o {k= d fy, tyok; vu:i tyok; LekV –f"k d fofHkUu rdfufd;k dh igpku dh x;hA p;fur xko e vklr tkr 0-97 g0 ik;k x;kA y?k ,o lhekr tkr oky ifjokjk dh l[;k dy ifjokjk d yxHkx 83% tk fd rth l ?kVrh gb tkr d vkdkj dk ldr gA if'peh mÙkj çn'k d bl enkuh {k= e –f"k ç.kkyh d :i e Qly mRiknu d lkFk lkFk i'k ikyu o ckxokuh e[; :i e ik;h x;hA

- if'peh mÙkj çn'k e efgykvk dk i#"kk dh ryuk e dik"k.k d çfr vf/kd lonu'khy ik;k x;kA lo{k.k l irk pyk dh bl {k= e 22% tul[;k de otu dh f'kdkj g ,o Åtk dh deh efgykvk e i#"kk d ryuk e T;knk gA vkgkj fofof/kdj.k e Hkh efgyk ef[k;k okyh ifjokjk e i#"k ef[k;k okyh ifjokjk dh ryuk e de fofo/krk nt dh x;hA

- if'peh mÙkj çn'k e fd, x, lo{k.k l çklr vkdMk d fo'y"k.k l ;g ldr feyk] fd Qly mRiknu e trkb dh NkMdj vU; dk;k e e'khuhdj.k dk mi;kx cgr gh de gA

- if'peh mÙkj çn'k d enkuh {k=k dh feêh e 0-5% l Hkh de tfod dkcu] 63 l 299 fd-xk-miyC/k ikVk'k çfr g0 ,o l{e ik"kd rRok dh deh d lkFk feêh dh mojrk de ik;h x;hA

ifjp;

Hkkjrh; —f"k vuqla/kku ifj"kn & ,d utj e

Hkkjrh; —f"k vuqla/kku ifj"kn ¼vkbZ,lvkj½ —f"k vuqla/kku vkj f'k{kk foHkkx ¼Mh,vkjb½] —f"k e=ky;] Hkkjr ljdkj d rgr ,d Lok;Ùk lxBu gA tks —f"k vuqla/kku ifj"kn d :i e tkuk tkrk g] ;g 16 tqykbZ 1929 dk —f"k ij j,;y deh'ku dh fjikVZ d vuqj.k e lkslkbVh ithdj.k vf/kfu;e] 1860 d rgr ,d ith—r lkslkbVh d :i e LFkkfir fd;k x;k ftldk e[;ky; ubZ fnYyh e gA

ifj"kn ij n'k e ckxokuh] eRL; ikyu vkj i'k foKku lfgr —f"k e vuqla/kku vkj f'k{kk d leUo;u] ekxn'ku vkj çc/ku d fy, lokPp lLFkk gA n'k e Qyh 111 vkbZ,lvkj lLFkkuk vkj 73 —f"k fo'ofo|ky;k d lkFk ;g nfu;k d lcl cMh jk"Vh; —f"k ç.kkfy;k e l ,d gA lLFkkuk vkj fo'ofo|ky;k e fodflr çk|kfxfd;k ifj"kn d 665 l vf/kd —f"k foKku dæ ¼dohd½ d ek/;e l gLrkrfjr vkj ifj"—r dh tk jgh gA

vkbZ,lvkj u viu vuqla/kku] f'k{kk vkj foLrkj xfrfof/k;k d tfj, Hkkjr e gfjr Økfr vkj —f"k d vk/kfudhdj.k d fy, vx.kh Hkfedk fuHkkb gA ifj"kn] vuqla/kku vkj çk|kfxdh fodkl d ek/;e l n'k dk 1951 l 2016 rd vukt mRiknu e 5 xquk] ckxokuh d mRiknu e 9.5 xquk] eNyh dh ek=k e 13 xquk] nX/k mRiknu e 8.5 xquk vkj vMh d mRiknu e 43 xquk c<k dj n'k dk jk"Vh; [kk| vkj ik"k.k lj{kk e vkRefuHkj fd;k gA

—f"k e mPp f'k{kk e mR—"Vrk dk c<kok nus e ifj"kn u Hkh ,d çe[k Hkfedk fuHkkb gA ;g foKku vkj çk|kfxdh fodkl d c<r {k=k e yxh gb g vkj bld oKkfud vrjk"Vh; Lrj ij mud {k=k e Lohdkj fd, tkr gA n'k dh c<rh vkcknh d fy, ikf"Vd lj{kk] ?kVfr [krh ;kX; Hkfe] ikuh dh deh d lkFk&lkFk Xykcy okfex vkbZ,lvkj d lkeu ,d cMh pukrh g] ftldk fujkdj.k ,fddr —f"k ç.kkyh dk viukdj fd;k tk ldrk gA bl dMh e Hkkjrh; —f"k vuqla/kku ifj"kn ¼vkbZ,lvkj½ dk lLFkku Hkkjrh; —f"k ç.kkyh vuqla/kku lLFkku] ekfnnije lrr dk;jr gA

Hkk-d-vu-i-&Hkkjrh; df"k i.kkyh vuqla/kku lLFkku

df"k i.kkyh vuqla/kku ifj;kstuk fun'kZ;] ¼ihMh,Q,lvkj½ dk i.k fodflr lLFkku dk ntk Hkkjrh; df"k i.kkyh vuqla/kku lLFkku ¼vkbvkbZ,Q,lvkj½ d u; uke d :i e 27 uocj 2014 dk fn;k x;k Fkk rFkk pkj foHkkx ¼,dh—r df"k ç.kkyh çc/ku] Qly ç.kkyh vkj llk/ku çc/ku] tfod —f"k ç.kkyh] vkj çk|kfxdh LFkkukrj.k 'kk/ku ,o ekuo llk/ku fodkl½ d lkFk&lkFk ,dh—r —f"k ç.kkfy;k ij vf[ky Hkkjrh; lefUor vuqla/kku ifj;kstuk ¼,vkbZlhvkjih&vkbZ,Q,l½ vkj tfod [krh ij uVod ifj;kstuk ¼,uihvk,Q½ Hkh lLFkku d vfHkUu vx gA

Hkk-d-vu-i-&Hkkjrh; df"k i.kkyh vuqla/kku lLFkku dh mn; ;k=k

1952&53 % Þ—"kd d [krk ij Þljy mojd ijh{k.kß ;kstuk 'k: gb FkhA

1956 % vkn'k lL; ç;kxk dk tkMk x;k vkj vf[ky Hkkjrh; lefUor lL; vuqla/kku ifj;kstuk ,d Hkk-d-vu-i- ifj;kstuk d :i e 'k: gbA

1968&89 % nk ?kVdk Þvkn'k lL; ç;kxß vkj Þ ljy mojd ijh{k.kß dk lkFk t¨Mdj ;ktuk dk vf[ky Hkkjrh; lefUor lL; vul/kku ifj;ktuk ¼,vkblh,vkjih½ d :i e iuo;ofLFkr vkj Lohdr fd;k x;kA

1989 % v-Hkk-le-lL; vu-ifj- dk Qly ç.kkyh;k ij vf[ky Hkkjrh; lefUor vul/kku ifj;ktuk d lkFk ßQly ç.kkyh vul/kku ifj;ktuk fun'kky;Þ d uke L® eknhije ejB e LFkkfir fd;k x;kA

2004&05 % 13 lg&lpkyu dæk d lkFk ub ;ktuk tfod [krh ij uVod ifj;ktuk ¼,uihvk,Q½ dk Q-ç-vu-ifj-fun- l tkMk x;kA

2010 % Qly ç.kkyh vul/kku ifj;ktuk fun'kky; vkj Qly ç.kkyh;k ij vf[ky Hkkjrh; lefUor vul/kku ifj;ktuk dk uke Øe'k% —f"k ç.kkyh vul/kku ifj;ktuk fun'kky; vkj —f"k ç.kkyh;k ij vf[ky Hkkjrh; lefUor vul/kku ifj;ktuk d :i e cny fn;k x;kA

2014 % ihMh,Qvkjvkj ¼—ç-vu-ifj-fun-½ dk i.k fodflr lLFkku e mUur ¼vixM½ dj fn;k x;k vkj bl Þ Hkkjrh; df"k i.kkyh vul/kku lLFkkuß d :i e u;k uke fn;k x;kA —f"k ç.kkyh;k ij vf[ky Hkkjrh; lefUor vul/kku ifj;ktuk vkj tfod [krh ij uVod ifj;ktuk ¼,uihvk,Q½ lLFkku d vfHkUu vx d :i e jgA

lf{kIr bfrgkl

Qly ç.kkyh vul/kku ifj;ktuk dh mRifÙk Mk ,-ch- LVhoV] ¼edy bLVhVîV v,Q l,by fjlp] ,cjMhu] ;-d-½ d Hkkjr;k=k d nkjku dgh mUuhl lk pkyhl d e/; e gb FkhA mUg feêh dh mojrk dh tkp d lc/k e fLFkfr dh leh{kk dju d fy, rRdkfyd bihfj;y dkfly v,Q ,fxdYpjy fjlp }kjk vkef=r fd;k x;k Fkk tk cgr gh de le; d Hkhrj feêh vkj tyok; dh fofHkUu fLFkfr;k d vrxr i;kIr tkudkjh çkIr dj vko';d dne mBk,] rkfd —f"k foHkkx Qly dh inkokj c<ku d fy, fdlkuk dk çklfxd fun'k n ldA mudh leh{kk fjikV] 1947 e çdkf'kr gb] ftldk n'k e mojd ç;kxk d rÙoKku vkj vH;kl ij dkQh çHkko iMkA fdlkuk d [krk ij gku oky ßljy [kkn ijh{k.kÞ dju vkj p;fur dUæk ij ßtfVy ç;kxkÞ d lpkyu d egRo dk fjikV e cy fn;k x;kA 1953 e feêh dh mojrk vkj mojd ç;kx ifj;ktukd ek/;e l Hkkjr&vefjdh çk|kfxdh lg;kx le>kr d rgr [krhdrkvk d {k= ij ßmojd ijh{k.kÞ dh 'k#vkr dk fuEufyf[kr mí';k d lkFk çkRlkfgr fd;k x;kA

- fdlku d {k= dh fLFkfr;k d vyx&vyx l;ktuk e ,uihd d ç;kxdk Qly dh çfrfØ;kvk dk v/;;u dju d fy,A
- 0;kid feêh legk e fofHkUu mojdk dh lki{k çfrfØ;k dh tkp vkj fofHkUu —f"k&tyok; {k=k d fy, b"Vre mojd l;ktu dk vueku djukA
- Lon'kh mRiknu d fy, fofHkUu ukbVkt u vkj Q,LQfVd mojdk d lki{k çn'ku dk v/;;u djukA
- fdlkuk d le{k Qly mRiknu ij mojd mi;kx dh Hkfedk dk çn'ku djukA

ckn e] 1956 e vkn'k l'; ijh{k.k] vFkkr tfVy ç;kxk d fy; /;ku l p;fur dæk dk Hkh ifj;ktuk d nk;j e yk;k x;k vkj bl vf[ky

Hkkjrh; lefUor l'; foKku ijh{k.k ¼,vkbl,b,l½ d :i e cny fn;k x;kA le; chru d lkFk gh ;g ;ktuk fodkl vkj fodkl d fofHkUu pj.kksa l xtjh rkfd foKku vkj çk|kfxdh d fodkl e of) gk vkj c<rh ekxk dk ijk fd;k tk ldA —f"k lkL—frd çFkkvksa] flpkb] ik"k.k] jklk;fud ?kkl fu;=.k vkj cg Qly dk 'kkfey djd vul/kku {k= dk foLrkj fd;k x;kA yfdu feêh dh mojrk vkj mojd mi;kx n{krk ij tkj tkjh jgkA 1968-69 e bl ;ktuk dk vf[ky Hkkjrh; lefUor lL; vul/kku ifj;ktuk ¼,vkblhvkj,i½ d :i e nk ?kVdk Þvkn'k lL; ç;kxß vkj Þljy mojd ijh{k.kß d lkFk Loh—r fd;k x;k FkkA

—f"k vul/kku] gfjr Økfr d ckn Hkh iFkØ Qly ij ij dfUær jgk yfdu ,dLFkk;h fodkl d fy, ç.kkyh –f"Vdk.k gkuk pkfg, bl vglkl u Qly ç.kkyh mUe[k vul/kku 'k: dju d fy, çkRlkgu fn;k vkj 7oh ipo"kh; ;ktuk d nkjku ;g ifj;ktuk fun'kky; e cny nh xb vkj bl Qly ç.kkyh vul/kku ifj;ktuk fun'kky; d uke d :i e ekp] 1989 e e[;ky; d ukr eknhije] ejB] ;ih LFkkfir fd;k x;kA bld vykok] 11oh ipo"kh; ;ktuk d nkjku ihMhlh,lvkj dk 2009-10 d nkjku —f"k ç.kkyh vul/kku ifj;ktuk fun'kky; ¼ihMh,Q,lvkj½ d :i e iuh ukfer fd;k x;kA 2014 d nkjku ¼12oh ipo"kh; ;ktuk½ ihMh,Qvkjvkj dk i.k fodflr lLFkku Hkkjrh; —f"k ç.kkyh vul/kku lLFkku d :i e mUur vkj ukfer fd;k x;k vkj ,dh—r —f"k ç.kkfy;k ij vf[ky Hkkjrh; lefUor vul/kku ifj;ktuk ¼,vkblhvkjih&vkb,Q,l½ d lkFk&lkFk ¼ektnk 31 dæk d vykok] Hkk-d-vu-i-&Hkk-d-lk-vu-l- dk u, LofPNd dæ d :i e tkMk x;k½ vkj tfod [krh ij uVod ifj;ktuk Òh ¼,uihvk,Q] ektnk 13 lg&lpkyu dæk d vykok] 7 u, lg;kx dæk dk tkMk x;k½ fuEufyf[kr tukn'kk d lkFk lLFkku dk ,d vfHkUu vx cu jgk ¼

- ,dh—r —f"k ç.kkfy;k e mRikndrk vkj llk/ku mi;kx {kerk e l/kkj d fy, mRiknu rduhdk ij cfu;knh vkj lkefjd vul/kku djukA
- fofHkUu —f"k fLFkfr;k d fy, d'ky] vkfFkd :i l 0;ogk; vkj i;koj.k dh —f"V l LFkk;h ,dh—r [krh ç.kkyh e,My fodflr djukA
- ç.kkyh vk/kkfjr —f"k mRiknu çk|kfxfd;k d v,u&Qke ijh{k.k] lR;kiu vkj ifj'kk/ku djukA
- ,dh—r —f"k ç.kkfy;k e ekuo llk/ku fodkl vkj {kerk fuek.k djukA
- —f"k ç.kkfy;k d vul/kku vkj fodkl d lHkh igyvk ij lpuk d ,d HkMkj d :i e dk; djukA
- n'k e ,dh—r —f"k ç.kkyh vul/kku dk leUo; vkj fuxjkuh djukA

bldh LFkkiuk d ckn l lLFkku u fofHkUu ikfjfLFkfrdh&'kf{kd vkj llk/ku&vk/kkj fLFkfr;k d fy, —f"k mRiknu çk|kfxfd;k d fodkl vkj 'kk/ku e egRoi.k ;kxnku fn;k gA bu çk|kfxfd;k dk mí'; ub çk|kfxfd;k d ek/;e l d'ky llk/ku mi;kx vkj vf/kdre ykHk çkIr djuk gA

vul/kku d dN çe[k {k= fuEu g ¼

- ,dh—r —f"k ç.kkyh
- t:jr&vk/kkfjr d'ky vkj ykHknk;d Qly@ —f"k ç.kkfy;k dk fodkl djuk

- fofHkUu Qly vuØek d fy, b"Vre fdLe dk l;ktu
- b"Vre Qly l;ktu vkj vrj Qly ç.kkyh d fy, jki.k T;kfefr
- fofHkUu Qly ç.kkfy;k d rgr trkb vko';drkvk vkj Qly LFkkiuk fof/k
- fofHkUu —f"k&ikfjfLFkfrd {k=k —f"k fLFkfr;k d vrxr —f"k lk/ku® dk pfj= fp=.k vkj ck/kk fo'y"k.k djuk
- —f"k@Qly ç.kkfy;k dk fo'y"k.k
- fofHkUu Qlyk vkj feêh d çdkjk d fy, mojdk d d'ky lkr
- fofHkUu —f"k@Qly ç.kkfy;k e ,dh—r ik"kd çc/ku djuk
- Qly dh inkokj vkj feêh dh mojrk ij nh?kdkfyd ,dh—r ik"kd çc/ku vkj jklk;fud mojd dk çHkko
- vukt&vukt Qly ç.kkfy;k e Qyhnkj Qlyk dk 'kkfey djuk
- lk/ku lj{k.k çk|kfxd;k
- Qke e'khuhdj.k vkj Qly vo'k"k çc/ku
- tyok; ypdnkj —f"k
- tfod ,o ifj'kf) [krh
- [krk ij Qly ç.kkyh çk|kfxd;k dk eY;kdu vkj 'kk/ku
- Qly@—f"k ç.kkyh lkcf/kr MVkcl çc/ku
- —f"k ç.kkyh vul/kku l lEcf/kr ekuo lk/ku fodkl dk fodkl djuk

1- Hkk-d-vu-i-&Hkkjrh; df"k i.kkyh vul/kku lLFkku }kjk fuEufyf[kr rhu ;ktukvk lpkfyr g%

Hkk-d-vu-i-&Hkkjrh; df"k i.kkyh vul/kku lLFkku dk e[;ky;] eknhije e g ftld vUrxr pkj foHkkx ¼,dh—r df"k ç.kkyh çc/ku] Qly ç.kkyh vkj lk/ku çc/ku] tfod —f"k ç.kkyh vkj çk|kfxdh LFkkukrj.k 'kk/k ,oa ekuo lk/ku fodkl½ d lkFk&lkFk ,d ifj;ktuk leUo;d bdkb dk;jr gA

2. ,dh—r —f"k ç.kkfy;k ij vf[ky Hkkjrh; lefUor vul/kku ifj;ktuk ¼,vkblhvkjih &vkb,Q,l½

¼,½ vkb,Q,l vul/kku dæ % ,vkblhvkjih&vkb,Q,l dk urRo ,d ifj;ktuk leUo;d }kjk fd;k tkrk g tk fun'kd vkbvkb,Q,lvkj d ç'kklfud fu;=.k d vrxr gkxkA v,u&LV'ku 'kk/k 31 e[; dæk vkj 11 mi dæk ij 'k: fd;k x;k gA ; dæ mu —f"k egkfo|ky;k d ;k mud {k=h; vul/kku dæ ;k lkekU; fo'ofo|ky;k e tgk etcr —f"k vul/kku vk/kkj miyC/k g] ij ey vkj 0;kogkfjd 'kk/k e yx g, gA

¼ch½ [kr ij 'kk/k % ;g ;ktuk 32 dæk ij py jgh g ; dæ fdlkuk d lgHkkfxrk vul/kku e yx g, gA [kr e 'kk/k dUæ fofHkUu —f"k tyok; {k=k e fLFkr g vkj ij {k= dk lekfoLV djr gA

3. tfod [krh ij uVod ifj;ktuk ¼,uihvk,Q½

;g ifj;ktuk oreku e jkT;k e fLFkr —f"k fo'ofo|ky;k ¼12½] vkblh,vkj lLFkkuk ¼7½ ,oa vU; fo'ofo|ky; ¼1½ e py jgh gA

EXECUTIVE SUMMARY

1. Name and address of the Institute ICAR- Indian Institute of Farming Systems Research, Modipuram, Meerut-250110, Uttar Pradesh, India

2. Budget (2016-17)

a) Institute (₹ in Lakhs)

Plan					Non Plan		
Provision	Expenditure	Govt. Grant	Allocation internal+ additional amount provided by Hqrs out of Council shares	Total Allocation (col. 3+4)	Exp. Out of Govt. Grant	Exp. Out of revenue generation	Total expenditure (col. 6+7)
1	2	3	4	5	6	7	8
175.0	156.00	-	-	1340.00	1117.00	-	1117.00

b) External sources (₹ in Lakhs)

Source	Budget	Expenditure
Pension and other retirement benefits	220.0	131.00
Personal loan and advances	3.00	2.90
Externally funded projects	54.40	35.13
Total	**277.40**	**169.03**

c) Revenue generated (₹ in Lakhs) during 2016-17

Source	Amount
Farm Produce	16.88
Sale of fish, milk and livestock	1.43
License fee/ water charges	3.02
Miscellaneous	7.81
Interest on loan and advances	12.91
Interest on TDR	18.72
Others (Royalty and Inst. Charges)	0.42
Total	**61.91**

3. Staff position (as on 31.03.2017)

Category	Sanction	Position	Vacant
Scientific			
Director	01	01	Nil
Principal Scientist	07	08	+01
Senior Scientist	12	08	04
Scientist	19	16	03
Total	**39**	**33**	**07**

Category	Sanction	Position	Vacant
Technical Staff			
Category-III (T-6, 7/8)	02	02	-
Category-II (T-3, T-4 & T-5)	18	18+1 One post of overseer from CSSRI, Karnal had been transferred which is to be returned in future	-
Category-I (T-1 & T-2)	03	03	-
Total	23	24	
Administrative Staff			
Sr. Administrative Officer	01	01	-
F & A O	01	01	-
A A O	01	-	01
Assistant	04	04	-
U D C	01	01	-
P S	02	02+01*	-
P A	02	02	-
Jr. Steno Gr.III	01	01+01*	-
L D C	03	03	-
Total	16	17	01
Supporting Staff	10	10	-
Temporary Status Casual Labourers	15	15	-
TOTAL	**41**	**42**	**08**

3.1 New appointments/joining

Sl. No.	Name	Designation	Date of Joining	From	Remarks
1	Sh. Amit Kumar	Scientist (Agronomy)	13.05.2016	ICAR-NAARM, Hyderabad	New Appointment

3.2 Selection/transfer/superannuation

Sl. No.	Name	Designation	Date	Selected to	Remarks
1	Dr. R. S. Yadav	Pr. Scientist	07.04.2016	Head, Regional Station Datia (ICAR- IISWC)	Selection
2	Sh. J.P. Singh	Chief Tech. Officer	31.07.2016		Superannaution
3	Dr. M. P. S. Arya	Pr. Scientist (Agronomy)	31.12.2016		Superannaution
4	Dr. B. K. Sharma	Pr. Scientist (Agril. Extension)	28.02.2017		Superannaution
5	Dr. J.P. Singh	Pr. Scientist (Agronomy)	31.03.2017		Superannaution

4. Salient Research Achievements

- Integrated Farming System developed in 1.5 ha area under Western plain zone of Uttar Pradesh realized net return of Rs. 2.68 lakhs ha^{-1}. The model comprised of field crops (1.04 ha), horticultural crops (0.22 ha), fish pond (0.1 ha) with 3 milch animals (2 Murrah buffaloes +1 HF cow). The systems was integrated with mushroom unit of 100 m^2 room size, a kitchen garden of 20 m^2, vermicompost unit in 100 m^2 with boundary plantation all around the field plots. The biogas unit of 2 cubic meter capacities generates biogas equivalent to 17 LPG gas cylinder of 14.5 kg capacity.

- Mushroom module of IFS realized net income of Rs.13900/- from 18'x13' dimension (05 tier track) with B: C ratio of 1.30 and employment generation of 40 man days.

- In three years old high density plantation of guava (*Psidium guajava*) cultivars *viz.*, Allahabad Safeda, Sardar (L-49) and Sweta, Ber (*Jujupus jujube) cultivars viz.*, Gola, Seb, Umran and Pomegranate (*Punica granatum*) cultivars *viz.*, Bhagwa, Arakta and G-137, Shweta, Gola and Bhagwa cultivars of guava, ber and pomegranate were found as the best cultivars with the yield of 39.44, 15.0 and 12 kg $plant^{-1}$ $year^{-1}$under the climatic condition of the Western Plain Zone of Uttar Pradesh.

- Intercrops of vegetable namely potato, okra and brinjal in *rabi*, *summer* and *kharif* season respectively produced significantly higher yield followed by cereal based cropping with wheat, mung and rice system and least yield was recorded from fodder based inter cropping system with high density fruit plantation.

- The fruit of Anna cultivar of low chilling apple took114 days to mature after fruit setting under the climatic condition of the Western plain zone of Uttar Pradesh. The fruit attained attractive clour and fruit size of 120 g weight, 3.0 inch (diameter) and 3.4 inch (length) with high TSS (18 ^oB).

- Three years older plantation of dragon fruit suceesfully established in Western Uttar Pradesh.The fruit took 45 days to mature from bud emergence to maturity.

- Apple ber cultivar of ber recorded average fruit weight of 65.55 g and 16 ^oB TSS with very high pulp and stone ratio (92.62 %) whereas, fruits of Valencia orange required 270 days to mature from flowering. The average fruit size was recorded as 240 g weight and 7.6 cm diameter with 7 ^oB TSS.

- Forage module of IFS recorded higher sorghum equivalent yield (SEY) with maize-pea-sorghum cropping system (171.46 t ha^{-1} $year^{-1}$) however *Cenchrus* grown round the year recorded the lower SEY (84.94 t ha^{-1} $year^{-1}$).

- Value addition of guava fruits using different post harvest treatments showed that the fruits treated with AA (0.3%) + CC(0.3%) + CL (0.4%) was found to be best for extending shelf life and quality during storage upto 10-12 days.

- Value added mushroom through instant mushroom pickles preparation was recorded higher nine point Hedonic scale with texture, taste, flavour and overall acceptability of 8.2, 8.4, 8.2 and 8.3 respectively.

- Among the nine cropping systems *viz.*, diversified system, rice-wheat system, sugarcane-sugarcane ratoon-wheat system, turmeric, brinjal-potato-french bean system, bottle gourd-cauliflower-tomato system, mango-carrot-radish-onion system, guava-okra-veg pea-brinjal system and banana-turmeric system, the highest energy output was obtained from sugarcane-sugarcane ratoon-wheat (858165 MJ ha^{-1}) and lowest from bottle gourd-cauliflower-tomato (34922.3 MJ ha^{-1}) system.

- The diversified fish based farming system model could provide a net return of Rs. 99395 from 0.9 ha area with fish component realizing Rs. 63462 from 0.5 ha fish pond and Rs. 35933 from rice wheat cropping system in 0.4 ha area which contributed to 63.85 % and 36.15 % of total net income respectively.

- Farming system charachterization of Meerut, Saharanpur and Bulandshahar districts of Western plain zone of Uttar Pradesh showed that Crop + Horticulture (vegetables) + Dairy and Horticulture + Crop + Dairy were found to be more gender sensitive farming systems due to higher amount of feminine farm operations and drudgery prone activities.

- The study on farming systems characterization at Surendranagar district of Gujarat revealed that the average holding size of the district was 3.66 ha which is substantially higher than that of national average. Therefore, the number of medium and large farms (65.6%) were higher than marginal and small farms (34.4%). The survey clearly showed that Crops +Dairy farming was the most prevailing farming system (78%) in the district, but some farm households (22%) were also dependent on crops only as sole farm enterprise.

- Growing of maize (cob)-potato-okra under bio-intensive, complementary cropping systems realized maximum systems productivity (58 kg wheat $ha^{-1}day^{-1}$) and profitability (Rs. 644 $ha^{-1}day^{-1}$) whereas sorghum+cluster bean (f)-maize(cob)+black gram (1:1)-methi-cowpea (veg+residue) recorded lowest wheat equivalent yield (10.22 t ha^{-1}).

- The wheat equivalent yield was maximum when weeds were used as fodder under various cropping systems *viz.* rice – wheat (15.41 t ha^{-1}), maize-wheat (14.54 t ha^{-1}) and sugar cane– ratoon (14.97 t ha^{-1}) except moog-wheat (12.15 t ha^{-1}).

- Resource conservation technologies (RCT) with potassium application @ 90kg K recorded higher grain yield (5.08 t ha^{-1}) and straw yield (14.27 t ha^{-1}) over treatment having application of K @ 90 kg without RCT.

- Results of two tillage systems, four cropping systems and four crop residue mulching and fertilizer combination showed that higher rice equivalanet yield (REY) was obtained in conventional tillage as compared to zro tillage over the years. The tillage influenced significantly on REY, whereas, the cropping systems and crop residue mulching and RDF combination significantly affected REY.

- The long-term experiments were carried to study the comparative performance of different methods of rice planting, namely; hand transplanting (HT), transplanting by self-propelled transplanter (MT), transplanting by manual transplanter (MaT), bed planting (BP), zero till drilling (ZT), strip till drilling (ST), rotary till drilling (RT), drum seeding (DS) and sprouted broadcasting (BS), with respect to rice yield (Y), benefit: cost ratio (B: C) and energy output: input ratio (EE).The HTS practice saved the diesel (70%), time (80%) and energy (65%) due to no-till sowing under crop residue.The highest effective field capacity was observed in ZT (0.44 ha hr^{-1}) followed by HT (0.41 ha hr^{-1}) however, highest field efficiency was measured in HT (60 %).

- Among nine early maturing cultivars of sugarcane evaluated under organic production systems, cv. CoPk 05191 produced higher number of millable canes (333.7) in summer planting followed by CoLk 013201 and CoLk 011201. Higher brix% (21.55) was foundin clones CoSe 03234 followed by Co 0238. Highest cane yield (90.27 t ha^{-1}) was recorded with cv. CoPk5191 over the others.

- A comparative study of soybean taking fourteen varieties under organic and inorganic management, higher grain yield was registered by 'DS 2705' followed by 'SL 982' and 'JS 20-71' under organic and inorganic management respectively. Variety KDS 705 was found highly susceptible to disease

resulted in complete failure of the crop. DS 2705, SL 982 and JS 20-71 were found suitable for growing in non-traditional western plain zone under both organic and inorganic production systems.

- Two varieties of black gram i.e. Pant Urd 31and Mash 1008 and five varieties of green gram i.e. Pant Moong 4, IPM 2-3, IPM 2-14, Meha and Samrat were evaluated under integrated pest management(IPM) and non-IPM package. Among black gram varieties, PU 31 was found to be best performing variety with lowest yellow mosaic incidence (0.04% under IPM conditions and 0.86% under non-IPM conditions) and highest grain yields (1141 kg ha^{-1} and 1038 kg ha^{-1} under IPM and non-IPM conditions respectively). Among green gram varieties, IPM 2-14 performed outstanding with 680 kg ha^{-1} and 549 kg $ha^{-1}$of grain yield under IPM and non-IPM conditions respectively.

- Twenty six cropping systems with improved technologies *viz*. improved cultivars, system for rice intensification (SRI), mechanical transplanting, nutrient management, green manuring (GM) in rice; zero tillage technology and crop residue management in wheat; raise bed planting(RB), broad bed furrow system(BBF) mustard, along with farmers practice were demonstrated in the technology park of the Institute. Four different modules namely, vegetable based, technology based, variety based and crop diversification cropping systems based were studied for their productivity and profitability. Among vegetable based systems, higher rice equivalent yield (REY) was obtained from rice –potato (K. Khyati)–maize system (19.0 t ha^{-1}) with net incomeof Rs. 299 day^{-1} ha^{-1}. In different technology based cropping systems modules, highest rice equivalent yield was obtained from Rice (nutrient management)–wheat (nutrient management)–Sesbania (10.96 t ha^{-1}).

- The results of On-farm trial on balanced use of fertilizers and micronutrient in wheat revealed that increase in yields of improved practice of varieties HD-3059, HD-2967, DBW-16, PBW-590 and PBW-226 through recommended NPK were 7.8%, 7.1%, 6.91%, 7.14% and 7.57%, respectively over the farmers' practice.

- The improved practice of quality seeds (100 kg ha^{-1}) realized increase in yield of varieties HD-2967, HD-3059, DBW-16, PBW-590 and PBW-226 by 3.1%, 3.2%, 2.4%, 3.4 and 3.6 respectively over the farmers' practice with benefit cost ratio of 1.68 in improved practice as compared to 1.66 in farmer practice.

- Using the data of 11 years (2004-05 to 2014-15) of field experimentation conducted at NPOF Centre, Bhopal, having three management practices *viz.*, organic (supply of 100% nutrients through organic sources and complete organic management as per NPOF standards), towards organic (supply of nutrients through 50% organic + 50% inorganic with complete organic management) and 100% inorganic management and 3 cropping systems (soybean-wheat, soybean-mustard, soybean-chickpea) resiliency of crops and cropping systems towards changing climate was assessed. It was found that soybean under organic production systems gained 17.3% and 18.4% yield over inorganic production systems under high and deficit seasonal rainfall respectively. Mustard grown under organic production systems gained 6.3 and 12.1% yield over inorgaaanic production system under higher and deficit rainfall respectively. Crops like chickpea with organic production system was found to be more climate resilient in comparison to others as up to 22.2% yield gain was recorded over inorganic production system under high seasonal rainfall. Further, soybean-chickpea cropping system with organic production system was found to be more climates resilient under extreme (high and deficit) rainfall situations for Vindhya Plateau Agroclimatic Region of Madhya Pradesh.

- AICRP on Integrated Farming Systems, a plan scheme initiated from 2010-11 operates currently with 75 centres (25 on-station main, 12 on-station

sub, 32 on-farm and 6 ICAR institute based voluntary centres) covering all the 15 agro-climatic regions. During the year under report, four experiments namely development of region specific integrated farming system models (32 locations), identification of need based cropping systems for different agro-ecosystems (37 locations), permanent plot experiment on long term nutrient management in cereal based cropping systems (13 locations) and development of organic farming package for system based high value crops (8 locations) were undertaken at on-station and voluntary centres while 3 experiments namely on-farm crop response to plant nutrients in predominant cropping systems (768 farm households in 192 villages in 64 blocks of 32 districts in 21 states), diversification of existing farming systems under marginal household conditions (768 farm households in 192 villages in 64 blocks of 32 districts in 21 states) and On-farm evaluation of farming system modules for improving profitability and livelihood of small and marginal farmers (384 farm households in 192 villages in 64 blocks of 32 districts in 21 states) and FLDs on farming systems involving oilseeds (125 no's) were undertaken through on-farm research centres.

- Through on station research programme, 38 region specific Integrated Farming Systemsmodels in 14 agro-climatic regions for research, extension, education and business (bankable projects) were established. Similarly 63 existing Integrated Farming Systems through On-farm farmer participatory research in similar number of agro-climatic regions were refined. These models provided 2 to 3 times higher income than existing farming systems besides meeting the household demand of food, fodder, fuel completely with fibre and fertilizer to the extent of 65-80 %.

- Through identification of need based alternative cropping systems, twenty six alternatives to rice-wheat for 11 zones of 9 states, pearl millet based for 4 zones of 4 states and maize based systems for 5 zones of 5 states having potential productivity ranging from 16 to 35.2 t ha^{-1} $year^{-1}$were identified for large scale adoption.

- Long term nutrient management in cereal-cereal cropping systems indicated substitution of 25-50% N with FYM or green manure in rice-wheat system with increase in the productivity by 4%. In rice-rice system, green manuring increased the yield by 3.6%.

- Across the various NARP zones and cropping systems, farmer's package resulted in lower yield compared to recommended package owing to the 29, 25, 71 and 100 % lower application of N P_2O_5 K_2O and micronutrients. On-farm system yield gap between recommended dose of N P_2O_5 K_2O + micronutrient and farmer's package was found to be 1192, 2059, 2636, 3575 and 1622 kg ha^{-1} in rice- rice, rice- wheat, maize- wheat, soybean-onion and rice-green gram systems respectively.

- Application of micronutrients based on soil test resulted in additional yield of 805, 786, 341, 877 and 246 kg ha^{-1} in rice-rice, rice- wheat, maize-wheat, soybean-onion and rice -green gram systems respectively. In all the NARP zones and systems, application of recommended N P_2O_5 K_2O alone or N P_2O_5 K_2O + micronutrient resulted in higher yield and use efficiency of nutrients.

- Across the locations and farming systems, improvement of existing farming systems with diversification approach in cropping system, livestock, product diversification and capacity building module resulted in considerable improvement in production (up to 2 times), marketable surplus (1-2 time), reduction in cost (20 %) due to recycling, returns (2 times) and profit (cash flow for family by 1-2 times). Best performing farming system has been identified for each district which needs to be up-scaled along with all possible interventions and diversification approach for improving the livelihood of marginal farm households.

- Under study on holistic approach of improvement of farming systems in small holder, the number of farming systems in different districts ranged between 1 (Samba, Ambedkarnagar, Sirsa, Amritsar, Pakur and Gadag) to 8 (Srikakulam).

- A highly diversified system was observed in Srikakulam district of Andhra Pradesh having many components namely field crop, dairy, goat, poultry in different combinations ranging from 1 to 4. Field crops + dairy was found to be the dominant farming system based on number of households in 20 districts (68 % of total districts studied). At all the locations, constraint based interventions in crop, livestock; processing and optional modules resulted in improvement in production (1-2 times), marketable surplus (2-5 times) and profit (2-3 times).

- Under FLDs on farming systems involving oilseeds, at Jagudan (Gujarat), 136.54% increase in hybrid caster yield was recorded through the intervention of improved variety while in maize-sunflower cropping system at Gadag, 36.30% increase in sunflower yield was realized through maintaining of row to row distance of 20 cm by thinning as against farmer's practice. At Seethampeta (Andhra Pradesh), introduction of groundnut improved variety K-6, has increased yield, gross and net returns by 25.28, 25.3 and 32.3%, respectively. Enhancement in yield of gobhi-sarson (88.26%) at Kangra (Himachal Pradesh) was recorded due to replacement of Kanchan variety with improved variety HPN-3. Likewise, in Thiruvalla also replacement of Kayamkulam-1 with HYV Tilak produced 32.06% higher yield over farmer's adopted variety (Kayamkulam-1).

- Network Project on Organic Farming (NPOF), a plan scheme initiated in 2004-05 operates currently with 20 centres covering 10 agro-climatic regions. The scheme is in operation at 11 SAU's, 7 ICAR institutes and 1 special heritage university and covers 16 states. Through the scheme, scientific package of practices for organic production for 42 cropping systems suitable for 11 states were developed. Under Identification of varieties for organic farming, best performing varieties of crops for organic farming in different seasons and states have also been identified while land configuration based resource conservation practices for organic farming were identified for Karnataka, Uttarakhand and Meghalaya. Based on the results of NPOF scheme, policy for promotion of organic farming was formulated in joint meeting of ICAR & DAC&FW.

- With the use of spatial tools combined with ancillary data, complete profiling of existing farming systems of 8 selected districts of 7 states was done and alternate efficient farming systems (08 nos.) for 08 NARP Zones *viz.*, North Gujarat Zone (Gujarat), East And South Eastern Coastal Plain Zone (Odisha), Coastal Saline Zone (West Bengal), Central Plain Zone (Uttar Pradesh), north-western zone (Tamil Nadu), Sub Humid Southern Plain Zone (Rajasthan), Western Maharashtra Plain Zone (Maharashtra) and Central Maharashtra Plateau Zone (Maharashtra) using number of household adopting the systems with socio economic index of different systems with time & resource saving for higher production, marketable surplus, profit and nutrition developed.

- Under Global Yield Gap and Water Productivity Atlas (GYGA), the yield potential of rice of Amritsar climatic buffer zone of Punjab was estimated as 8.48 t ha^{-1} using APSIM and its mean actual yield was 2.89 t ha^{-1}, hence the yield gap of about 5.59 t ha^{-1} was recorded in this climatic buffer zone which accounts to 65.9% of the potential yield. Similarly, the yield potential of rice of Kalyani climatic buffer zone of West Bengal was estimated as 7.12 t ha^{-1} using APSIM and its mean actual yield was 2.29 t ha^{-1}, hence the yield gap of about 4.83 t ha^{-1} was recorded in this zone which accounts to 67.8% of the potential yield.

- The application of neem coated urea in the conventional treatment reduced 23.8 % emission of methane whereas sulfur treated Urea reduced 11.16 % methane emission. The methane emission was 28.7%, 26.58% and 17.74% lower when normal urea was applied in direct seeded rice (Wet), direct seeded (Dry) and SRI system respectively. Among the different paddy establishment methods, application of sulfur treated urea in direct seeded (Dry) plot emited 21.76 % less methane as compare to the conventional plot treated with same types of Urea.

- Global warming potential in terms of gaseous carbon emission varied significantly with various treatments between 1252.61 kg CO_2 equivalent ha^{-1} in the conventionally paddy cultivation plots treated with normal urea to 932.34 kg CO_2 equivalent ha^{-1} after application of neem coated urea in DSR (Wet). GWP on CO_2 equivalent basis in DSR (Dry) and DSR (Dry) establishment method with neem coated urea has the best treatment in respect of global warming.

- The current production system under climate change would experience a decline in mean net farm returns ranging from 2–8% under RCP4.5 scenario and 1–9% under RCP8.5 scenario, except one climate scenario with DSSAT (DSSAT-L). Impact of climate change on rice yield under both scenarios (RCP4.5 & RCP 8.5) was not found uniform.In both the scenarios, rice yield witnessed increase as well as decreased with both the models (APSIM & DSSAT). However, wheat yields declined 1–23% under both RCP4.5 & RCP8.5 scenario with both the models (APSIM & DSSAT), except one climate scenario under RCP 4.5 (APSIM –L). On the basis of available empirical evidences on climate change impact on livestock sector, it was assumed that milk yield is likely to be declined by 10% under climate change. The per capita income would decline and, as expected, the population poverty rates would increase marginally under climate change. The sensitivity of current production system to climate change showed that there will be 9% reduction in yield of rice and wheat under current production system. Therefore the poverty rate may be increased by 2 % in 2050.

- In Western Plain Zone of Uttar Pradesh, mean holding size of the households was found to be 0.97 ha. Small and marginal households constituted about 83% of the households while medium farm households (2-4 ha) constituted only 17% of the total households. Sugarcane, paddy, wheat, sorghum (fodder) were the major crops being cultivated in the region. Crops along with livestock and horticulture were observed to be the dominant farming system with preference for 1-2 buffalos with 1 cow among livestock in the region.

- More vulnerability of women to under-nutrition as compared to men was recorded in Western Plain Zone of Uttar Pradesh. While data on anthropometry revealed that the 22% population was underweight (BMI <18.5) and prevalence of chronic energy deficiency was found more in women (27%) as compared to men (18.5%). Gender differences in diet diversification pattern were also noticed which was depicted by their lower HDDS in women headed families (6.28) as compared to men headed families (6.61). The study further revealed that the farmers lacking pulse, oilseed, vegetables and fruit component in their farming system.

- The level and constraints of mechanization was analyzed through survey using stratified random sampling technique in Western Plain Zone of Uttar Pradesh. Results indicated lower level of mechanization in all crops except tillage operation (80-90%).

- The fertility status of soils of Western Plain Zone of Uttar Pradesh was found very poor with > 0.5% organic carbon, 63 Kg ha^{-1} to 299 Kg ha^{-1} available potash and deficient micronutrient status.

INTRODUCTION

Indian Council of Agricultural Research-at a glance

Indian Council of Agricultural Research (ICAR) is an autonomous organisation under the Department of Agricultural Research and Education (DARE), Ministry of Agriculture, Government of India. Formerly known as Imperial Council of Agricultural Research, it was established on 16 July 1929 as a registered society under the Societies Registration Act, 1860 in pursuance of the report of the Royal Commission on Agriculture. The ICAR has its headquarters at New Delhi.

The Council is the apex body for co-ordinating, guiding and managing research and education in agriculture including horticulture, fisheries and animal sciences in the entire country. With 111 ICAR institutes and 73 agricultural universities spread across the country this is one of the largest national agricultural systems in the world. The developed technologies at institutes and universities are being transferred, validated and refined through more than 640 KrishiVigyanKendras (KVKs) of the council.

The ICAR has played a pioneering role in ushering Green Revolution and modernization of agriculture in India through its research, education and extension activities. Developments in agriculture in India through councils research and technology development enabled the country to increase the production of food grains by 5 times, horticultural crops by 9.5 times, fish by 13 times , milk by 8.5 times and eggs by 43 times since 1951 to 2016, thus making a visible impact on the national food and nutritional security. This has been achieved despite the limitations of decline in water table as also rainfall by >100 mm compared to 1950s, increase in minimum temperature by 1.6 degrees Celsius, macro and micro nutrient starved soils and loss of around 16 tonnes of soil/ha through land erosion. ICAR applied science to agriculture which ushered in the green revolution making India self-sufficient and self-reliant.

The council has also played a major role in promoting excellence in higher education in agriculture. It is engaged in cutting edge areas of science and technology development and its scientists are internationally acknowledged in their fields.The challenge before ICAR is to ensure nutritional security to ever-growing population of the country with little potential for increase in cultivable land area, ensuing shortage of water and global warming.

Mandate of ICAR

- Plan, undertake, coordinate and promote research and technology development for sustainable agriculture
- Aid, impart and coordinate agricultural education to enable quality human resource development
- Frontline extension for technology application, adoption, knowledge management and capacity development for agri-based rural development
- Policy, cooperation and consultancy in Agricultural Research, Education and Extension.

ICAR-Indian Institute of Farming Systems Research, Modipuram is one of the institute working under Indian Council of Agricultural Research.

The Project Directorate for Farming Systems Research (PDFSR) was given the status of full-fledged institute w.e.f. 27th November, 2014 and renamed as "**Indian Institute of Farming Systems Researc**h" (IIFSR) with 4 divisions (Integrated Farming Systems Management, Cropping Systems & Resource Management, Organic Agriculture Systems and Transfer of Technology, Refinement & Human Resource Development) along with AICRP on IFS and NPOF being an integral part of the institute.

Brief History

The genesis of the Cropping Systems Research Project may be traced back to the visit of Dr. A.B.

Stewart of Macaulay Institute of Soil Research, Aberdeen, U.K., somewhere in mid- nineteen forties. He was invited by the then 'Imperial Council of Agricultural Research' to review the status in respect of soil fertility investigations, in general, and manuring in particular, and to suggest necessary steps which might be taken to obtain adequate information under different conditions of soil and climate within a very short time so that the agricultural departments could provide relevant instructions to the farmers for increasing the crop yields. His review report, published in 1947, significantly influenced the philosophy and practice of fertilizer experimentation in the county. The importance of conducting simple fertilizer trials on cultivators fields and complex experiments at selected centers was emphasized in the report which promoted the initiation of "Simple Fertilizer Trials on Cultivators Fields" in 1953 under Indo-American Technology Cooperation Agreement through Soil Fertility and Fertilizer Use Project:" with the following objectives:

- To study crop responses to NPK, when applied separately and in different combinations under the cultivator's field conditions.
- To investigate the relative response of different fertilizers in various broad soil groups and to work out the optimum fertilizer combinations for different agro-climatic regions.
- To study the relative performance of different nitrogen and phosphatic fertilizers for indigenous production.
- To demonstrate the role of fertilizer use on crop production before the farmers.

Later, in 1956, Model Agronomic Experiments, i.e., complex experiments on carefully selected centers, were also brought under the purview of the project and it was renamed as 'All India Coordinated Agronomic Experiments Scheme (AICAES)'. With the passage of time the scheme went through various stages of evolution to keep pace with the development in science and technology and to meet the increasing demands. The research arena was expanded to include agronomic research encompassing cultural practices, irrigation, nutrition, chemical weed control and multiple cropping. But the emphasis continued to remain on soil fertility and fertilizer use efficiency. In 1968-69 the scheme was sanctioned as 'All India Coordinated Agronomic Research Project (AICARP) with two components *viz*; 'Model Agronomic Experiments and 'Simple Fertilizer Trials'.

Nevertheless, even after green revolution, agricultural research centered on only individual crops in isolation. But for a sustainable development the system approach is a must. This realization might have given an impetus to start cropping systems oriented research and the project was upgraded into a Directorate during 7th five year plan and was established as the '**Project Directorate for Cropping Systems Research (PDCSR)**', which became functional in March,1989 with its headquarters at Modipuram, Meerut, U.P. Further, during 11th five year plan PDCSR has been re-designated as '**Project Directorate for Farming Systems Research (PDFSR)**' during 2009-2010. During 2014 (12th five year plan) PDFSR was upgraded to a full-fledged institute and renamed as "**ICAR-Indian Institute of Farming Systems Research**" besides AICRP on IFS (In addition to existing 31 centres, ICAR-IASRI was added as new voluntary centre) and NPOF (in addition to existing 13 co-operating centres, 7 new cooperating centres were added) as an integral part of institute (with the following mandates:

- To undertake basic and strategic research in integrated farming systems on production technologies for improving productivity and resource use efficiencies.
- To develop efficient, economically viable and environmentally sustainable integrated farming systems models for different farming situations.
- To undertake on-farm testing, verification and refinement of system-based farm production technologies.

- To undertake human resource development and capacity building in integrated farming systems.
- To act as a repository of information on all aspects of farming systems research and development.
- To coordinate and monitor integrated farming systems research in the country

Since its inception, the institute has made significant contributions to the development and refinement of agricultural production technologies for diverse eco-edaphic and resource-base situations. These technologies have been aimed at efficient resource utilization and yield maximization through new technologies.

Some of the major areas of research are:

- Integrated farming systems.
- Development of need-based efficient and profitable cropping/farming systems and its analysis.
- Optimum varietal combinations for various crop sequences.
- Optimum crop combinations and planting geometry for intercropping systems.
- Tillage requirements and crop establishment practices under different cropping systems.
- Agricultural resource characterization and constraint analysis under different agro-ecological regions/ farming situations.
- Efficient sources of fertilizers for different crops and soil types.
- Effect of long term INM and chemical fertilizer use on crop yields and soil fertility under different farming/cropping systems.
- Options for introducing legumes in cereal-cereal cropping systems.
- Farm mechanization and crop residue management.
- Climate resilient agriculture.
- Organic and precision farming.
- On-farm evaluation and refinement of cropping systems technologies.
- Cropping/ farming systems related database management
- Human Resource Development related to Farming Systems Research

During the year ICAR-IIFSR was operating through following three plan schemes:

1. ICAR-Indian Institute of Farming Systems Research, Modipuram

On-station and on-farm research under four major themes namely, integrated farming systems management, cropping systems & resource management, organic agriculture systems and transfer of technology, refinement & human resource development is being carried out.

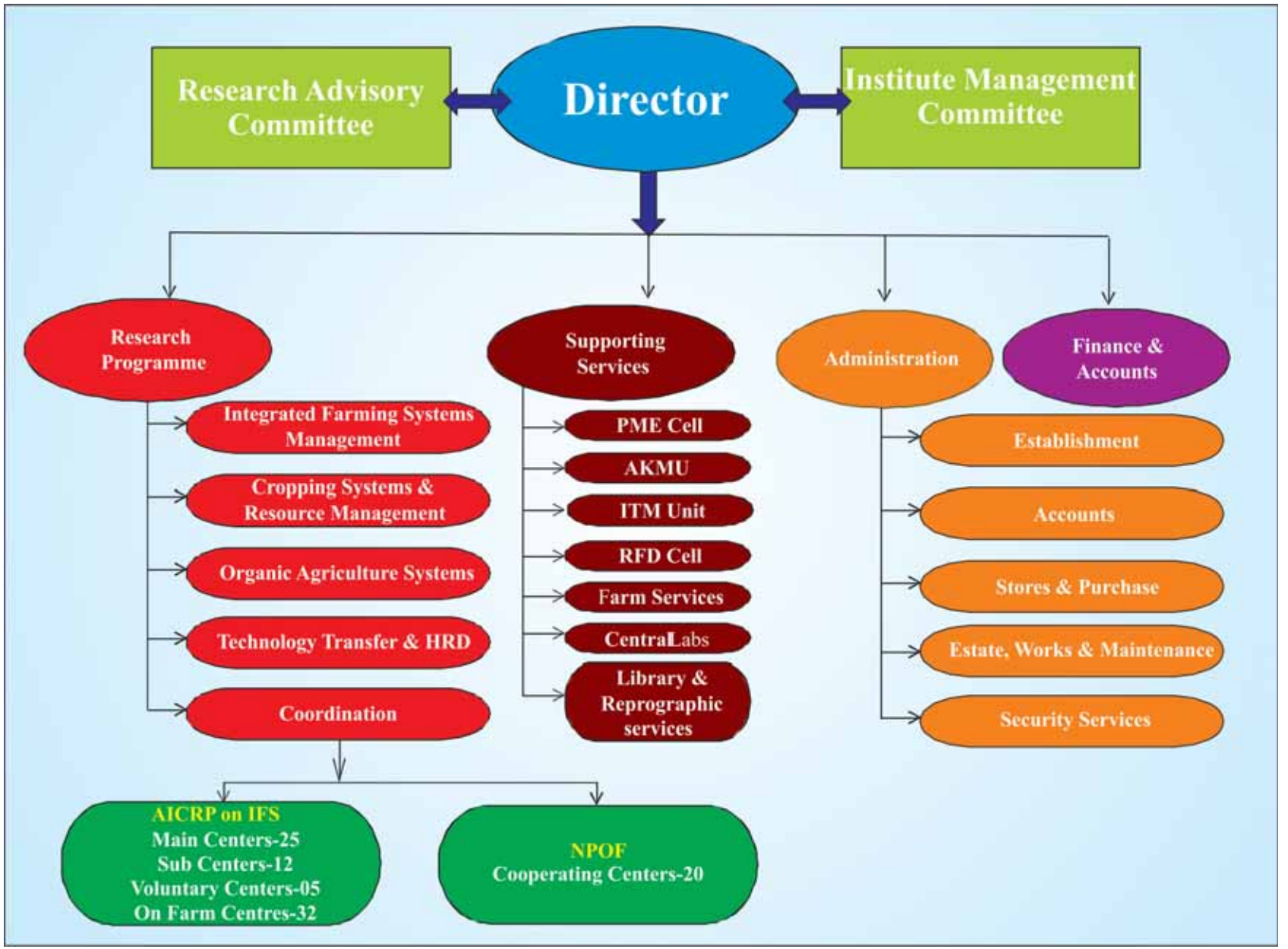
2. AICRP on Integrated Farming Systems (IFS)

Under the aegis of AICRP on IFS, on-station research at 31 main centres with 11 sub centres and on-farm research at 32 centreslocated in different agro climatic zones and cover the entire country is being operatingunder the administrative control of Director, ICAR-IIFSR.

3. Network Project on Organic Farming (NPOF)

Research on Organic farming through Network Project on Organic Farming (NPOF) at 20 centres covering 10 agro-climatic regions involving 11 SAU's, 7 ICAR institutes and 1 special heritage university is being carried out since 2004-05.

ICAR-IIFSR ORGANOGRAM



SOIL AND CLIMATE

ICAR-IIFSR, Modipuram is situated at an elevation of 230 meters above mean sea level, 29°4' N latitude and 77°46' E longitude. As per Planning Commission of India this region falls under 'Western Plains Sub-Zone' of 'Upper Gangetic Plains'. However, as per National Bureau of Soil Survey and Land Use Planning, Nagpur, the area falls under 'Northern Plain and Central Highland's Hot Semi-Arid Eco-region' with Alluvium derived soils. Soil of the research farm is neutral to slightly alkaline in nature and belongs to Typic Ustochrept group.

During the reporting year the onset of southwest monsoon was recorded on 1st July, which was 3 days delayed compared to normal onset. Total annual precipitation of 665.1 mm was received with erratic distribution. This was 13.4% lesser than the normal precipitation. Out of the total annual precipitation, Southwest monsoon contributed 84.9%. The mean maximum temperature varied from 20.6°C in January to 38.1°C in April while the mean minimum temperature varied between 7.1°C in January to 25.8°C in August. The average relative humidity and sunshine hours were 73.4% and 6.3 hours/day, respectively. There were 29 rainy days with rainfall more than 2.5 mm. The highest daily maximum temperature recorded was 43.5°C on 2nd May and the lowest minimum temperature was 2.5°C on 18th January. The summary of the monthly meteorological data are presented in Table 1.

Table 1. The summary of the monthly meteorological data recorded at Agromet observatory

Month	Temperature (°C)		Avg. RH (%)	Sunshine hours (hrs/day)	Rainfall (mm)	Rainy days (nos.)	Pan evaporation (mm)
	Max.	Min.			Observed		
January	20.6	7.1	80.0	2.9	0.0	0	40.8
February	25.3	8.5	73.5	6.6	1.0	0	82.8
March	30.0	14.0	71.7	7.2	20.2	3	127.9
April	38.1	19.7	47.7	8.9	1.2	0	258.8
May	37.4	22.3	60.4	8.4	76.9	6	248.8
June	37.1	24.2	72.1	8.3	43.4	2	215.9
July	33.2	24.6	86.1	4.5	288.1	10	131.4
August	34.4	25.8	86.1	5.6	209.4	9	127
September	34.4	24.3	81.2	7.1	23.7	1	125.4
October	33.0	18.7	72.0	5.3	1.2	0	102.5
November	28.4	10.6	71.8	5.7	0.0	0	64.8
December	23.1	8.0	77.8	4.5	0.0	0	43.1
Annual Avg/Total	31.2	17.3	73.4	6.3	665.1	29	1569.2

The weekly pan evaporation reached 50.0 mm during the 15thstandard meteorological week (SMW) and came down from 27thSMW onwards (Fig. 1 & 2). Highest maximum temperature of 40.9°C was recorded during the 20th SMW and lowest minimum temperature of 5.0°C was recorded during the 4th SMW.

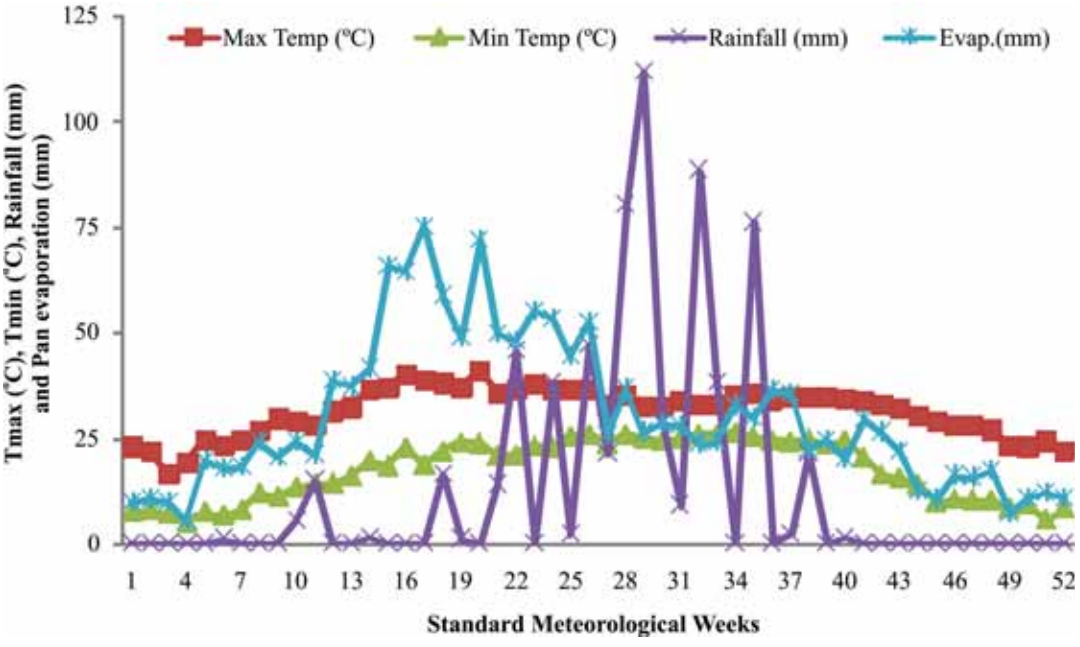


Fig. 1. Weekly Pan Evaporation, Rainfall, Maximum and Minimum temperature recorded during the year 2016

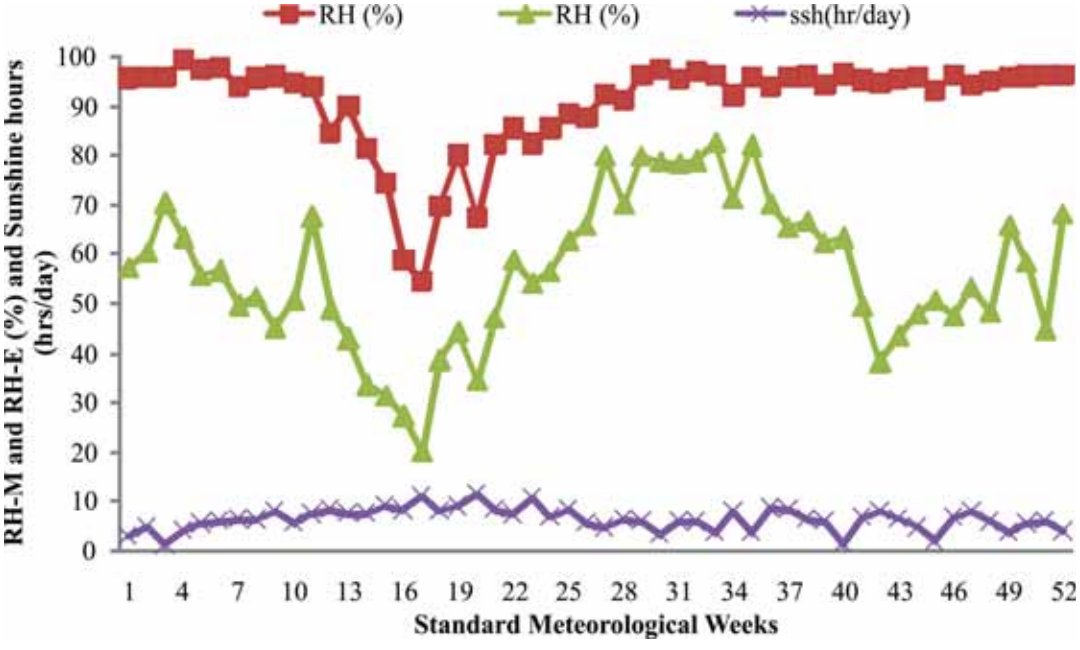


Fig. 2. Weekly RH (morning), RH (evening) and sunshine hours recorded during the year 2016

RESEARCH ACCOMPLISHMENTS

Integrated Farming Systems Management (IFSM)

Sustainable Integrated Farming System Models for livelihood improvement of small farm holders

Integrated Farming System model of 1.5 ha under irrigated condition has been developed at main research farm of the Institute. The model comprised of crops/ cropping systems of 1.04 ha area, fruit plantation (0.22 ha), boundary plantation all around the field plots, a small kitchen garden (20 m^2), three milch animals (2 Murrah buffaloes +1 HF cow), fresh water fish production (0.1 ha), mushroom unit (100 m^2), vermicompost unit (0.001 ha) and a biogas unit.

The yield of different components of crops/cropping systems (1.04 ha) was 3.14, 0.368, 0.220, 16.60, 5.00 and 24.40 tonne cereals, pulses, oilseeds, green fodder, dry fodder and sugarcane respectively. The highest gross and net income(38.0%) from crop component was Rs 1, 84,760 and Rs 1, 53,140 respectively. The fruit yield of 2.76, 0.295, 0.640, 0.034 and 0.180 tonne

Table 1: Production, productivity and profits of different components of IFS Model (1.5 ha)

Components of IFS Model	Farm products	Total farm production in tonnes (REY)	Gross returns (Rs $year^{-1}$)	Cost of cultivation (Rs)	Net returns (Rs $year^{-1}$)	Man days*	B:C ratio
Crops (1.04 ha)	Cereals (3.14 t) Pulses (0.368 t) Oilseeds (0.22 t) Sugarcane (24.44 t) Green fodder (16.6 t) Dry fodder (5.0 t)	13.41	1,84,760	31,620	1,53,140 (38.08%)	205	4.84
Horticulture (Fruit production) (0.22 ha)	Fruits, Intercrops	7.57	1,05,980	33,080	72,900 (18.13%)	36	2.20
Kitchen gardening	Seasonal vegetables	0.50	7000	800	6,200 (1.54%)	12	7.75
Dairy (2 Buffalo + 1 Cow)	Milk (4228 litre) Vermicompost (12.0 t) FYM (13.0 t)	14.23	1,99,230	1,05,206	94,024 (29.56%)	180	0.89
Fish production (0.10 ha)	Fish	1.94	27,180	12,500	14,680 (3.65%)	24	1.17
Mushroom	Mushroom	1.29	19,809	4200	15,609 (3.88%)	40	3.71
Boundary plantation	Fruits/Fuel wood etc.	4.21	58950	13,360	45,590 (11.34%)	14	3.41
Total IFS (1.5 ha)	-	43.06	6,02,909	2,00,766	4,02,143	511	2.00
Per hectare basis		28.70	4,01,939	1,33,844	268095	340	

*In IFS model a total of farm production in terms of sugarcane yield equivalent came to the yield level of 134 t ha^{-1} which was 97% higher than average yield of Western Uttar Pradesh (68 t ha^{-1})

were recorded for guava, mango, pear, peach and vegetables respectively obtained from horticultural component (0.22 ha) which registered gross and net returns of Rs 1,05,980 and Rs 72,900 respectively. Livestock component having 3 milch animals yielded 4228 liters of milk. Besides, 12.00 tonnes of vermicompost and 13.00 tonnes of FYM were prepared. The contribution of livestock component was found to be 29.56 % to the net farm income. The mushroom unit in 100 m^2 area having 12 racks registered gross return of Rs. 19809 which included Rs 1,709 from recycling of mushroom compost. The recycling of farm dung and urine in FYM/compost form supplied nutrients of 49.4 kg N+ 15.6 kg P+26 kg K. Total farm production, cost of production and returns from different components which were included in the IFS model are summarized in the Table 1 and also illustrated in the Fig. 1.

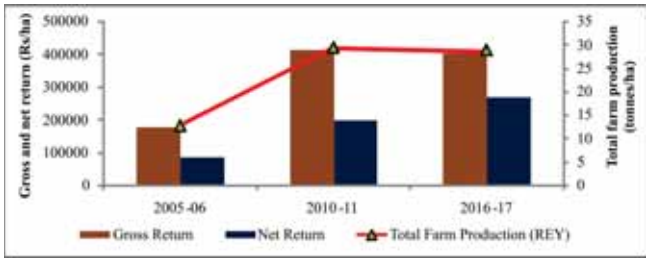


Fig. 1. Productivity (t ha^{-1} $year^{-1}$), gross and net returns (Rs. ha^{-1} $year^{-1}$) of IFS model during 2005-06, 2010-11 and 2016-17

The total farm production in IFS approach was 95% higher than prevailing dominant cropping system like sugarcane-ratoon-wheat of western plain zones of UP. This system not only increased the production and profitability but also ensured the food requirement of farmer's family along with nutritional improvement by way of producing sufficient and regular supply of all the food and feed ingredients like cereals, vegetables, oilseeds, fruits, mushroom and fish meat for consumption and supply round the year green and dry fodders to the dairy animals. The diversified IFS model resulted in safeguard to farmers against the climatic hazards and also helped in reducing production cost through adding recycled products, thus, saving the cost of market inputs by 30-40%.

Fisheries Module

Optimization of the fisheries module under IFS systems was continued. Stocking of the pond was carried out during the month of July with advanced fingerlings of rohu, katla, mrigal, common carp, silver carps and grass carp @ stocking density of 10000 fingerlings per hectare in ratio of 20:20:20:10:20:10. A production of 388 kg fish was achieved. Pond dykes were utilized for nutritional kitchen gardening by cultivation of seasonal vegetables for additional income. The water quality of the fish pond was measured and were found to be within the optimal range for carp culture (Table 2).

Table 2: Water quality parameters of IFS pond

Parameters	Range
Water Temp (^{0}C)	22.2- 30.8
pH	7.5-8.93
Total Alkalinity (mg/l)	220-340
Dissolved Oxygen (mg/l)	6.8-9.0
EC (µs/cm)	580-950
TDS (mg/l)	275-475
Ammonia (mg/l)	0.02-0.04
ORP (mV)	239.9-410.8

Keeping in view the requirements of small and marginal land holders of theregion, low input based management system, relying on enhancing the fertilityof pond through maintaining sufficient feed in terms of phytoplankton andzooplankton in the pond for entire growth phases, was practised. For enhancing resource use efficiency, by-products of crops and diary enterprise such as raw cow dung/cow dung slurry, rice polish etc. were used as input for fish pond besides periodic application of inorganic fertilizers of NPK for plankton growth. The growth dynamics of different fish species were recorded in the IFS pond (Table 3).

Table 3: Growth dynamics of various fish species

Fish Species	Stocking Range (wt. in g)	After 3 months	After 6 months	After 9 months	Harvest Range (g)
Catlacatla	10-15	90-95	180-215	415-550	750- 1100
Labeorohita	12-18	105-110	230-250	410-650	800- 950
Cirrhinusmrigala	6-8	80-85	150-175	350-450	650-750
Silver carp	8-10	130-140	225-275	400-650	750-1200
Grass carp	8-12	110-130	230-260	375-425	800-900
Common carp	5-8	60-70	190-240	450-510	700-950

Plate 1: Fisheries module of IFS

Mushrooms Module

A module of year round production of mushroom was developed by during 2013-14 and continued to 2016-17 through adjustment of combinations of oyster mushroom (*Pleurotus* spp.), milky mushroom (*Calocybe indica*) and white button mushroom (*Agaricus bisporus*). Mushroom house of 18' x 13' dimension with five tier racks was used for the module. Two crops of button mushroom from October-February with long method of composting, 2 crops of oyster mushroom during October-November and February-March and 2 crops of milky mushroom from March-September were taken in the module.The yield of 235 kg of all the mushrooms (100 kg button mushroom, 100 kg oyster mushroom and 35 kg milky mushroom) was harvested besides 1400 kg of spent substrate (as high quality organic manure) of which, 1000 kg obtained from button mushroom and 400 kg from spent straws of oyster and milky mushroom. The spent straw was used as animal feed as additive. The total gross return from this module obtained was Rs.18100/- with net income of Rs.13900/-, B:C ratio of 1.30 and employment generation of 40 man days (Table 4). The previous year (2015) spent compost of button mushroom (2600 kg) recorded 49.4 kg nitrogen, 15.6 kg phosphorus and 26 kg potash having market value of Rs.1709/- was recycled in the crop production component.

Table 4: Economics of the year-round mushroom production module

Mushroom species	Button mushroom (*Agaricusbisporus*)	Oyster mushroom (*Pleurotus* spp.)	Milky mushroom (*Calocybe indica*)	Total
Annual yield of mushroom (kg)	100	100	35	235
Gross income from mushroom (Rs.)	10000	6000	2100	18100
Cost of Production (Rs.)	2000	1500	700	4200
Net Income (Rs.)	8000	4500	1400	13900

Horticultural Module

High density planting of three varieties of guava (*Psidium guajava*) *viz.*, Allahabad Safeda, Sardar (L-49) and Sweta, three varieties of Ber (*Jujupus jujube) viz.*Gola, Seb, Umran, three varieties of Pomegranate (*Punica granatum*) *viz.*, Bhagwa, Arakta and G-137, were planted along with plants of Sweet orange/ Mosambi (*Citrus sinensis*), Nagpur mandarin (*Citrus reticulata*) and Kinnow (Mandarin X Orange)during July – August 2014. Observations on vegetative growth, flowering, fruiting, yield and quality of fruit crops and yield of intercrops was recorded (Table 5).

Vegetative growth of ber crop was maximum followed by guava. Among ber cultivars, growth of Cv Gola was significantly higher than other cultivars (height 6.11 m and canopy spread 4.90 m^2) followed by Seb. Among guava cultivars, annual fruit yield of Shweta was significantly higher than yield of any other fruit crop or cultivar; it yielded 39.44 kg / plant followed by Allahabad Safeda (36.00 kg / plant). Among pomegranate cultivars, Bhagwa yielded maximum fruits (12.0 kg / plant) followed by Arakta (11.0 kg / plant).

Average fruit yield per plant was 15.0 kg, 14.0 kg and 11.0 kg in Cvs. Gola, Seb and Umran respectively which was significantly lower than yields of guava cultivars. All three Cvs. of Pomegranate (Arakta, Bhagwa and G -137) came in bearing during August – September 2016. Average fruit yield at the plant age of two years was 11.0 kg, 12.0 kg and 6.00 kg in Cultivars Arakta, Bhagwa and G-137 respectively. Plants of citrus fruits showed only stray flowering at this age. Flowering and fruiting was reported only in plants of Kinnow while, it was not seen in Mandarin and Mosambi. In control plots, where only fruit crops were grown without intercropping, the yield of fruit crops was at par with crops grown with intercrops.

Observations on temperature (^oC) and relative humidity (%) inside plant canopy and under open conditions was recorded in all crops and varieties. Microclimate in plant canopies was modified due to shading by branches. During May 2016 when temperature in open area was 45 ^oC, it was 43.0 ^oC in canopies of all fruit crops. This reduction in 2.0 ^oC in temperature was reported as 4.4% reduction of temperature. During January 2017, when open temperature was 8.0 ^oC, it was 8.6 ^oC under the canopies. This showed 7.5% increase in canopy temperature.

Yield of intercrops in high density fruit plantation in terms of rice equivalent yield (REY) is given in Table 6. Perusal of data presented in the table shows that there

Table 5: Growth and fruit yield of fruit crops (Ber, Guava, Pomegranate and Citrus)

S. No.	Crop	Cultivar	Height (m)	Canopy spread (m^2)	Fruit yield (kg/plant)
1	Ber	Gola	6.11	4.90	15.00
		Seb	3.96	3.90	14.00
		Umran	4.10	3.80	11.00
2	Guava	Shweta	3.00	2.10	39.44
		Allahabad Safeda	3.36	2.05	36.00
		Lucknow -49	2.95	2.13	32.00
3	Pomegranate	Arakta	2.30	1.47	11.00
		Bhagwa	1.87	1.45	12.00
		G-137	2.00	1.55	06.00
4	Citrus	Kinnow	2.16	0.82	04.00
		Mosambi	3.20	1.88	—
		Mandarin	2.46	1.90	—

Table 6: Yield of intercrops (REY) grown under different cultivars of fruit crops

Cropping systems	Yield of intercrops (REY) in kg/ plot in cultivars of fruit crops											
	Ber			Guava			Pomegranate			Citrus spp		
	Gola	Seb	Umaran	Shweta	A Safeda	L-49	Arakta	Bhagwa	G 137	Kinnow	s. orange	Mandarin
Cereal based	23.21	22.85	23.58	23.45	21.94	24.25	19.993	23.37	22.86	21.337	23.250	24.163
Vegetable based	41.03	50.75	53.64	59.82	54.73	50.28	48.703	53.78	51.43	47.403	50.107	48.017
Fodder based	5.07	4.3	4.983	4.563	4.543	5.240	4.230	4.173	4.963	4.413	4.413	4.690
CD	0.516											
SEm	0.182											

Plot size for cropping 30 m^2

was significant effect of cropping systems on yield (REY). Vegetable based cropping system, which includes Potato, Okra and Brinjal in *rabi*, *summer* and *kharif* season respectively produced maximum yields followed by cereal based cropping with wheat, mung and rice system and least yield was recorded from fodder based cropping system.

Non-traditional high value fruit crops

High value non-traditional fruit crops *viz.* low chilling apple (*Malus domestica*) Cv. Anna, Dorsett Golden and Michel, two types of Dragon fruit (*Hylocereus undatus*) red fleshed and white fleshed, Apple Ber, Seedless Jamun (*Syzygium cumini*), Valencia orange, Khasi mandarin and Assam Lemonwere studied to evaluate their performance under Western UP conditions for exploring the possibility of inclusion of above crops in existing farming systems.

Low chilling apple Cv Anna was planted during March 2014 for evaluation under western UP conditions. The plants attained good vegetative growth and started flowering from first year of establishment. Flowering in Feb.-March resulted in fruit setting during April and maturity followed by harvesting during June (Table 7). Floral biology was also studied. In the absence of pollen grain of any other cultivar for pollination, 28.0% fruit setting in this cultivar with pollen of same cultivar was recorded. Main pollinator insects observed during this period were Honey bee (Apis melifera), Wasp (*Palaeovespa florissantia*) Hover fly *(Syrphidae spp)* and House fly (*Musca domestica*) (Table 8). Fruit development continued during warm

Table 7: Relationship between time of bud emergence and fruit set in in Anna apple at the age of two years

Bud emergence (Period)	Opened Flowers (nos.)	Fruit set (nos.)	Fruit retention (nos.)
15 - 21 February	76	20	04
22-28 February	136	46	11
01-07 March	154	37	12
08-14 March	163	28	08
15-21 March	64	21	08
22-28 March	19	19	01
Total	**612**	**171**	**44**

Table 8: Dynamics of pollinator insects in apple

S. No.	Pollinaors	Population (%)	Duration of visit
1	Honey bee *(Apis melifera)*	73	20 February to first week of April
2	Hover fly *(Syrphidae spp)*	19	20 February to first week of April
3	Wasp (*Palaeovespa florissantia*)	06	March to first week of April
4	House fly (*Musca domestica*)	04	Last week of February to March

climate of western plains of UP (max temp 46 °C during June) and flowering (pink bud stage) to fruit harvesting duration was recorded as 114 days. Height and canopy spread of plants was measured during December and it was reported as 3.8 m and 3.0 m^2 respectively. Fruit quality was analysed and it was improved over first year of bearing. Average fruit weight was recorded as 120 gram with fruit dimensions of 3.0 inch diameter and 3.4 inch length. The total soluble solids (TSS) was observed 18.0 °B.

In order to evaluate other pollinizer varieties of low chilling apple for better fruit set in apple, 5 plants of low chilling Cv. Dorsett Golden and 10 plants of Cv. Michel were planted on 9th January 2016. At the time of planting, average height of Dorsett Golden and Michel plants were 110.74 cm and 112.4 cm respectively. After growth of one year plant height reached up to 218.0 cm in Dorsett Golden and 270.0 cm in Michel (January 2017). Canopy spread of Dorsett Golden was 84.75 cm while it was 63.25 cm in Michel Among these varieties; Dorset Golden produced the flower buds during February 2017. Floral biology and bearing behavior of this cultivar is under study.

Research and development on Dragon Fruit (*Hyalocerous undatus*) or Pitaya, a lithophytic or hemiepiphytic fruit from cactus family is in infancy stage in our country. Keeping these points in view, two type of germplasm (white pulped and red pulped) of this fruit crop was brought from Maharastra and rooted cuttings of 8-10 inch length were planted with the support of cemented pillar during August, 2014.

Initial vegetative growth was poor but the height of plants after two year of growth was about 6.5 feet. There was side branching also from all the plants. This crop tolerated the minimum temperature of about 1 °C and maximum temperature of about 45 °C during extreme winters and summers of western plains of UP. Floral biology of dragon fruit was studied under conditions of western UP. After two years of planting, floral buds appeared on plants. Deatiled floral biology is given in Table 9. It took 45 days from flower bud emergence to fruit harvesting. The fruit is oblong, 8- 9 cm long, 7.5-8.5 cm thick, red with large bracteoles, with white pulp and are edible, seeds are black. Average fruit weight was recorded as 375 gram and TSS of fruits was recorded 18 -19 °B.

Plate 2: Visit of Dr. Sanjeev Balyan, MoS for Water Resources, Government of India

Plate 3: Mature fruits of Anna apple

Table 9: Floral biology of Dragon fruit (*Hyalocerous undatus*)

Parameter	Value
Age of flowering	24 months
Time of flowering	August – September
Floral buds per vine	06-Aug
Length of floral buds	15.0 cm
Time of flower opening	night
Flower colour	White
Width of flowers	15-16 cm
Length of flowers	20-22 cm
Length of pericarpel	2.5 cm
Thickness of pericarpel	2.0 cm
Thickness of receptacle	3.0 cm
bracteoles	linear-lanceolate, 5-8 cm long
Outer tepals	lanceolate-linear to linear acuminate
Length and width of tepals	13-15 cm long, 10–12 mm wide
Colour of tepals	greenish-yellow or whitish
Inner tepals.	lanceolate up to 10–15 cm long about 40 mm wide at widest point and white
Stamens	7-9 cm long, are declinate, inserted in one continuous zone from throat to 30 mm above the pericarpel

Plate 4: Dragon fruit at harvesting stage

Ber (*Ziziphus mauritiana* L.) is a multipurpose tree known for its nutritious fruits, seeds, fodder, timber, medicines and industrial components. Apple Ber is an exotic cultivar of Ber and is spreading very fast due to its high production potential, bigger sized fruits and better shelf life. In order to test feasibility of this variety in western plains of Uttar Pradesh, planting of this variety was done at experimental plot. After two year of growth, the height of plant was recorded as 2.8 m with canopy spread of 2.75 m^2. Trunk circumference at the height of 10 cm, from ground was 32.0 cms,. Few leaves (15 - 20 %) of this variety were damaged by Leaf webber (*Synclera univocolis* Walker) during July – August months which was under control. During second year, all the branches came in bloom. Flowering started from last week of August and continued up to September, it prolonged for about 42 days. Few fruits attained exceptionally bigger size and weight of 100.0 gram but average fruit weight was recorded 65.55 grams with TSS of 16 ^oB. The pulp stone ratio was also very high with 92.62% of pulp and only 7.38% of stone. About 50% stones were very soft and breakdown during cutting. Fruits developed and attained marketable size and quality during last week of December and continued up to end of February.This variety of ber produced 25 kg fruit at the age of 28 months and proved its high production potential. In order to maintain its productivity in long term, storage of fruits at room temperature showed that physiological loss in weight (PLW) was very slow and it reached 8.11 % after 8^{th} day of storage

Valencia orange is a sweet orange from California, USA. Budded plants of Valencia orange, procured from nursery of Central Institute of Horticulture (CIH), Nagaland were planted in experimental plot during March, 2015. After one year of growth the plants attained the height and spread of 150.0 cm and 145.0 cm respectively and started flowering. Fruit set was recorded in first week of April 2016. Fruits matured during December 2016. It took approximately 270 days from flowering to fruit maturity. Fruit quality was analysed and average fruit weight was recorded as 240

grams with bright yellow skin colour. Fruit diameter was 7.6 cm, total soluble solids content in fruits was 7.0 °B.

Plants of seedless variety of Jamun are growing well and are under vegetative phase. After two years of growth, plants have attained the height of 210 cm and canopy spread of 188 cm^2. Similarly plants of Khasi mandarin and Assam lemon are growing well under field conditions.

Plate 5: Valencia orange

Forage Module

The evaluation of forage based cropping system was done with the treatments consisted of five crop modules viz. *Cenchrus* round the year, *Stylo hamata*-carrot–cowpea; maize-pea-sorghum; *Clitoria*-oat-bajra and *Dolichos*-wheat-teosinte during all three seasons (Table 10). The productivity of individual crop under different fodder based cropping systems was varied. However, the highest sorghum green fodder equivalent yield was observed in carrot (110.54 t ha^{-1}) followed by *Clitoria* (73.41 t ha^{-1}), wheat (66.32 t ha^{-1}), *Dolichos* (63.10 t ha^{-1}) and maize (57.93 t ha^{-1}).

Plate 6: *Cenchrus setigerus* (Dhaman grass)

The sorghum equivalent yield (SEY) of maize-pea-sorghum cropping system was the highest (171.46 t ha^{-1} $year^{-1}$) and lowest SEY was reported under *Cenchrus* grown round the year (84.94 t ha^{-1} $year^{-1}$). The difference between clitoria- oat-bajra and dolichos- wheat -teosinte cropping systems for sorghum equivalent yield was found statistically at par with each other. While both the cropping systems namely stylo-carrot-cowpea and Cenchrus alone were found superior in terms of sorghum equivalent yield. Higher nutrients (N, P, K, Cu, Mn, Zn and Fe) content in dry matter was observed in *Clitoria ternatea* (Titli matar) than other crops viz. *Stylo hamata*, *Dolichos lab lab*, oat, *Cenchrus*, teosinte, bajra, wheat and maize when grown under different crop modules. The least nutrient

Plate 7: *Clitoria ternatea* (Titli matar)

Table 10: Effect of different crop modules on green fodder, dry matter, seed, green pea pods and economics

Treatment	*Kharif*			*Rabi*			Summer			Economic return		
	GF yield (t ha^{-1})	DM yield (t ha^{-1})	Grain yield (t ha^{-1})	GF yield (t ha^{-1})	DM yield (t ha^{-1})	Seed/ green pod /carrot yield (t ha^{-1})	GF yield (t ha^{-1})	DM yield (t ha^{-1})	SEY (t ha^{-1}yr^{-1})	Gross return (Rs ha^{-1})	Net return (Rs ha^{-1})	B:C ratio
Cenchrus round the year	48.76	14.78	4.02	21.23	5.77	-	16.47	3.21	84.94	1,11,480	75160	2.06
Stylo-carrot-cowpea	14.70	4.41	-	22.82	7.32	28.60	27.13	5.50	138.19	3,19,130	2,20430	2.33
Maize-pea-sorghum	-	8.36	7.14	6.74	2.04	3.58	53.66	11.63	171.46	3,58,000	2,53,450	2.42
Clitoria–oat-bajra	44.05	13.35	-	22.53	6.78	2.53	44.57	9.70	149.97	3,07,315	2,10,115	2.16
Dolichos-wheat-teosinte	47.33	14.20	-	-	5.52	4.17	30.37	6.37	146.41	2,92,880	1,94,230	1.96
CD(P=0.05)	8.76											

content was observed in dry matter of maize stover after the harvesting of cobs. Nitrogen (N) content in dry matter of fodder crops varied and it was higher in *Clitoriaternatea* (2.52%) followed by in *Stylo hamata*, cowpea and pea, respectively. In cereal crops, N content in *Cenchrus* was higher than other crops *viz*. maize, bajra and oat. The crude protein content in dry matter of *Clitoria ternatea* was highest (15.75%) followed by *Stylo hamata* (15.06%) and least was observed in case of wheat straw (5.56%) and the highest protein yield was accrued in the dry fodder of *Dolichos* (1.48 t ha^{-1}). The maize-pea-sorghum crop module had higher gross return (Rs.3, 58,000 ha^{-1} year^{-1}), net return (Rs.2, 53,450 ha^{-1} year^{-1}) and benefit: cost ratio (2.42) than other crop modules (Table 10).

Value addition Module

Guava (*Psidium guajava* L.) fruits are rich source of vitamin C and phyto-chemicals *viz.*, antioxidants, phenols, flavonoids etc. but it has very short shelf life and highly perishable in nature. Therefore, an experiment was conducted on guava fruits for extending the shelf life using different post harvest treatments and evaluated qualities during storage. The matured guava (Cv. Allahabad safeda) was harvestd and washed with clean water followed by trimming and halving. Fruits were treated with different solutions *viz.*, ascorbic acid (AA) - 1%, $CaCl_2$(CC)- 1%, Ca-lactate (CL)- 1%, AA (0.5%)+CC(0.5%), AA (0.5%)+ CL (0.5%), CC(0.5%)+ CL(0.5%), AA (0.3%)+ CC(0.3%) + CL (0.4%)-(ABC) and control (distilled water) by dipping for five minutes. Treated fruits were dried in air for one hour and packed in polyethylene terephthalate (PET) trays, externally covered with polyethylene cling film and stored at 5±1°C with 90±5% RH.

The minimum changes in TSS and physiological losses in weight (PLW) (12.5% and 9.6%) were recorded in guava fruits when treated with ABC and CC(1%) at 12 days of storage (Fig 2 &3). The results showed that the guava fruits treated with ABC retained the maximum ascorbic acid content (150 mg/100 g) as compared to other treatments. The maximum antioxidant activity, phenolic content, flavonoid, α-Carotene were recorded as 32.83 % DPPH scavenging activity, 14.63 GAE mg/100 gm, 10.66 QE mg/100 g

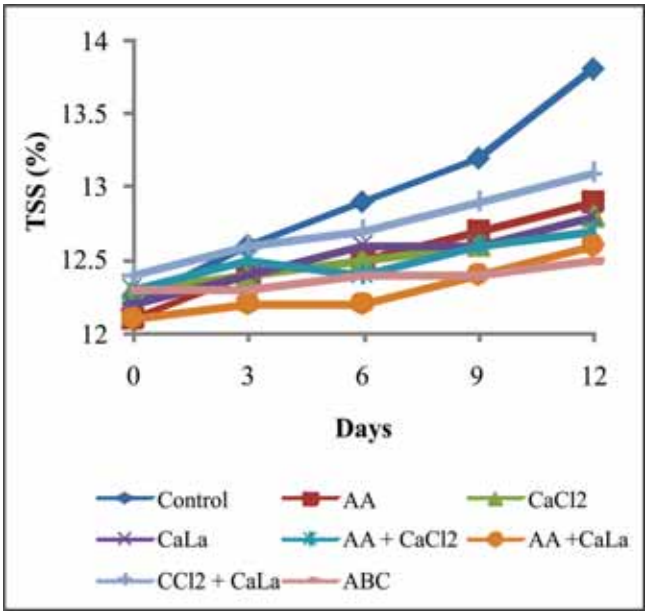


Fig. 2. Changes in TSS of minimally processed Guava during storage

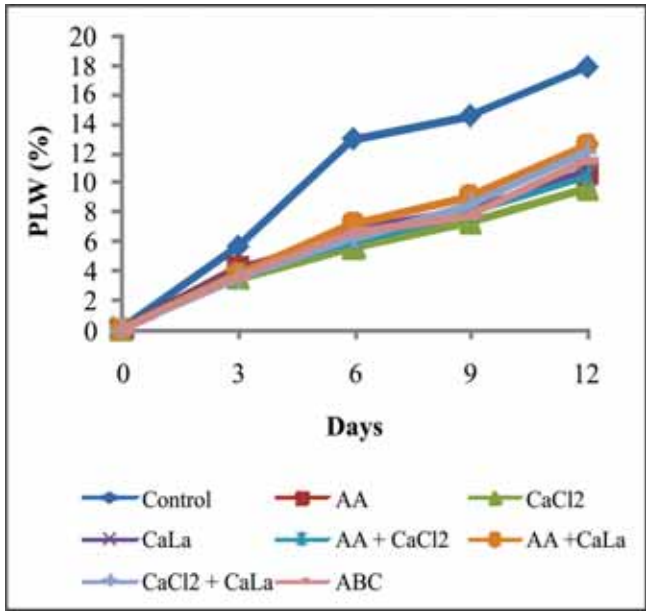


Fig. 3. Changes in PLW of minimally processed Guava during storage

and 0.36 mg/100 g for guava fruits treated with CC (1%), ABC, AA (1%) and ABC respectively at 12 days of storage. However,maximum organoleptic scores (8.2) upto a shelf life of 10 days were recorded in fruits treated with AA (1%) and CC(1%)which indicated that the shelf life of minimally processed guava fruits with rich source of poly phenols (60-70%) may be obtained up to 12 days with the help of post harvest treatments. The minimum loss in antioxidant content during storage was observed in fruits treated with ABC (0.3%AA + 0.3% CC + 0.4% CL).The study suggested that among the treatments, the fruits treated with AA (0.3%) + CC(0.3%) + CL (0.4%) may be considered as best treatment for minimally processed

Plate 8: Instant pickle of milky mushroom

guava fruits for extending shelf life and quality during storage upto 10-12 days.

The instant mushroom pickles were prepared from freshly harvested milky mushrooms. The mushroom was washed with clean water and cut into small pieces followed by blanching with water containing 1% common salt at 90°C for 10 minutes. Drained slices were dried and kept in vinegar solution for 15 minutes. Spices required were roasted and grinded and heated with edible oil (10-15%). The blanched mushroom slices were then mixed with heated oil containing spices followed by addition of 10% common salt. The product was cooled for one hour at room temperature. The final products were tested for texture, taste and flavour and sensory score of mushroom pickle (Nine point Hedonic scale) and it was found that texture, taste, flavour and overall acceptability were 8.2, 8.4, 8.2 and 8.3 respectively.

Energy budgeting

The field experiments were carried out to estimate the energy input, output, energy use and net return energy return of the different cropping systems. The nine cropping systems *viz.*, diversified system, rice-wheat system, sugarcane-sugarcane ratoon-wheat system, turmeric, brinjal-potato-french bean system, bottle gourd-cauliflower-tomato system, mango-carrot-radish-onion system, guava-okra-veg pea-brinjal system and banana-turmeric system. For energy budgeting of these farming systems models three years average input and output data were considered while for sugarcane-sugarcane ratoon-wheat system only one cycle was considered for the energy budgeting because of its duration. Mango, guava and banana based cropping system include carrot-radish-onion, okra-veg pea-brinjal and turmeric, respectively, were grown in the available inter space area as inter crops. The diversified system consist different agro-horticultural sub-system of different plot size as rice-wheat (1645 m^2), sugarcane-sugarcane ratoon-wheat (1800 m^2), turmeric (700 m^2), brinjal-potato-french bean (700 m^2), bottle gourd-cauliflower-tomato (700 m^2), mango-carrot-radish-onion (1500 m^2), guava-okra-veg pea-brinjal (900 m^2), banana-turmeric (700 m^2) and 100 m row of karonda plantation. Input and output energy were calculated for each system on per hectare basis.

The current study revealed that highest total energy input was required in sugarcane-sugarcane ratoon-wheat cropping system (1063.04 $GJha^{-1}$) followed by mango-radish-carrot-onion (1034.24 $GJha^{-1}$) and brinjal-potato-french bean (659.71 $GJha^{-1}$) etc. and the least in the banana-turmeric cropping system (294.45 $GJha^{-1}$) followed by turmeric (329.10 GJ ha^{-1}), guava-okra-veg pea-brinjal (352.41 $GJha^{-1}$) and rice-wheat (376.81 $GJha^{-1}$) etc. (Table 11). The labor energy share in proportion to rest of the energy input from various sources was highest in banana-turmeric system (24.1%) followed by guava-okra-veg pea-brinjal (19.5%), bottle gourd-cauliflower-tomato (14.8%) and least in sugarcane-sugarcane ratoon-wheat cropping system (3.7%) followed by rice-wheat system (6.3%) and turmeric (8.3%) etc. While, fuel energy consumption in proportion to rest of the energy input from different sources was recorded highest in bottle gourd-cauliflower-tomato (16.5%) followed by rice-wheat system (13.2%) and least in sugarcane-sugarcane ratoon-wheat (5.3%) mango-radish-carrot-onion (7.6%) etc. Similarly, highest electrical energy consumption was in rice-wheat system (10.6%) followed by sugarcane-sugarcane ratoon-wheat (5.7%) and least in banana-turmeric (0.6%) followed by mango-radish-carrot-onion (0.9%) etc. (Table 12). Nitrogen based energy consumption in proportion to rest of the energy input from various resources was observed highest in mango based farming system (60.5%) followed by bottle gourd-cauliflower-tomato (38.9%), guava-okra-veg pea-brinjal (38.7%) and least in banana-turmeric (9.2%), turmeric (15%) and brinjal-potato-french bean (23.3%) etc. Likewise, water energy consumption in found to be highest in rice-wheat cropping system (20.3%) followed by bottle gourd-cauliflower-tomato (16.2%) sugarcane-sugarcane ratoon-wheat (10.1%) and least in mango-radish-carrot-onion (2.6%), guava-okra-veg pea-brinjal (4.2%) brinjal-potato-french bean (7%) etc. Similarly, seed energy contribution in proportion to rest of the energy input was highest in turmeric crop (51.4%)

Table 11: Energy Input and Output in different farming systems (MJ/ha)

	DIVERSE	RW	SSRW	T	B-P-FB	BG-CF-TO	M-RD-CR-O	G-OK-VP-B	BN-T
A) DIRECT									
1) Labor	4506.0	2385.3	3978.4	2744.0	6573.0	6987.4	7870.7	6867.1	7090.53
2) Fossil fuel (Diesel)	4501.4	4964.5	5632.7	3166.2	8640.5	7789.1	7901.3	4355.3	2311.44
3) Electricity	2222.3	4004.8	6100.0	752.9	1223.4	1976.4	941.4	1073.4	188.23
B) INDIRECT									
1) Seed/Nursery Transplantation	12259.0	1876.5	44181.3	16925.7	18425.19	3.00	736.4	1376.7	12332.51
2) Fertilizer									
Nitrogen (N)	16658.2	12364.6	24181.4	4927.6	15399.3	18347.9	62620.0	13637.5	2698.4
Phosphorus (P_2O_5)	2906.7	1831.3	4098.9	889.9	2100.1	2903.1	12935.9	1974.9	497.4
Potassium (K_2O)	1154.8	806.4	1712.9	333.0	1073.9	1211.7	4232.7	1222.0	232.5
Farm Yard Manure	1344.0	0.0	0.0	0.0	6428.5	0.00	3192.0	2754.0	115.8
3) Insecticide/Herbicide	1308.0	1605.3	5466.6	0.0	856.9	0.00	0.0	333.6	0.0
5) Fungicide	24.2	0.0	0.0	0.0	364.2	0.00	0.0	0.0	0.0
6) Machinery including self-propelled	167.2	192.2	241.3	110.8	295.3	280.3	266.8	150.4	79.4
7) Animal Ploughing	40.4	0.0	0.0	0.0	0.0	0.00	0.0	0.00	72.1
8) Irrigation	4905.6	7650.0	10710.0	3060.0	4590.0	7650.00	2726.4	1495.7	3826.5
Total Energy Input (MJ/ha)	**51998.3**	**37681.2**	**106303.8**	**32910.3**	**65970.7**	**47149.0**	**103423.9**	**35240.9**	29444.9
ENERGY OUTPUT (MJ/ha)	**DIVERSE**	**RW**	**SSRW**	**T**	**B-P-FB**	**BG-CF-TO**	**M-RD-CR-O**	**G-OK-VP-B**	**BN-T**
Energy (main)	197454.4	174768.3	709888.4	90341.0	155262.6	17296.3	57949.7	81626.3	105034.6
Energy (byproduct)	72902.5	154787.2	148276.6	6100.0	29021.0	17626.0	23749.4	4293.2	118318.0
Total Energy Output (MJ/ha)	**270356.9**	**329555.5**	**858165.0**	**96441.0**	**184283.6**	**34922.3**	**81699.2**	**85919.6**	**223352.6**

Table 12: Percentage energy shared by different components in different farming systems

	DIVERSE	RW	SSRW	T	B-P-FB	BG-CF-TO	M-RD-CR-O	G-OK-VP-B	BN-T
A) DIRECT									
1) Labor	8.7	6.3	3.7	8.3	10.0	14.8	7.6	19.5	24.1
2) Fossil fuel (Diesel)	8.7	13.2	5.3	9.6	13.1	16.5	7.6	12.4	7.9
3) Electricity	4.3	10.6	5.7	2.3	1.9	4.2	0.9	3.0	0.6
B) INDIRECT									
1) Seed/Nursery Transplantation	23.6	5.0	41.6	51.4	27.9	0.01	0.7	3.9	41.9
2) Fertilizer									
Nitrogen (N)	32.0	32.8	22.7	15.0	23.3	38.9	60.5	38.7	9.2
Phosphorus (P_2O_5)	5.6	4.9	3.9	2.7	3.2	6.2	12.5	5.6	1.7
Potassium (K_2O)	2.2	2.1	1.6	1.0	1.6	2.6	4.1	3.5	0.8
Farm Yard Manure	2.6	0.0	0.0	0.0	9.7	0.0	3.1	7.8	0.4
3) Insecticide/Herbicide	2.5	4.3	5.1	0.0	1.3	0.0	0.0	0.9	0.0
5) Fungicide	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0
6) Machinery including self-propelled	0.3	0.5	0.2	0.3	0.4	0.6	0.3	0.4	0.3
7) Animal Ploughing	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
8) Irrigation	9.4	20.3	10.1	9.3	7.0	16.2	2.6	4.2	13.0
Direct Energy	**21.6**	**30.1**	**14.8**	**20.2**	**24.9**	**35.5**	**16.2**	**34.9**	**32.6**
Indirect Energy	**78.4**	**69.8**	**85.2**	**79.8**	**74.3**	**64.5**	**83.8**	**65.0**	**67.4**
Renewable Energy	**11.3**	**6.3**	**3.7**	**8.3**	**19.7**	**14.8**	**10.7**	**27.3**	**24.5**
Non-renewable Energy	**88.7**	**93.6**	**96.2**	**91.7**	**79.5**	**85.2**	**89.3**	**72.6**	**75.5**

followed by banana-turmeric (41.9%), sugarcane-sugarcane ratoon-wheat (41.6%) and least in bottle gourd-cauliflower-tomato system (0.01%), mango-radish-carrot-onion (0.7%), guava-okra-veg. pea-brinjal (3.9%) etc. The direct energy consumption was found to be highest in bottle gourd-cauliflower-tomato (35.5%) followed by guava-okra-veg pea-brinjal (34.9%), banana-turmeric (32.6%) and least in sugarcane-sugarcane ratoon-wheat (14.1%) followed by mango-radish-carrot-onion (16.2%) and diversified system (21.6%) etc. Indirect energy input was highest in sugarcane-sugarcane ratoon-wheat (85.2%) followed by mango-radish-carrot-onion (83.8%), turmeric (79.8%) and diversified system (78.4%) and least in the farming systems which have consumed highest direct energy i.e. bottle gourd-cauliflower-tomato (64.5%) followed by guava-okra-veg pea-brinjal system (65%), banana-turmeric (67.4%) etc.

The highest renewable energy requirement was observed in guava-okra-veg pea-brinjal (27.3%) followed by brinjal-potato-french bean system (19.7%), banana-turmeric system (24.5%) and least in sugarcane-sugarcane ratoon-wheat system (3.7%) followed by rice-wheat system (6.3) and turmeric (8.3%) and vice-versa for non-renewable energy consumption. The highest energy output was obtained from sugarcane-sugarcane ratoon-wheat system (858165 MJ ha^{-1}) followed by rice-wheat system (319555.55 MJ ha^{-1}), diversified system (270356.98 MJ ha^{-1}) and lowest from bottle gourd-cauliflower-tomato (34922.3 MJ ha^{-1}) followed by mango-radish-carrot-onion system (81699.22 MJ ha^{-1}), guava-okra-veg pea-brinjal system (85919.62 MJ ha^{-1}) etc. The highest and lowest energy obtained from main and by product of sugarcane-sugarcane ratoon-wheat (709888.4 MJ ha^{-1}), bottle gourd-cauliflower-tomato (17296.30 MJ ha^{-1}) and sugarcane-sugarcane ratoon-wheat (148276.60 MJ ha^{-1}) guava-okra-veg pea-brinjal system (4293.25 MJ ha^{-1}), respectively.

Development of on-farm fish based farming system

An integrated farming system (IFS) model of 0.9 ha having fish pond (0.5 ha) and rice-wheat cropping system (0.4 ha) was evaluated at farmers field in Dabathuwa village in Meerut district near Ganga canal command with the objective of maximizing farm income through fish based farming systems. The farm was selected based on its strategic location, water availability and low land condition. Existing management practices (low input based aquaculture) fed with rice polish and occasional broadcasting of mustard oil cake was recorded. Management of water quality through liming, balanced nutrition through feeding management and maintenance of optimum stocking density in composite carp culture system could enhance the fish production from existing production of 2.0 t/ha to 3.5 t/ha. The diversified fish based farming system model could provide a net return of Rs. 99395 from 0.9 ha area with fish component realizing Rs. 63462 from 0.5 ha fish pond and Rs35933 from rice wheat cropping system in 0.4 ha area which contributed to 63.85 % and 36.15 % of total net income respectively.

Plate 9: On-farm fish based farming system

Role of women in farming systems

A survey was conducted in three districts of western plain zone of Uttar Pradesh (Meerut, Saharanpur and Bulandshahar) to study the role of women in farming systems. The total random sample comprises of 180 households (3 District x 3 blocks/district x 2 villages/block x 10 households) using a stratified sampling frame. Data was collected by personal interview using pre-tested structured questionnaire through face to face interaction with men and women farmers.Both the quantitative and qualitative data were used in the study.

The analysed data revealed that around 62.9% of of households were having Crop+ dairy (1C+1-2B)

farming system covering 57 per cent total farming area with annual net return of Rs 1,24730/- and was a dominant farming system in western plain zone of U.P (Table 13).

Sugarcane/sorghum-ratoon-wheat was the most dominant cropping system found followed by paddy-wheatin western plain zone of U.P. The major crops sown in all the pre-dominant farming system was found wheat followed by sugarcane covering more than 60% of gross sown area whereas in case of FS_2 sugarcane followed by mango were found the major crops sown covering more than 2/3rd of gross sown area (Table 14).

Women were doing manual and repetitive tasks such as load carrying, paddy transplanting, harvesting, sowing (dibbling/furrow sowing), weeding, threshing through manual beating etc with postural disarrays which was leading to musculoskeletal disorders. Drudgery score of women in different farming system activities is given in Table 15. In case of sowing methods, dibbling was the maximum practiced feminine operation (66%) in FS_4followed by furrow sowing (42%) in $FS_4$and (34%) in FS_1. Paddy transplanting was manually practiced feminine operation (85%) in FS_1followed by (82%) in FS_3. Weeding through *Khurpi* and hand weeding was found 100 percent feminine farm operation with maximum being observed in FS_3(80%) followed by FS_4 (66%) as family labour.

Harvesting of field crops by use of serrated sickle was the maximum practiced feminine farm operation in FS_3(76%) followed by FS_4 (58%) as family labour. Harvesting of fodder by the use of both serrated and traditional sickles by women was observed (91% in FS_3 followed by 88% in FS_4). Harvesting of sugarcane by use of *Balkati* was observed as feminine operation (48 % of women in FS_4 and 44 % in FS_3). De-trashing and de-topping using traditional sickle was found to be done by 55 percent of women in FS_1 followed by 48% women in FS_3. Threshing of field crops (paddy/pulses/mustard) through beating was found to be a feminine based farm operation (32%) in FS_1. Winnowing of field crops under fan was also found to a feminine based farm operation (85%) each in FS_1 and FS_2. Carrying of fodder as headload was found to be a feminine farm operation (63%) including 56% female hired laborers in FS_2 followed by 49% in FS_3. However, only 10 to 15% fetching of fodder was found to be done by females using cart. Fodder chaffing through electric/

Table 13: Pre-dominant Farming systems of Western plain zone of Uttar Pradesh (N=180)

		Pre-dominant Farming systems			
		FS_1(n=113)	FS_2(n=17)	FS_3(n=34)	FS_4(n=12)
Area share (%)	Meerut	74.8	1.2	19.4	4.5
	Saharanpur	23.7	62.6	9.3	4.3
	Bulandshahar	72.9	3.1	23.9	-
	Overall	57.1	22.3	17.53	2.93
Farmer's distribution (%)	Meerut	80	1.6	15	3.3
	Saharanpur	36.6	26.6	19.6	17
	Bulandshahar	72.1	3.5	23.9	-
	Overall	62.9	10.6	19.6	6.77
Net Return (Rs)	Meerut	118340	265800	112650	120420
	Saharanpur	145600	426460	130420	122600
	Bulandshahar	110250	254000	108500	-
	Overall	124730	315420	117190	121510

FS_1:Crop+ Dairy (1C+1-2B), FS_2: Crop + Horticulture (Fruits)+ Dairy (2C+ 1-2 B), FS_3: Crop + Horticulture (vegetables) + Dairy (1C + 1B), FS_4: Horticulture +Crop+ Dairy (1C+1B)

Table 14: Prevalent cropping systems under the predominant farming systems

		Cropping System (CS)	Percentage
FS_1	CS_1	Sugarcane/sorghum -ratoon -wheat	55
	CS_2	Paddy –wheat	25
	CS_3	Maize/pigeon pea – Mustard-wheat	10
FS_2	CS_1	Sugarcane/sorghum -ratoon-wheat + BP	70
	CS_2	Paddy-wheat + BP	20
	CS_3	-	-
FS_3	CS_1	Sugarcane/sorghum-ratoon-wheat + vegetables	40
	CS_2	Paddy-wheat + vegetables	25
	CS_3	Paddy/pegion pea-wheat	10
FS_4	CS_1	Vegetables (cucurbits/okra + crop (wheat)	35
	CS_2	Vegetables (cucurbits-tomato/onion) + crop (Sugarcane- ratoon- wheat)	25
	CS_3	-	-

*FS_1:Crop+ Dairy (1C+1-2B), FS_2: Crop + Horticulture (Fruits)+ Dairy (2C+ 1-2 B), FS_3: Crop + Horticulture (vegetables) + Dairy (1C + 1B), FS_4: Horticulture +Crop+ Dairy (1C+1B): BP = Boundary plantation

diesel operated machine was found to be done by 53% women in FS_1, 40% chaffing through hand operated machine and 32% chaffing through chopper each in FS_4, respectively. Carrying of dung as headload was observed maximum by women (88%) in FS_1 and was least (36%) in FS_2. Milking was found to be a 100% feminine operation in FS_3 followed by 95 % feminine operation in FS_1, whereas in FS_4it was found least 87 %. Dung collection using spade was noticed to be maximum (100 %) for each in $FS_3$and FS_4 whereas least (74%) was found in FS_2. Carrying of dung through basket as headload was a feminine farm operation with 88 % in FS_3, 83 % in FS_4 and least observed in FS_2. Carrying of dung as headload, and fodder collection and carrying are the most drudgery prone activities depicted by their drudgery scores as 62.58 and 61.7, respectively.

The non-involvement in the farm operations by females was due to more male involvement either as family labour or hired labour or using mechanized/better tools and technologies by the male farmers.Crop + Horticulture

Table 15: Drudgery score of women in farming systems activities

Farming system activities	Frequency coefficient	Difficulty coefficient	Average time spent coefficient	Drudgery score
Collection of fuel wood	0.46	1.00	0.036	49.86
Collection and carrying of fodder	0.84	1.00	0.011	61.70
Chaff cutting	0.92	0.66	0.005	53.05
Dung collection	0.95	0.66	0.003	54.02
Dung carrying as headload	0.87	1.00	0.004	62.58
Milking	0.92	0.66	0.002	52.73
Paddy transplanting	0.20	1.00	0.500	56.66
Cane cutting	0.80	1.00	0.016	60.8
Detrashing and detopping	0.80	1.00	0.015	60.76
Harvesting of field crops	0.20	1.00	0.600	60.00
Dehusking of maize	0.20	1.00	0.300	50.00
Stripping of groundnut	0.20	1.00	0.300	50.00
Weeding in field crops	0.39	1.00	0.042	47.66
Threshing of paddy	0.20	1.00	0.230	47.66
Hoeing and weeding in vegetables	0.40	1.00	0.044	48.10
Transplanting of vegetables	0.26	1.00	0.176	47.88
Earthing up in potato	0.20	1.00	0.187	46.25

(vegetables) + Dairy (FS_3) and Horticulture + Crop + Dairy (FS_4) can be tagged as gender sensitive farming systems due to the higher amount of feminine farm operations and drudgery prone activities.Cane cutting, de-trashing and de-topping of sugarcane, harvesting of field crops and paddy transplanting were found to be the next drudgery prone activities in the predominant farming systems of western plain zone of Uttar Pradesh.

Characterization and mapping of farming systems

The study on farming systems characterization at Surendranagar district of Gujarat revealed that the average holding size of the district was 3.66 ha which is substantially higher than that of national average. Therefore, the number of medium and large farms (65.6%) is more than marginal and small farms (34.4%). The average age of farmers involved in farming was about 44 years, with only 6 years of formal schooling and a large family size (7.2) (Table 16).

The survey clearly shows that crops +dairy farming is the most prevailing farming system (78%) in the district, but some farm households (22%) were also dependent on crops only as sole farm enterprise (Table 17). Cotton (kharif season) and cumin, fennel (rabi season) are the main crops on the sample farms in addition to sorghum, pearlmillet (kharif) and wheat (rabi) wherever irrigation facility is available.

Declining water table (86.1%), lack of remunerative and assured prices of farm produce (77.2%), crop losses due to wild animals (75%) and high incidence of insects pests and diseases (68.9%) emerged as the major constraints in the existing farming systems. Scarcity of farm labour (50%), poor quality of fertilizers and pesticides (40.6%) and non-availability of quality seeds/planting material (38.9%) were also some other constraints reported by the respondents (Fig. 4).

Interestingly, farmers' perceptions about the changes in the agro-ecosystem over the last two decades reveal that their economic status has improved over time. This may be attributed to higher productivity of crops/livestock and intensive use of fertilizer and pesticides. However, it is accompanied with declining water table, poor water quality, deterioration in soil fertility and climate change as reflected in the temperature variations. In recent time, crop loss due to wild animals has emerged as one of the major constraints affecting farm incomes (Fig. 5).

Table 16: Socio-economic characteristics of sample farms in Surendranagar district (Gujarat), 2016

Category of farm	Sample household (number)	Size of holding (ha.)	Age (years)	Education (years)	Family size (number)
Marginal	25	0.93	37.68	5.76	5.92
Small	37	1.61	46.41	4.30	7.14
Medium	51	2.57	44.92	5.94	7.04
Large	67	6.62	43.19	7.40	7.81
Overall	180	3.66	43.58	6.12	7.19

Table 17: Existing farming systems in Surendranagar district (Gujarat), 2016

Category	Marginal	Small	Medium	Large	Total
Crops	06 (24.0)	09 (24.3)	15 (29.4)	10 (14.9)	40 (22.2)
Crops+Dairy	19 (76.0)	28 (75.7)	36 (70.6)	57 (85.1)	140 (77.8)
Total (N)	25 (100)	37 (100)	51 (100)	67 (100)	180 (100)

Figures in parentheses indicate percentage of total in the respective category.

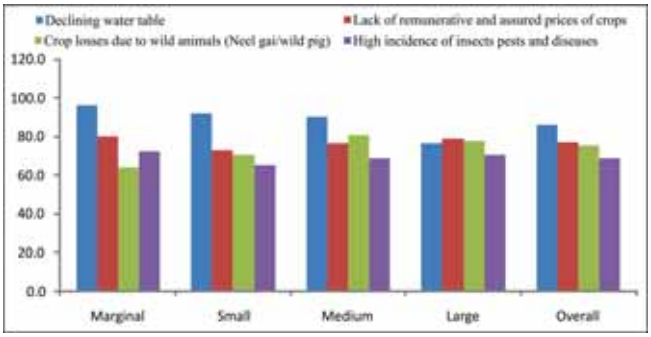


Fig. 4. Category-wise major constraints in farming systems of Surendranagar district

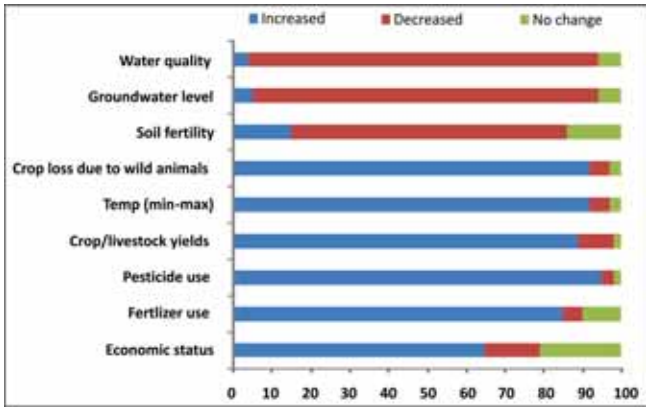


Fig. 5. Farmers' perceptions about the changes in agro-ecosystem over the last two decades (percent).

Web based Information for Farming Systems Research

An online as well as offline multi-modal information delivery arrangement linking online content and expert knowledge with query services has been designed for an Integrated Information System for Indian Farming Systems Research web portal. The information system under developed is user friendly using ASP.Net as front end and SQL server as back end database to facilitate information dissemination under farming system research. An extraction, transportation and loading (ETL), an online analytical processing (OLAP) engine, and other application to manage the process of gathering data and delivering to different users have also been designed. The following activities were undertaken to develop the web portal, namely;

o Software Design

Designed six (6) web forms in .NET framework using C# programming language to accommodate the AICRP-IFS data

o Source Coding

Completed coding of these six web forms for data connectivity in C# programming language

o Software Integration & Verification

Created and integrated two data tables in SQL server (database) having almost 250 records of the two IFS centres *viz.* Modipuram in UP and Sabour in Bihar.

Verified the data integrity and found some bugs in the source code that has to be removed in coming months for proper functioning of the software.

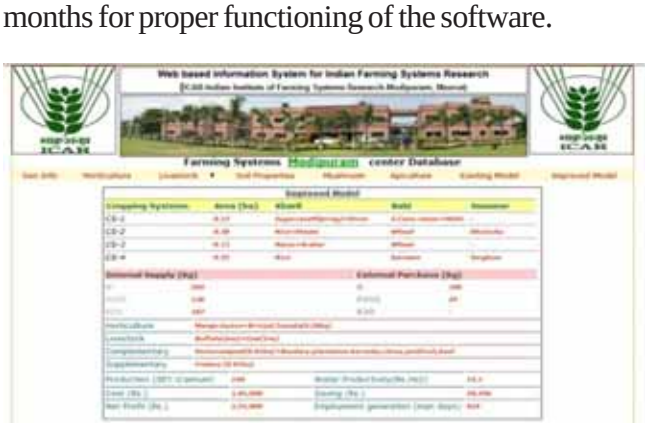


Plate 10: Screen shots of the Web based Information System

Cropping Systems and Resource Management (CSRM)

Bio-intensive, complementary cropping systems

Five complementary cropping systems were evaluated for higher productivity and profitability under flatbed and raised bed land configuration. The cropping systems comprised of T_1: maize (cob)+veg.cowpea (broad bed)+sesbania (Furrow)-lentil (broad bed)+mustard (furrow)-green gram (grain+residue), T_2: maize+cowpea(fodder)-maize (cob)+black gram-wheat+methi (6:1)-green gram (grain+residue),T_3: sorghum+ cluster bean(fodder)-maize(cob)+blackgram (1:1)-methi-cowpea (vegetable+residue), T_4: sugarcane-ratoon-wheat andT_5: maize(cob)-potato-okra. Maximum wheat equivalent yield (21.18 t ha^{-1}) was recorded with maize (cob)-potato-okra followed by maize+cowpea (fodder)-maize (cob) +black gram-wheat+methi (6:1)-green gram (grain+residue) which was to the tune of 13.58tha^{-1} while lowest wheat equivalent yield (10.22 tha^{-1}) was recorded with sorghum+cluster bean (f)-maize(cob)+black gram (1:1)-methi-cowpea (veg+residue). Systems productivity (58 kgha^{-1}day^{-1}) and profitability (Rs. 644 ha^{-1}day^{-1}) were also highest in maize (cob)-potato-okra (Fig. 7).

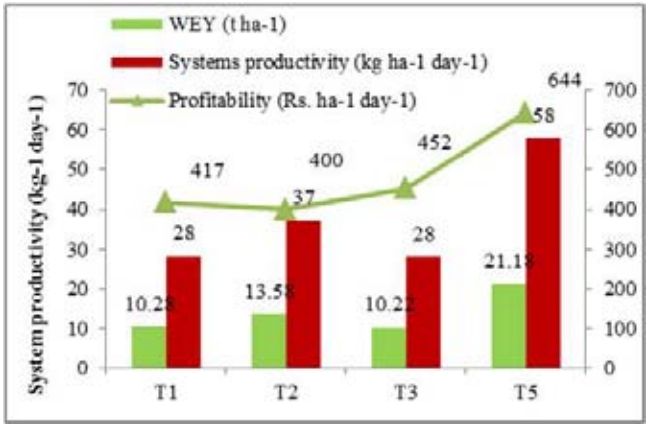


Fig. 7. Effect of bio-intensive complementary cropping systems on wheat equivalent yield productivity and profitability

Weed utilization

The wheat equivalent yield was maximum when weeds were used as fodder under various cropping systems *viz.* rice – wheat (15.41 t ha^{-1}), maize- wheat (14.54 t ha^{-1}) and sugar cane– ratoon (14.97 t ha^{-1}) except moog-wheat (12.15 t ha^{-1}). Next best treatment was chemicaly controlled weeds in rice – wheat (14.94 t ha^{-1}), maize- wheat (14.15 t ha^{-1}) and sugar cane– ratoon-wheat (14.89 t ha^{-1}) except moog-wheat (12.02 t ha^{-1}) cropping system. Weeds were also used as mulch under all four cropping systems and resulted tangible increase in yields of all cropping systems and showed superior then weedy check. Among the different cropping systems the highest wheat equivalent yield was obtained under sugarcane-ratoon-wheat followed by rice-wheat cropping system (Table 18).

Table 18: Effect of various weed control techniques on wheat equivalent yield (t ha^{-1}) of different cropping systems

Treatment	Rice-Wheat	Maize-Wheat	Moong- Wheat	S.cane - Ratoon - Wheat
Weedy cheek	9.36	8.92	6.58	7.36
Chemical control	14.94	14.15	12.02	14.89
Weeds used as fodder	15.41	14.54	12.15	14.97
Weeds used as mulch	14.61	13.81	11.88	14.79
Incorporation by wheel hand hoe(one pass)	11.63	10.49	8.49	10.13
Incorporation by wheel hand hoe(two passes)	13.03	12.23	9.94	11.83
Incorporation by wheel hand hoe(three passes)	14.09	13.47	11.15	13.57
Mean	13.29	12.52	10.31	12.51

Effect of resource conservation technologies and potassium application on productivityof rice wheat cropping system

The highest greenness index 1.34 was recorded with RCT alongwith application of potassium @ 90kg K at flowering stage which was found at par with application of 90 kg K without RCT. The highest grain yield (5.08 tha^{-1}) and straw yield (14.27 t ha^{-1}) was recorded in treatment of RCT with potassium application @ 90kg K (Figure 1) which was found at par with grain yield (4.90 t ha^{-1}) and straw yield (13.77 t ha^{-1}) under treatment having application of K @ 90 kg without RCT and significantly superior over grain yield (3.82 t ha^{-1}) and straw yield (10.40 t ha^{-1}) under control (Fig. 8).

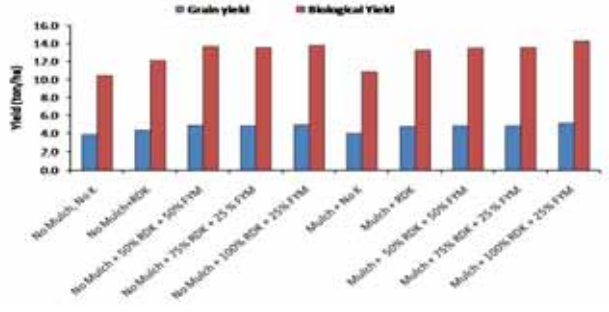


Fig. 8. Effect of resource conservation technologies and potassium application on productivity of rice-wheat system

Resource conservation technologies to mitigate the ill-effects of climate change

Two tillage systems, four cropping systems and four crop residue mulching and fertilizer combination were tested in factorial analysis with split-split plot design having three replications. The tillage systems (main plots) were: no tillage (NT) and conventional tillage (CT), i.e. 4 harrowing and one patella. The cropping systems (sub-plots:C_1- rice-wheat; C_2- maize-wheat; C_3-rice-barley and C_4- rice-mustard). The crop residue used as mulching and fertilizer combination treatments (sub-sub-plots) consisted of four M_1 - No mulch + recommended dose of fertilizer (RDF), M_2 - Mulch (6 t/ha) + recommended dose of fertilizer (120:60:40 kg NPK) (RDF), M_3 - Mulch (0) +125% recommended dose of fertilizer (RDF), M_4 - Mulch (6 t/ha) +125 % recommended dose of fertilizer (RDF). A recommended fertilizer dose of 120:60:40 kg NPK/ ha was applied in all *rabi* crops.

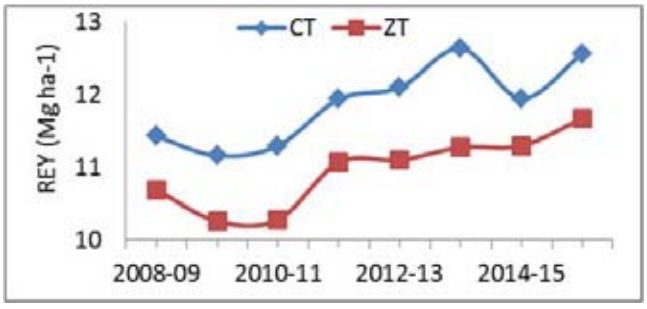


Fig. 9. Rice equivalent yield (REY) of different tillage system

The Result indicated that higher REY was obtained in CT as compared to ZT over the years (Fig. 9). The tillage influenced significantly ($P<0.05$) on REY, whereas, the cropping systems and crop residue mulching and RDF combination significantly affected REY at P=0.01. However, all the interactions were found to be non-significant. Greater REY observed in treatment of M4 (6 t ha^{-1} mulch + 125% RDF) followed by M2 (6 t ha^{-1} mulch + RDF).The REY in treatment M_4 and M_2 had shown at par value in all years. The REY was ranked in order $M_1<M_3<M_2<M_4$ in all years (Fig. 10). As far as the effect of cropping system (Fig. 11) is concerned, higher REY observed in C_1 (rice-wheat) followed by C_2 (maize –wheat), C_4 (rice mustard) and C3 (rice- barley).

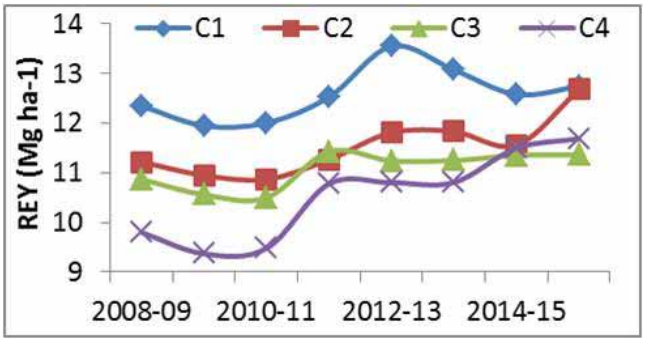


Fig. 10. Rice equivalent yield (REY) of various cropping system

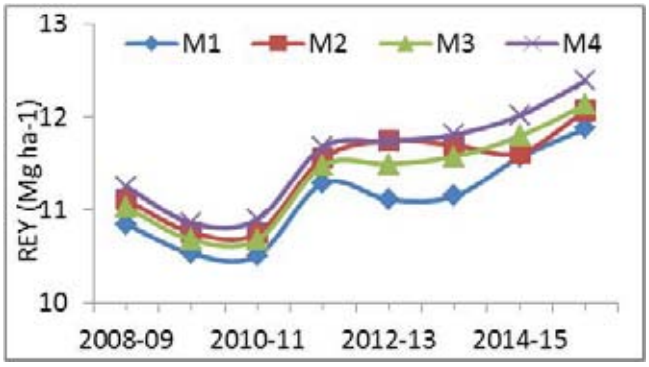


Fig. 11. Rice equivalent yield (REY) of different crop residue management and RDF combination

Resource conservation in agriculture is the prime concern under changing climatic scenarios. Direct seeded zero-tilled rice is the growing area under resource conservation systems in many parts of the world. Studies were conducted to compare the direct seeded zero-tilled rice with conventionally tilled transplanted rice with respect to weed infestation and sheath blight attack. Aromatic rice variety Pusa Sugandha 5 was taken into the study. Observations on weed infestation, weed biomass and sheath blight severity were taken at 90 DAS/DAT after panicle emergence. Maximum weeds biomass (126.34 g m^{-2}) was recorded in Zero-tilled rice as compared to conventionally tilled transplanted rice (8.59 g m^{-2}). Perennial weed species like *Cynodondactylon* and *Eleusine indica* dominated in Zero-tilled plots. The sheath blight disease of rice caused by the fungus *Rhizoctonia solani*, which found to besevere in zero-tilled rice than conventionally tilled transplanted rice. The incidence, relative lesion height and sheath blight index (71.67%, 80.81% and 60.03 respectively) were higher in zero-tilled rice compared to transplanted rice (25.83%, 71.20% and 18.39 respectively) as shown in Fig. 12. Higher infestation of perennial weed species like *Cynodondactylon* aggravated the sheath blight index in zero tilled rice by facilitating its horizontal spread within the crop. Other weed species like *Paspalum distichum, Sorghum halepense, Echinocloa glabrescens* and *Dactyloctenium aegyptium* were also found to harbor the sheath blight pathogen (*Rhizoctonia solani*) in the rice field. Hence, the long term sustainability of resource conservation modules like Zero-tilled rice may depend upon integrated weed, pests and disease management strategies. Resource conservation in agriculture is the prime concern under changing climatic scenarios. Direct seeded zero-tilled rice is the growing area under resource conservation systems in many parts of the world. The success of direct seeded zero-tilled rice largely depends upon the sound weed management practices.

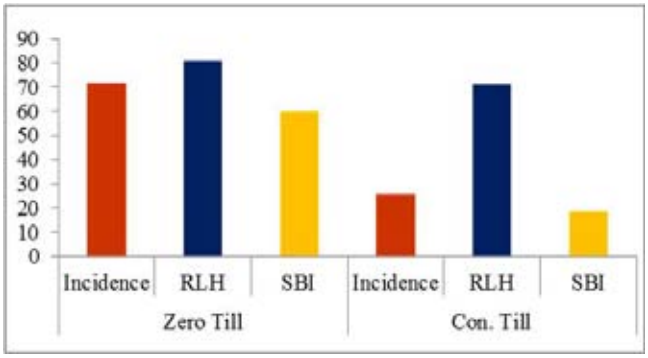


Fig. 12. Incidence, relative lesion height (RLH) and sheath blight index (SBI) of conventional till transplanted and zero tilled rice

Inputs Energy (EI) of different cropping system under two tillage system and four rice crop residue with RDF combination were estimated using direct and indirect energy inputs**.**A complete inventory of all crop inputs (fertilizers, seeds, plant protection chemicals, fuels, human labour, irrigation water and, machinery power) and outputs of both grain and straw yields were recorded. Energy inputs in different treatments were computed by multiplying the inputs with the corresponding energy coefficients and summing up of all these. The average grain and straw yields of all years were considered for calculating output energy. Energy outputs were calculated by multiplying the grain and straw yields with corresponding energy coefficients. Energy efficiencies or intensities of the different cropping systems were estimated as: i) net energy (NE) ii) ratio of output to energy input (energy use efficiency, EUE) and iii) specific energy i.e. energy use per kg production (SE).

Results revealed that on average of all cropping system the conventional tillage (i.e. 45828 MJ ha^{-1}) consumed higher input energy than zero till system (37731 MJ ha^{-1}). The lowest input energy was observed in ZT, C_2 and M_3 (Table 19). Highest input energy consumed in rice- wheat followed by rice–barley, rice- mustard and maize-wheat. Energy use efficiency (EUE) was highest in ZT, however, specific energy of grain (SE) was more in CT. Highest output energy & net energy was observed in ZT than CT. The energy budgeting indicates the tillage does not influence significantly on energy (i.e. EO, NE, EUE) however, SE was influenced significantly by different tillage. Various cropping systems and mulching and RDF influenced the significantly parameters i.e. EQ, NE, EUE and SE.

Long term effect of resource conservation technologies in rice-wheat system

The long-term experiments were carried to study the comparative performance of different methods of rice planting, namely; hand transplanting (HT), transplanting by self-propelled transplanter (MT), transplanting by manual transplanter (MaT), bed planting (BP), zero till drilling (ZT), strip till drilling (ST), rotary till drilling (RT), drum seeding (DS) and sprouted broadcasting (BS), with respect to rice yield (Y), benefit: cost ratio (B: C), energy output: input ratio (EE) etc. In *rabi* season, the comparative performance of different machines namely; bed planter (BP), zero-till drill (ZT), happy-turbo seeder (HT), rotary-till drill (RT), and conventional drill (CS), in terms of wheat yield (Y), benefit: cost ratio (B: C), energy output: input ratio (EE) in each succeeding rice plots were assessed. The experiments were design in randomized block designed with three replications. Both the crops were grown with recommended package of practice. A recommended fertilizers dose of 120-60-40 kg ha^{-1} was applied in rice (Saket-4) and wheat (PBW-343).

The study also included evaluation of the energy input, GWP potential and yield-scaled GHG emissions of different methods of rice cultivation *viz.*, zero tillage (ZT), happy turbo seeder (HTS), bed planting (BP), reduced tillage (RT), conventional sowing (CS). The HTS saved the diesel (70%), time (80%), and energy (65%) due to no-till sowing under crop residue. The rice crop sowing was done 22 cm row spacing by ZT, HTS, RT and CS. The highest effective field capacity was observed in ZT (0.44 ha/h) followed by HT (0.41 ha/h), RT (0.21 ha/h) and BP (0.30 ha/h), however, highest field efficiency was measured in HT (60 %) followed by ZT (55%), BP (50%) and RT (45%).

Table 19: Energy budgeting (MJ ha^{-1}) of different treatment as on various tillage, cropping system and residue management

Treatments	EI	EO	NE	EUE	SE
ZT	37731	170189	132458	4.51	3.42
CT	45828	157224	111396	2.43	4.43
Cropping systems					
C1	46040	181541	136067	3.94	3.70
C2	35469	164887	121437	4.65	3.89
C3	43733	161430	118263	3.69	3.95
C4	41877	146970	105658	3.51	4.16
Mulching & RDF combination					
M1	40788	160777	117509	3.94	3.99
M2	43951	164438	120103	3.74	4.00
M3	39839	163307	120938	4.10	3.85
M4	42541	166305	122874	3.91	3.87

The effect of planting methods on wheat yield over the years is depicted in Fig.13. The over the year the higher yield was observed in ZT followed by RT and RT. The lowest yield was noticed in conventionally tilled plot (CS). The higher yield was found in BP than CS but lower than ZT, RT and HT. The higher yield was observed in ZT (11%), HT (8%), and RT (7%) than CS.

The comparative performance of different methods of rice planting, namely, hand transplanting (HT), transplanting by self-propelled transplanter (MT), transplanting by manual transplanter (MaT), bed planting (BP), zero till drilling (ZT), happy-turbo seeder (HT), rotary till drilling (RT), drum seeding (DS) and sprouted broadcasting (BS), with respect to rice yield (Y), benefit: cost ratio (B: C), energy output: input ratio (EE) was evaluated. The effect of planting methods on rice yield over the year is depicted in Fig. 14. The highest yield was found in MaT followed by MT, HT among the puddled transplanted rice. It was observed that the yield was higher in MaT (5%) and at par with MT (4%) with comparison to traditional transplanting method. The higher net return was noticed in the five direct seeded rice as compared to three puddled transplanted rice (i.e. HT, MT MaT) and two sprouted rice seeding method. The energy net return was 9 to 11% higher in ZT and HTS, as compared to HT. Energy output: input ratio was 20% higher in ZT, 15 to 4% higher in all the methods except DS, CS and BS, where it was 2 to 10% lower, compared to HT.

The comparative performance of different methods of wheat planting machines, namely; zero till drill (ZT), rotary tiller (RT) and conventional sowing (2 harrow +2 tiller followed by ZT) (CS) as a horizontal plots and rice residue recycling as RR: residue removal, RB: residue burning and RI: residue in-corporation as a vertical plots., with respect to wheat yield (Y), benefit: cost ratio (B: C), and weed infestation (We) was evaluated. The effect of planting methods and residue managements on wheat and rice yield is depicted in Fig. 15 &16.

The crop residue recycling was done before planting of both crop seasons (as *kharif* and *Rabi*). The residue recycling were done as rice residue (5 to 6 t ha^{-1}) as well as wheat straw (8 to 8.6 t ha^{-1}) and the degree of recycling was 76-81%. The wheat yield varied from (5.6 to 6.2 t ha^{-1}) in rice residue managements viz.,

Plate 11: Rice crop under zero tillage

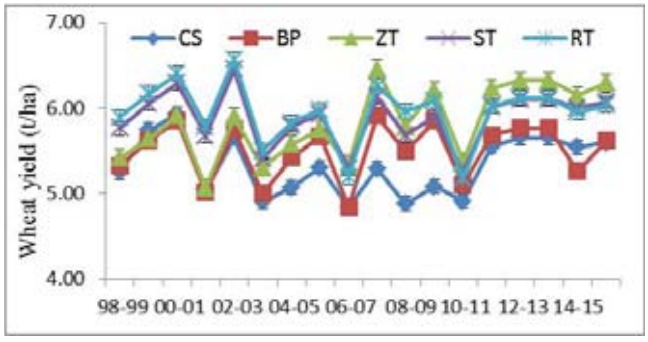


Fig. 13. Effect of different RCT machineries used for wheat crop establishment on yield over the year

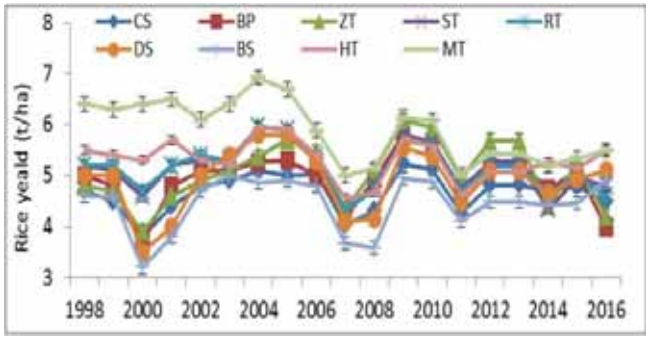


Fig. 14. Effect of planting methods on rice yield over the year

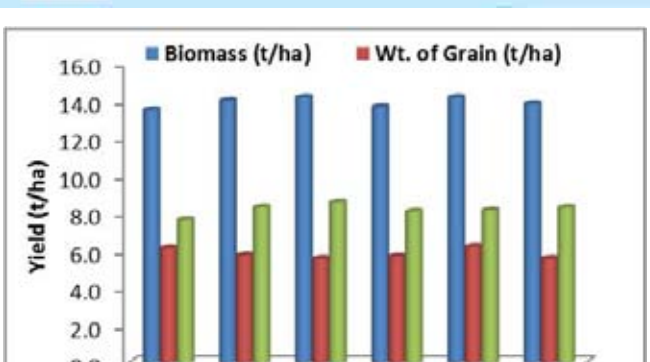


Fig. 15. Effect of residue management and different machineries on wheat yield

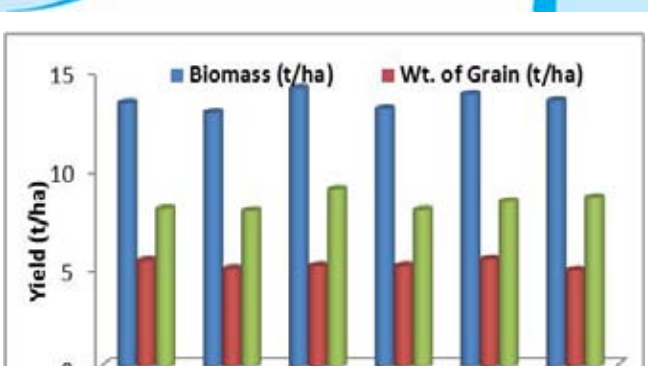


Fig. 16. Effect of residue management and different machineries on rice yield

RR, RB and RI and crop establishment methods viz., ZT, RT and CS**.** The wheat yield has no significant difference among the treatments. There was appearance of yellowing in seedlings at the initial stage but subsequent establishment and growth of crops was found similar to non-straw recycled fields. The recycled wheat straw got decomposed after about 50 to 55 days in rice fields.

In case of kharif crop (rice), the highest yield was observed in residue recylining (5.37 t ha^{-1}) (RR) followed residue incorporation (RI) and residue burning (RB). However, highest yield was observed HT (5.43 t ha^{-1}) followed by ZT and CS Plot.

The input cost was lowest in zero till drill (ZT) field followed by rotary tiller (RT) and conventional sowing (CS); however, output cost was higher in ZT and RT as compared to CS. The weed populations were found less numbers in residue in-corporation.

The effects of various wheat planting method of resource saving technologies revealed that zero till sown field given about 60 and 80 higher benefit and B: C ratio as compared to conventional sowing, however, rotary till sown produced 20 and 25 % higher benefit and B: C ratio as compared to conventional sowing. The yield and yield attributes has no significance difference among the treatments (Fig. 17).

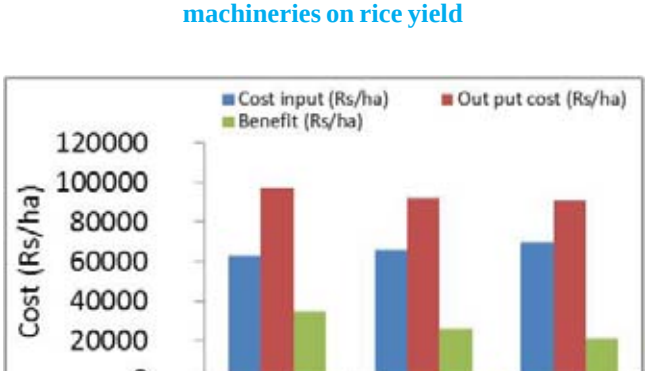


Fig. 17. Effect of residue management and various machineries on cost analysis

Plate 12: Wheat crop under conventional method of sowing

Organic Agriculture Systems (OAS)

Evaluation of crops under organic conditions

Sugarcane

Nine early maturing varieties of sugarcane have been evaluated in RBD under inorganic condition. The variety CoPk 05191 produced highest number of millable canes (NMC) (333.7) in summer planting followed by CoLk 013201 and CoLk 011201. Highest cane weight (1.35kg) was gained by Co 0118 followed by Co 0238, CoSe 03234 and CoPk 05191. While, cane height was recorded highest (273.33cm) in case of Co 098014 followed by Co 0238, Co 0118 and CoPk 05191. However Brix reading was found highest (21.55) in clones CoSe 03234 followed by Co 0238 and Co 0118. Variety CoPk 05191 recorded highest cane yield (90.27 t ha^{-1}) followed by Co098014 (85.84 t ha^{-1}). Although, highest green top under summer planting was registered in variety CoPk05191 (23.42 t ha^{-1}) followed by CoLk013201 (19.96 t ha^{-1}) (Table 20).

Soybean

A comparative study of soybean taking fourteen varieties has been conducted under organic and inorganic management during *kharif* 2016. Among the tested varieties, highest grain yield was registered by 'DS 2705' followed by 'SL 982' and 'JS 20-71' under organic and inorganic management. Highest biological yield was recorded by 'SL 982' and 'DS 2705' in organic and inorganic management, respectively. In general grain yield in tested varieties was higher under inorganic management as compared to organic management. Variety KDS 705 was found highly susceptible to disease resulted in complete failure of the crop. On the basis of this study it is concluded that DS 2705, SL 982 and JS 20-71 may be grown in non-traditional western plain zone under organic and inorganic management (Table 21).

In general, there was lower incidence (12.14%) of yellow mosaic disease in soybean under organic management systems as compared to inorganic management system (38%). All the varieties/lines of soybean showed lower disease incidence under organic conditions and higher incidence under inorganic management system.

Data on the incidence of yellow mosaic disease in different varieties of soybean in Table 22 showed that,

Table 20: Performance of early maturing sugarcane varieties under inorganic conditions during summer planting (Mean value)

Varieties	NMC	Single Cane Weight (kg)	Cane height (cm)	Brix % (300 days)	Cane yield (t/ ha)	Green Top Yield (t/ ha)
Co 0238	156.3	1.48	250.11	21.33	72.87	15.41
CoSe 03234	210.7	1.35	247.89	21.55	80.45	15.57
UP 05125	214.7	0.88	200.56	21.33	60.44	10.78
CoS 03251	159.3	1.02	184.22	19.76	55.83	12.84
Co 098014	216.7	1.26	273.33	20.89	85.84	13.17
Co 0118	194.0	1.35	226.44	21.31	81.42	16.95
CoLk 011201	237.0	1.11	218.67	19.91	67.89	13.70
CoLk 013201	288.3	1.03	251.33	19.53	70.03	19.96
CoPk 05191	333.7	1.29	249.78	19.33	90.27	23.42

Table 21: Performance of different soybean varieties under organic and inorganic management.

S.No.	Varieties	Organic condition		Harvest index (%)	Inorganic condition		Harvest index (%)
		Grain yield (kg ha^{-1})	Biological yield (kg ha^{-1})		Grain yield (kg ha^{-1})	Biological yield (kg ha^{-1})	
1	NRC 93	780	1797	43.4	875	1917	45.6
2	NRC 94	935	2674	35.0	1119	2791	40.1
3	NRC 113	798	2072	38.5	824	2714	30.4
4	JS 20-71	1013	2521	40.2	1169	2796	41.8
5	JS 20-69	850	1956	43.5	963	2144	44.9
6	MACS 1407	724	2456	29.5	809	2638	30.7
7	MACS 1416	974	2905	33.5	1101	3055	36.0
8	MSUS 612	869	1979	43.9	924	2170	42.6
9	KDS 705	0	0	0	0	0	0
10	DS 2705	1296	3793	34.2	1435	4193	34.2
11	KBS 22	827	2742	30.2	899	2978	30.2
12	RAU 200-18	929	3278	28.3	1073	3474	30.9
13	SL 979	805	2681	30.0	890	2874	31.0
14	SL 982	1283	3973	32.3	1331	4045	32.9

Table 22: Incidence of yellow mosaic disease indifferent soybean varieties under organic and inorganic management systems

S. No.	Varieties	Percent incidence	
		Inorganic system	Organic system
1.	NRC 93	68.3	30.0
2.	NRC 94	20.0	11.6
3.	NRC 113	83.3	26.6
4.	JS 20-71	15.0	8.3
5.	JS 20-69	6.6	0.0
6.	MACS 1407	100.0	36.6
7.	MACS 1416	36.6	11.6
8.	MSUS 612	76.6	26.6
9.	KDS 705*	0.0	0.0
10.	DS 2705	0.0	0.0
11.	KBS 22	93.3	18.3
12.	RAU -200-18	32.0	0.0
13.	SL 979	0.0	0.0
14.	SL 982	0.0	0.0
	Average	**38.0**	**12.14**

*Plant rotted in early stage of growth and failed to establish

the cultivars/lines SL 979 and SL 982 and DS 2705 were best performing varieties with complete absence of disease under both the management systems. However verities/lines JS 20-69, RAU-200-18 and JS-20-71 also showed lower incidence of the yellow mosaic, but it was higher under inorganic management systems and lower or nil under organic management system (Fig. 18). Highest disease incidence (100%) was recorded in MACS 1407 under inorganic management system as compared to organic system (36.67%). The results of the study showed that cultivars/ lines SL 979 and SL 982 and DS 2705 have good potential for inclusion of soybean under farming systems of Western Plain Zone of Uttar Pradesh.

Mustard

Under this study, F_2 population of six crosses (procured from ICAR-DRMR, Bharatpur) have been put in separate six blocks in spacing planting for tapping individual plant having physiologically vigor, early maturity, high yield and oil content. Near about 300 individual plant selection have been made in first round of observation on the basis of early flowering and

physiological vigor. Plants found fit on selection criteria will be advanced in F_3 generation (Table 23).

Table 23: Selection of individual plants across the crosses.

Sl. No.	F_2 population of Crosses	Selected plant (F_3)
1	IJ 31 × EC 597313	63
2	MJA 38 × MJR 9	54
3	MJA 25 × MJR 3	45
4	MJA 39-3-2-2 × MJR 8	51
5	EC 597326 × RB 50	47
6	EC 597326 × EC 597313	25

Identification of yellow mosaic disease resistant Black gram and Green gram varieties

Two varieties of black gram i.e. Pant Urd 31 (PU 31) and Mash 1008 (local variety from Punjab) and five varieties of green gram i.e. Pant Moong 4, IPM 2-3, IPM 2-14, Meha and Samrat were evaluated under two conditions i.e. under integrated pest management(IPM) package and under non-IPM package. Among black gram varieties, PU 31 was best performing variety with lowest yellow mosaic incidence (0.04% under IPM conditions and 0.86% under non-IPM conditions) and highest grain yields (1141 kgha^{-1} and 1038 kg ha^{-1}under IPM and non-IPM conditions respectively). Among green gram varieties, IPM 2-14 performed outstanding with 680 kg ha^{-1}and 549 kg ha^{-1}of grain yield under IPM and non-IPM conditions respectively. This variety also showed lower yellow mosaic incidence (3.33%) under IPM conditions but slightly higher yellow mosaic incidence (6.67) under non-IPM conditions when compared to variety Samrat IPM 2-3 although, showed comparatively higher incidence of yellow mosaic (16.60% under IPM conditions and 23.30% under non-IPM conditions), but performed better than rest of the green gram varieties with 576 kg ha^{-1}and 427 kg ha^{-1}of grain yield under IPM and non-IPM conditions respectively. In general, all the varieties performed better and produced higher yield under IPM conditions with comparatively lower incidence of yellow mosaic disease (Table 24). Based on the results of above study, PU 31 of black gram and IPM 2-14 were found promising for growing as pulse crop in the region.

Table 24: Effect of IPM measures on Yellow Mosaic incidence and grain yield in different Black gram/ Green gram varieties

Character	Pest control practice	Black gram		Green gram				
		PU 31	Mash 1008	PM 4	IPM 2-3	IPM 2-14	Meha	Samrat
Yellow mosaic incidence (%) at 75 DAS	IPM	0.04	43.3	30.0	16.6	3.3	6.6	3.3
	Non-IPM	0.86	50.0	80.3	23.3	6.6	10.0	3.3
Grain yield (kg ha^{-1})	IPM	1141	699	245	576	680	477	381
	Non-IPM	1038	612	193	427	549	365	260

Plate 13: Performance of black gram (Pant Urd 31) under IPM

Plate 14: Performance of green gram (IPM 2-14) under IPM

Transfer of Technology Refinement & Human Resource Management (TTR & HRD)

Demonstration of System based proven technologies

Twenty six cropping systems demonstrating improved technologies *viz*. improved cultivars, system for rice intensification (SRI), mechanical transplanting, nutrient management, green manuring (GM) in rice; zero tillage technology and crop residue management in wheat; raise bed planting(RB),broad bed furrow system (BBF) mustard, along with farmers practice were demonstrated in the technology park of ICAR-IIFSR. Four different modules namely, vegetable based, technology based, variety based and crop diversification cropping systems based were studied for their productivity and profitability. Productivity of different systems were computed in terms of rice equivalent yield (REY) and maximum higher yield whereas profitability were compared in terms of system gross return, net return and net return per day per ha.

Among vegetable based systems, higher rice equivalent yield (REY) was obtained from rice –potato (K. Khyati)–maize (T_2) system(19.00 t ha^{-1}), followed by rice-potato (K. Garima)–okra (T_3) (18.27 t ha^{-1}), sorghum-potato (K. Farisona)–maize (T_4) (16.69 t ha^{-1}), rice–cauliflower–onion (T_5) (16.55 t ha^{-1}),Okra-vegetable pea + wheat (F)-bottle guard (T_7) (15.52 t ha^{-1}) and brinjal–maize (T_6)(13.51 t ha^{-1}) as compared to rice –wheat (T_1) (10.05 t ha^{-1}). Moreover, highest net return and income per day per hectare was also obtained from rice –potato (K. Khyati)–maize (Rs. 299) as compare to different tested vegetable based modules of cropping systems (Fig. 19).

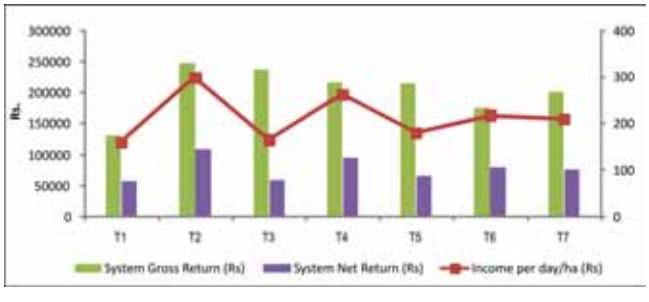


Fig. 19. Grossreturn, net return and income in different vegetable based systems

In different technology based cropping systems modules evaluated, highest rice equivalent yield (t ha^{-1}) was obtained from Rice (nutrient management)–wheat (nutrient management)–Sesbania (T_2) (10.96 t ha^{-1}) followed by rice (SRI, nutrient management) –wheat (ZT, nutrient management)–Sesbania (T_3) (10.92 t ha^{-1}), rice (MT, nutrient management)–wheat(RFD)–Sesbania (T_4) (10.43 t ha^{-1}), rice (nutrient management)–wheat (RFD)–Sesbania (T_5) (9.93 t ha^{-1}) and lowest under rice (DSR)–wheat (nutrient management)–Sesbania (T_1) (9.88 t ha^{-1}) cropping system. The maximum net return(Rs 190 day^{-1} ha^{-1}) was also obtained from rice (nutrient management) - wheat (nutrient management) –Sesbania (T_2) system as compared to rice (DSR)–wheat (nutrient management) – Sesbania system (Rs 174 per day per hectare) (Fig. 20).

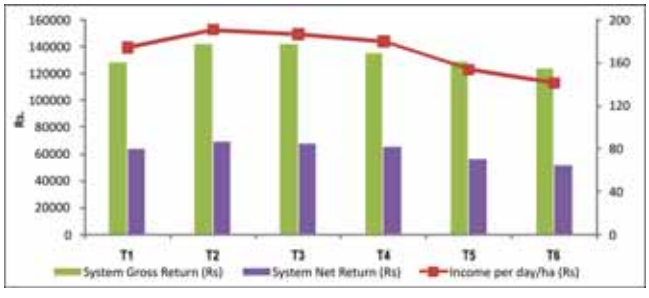


Fig. 20. Grossreturn, net return and income in different technology based cropping systems modules

Comparative performance of different varietal based systems revealed that, maximum REY was recorded in rice (PB 1509) –wheat (HD3086) (T_3) system (11.30 t ha^{-1}) followed by rice (VL 22)–wheat (HD3059) (T_2) system (10.89 t ha^{-1}), rice (Pusa1612)–wheat (HD2967) (T_1) system (10.16 t ha^{-1}) and Basmati rice (VL24)–wheat (HD2894) (T_5) system (9.99 t ha^{-1}). The lowest REY yield was obtained from Basmati rice (PB 6)–wheat (DBW 17) (T_4) system

(9.69 t ha^{-1}). Beside this the highest net return per day per hectare was obtained from rice (PB1509)–wheat (HD3086) (T_3) system being Rs 205 day^{-1} ha^{-1} (Fig. 21).

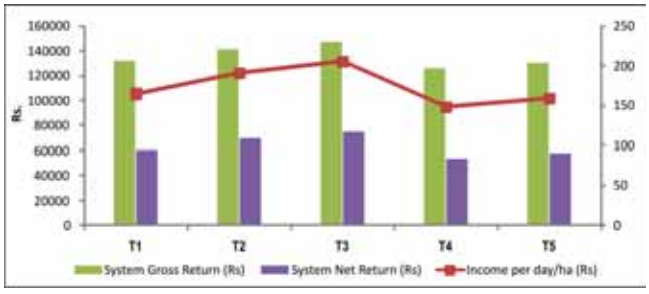


Fig. 21. Gross return, net return and income in different varietal modules

The crop diversification modules were also evaluated in this study. It was found that rice–sugarcane (autumn planting)+ potato–ratoon (T_5) gave highest REY (18.76 t ha^{-1}) followed by rice- potato-sugarcane (Spring planting)-summermoong-ratoon (T_6) system (17.64 t ha^{-1}), maize(F) + pigeon pea (BB) –wheat (nutrient management) (T_4) system (16.32 t ha^{-1}), maize(F) + pigeon pea (RB)–wheat (nutrient management) (T_3) system (14.90 t ha^{-1}) and maize (R&F, nutrient management)–mustard (nutrient management) –summer moong (T_2) system (14.26 t ha^{-1}). Predominant sugarcane based cropping system adopted by the farmer *i.e.* sugarcane (summer)–ratoon (T_7) resulted lowest productivity (14.26 t ha^{-1}). The maximum return per day per hectarewas obtained from rice-sugarcane (autumn planting)+potato-ratoon (T_5) system (Rs.435/-) amongst all the systems under crop diversification module (Fig. 22).

Fig. 22. Gross return, net return and income in crop diversification based systems

Evaluation of different modules revealed that rice –potato (K. khyati)-maize (T_2) among vegetable based module, rice- sugarcane (autumn planted) + potato–ratoon (T_5) among diversification based module, rice (PB1509) –wheat (HD3086) (T_3) among variety based module and rice (nutrient management) -wheat (nutrient management) –Sesbania (T_2) among technology based module provided highest REY (19.00,18.76, 11.30, 10.96 t ha^{-1}, respectively) as well as net return per day per ha in comparison to farmer practice.

Plate 15: Harvesting of brinjal from vegetable based cropping system

On-farm trial on recommended seed rate and use of quality seed in late sown wheat

On-farm trialson recommended seed rate and quality seed of wheat varieties HD-3059, HD-2967, DBW-16, PBW-590 and PBW-226 were conducted at thirty six farmers fieldin Kailawara Kalan village of Khatauli block in Muzaffarnagar district during 2015-16.Two treatments were taken under each OFT and each of these treatment was laid on an area of 800 m^2.The treatments were- T_1: Farmers' Practice (FP) farmers own seed and seed @150 kg ha^{-1}, T_2: Improved practice (IP) recommended quality seed @ 100 kg ha^{-1}. The improved practice resulted increase in yield of varieties HD-2967, HD-3059, DBW-16, PBW-590 and PBW-226 by 3.1%, 3.2%, 2.4%, 3.4 and 3.6 respectively over the farmers' practice. The

benefit cost ratio was 1.68 in improved practice as compared to 1.66 in farmer practice.

On-farm trial on balanced use of fertilizers and micronutrient in wheat

Thirty four farmers were selected randomly from Kailawara Kalan village for conducting on-farm trials on balanced use of fertilizers and micronutrient in wheat varieties HD-3059, HD-2967, DBW-16, PBW-590 and PBW-226 during 2015-16.Three treatments were taken under each OFT and each of these treatments was laid on an area of 800m^2.The treatments were- T_1: Farmers' Practice (FP) NPK @ 150:60:0 kg ha^{-1} T_2: Improved Practice (IP) NPK @ 120:60:60 kg ha^{-1} and T_3 T2+ Sulphur @ 25 kg ha^{-1}. The results revealed that increase in yields of improved practice of varieties HD-3059, HD-2967, DBW-16, PBW-590 and PBW-226 through recommended NPK were 7.8%, 7.1%, 6.91%, 7.14% and 7.57%, respectively over the farmers' practice.Increase in yields of improved practice of varieties HD-3059, HD-2967, DBW-16, PBW-590 and PBW-226 through recommended NPK + Sulphur were 9.1%, 8.3%, 8%, 8.82 and 8.97%, respectively over the farmers' practice.As regards to benefit cost ratio through use of recommended NPK, it was 1.74 in IP as compared to 1.68 in FP. In case of recommended NPK + Sulphur the benefit cost ratio was 1.74 in IP as compared to 1.68 in FP (Table 25).

On-farm trial on use of balanced use of fertilizers and micronutrients in mustard

Twelve on-farm trials on balanced use fertilizers and micronutrient in mustard were laid during 2015-16 in Kailawara Kalan village.Three treatments were taken under each OFT and each of these treatments was laid on an area of 1000m^2.The treatments were- T_1: Farmers' Practice (FP) NPK @ 60:60:0 kg ha^{-1}, T_2: Improved Practice (IP) NPK @ 120:60:60 kg ha^{-1} and T_3: T_2+ sulphur @ 25 kg ha^{-1}. The results revealed that increases in yields of improved practice of the variety Pusa Bold through recommended NPK was 7.7% over the farmers' practice.Increase in yields

Plate 16: Standin crop of mustard under INM and IPM Package

Table 25: On-farm trials on balanced use of fertilizers and micronutrient in wheat Kailawara

Wheat varieties	No of OFTs	Average yield t ha^{-1}			Increase in yield of T_2 over T_1 (%)	Increase in yield of T_3 over T_1 (%)
		T_1	T_2	T_3		
HD 2967	2	4.95	5.30	5.36	7.07	8.28
HD 3059	2	4.85	5.23	5.29	7.84	9.07
DBW 16	3	4.30	4.60	4.64	6.98	7.91
PBW 590	9	4.64	4.97	5.05	7.11	8.84
PBW 226	20	4.35	4.68	4.74	7.59	8.97
Average		4.62	4.96	5.02	7.32	8.61

T_1: Farmers' Practice, T_2: Improved Practice (FP+Potash), T_3: Improved Practice (FP+Potash+Sulphur)

of improved practice through recommended NPK + sulphur 9.1% over the farmers' practice. As regards to benefit cost ratio through use of recommended NPK, it was 2.8 in IP as compared to 2.7 in FP. In case of recommended NPK + sulphur the benefit cost ratio was 2.8 in IP as compared to 2.7 in FP. Application of potash and sulphur also resulted in lower incidence of white rust and *Alternaria* leaf spot disease in mustard.

On-farm trial on integrated management of insect pest and disease in rice

Eight on-farm trials on balanced use fertilizers and micronutrient in rice (Pusa basmati-6) were laid during *kharif* in Kailawara Kalan village.Three treatments were taken under each OFT and each of these treatments was laid on an area of 800 m^2.The treatments were T_1: Farmers' Practice (FP), T_2: Recommended doses of chemical pesticides and $T_{3:}$ Recommended doses of bio-control agents (*Beauvaria bassiana* and *Trichogramma*).The results revealed that an increases in yields in IP over the FP through recommended chemical pesticides was 8.03%.Increase in yields in IP over the FP through bio-control agents (*Beauveria bassiana* and *Trichograma*) was 8.88%. Yellow stem borer was major pest observed in the rice and its infestation was only 2.5% in $T_{3,}$ 4% in T_2 against 15%

Plate 17: Healthy crop of PB 1 under IPNM Treatment

in case of FP. As regards to benefit cost ratio through use of chemical pesticides, it was 1.46 in IP as compared to 1.43 in FP. In case of pest control through bio-agents, the benefit cost ratio was 1.52 in IP as compared to 1.43 in FP.

On farm trials on use of balanced use of fertilizers and micronutrient in rice

Seven on-farm trials on balanced use fertilizers and micronutrient in rice (Pusa basmati-6) were laid during *kharif* in Kailawara Kalan village. Three treatments were taken under each OFT and each of these treatments was laid on an area of 800 m^2.The treatments were T_1: Farmers' Practice (NPK @ 60:60:0/ha), T_2: NPK 100:60:60 kg ha^{-1} $T_{3:}$ T_2 + Zinc sulphate @ 25 kg ha^{-1}.The results revealed that increase in yields in IP over the farmers' practice of the variety Pusa Basmati-6 through recommended NPK was 5.86%.Increase in yields in IP over the farmers' practice through recommended NPK + Zinc sulphate was 8.82%.As regards to benefit cost ratio through balanced use of NPK, it was 1.47 in IP as compared to 1.43 in FP. In case of application of recommended NPK combination with Zinc sulphate the benefit cost ratio was 1.50 in IP as compared to 1.43 in FP.

Demonstrations on MYMV resistant black gram

A total of 39 Demonstrations on popularization of MYMV resistant black gram variety Pant Urd 31 (PU-31) with INM and IPM were laid in above cited village during last week of August, 2016.The comparison of black gram variety PU-31(resistant to Yellow mosaic virus) was made with the local varieties which were grown by the farmers.The results revealed that yellow mosaic (YM) incidence in improved variety PU-31 was found to be 0.1 %as compared to70% inlocal varieties. As regards to yield of improved variety PU-31 varies from 3.7-7.7 q ha^{-1} with an average of 5.2 q ha^{-1} with compared to local varieties which was almost nil.

Coordination Unit (CU)

AICRP on Integrated Farming Systems

AICRP on Integrated Farming Systems, a plan scheme initiated from 2010-11 operates currently with 75 centres (25 on-station main, 12 on-station sub, 32 on-farm and 6 ICAR institute based voluntary centres) covering all the 15 agro-climatic regions. The scheme is in operation at 34 SAU's, 2 General universities and 6 ICAR institutes and also covers 23 states and 2 Union territories. During the year under report, four experiments namely Development of region specific integrated farming system models (32 locations), identification of need based cropping systems for different agro-ecosystems (37 locations), permanent plot experiment on long term nutrient management in cereal based cropping systems (13 locations) and development of organic farming package for system based high value crops (8 locations) were undertaken at on-station and voluntary centres while 3 experiments namely on-farm crop response to plant nutrients in predominant cropping systems (768 farm households in 192 villages in 64 blocks of 32 districts in 21 states), Diversification of existing Farming Systems under marginal household conditions (768 farm households in 192 villages in 64 blocks of 32 districts in 21 states) and On-farm evaluation of farming system modules for improving profitability and livelihood of small and marginal farmers (384 farm households in 192 villages in 64 blocks of 32 districts in 21 states) and FLDs on farming systems involving oilseeds (125 no's) were undertaken through on-farm research centres. Spatial distribution of centres is given in Map 1 and 2. The salient findings are presented below.

Spatial distribution of AICRP on IFS (On-Farm and On-Station) centres

Map 1: Locations of On-farm centres of AICRP on IFS

Map 2: Locations of On-station centres of AICRP on IFS

On-station Research

Region specific Integrated Farming Systems

Established 38 on-station integrated farming system models in 14 agro-climatic regions for research, extension, education and business (bankable projects).

Similarly, refined 63 existing integrated farming systems throughon-farm farmer participatory research in 14 agro-climatic regions through on-farm research centres. Agro-climatic zone wise establishment and refinement of IFS models are given Table 26.

Table 26: Number of Integrated Farming Systems developed at on-station and refined through on-farm centres in various agro-climatic regions

Agro-climatic region	Number of Integrated Farming Systems	
	On-station integrated farming systems	On-farm farmer participatory refined integrated farming systems
Western Himalaya	3	3
Eastern Himalaya	2	6
Lower Gangetic Plains	1	9
Middle Gangetic Plains	5	3
Upper Gangetic Plains	2	4
Trans Gangetic Plains	2	1
Eastern Plateau and Hills	2	7
Central Plateau and Hills	2	5
Western Plateau and Hills	3	4
Southern Plateau and Hills	4	6
East Coast Plains and Hills	2	4
West Coast Plains and Hills	7	4
Gujarat Plains and Hills	1	6
Islands	2	1
Total	**38**	**63**

Plate 18: Components and output of Integrated Farming System model at Kathelgere (Karnataka)

The major components of the IFS models include location specific cropping systems + location specific livestock components (Cow/buffalo/poultry/duck/goat/pig) + location specific integration of fisheries + location specific integration of Horticulture (fruit orchard intercropped with vegetables) + location specific integration of Complementary/supplementary enterprises such as Apiary, mushroom, bio-gas + compulsory integration of Kitchen garden, boundary plantations & vermicompost. These models provided 2 to 3 times higher income than existing farming systems besides meeting the household demand of food, fodder, fuel completely with fibre and fertilizer to the extent of 65-80 %.

Identification of need based alternative cropping systems

Based on multi location studies at 37 on-stations, efficient alternative cropping systems with agronomic management practices were identified, documented and recommended for different agro-climatic zones having potential productivity ranging from 16 to 35.2 t ha^{-1} $year^{-1}$. Twenty six alternatives to rice-wheat for 11 zones of 9 states, pearl millet based for 4 zones of 4 states and maize based systems for 5 zones of 5 states were identified for large scale adoption.These alternative systems along with production packages have been included in the Crop Production Guide /package of practices of respective states.

Long term INM in cereal-cereal system

Long term nutrient management in cereal-cereal cropping systems indicated substitution of 25-50% N with FYM or green manure in rice-wheat system was found to increase the productivity by 4%. In rice-rice system, green manuring increased the yield by 3.6%. Frequent application of organic manures (at least once in each crop cycle) is must for realizing the sustainable yield in pre dominant cereal-cereal food systems like rice-rice, rice-wheat and rice-maize.

On-Farm Research

Response of cropping systems to nutrients

Across the various NARP zones and cropping systems, farmer's package resulted in lower yield compared to recommended package owing to the 29, 25, 71 and 100 % lower application of N P_2O_5 K_2O and micronutrients. On-farm system yield gap between recommended dose of N P_2O_5 K_2O + micronutrient and farmer's package was found to be 1192, 2059, 2636, 3575 and 1622 kg ha^{-1} in rice- rice, rice- wheat, maize- wheat, soybean-onion and rice-green gram systems respectively.Application of micronutrients based on soil test resulted in additional yield of 805, 786, 341, 877 and 246 kg ha^{-1} in rice-rice, rice- wheat, maize- wheat, soybean-onion and rice -green gram systems respectively. In all the NARP zones and systems, application of recommended N P_2O_5 K_2O alone or N P_2O_5 K_2O + micronutrient resulted in higher yield and use efficiency of nutrients. Suboptimal application in terms of number and quantity resulted in significantly lower yield and use efficiency of nutrients especially nitrogen.

Plate 19: OFR Farmers discussion at Aurangabad (Maharashtra)

Diversification of farming systems in marginal farm households

Under innovative approach of improving farming systems of marginal household conditions, presence of maximum of 8 farming systems was observed in South 24 Paragnas district (West Bengal) and minimum of one farming systems in 5 districts namely Samba (Jammu & Kashmir), Amritsar (Punjab), Palghar and Pune (Maharashtra) and Gadag (Karnataka). Existence of six farming systems at Panchmahal (Gujarat) and 5 farming systems at Kabirdham (Chhatisgarh), Dindori (Madhya Pradesh), Srikakulam (Andhra Pradesh), Warangal (Telangana), Kendrapara (Odisha) districts were also observed. Field crops + dairy was found to be the common farming system at all locations in marginal households and it is the dominant system practiced in 17 districts based on number of households adopting the system. Field crops + dairy + poultry is found to be the dominant farming system in Udaipur (Rajasthan), Warangal (Telangana), Srikakulam (Andhra Pradesh) and Sivagangai (Tamil Nadu). Similarly, field crops + dairy + goat were found to be pre-dominant system in Purnea (Bihar) district. At Kanpur Dehat (Uttar Pradesh), both field crops + dairy and filed crops + dairy + goat were found as dominant systems. In case of South 24 Paragnas (West Bengal) and Panchmahal (Gujarat), highly diversified system was noticed. Field crop alone was found to be dominant practice adopted by large number of households in Kabirdham (Chhatisgarh) and Aurangabad (Maharashtra) districts. Across the locations and farming systems, improvement of existing farming systems with diversification approach in cropping system, livestock, product diversification and capacity building module resulted in considerable improvement in production (up to 2 times), marketable surplus (1-2 time), reduction in cost (20 %) due to recycling, returns

(2 times) and profit (cash flow for family by 1-2 times). Based on the statistical analysis, best performing farming system has been identified for each district which needs to be up-scaled along with all possible interventions and diversification approach for improving the livelihood of marginal farm households.

Improvement of farming systems in small holder farms

Under study on holistic approach of improvement of farming systems in small holder farms, the number of farming systems in different districts ranged between 1 (Samba, Ambedkarnagar, Sirsa, Amritsar, Pakur and Gadag) to 8 (Srikakulam). Nainital, Kolar and Panchmahal districts were having 5 farming systems while Kendrapara has 7 systems. Field crops + dairy was found to be the dominant farming system based on number of households in 20 districts (68 % of total districts studied). The dominant systems observed in other districts are field crops (Pakur in Jharkhand), field crops + dairy + poultry (Kabirdham in Chhatisgarh, Pune in Maharashtra and Sivagangai & Pudukottai in Tamil Nadu), field crops + dairy + goat (Udaipur in Rajasthan), field crops + dairy + goat + poultry (Kendrapara in Odisha and Panchmahal in Gujarat) and field crops + horticulture (coconut / rubber) + dairy (Pathinamthitta in Kerala). Highly diversified system was observed in Srikakulam district of Andhra Pradesh having many components of farming system namely field crop, dairy, goat, poultry in different combinations ranging from 1 to 4. In general, at all the locations, constraint based interventions in crop, livestock; processing and optional modules resulted in improvement in production (1-2 times), marketable surplus (2-5 times) and profit (2-3 times). At many locations, interventions also contributed for significant reduction in cost due to better recycling.

Plate 20: Diversification of existing cropping/farming system in Dharmapuri district (Tamil Nadu)

FLDs on farming systems involving oilseeds

The FLD's on cropping systems involving oilseeds were conducted at 10 OFR units of All India Coordinated Research Project on Integrated Farming Systems (AICRP on IFS) in five agro ecosystems viz., Arid, Semi-Arid, Sub Humid, Humid and Coastal; covering 10 states. Across different ecosystems and FLD centres, total 125 demonstrations were conducted. Total 39 demonstrations were on systems involving groundnut followed by 38 demonstrations on systems with hybrid caster. The systems involving sunflower was undertaken in 22 demonstrations while gobhi sarson and mustard crops were taken in 18 and 12 demonstrations, respectively. Major cropping systems in which oilseed crops were tested are hybrid castor, hybrid castor without sunhump in farmers practice and with sunhump in improved practice, hybrid castor + lucerne, groundnut + hybrid castor (2:1) and Maize – Sunflower in arid ecosystem, gobhi sarson, sunflower, groundnut and sesame in Semi-Arid, groundnut-mustard, maize-gobhi sarson and groundnut in Sub Humid, toria in Humid and sesame in Coastal ecosystems. Across the regions farmers practice (FP) was compared against improved practice (IP). At Jagudan (Gujarat), 136.54% increase in hybrid caster yield was seen due to use of improved variety. Likewise in same centre, green manuring of sunhemp in hybrid castor increased cost (41884 Rs/ha) as compared to farmers practice involving no green manuring with sunhamp (33480 Rs/ha). However, it also gave 38.13 and 66.78% higher gross and net returns. Hybrid caster + lucerne intercropping enhanced cost by 61.48% than sole caster cultivation in farmers practice. From same

Plate 21: Release of publication in the on-farm farming systems research: impact and farmers perception at Dharmapuri district (Tamil Nadu)

intercropping system 29.38 and 79.82% higher gross and net returns over sole crop of hybrid caster in farmer's practice were also realized. In a similar fashion, groundnut + Hybrid castor intercropping increased cost by 63.71%, gross and net returns by 63.68 and 91.06% respectively over sole hybrid caster cultivation in farmers practice. In Gadag in maize-sunflower cropping system, 36.30% increase in sunflower yield was seen due to maintenance of row to row distance of 20 cm by thinning as against farmer's practice of broadcasting. Though cost of cultivation of system increased by 18.98%. At Seethampeta (Andhra Pradesh), introduction of groundnut improved variety K-6, has increased yield, gross and net returns by 25.28, 25.3 and 32.3%, respectively. Enhancement in yield of gobhi-sarson (88.26%) at Kangra (Himachal Pradesh) was seen due to replacement of Kanchan variety with improved variety HPN-3. Likewise, in Thiruvalla also replacement of Kayamkulam-1 with HYV Tilak produced 32.06% higher yield over farmer's adopted variety (Kayamkulam-1). At Amritsar in gobhi sarson, maintenance of 45 x 10 cm spacing by thinning has produced higher gross and net returns (19.25 and 26.42% respectively). At Fathepur (Rajasthan) in groundnut-mustard cropping system, replacement of local varieties of groundnut and mustard with improved groundnut variety (HNG-10) and mustard variety (Laxmi) has improved the yield of groundnut and mustard by 24.1 and 27.1%, respectively. Similarly net return has also improved by 118.76 and 105.89%. Due to maintenance of 30 x 10 cm spacing in groundnut (variety ICGS 91114) at Angul, gross and net returns have improved by 36.2 and 73.3% respectively. The higher cost of cultivation of sesame (2.71%) was found with replacement of sesame variety Kayamkulam-1 with HYV Tilak variety at Thiruvalla (Kerala). Gross returns of 107520 Rs/ha and net returns of 43007 Rs/ha were realized due to replacement of sesame variety Kayamkulam-1 with the variety HYV Tilak at Thiruvalla (Kerala).

Network Project on Organic Farming

Network Project on Organic Farming (NPOF), a plan scheme initiated from 2004-05 operates currently with 20 centres covering 10 agro-climatic regions. The scheme is in operation at 12 SAU's, 7 ICAR institutes and 1 special heritage university and covers 16 states. Distribution of locations is given in Map 3.

Map 3: Locations of NPOF centres

Table 27: State wise package of practices developed for various cropping systems

State	Cropping systems
Chhattisgarh	Soybean-chickpea Soybean-onion Rice-chickpea
Himachal Pradesh	Maize - Garlic Cauliflower - Pea -Tomato Coriander - Pea -Tomato
Jharkhand	Rice (Basmati type)-wheat Rice (Basmati type)-lentil Rice (Basmati type)-linseed Rice (Basmati type)-potato
Kerala	Turmeric Ginger Black pepper
Madhya Pradesh	Soybean-Wheat Soybean-Mustard Soybean-Chickpea Soybean-Isabgol/Linseed
Maharashtra	Rice-groundnut Rice-Dolichos bean Rice-cucumber Rice-red pumpkin
Meghalaya	Rice-Carrot (Raised beds in lowland) Rice-Tomato (Raised beds in lowland) Maize + soybean- French bean (Upland)
Punjab	Maize-potato-summer moong Turmeric-onion Basmati rice-wheat-green manure *(Sesbania)* Maize-durum wheat-cowpea (fodder) Maize-berseem-bajra (fodder system) Maize-berseem-maize+cowpea (fodder system)
Tamil Nadu	Cotton-maize-green manure (*sesbania*) Chillies-Sunflower-green manure (*sesbania*) Beetroot-maize- green manure (*sesbania*)
Uttar Pradesh	Basmati rice – wheat - *Sesbania* green manure Coarse rice– barley + mustard – greengram Maize (grain) – potato– okra Maize (green cobs) – mustard + radish - *Sesbania* green manure
Uttarakhand	Basmati rice- wheat-*Sesbania* Basmati rice- Lentil-*Sesbania* Basmati rice- Vegetable pea-*Sesbania* Basmati rice- *Brassica napus* –*Sesbania* Basmati rice- Chickpea –*Sesbania* (under biodynamic practices)

During the year under report, ten experiments namely Evaluation of organic, inorganic and integrated production systems (20 locations), Evaluation of response of different varieties of major crops for organic farming (20 locations), Evaluation of bio-intensive complimentary cropping systems under organic production systems (3 locations; Pantnagar, Dharwad, Umiam), Development of Integrated Organic Farming System models (7 locations; Calicut, Thiruvananthapuram, Coimbatore, Umiam, Udaipur, SK Nagar, Almora), Evaluation of Farm waste recycling techniques for organic farming (3 locations; Dharwad, Modipuram, Almora), Documentation & validation of organic ITKs (4 locations; Udaipur, Narendrapur, Gangtok, Ajmer), Evaluation of organic management practices for insect pest in various crops (3 locations; Almora, Gangtok, Ajmer), Evaluation of organic management practice for diseases in crops (Gangtok and Ajmer), Development of scientific organic package for large cardamom (Gangtok) and Biochemical characterization & molecular identification of microbial population of different organic manures (Narendrapur) were undertaken. Besides these, 2 studies namely Geo-referenced characterization of organic farmers (20 locations) and Cluster based demonstration of Organic Farming Package under TSP (3 locations, Coimbatore, Umiam and Karjat) were also undertaken. The Salient achivements are summarized below.

Scientific PoPs for Organic farming: Developed the scientific package of practices for organic production of crops in cropping systems perspective. PoPs for 42 cropping systems suitable for 11 states were developed. The details of states and cropping systems for which PoPs developed are given Table 27.

Technologies developed under NPOF for up-scaling through developmental schemes

1. Reduced manuring

Application 75 % nutrients only through combination of organics such as FYM, vermicompost, Non edible oil cakes and other locally available sources + 2 innovative

inputs such as cow urine, panchagavvya, PGPR with complete organic management developed (Table 28).

Table 28: Best performing cropping systems with reduced manuring in different states

State	Crop/Cropping System
Chhattisgarh	Soybean-pea, soybean-chilli
Himachal Pradesh	Okra-pea-tomato (Summer)
Jharkhand	Rice (Basmati type)-wheat
Karnataka	Greengram-sorghum
Madhya Pradesh	Soybean-wheat, soybean-mustard, soybean-chickpea, soybean-linseed
Punjab	GM-basmati rice-chickpea
Uttar Pradesh	GM-basmati rice-mustard
Uttarakhand	GM-basmati rice-vegetable pea + coriander (4:2 rows)

2. Normal manuring

Application 100 % nutrients through combination of organics such as FYM, vermicompost, Non edible oil cakes with complete organic management have been developed (Table 29).

Table 29: Best performing cropping systems with normal manuring in different states

State	Crop/Cropping System
Jharkhand	Rice (Basmati type)-potato, Rice (Basmati type)-linseed
Kerala	Black pepper
Maharashtra	Rice-groundnut
Meghalaya	Rice in sunken beds and French bean and tomato in raised beds
Punjab	GM-basmati rice-wheat; soybean-wheat
Uttarakhand	GM-basmati rice-chickpea + coriander (4:2 rows), GM-basmati rice-potato

3. Integrated Crop Management (ICM)

Also called towards organic approach with 75 % organic + 25 % inorganic package and 50 % organic + 50 % inorganic package have also been developed (Table 30).

Table 30: Best performing cropping systems with ICM (towards organic approach) in different states

State	Crop/Cropping System
Himachal Pradesh	Blackgram-cauliflower-summer squash; Cauliflower-frenchbean
Kerala	Turmeric
Maharashtra	Rice-mustard, Rice-dolichos bean
Meghalaya	Rice in sunken beds and Brocoli, potato & carrot in raised beds
Tamil Nadu	GM-beetroot-maize; GM-cotton-maize; GM-chilli-sunflower

4. Identification of varieties for organic farming

Best performing varieties of crops for organic farming in different seasons and states have also been identified (Table 31).

5. Resource conservation practices

Resource conservation practices for organic farming were identified for Karnataka, Uttarakhand and Meghalaya (Table 32).

6. Integrated Organic Farming System

IOFS models for Tamil Nadu and Meghalaya were developed. IOFS model developed at Meghalaya comprised of field crops & horticulture based system (Cereals + pulses + vegetables +fruits + fodder) + Dairy (1 cow + 1 calf) + fishery + vermicompost however Field crop based system (Green manure-cotton-sorghum; Okra + coriander-maize + cowpea (fodder), desmanthus, 1 milch cow, 1 heifer & 1bull calf + vermicompost + boundary plantations (*Gliricidia*, *coconut*) aere the various components of the IOFS model developed at Tamil Nadu.

Policy input: Policy for promotion of organic farming in India was formulated based on the results of NPOF project. This policy was finalized with joint meeting of ICAR & DAC&FW. Financial express covered the policy in its issue dated 16 April 2016.

Table 31: Best performing varieties of identified crops in different states

Location (State)	Season	Crop	Variety
Chhatisgarh	*Kharif* *Rabi*	Rice Chickpea	Jayagundi and CR Sugandh dhan- 907 Vijay and Daftari-21
Himachal Pradesh	*Kharif* *Rabi* *Summer*	Okra Pea Cauliflower Tomato	Chameli 015 and Indranil Ten plus and Nirali US-178 andChandra mukhi Red Gold and Hybrid 7730
Jharkhand	*Kharif* *Rabi*	Rice Wheat	MTU-10 andLalat K-0307 and Raj-4229
Karnataka	*Rabi*	Chickpea Wheat	BGD 103 and JAKI 9218 UAS 347 (Bread wheat) and NIAW 1415 (Bread wheat)
Kerala	*Kharif*	Turmeric Black pepper	Sudarsana and Suvarna Sreekara and Panniyur 1
Madhya Pradesh	*Kharif* *Rabi*	Soybean Maize Wheat Chickpea	RVS-2002-4 and JS-20-41 Kanchan-101 and Proagro-4412 GW-366 and HI-8498 JG-130 and RVG-203
Maharashtra	*Kharif*	Rice Groundnut	Sahyadri-5 and Sahyadri-3 Konkan Gaurav and TG-26
Meghalaya	Pre-Kharif Kharif Summer	Maize French bean Tomato	DA-61-A and RCM-75 Naga local and RCM FB 18 MT 2
Punjab	*Kharif* *Rabi*	Basmati rice Wheat	Pusa Basmati 1509 and Pusa Basmati 1121 PBW 621 and PBW 644
Tamil Nadu	*Rabi*	Rice	CB 05022 and Mappillai samba
Uttar Pradesh	*Kharif* *Rabi*	Maize Mustard	PMH -4 and Seed Tech-2324 RGN – 229 and RH - 0406
Uttarakhand	*Kharif* *Rabi*	Rice Wheat	NDR-359 and Pant Basmati 1 HD-2967 and UP-2565

Table 32: Land configuration based resource conservation practices identified for organic farming in different cropping systems

Cropping System	Land configuration
Karnataka	
Soybean-Wheat	BBF with crop residues
Groundnut + Cotton (2:1)	Conventional FB with crop residues
Greengram-Sorghum	Conventional FB without crop residues
Soybean + Pigeonpea (2:1)	BBF with crop residues
Uttarakhand	
Direct seeded rice - greengram in BBF	Direct seeded rice with chickpea chickpea– on broad bed (105 cm x 45 cm)
Meghalaya	
Carrot- Okra	Raised bed
Rice (Lampnah) -Pea	Sunken bed

Plate 22: Integrated Organic Farming System model at Umiam (Meghalaya)

Identification of Climate Resilient Production System

Using the data of 11 years (2004-05 to 2014-15) of field experimentation conducted at NPOF Centre, Bhopal, having three management practices *viz.*, organic (supply of 100% nutrients through organic sources and complete organic management as per NPOF standards), towards organic (supply of nutrients through 50% organic + 50% inorganic with complete organic management) and 100% inorganic management and 3 cropping systems *viz.*, (Soybean-wheat, soybean-mustard, soybean-chickpea) and also the long term meteorological data viz., rainfall, maximum and minimum temperature (1951 to 2015), climate resilient production system and crops were identified by working out % gain in yield over inorganic management during normal, high and deficit rainfall years which are described below.

The positive deviation (%) in the grain yield of the soybean was found under organic production systems in deficient rainfall years (2007-2010) in comparison to towards organic and inorganic production systems. However, the grain yield of the same production system (Organic) recorded the least negative deviation from the mean grain yield over the years under high rainfall years (2011-13) (Fig. 23).

Soybean grown under organic and towards organic production systems gained 17.3 and 5.8% yield respectively over inorganic production systems under high rain fall during crop season (June –September).

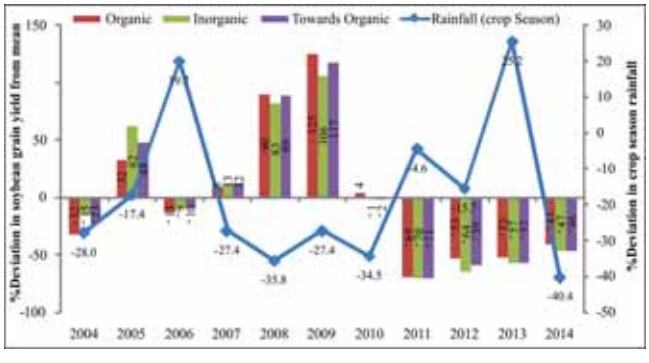


Fig. 23. Effect of per cent deviation in crop season rainfall from normal on the productivity of soybean over the years

However gain in yield of soybean was higher during deficit rainfall condition in the organic (18.4%) and towards organic production systems (7.8%) as well as in normal rainfall years (Fig. 24).

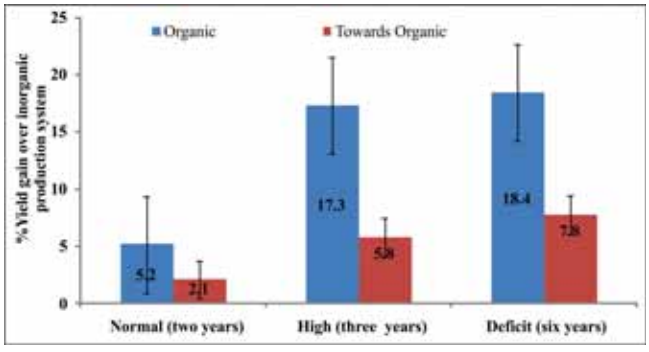


Fig. 24. Per cent yield gain in soybean through organic and towards organic production system over inorganic

Under deficit rainfall years (2006-07 to 2011-12), wheat productivity under organic production system recorded least per cent deviation from the mean grain yield over the years. However, due to high terminal rainfall during crop seasons (2012-13 to 201-15), least yield loss was recorded in the wheat under organic production system over the others (Fig. 25). The gain yield of wheat during high rainfall was found to be 7.8 & 4.9 % under organic and towards organic systems. However, the gain was higher (8.7 and 6.8% respectively) in deficit rainfall situation (Fig. 26) under organic and towards organic production systems in comparison to inorganic practices.

Out of 11 crop season(November to February) of mustard , only two season *viz.*, 2006-07 and 2014-15 was recorded higher rainfall while rest others were

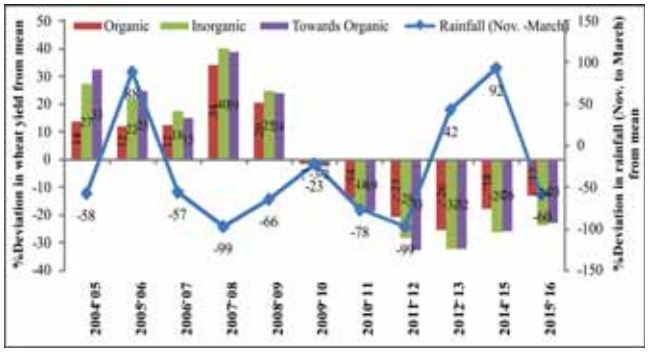


Fig. 25. Effect of per cent deviation in rainfall during crop season on the productivity of wheat over the years

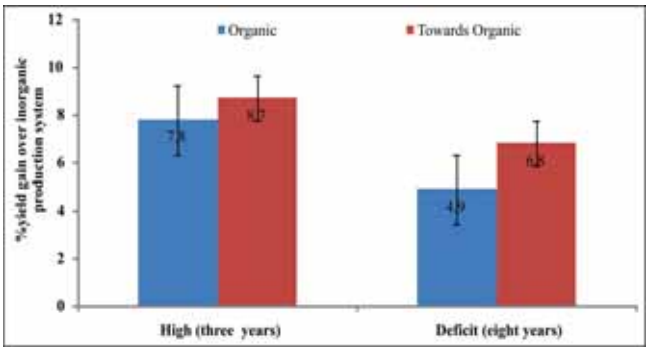


Fig. 26. Effect of rainfall during crop season (November – March) on per cent yield gain in Wheat over inorganic production system

deficit rainfall seasons. The negative deviation in the mustard yield from the mean yield over the years was recorded least over the others under organic production systems in case of deficit rainfall. However, the positive gain in early years was found to be higher in inorganic condition (Fig. 27). Mustard grown under organic production systems gained 6.3 and 12.1% yield under higher rainfall and deficit rainfall conditions respectively. In case of mustard with towards organic production management, the yield difference among high and deficit rainfall situation during crop season was less (5.7 & 5.8% under high & low rainfall years) (Fig. 28).

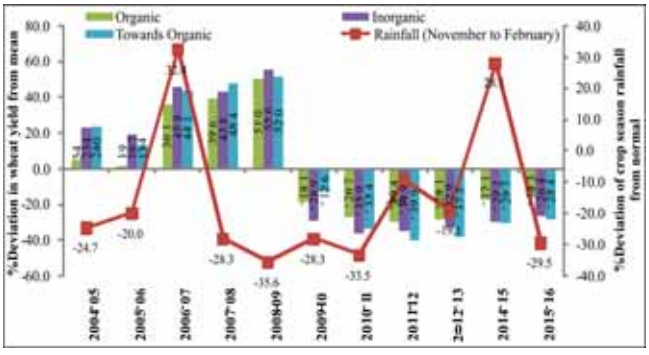


Fig. 27. Effect of deviation in rainfall during crop season (November to February) from normal on the productivity of Mustard over the years

In early five years (2004-05 to 2008-09), the performance of chick pea grown under inorganic condition was better than the others. But after stabilization, the chickpea crop performed better both in higher rainfall and deficit rainfall situation (Fig. 29).

Chickpea was found to be more resilient crop as compared to others under organic production system

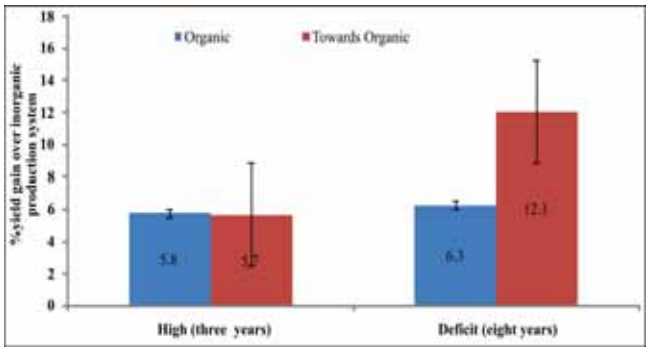


Fig. 28. Effect of rainfall during crop season (November – February) on percent yield gain in Mustard over inorganic production system

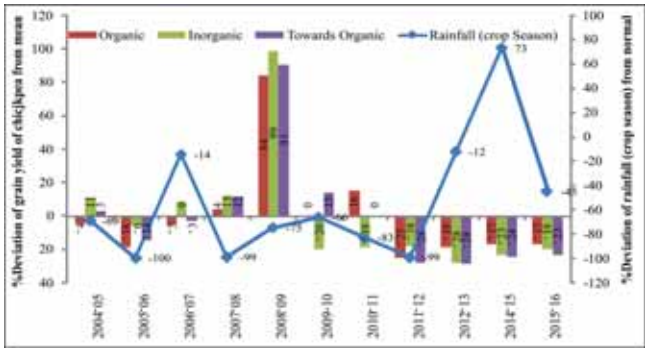


Fig. 29. Effect of deviation in rainfall during crop season (October to February) from normal on the productivity of chickpea over the years

in comparison to inorganic in the case of high rainfall (Fig. 30).

It can be concluded that soybean-chickpea cropping system with organic production system was found to be more climates resilient under extreme (high and deficit) rainfall situations for Vindhya Plateau Agroclimatic Region of Madhya Pradesh.

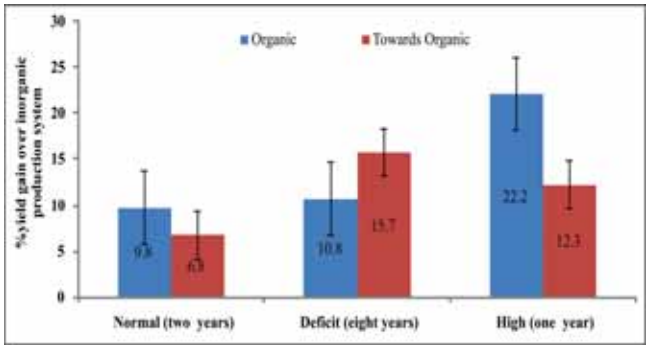


Fig. 30. Effect of rainfall during crop season (October-February) on percent yield gain in Chickpea over inorganic production system

Externally Funded Projects (EFP)

Integrated Spatial Farming Systems Analysis Techniques with Remote Sensing and Ancillary data (INFARM)

The study was undertaken in 8 selected districts namely Mehsana (Gujarat), Kendrapara (Odisha), 24 Paragnas (West Bengal), Kanpur Dehat (Uttar Pradesh), Dharmapuri/Krishnagiri (Tamil Nadu), Udaipur (Rajasthan), Pune and Amravati (Maharashtra). Field survey was conducted during 2013-2015 and required data base was developed for the analysis of spatial and non-spatial data of selected district at blocks and village level. Based on the analysis and using scale, family size index, land utilization index and socio-economic index were developed and used for comparison of different farming systems.Salient findings are summarized below.

Two predominant farming systems were found in Mehsana district (Gujarat) where 83% households having 1.07 ha holding size and 5-6 family member are having field crops + dairy. Results revealed that family size increase is inversely related with household index. Three crops (*kharif, rabi& summer*) were taken by 75% of the households in the district however 25% households were taking only two crops i.e. *kharif & rabi*. On the bases of socio economic index, it was found that the 47% households were earning between Rs 40, 000 to Rs 60, 000 each from *rabi* and *kharif*.

A highly diversified farming system was observed in Kendrapara in Odisha where eight major farming systems were found. Maximum households having average size of 4-5 family member adopted field crop + dairy farming system. The results showed that the larger is the family size, the more farming system components are adopted in larger area. It was found that 31% households in the district were growing three crops (*kharif, rabi* and *summer)* in a year whereas, 69% households were taking only two crops i.e. *kharif* and *rabi.* It was also found that the 75% households were earning up to Rs 20,000 each and 25% households were earning between Rs 20, 000 to Rs 40, 000 each from *kharif* and *rabi*.

In 24-Paragnas (West Bengal), maximum households were practicing field crop + dairy + fish farming system. Main crops were found to be rice, sunflower, potato and greengram. Two crops (*kharif* and *rabi)* in a year were being taken by 86% households, however only 11% households were taking three crops *i.e. kharif, rabi* and *summer*. It was found that the 97% households were earning up to Rs 20,000 each from *kharif* and *rabi*.

Four farming systems were found in Kanpur Dehat, Uttar pradesh however 52% households having 0.96 average holding sizes and 4-5 family members were growing field crop and rearing dairy animals. Results revealed that the family size is constant for all indexes. Two crops (*kharif &rabi*) in a year were being taken by 94% households in the district however 6% households were taking three crops i.e. *kharif, rabi & summer*. It was found that the 41% households were earning between Rs 40,000 to Rs 60,000 and 38% households were earning between Rs 20,000 to Rs 40,000 each from *kharif* and *rabi*.

Maximum households (94%) having family size of 3-4 members have adopted field crop + dairy farming system in Dharampuri & Krishnapuri. Main field crops grown were rice, coconut, ragi, turmeric and chilli. Two crops (*kharif &rabi*) were taken by 44% households in the district, however only 17% households were taking three crops i.e. *kharif, rabi* and *summer* and only 39% households were taking only one crop i.e *kharif*. It was found that the 37% households were earning between Rs 20, 000 to Rs 40, 000 and 34% households were earning up to Rs 20,000, 28% households were earning between Rs 40,000 to Rs 60, 000 each from *kharif* and *rabi*.

Three different farming systems have been found and adopted by 97% households with average family

size of 6-7 members in Udaipur, Rajasthan. Results of socio economic index showed that the 83% households were earning upto Rs 20,000 whereas, 17% households were earning between Rs 20,000 to Rs 40,000 each from *kharif* and *rabi*.

Maximum households (83%) having 3-4 family members and holding size of 0.58 ha have adopted field crop + dairy farming system in Pune, Maharastra. Three crops (*kharif*, *rabi* and *summer)* in a year were being taken by 71% households in the district, however 14% households were taking two crops i.e. *kharif & rabi* and 14% households were taking only one crop.

Maximum households (80%) having family size of 4-5 members and holding size of 0.95 ha adopted field crop + dairy farming system in Amravati district of Maharashtra. Three crops (*kharif*, *rabi* and *summer)* in a year were being taken by 39% households in the district, however 61% households are taking two crops i.e. *kharif & rabi*. Results of socioeconomic index showed that 50% households were earning up to Rs 20,000 however, 45% households were earning between Rs 20,000 to Rs 40,000 and 5% households were earning between Rs 40,000 to Rs 60,000 each from *kharif* and *rabi*.

Based on the complete profiling of existing farming systems, ideal farming systems was identified using number of household adopting the systems with socio economic index of different systems. It can be concluded that spatial tools combined with ancillary data can serve as a time & resource saving methodology for characterization and identification of ideal alternate farming systems. The recommended alternate efficient farming systems in different districts are given in Table 33.

Table 33: Existing Farming systems and alternate efficient farming systems based on geospatial interpolation in the various districts

District (State)	Existing Farming Systems	Recommended alternate efficient farming Systems with diversification approach for higher production, profit and nutrition
Mehsana (Gujarat)	Field crops Field crops+dairy	**Crops intensification** 1. Hybrid Castor + Lucerne (Fodder+Seed) broadcasting 2. Hybrid Castor+Chicory (fodder) broadcasting 3. Hybrid Cotton + Hybrid Castor 4. Mustard + Lucern (seed) **Crop diversification** 1. Hybrid Castor with Fennel/chilly 2. Wheat with *rabi* fennel 3. Fodder sorghum with fodder bajra **Livestock** 1. Supply of green fodder throught year 2. Mineral mixture supplementation 3. Deworming **Product diversification** 1. Vermicompost 2. Enrichment of wheat straw 3. Kitchen gardening 4. Chilli powder making

District (State)	Existing Farming Systems	Recommended alternate efficient farming Systems with diversification approach for higher production, profit and nutrition
Kanpur Dehat (Uttar Pradesh)	Field crop Field crop+dairy Field crop+dairy+goat Field crop+goat	Cropping systems (rice/maize/green gram-wheat/potato/mustard/ berseem-mentha/greengram) + dairy (cow) + goat (4 no's) + kitchen garden + vermicompost + boundary plantations
Udaipur (Rajasthan)	Field crop Field crop+dairy Field crop+dairy+goat	Cropping systems (maize- wheat, growing of vegetables namely tomato, brinjal, chilli, okra, onion, bottle gourd, ridge gourd) + mineral mixture, deworming and cut fodder (dry and green) to cattle + 20 number of Pratapdhan poultry + vermicompost preparation
Kendrapara (Odisha)	Field crop+dairy Field crop+dairy+forestry Field crop+dairy+goat Field crop+dairy+forestry Field crop+dairy+goat+poultry +forestry Field crop+dairy+goat+poultry Field crop+dairy+poultry	Cropping systems (rice/jute-greengram/rice/vegetables/blackgram/ groundnut/mustard)+ dairy (cow) + goat (6 no's) + backyard poultry (10 no's) + Azolla for feeding + vermicompost + kitchen garden + ber budding
24 Parganas (West Bengal)	Field Crop+dairy+poultry +forestry Field crop Field crop+dairy Field crop+dairy+forestry Field crop+dairy+Poultry+forestry Field crop+dairy+goat+forestry Field crop+dairy+poultry+poultry+forestry Field crop+forestry Field crop+goat+forestry Field crop+poultry+forestry	Cropping systems (Rice-greengram/onion /okra/sunflower) + mineral mixture feeding, vaccination and deworming of cow + poultry with vaccination and azolla feeding + cultivation of mixed carp with proper ratio and fertilization + boundary plantations
Dharampuri & Krishnapuri (Tamil Nadu)	Field crop+dairy Field crop+dairy+goat	Vegetables +flower crops+ turmeric +balanced nutrition +bio intensive integrated pest and disease management + Co CN 4 & 5 fodder + area specific mineral mixture+ improved poultry breeds + vermi composting + kitchen garden
Pune (Maharashtra)	Dairy Field crop+ dairy Field crop+dairy+goat	Cropping systems (soybean-onion, rice - wheat, pearl millet-chickpea) + hybrid napier in bunds + goat (1) + Backyard poultry(10)
Amravati (Maharashtra)	Field crop Field crop+dairy Field crop+dairy+goat Field crop+goat	Cropping systems (soybean + pigeonpea (4:2) chickpea + linseed (5:1) – Summer sesame) + goat (1) + hybrid napier in bunds + berbudding + compost with bio decomposers + kitchen garden

Global Yield Gap and Water Productivity Atlas (GYGA)

To assess the yield potential (Yp) or water-limited yield potential (Yw), yield gap (Yg) and water productivity (WP) using a bottom-up approach based on actual data and robust crop simulation models was the main objective of Global Yield Gap and Water Productivity Atlas (GYGA) Project. GYGA aspires for global coverage of yield gaps for all major food crops focusing on maize, rice, wheat, sorghum and millet in 20 countries. Based on the area of five major crops, reference weather stations (RWS) were identified. Thirty reference weather stations and respective climatic buffer zones for estimating actual and potential yields of rice have been identified and soil as well as crop related basic data were collected. Similarly, reference weather stations for wheat (20), maize (30), sorghum (30) and bajra (30) were also identified in different agro-climatic zones. Actual weighted crop yields for 10 years were estimated for all RWS taking the respective district as well as the surrounding district with in 100km radius.

The highest and lowest mean actual yields of maize were recorded with Nizamabad buffer zone of Telangana (3.92 t ha^{-1}) and Bahraich buffer zone of Uttar Pradesh (0.99 t ha^{-1}) respectively. Similarly, the highest and lowest mean actual yields of sorghum were recorded with Kurnool buffer zone of Andhra Pradesh (2.9 t ha^{-1}) and Jodhpur buffer zone of Rajasthan (0.41 t ha^{-1}) respectively. The quality control exercise of APSIM simulation for assessing potential yield of rice and wheat was completed and yield gap of rice and wheat were estimated for different climatic buffer zones.The yield gaps of rice and wheat were estimated based on the difference between actual yield and potential yield estimated through APSIM model. As per the protocol of GYGA, the yield potential of rice of Amritsar climatic buffer zone of Punjab was estimated as 8.48 t ha^{-1} and its mean actual yield (10 years) was 2.89 t ha^{-1}, hence the yield gap of about 5.59 t ha^{-1} was recorded which accounts to 65.9% of the potential yield. Similarly, the yield potential of rice of Kalyani climatic buffer zone of West Bengal was estimated as 7.12 t ha^{-1} using APSIM and its mean actual yield (10 years) was 2.29 t ha^{-1}, hence the yield gap of about 4.83 t ha^{-1} was recorded in this climatic buffer zone which accounts to 67.8% of the potential yield.

Adaptation and mitigation potential through conservation agriculture and IFS modules

Three objectives were identified for IIFSR viz., Study of carbon sequestration in different cropping systems in the on- going long- term experiments of AICRP-IFS, Study of GHG emissions in rice-wheat and other prevalent cropping systems in IIFSR network in at least two treatments (farmers' practice vs. the best practice) throughout the season at periodical intervals and modeling studies with farming systems experimental data and relating it to GCMs to assess the adaptation potential of IFS to climate change. During the year 2016-17, we have completed the following tasks,

GHG measurement under different crop establishment methods and different source of Nitrogen under rice-wheat system

A field experiment was carried out for two years (2014 & 2015 *kharif* season) to monitor GHG emission from rice-wheat system under different crop establishment methods and different source of nitrogen. Three different source of nitrogen were applied as per treatment viz. normal (S_1), neem coated (S_2) and sulfur treated (S_3) under different establishment methods viz. conventional (T_1), direct seed (Wet)-(T_2), direct seed (Dry) -(T_3) and System of rice intensification (SRI)-(T_4). The treatments were imposed in a randomized block design with three replications and followed recommended management practices. The treatments details : T_1S_1-Conventional +Urea, T_1S_2- Conventional + Neem coated, T_1S_3- Conventional+ Sulphur treated Urea, T_2S_1- DSR (wet)+Urea, T_2S_2- DSR (wet)+Neem Coated Urea, T_2S_3- DSR (wet)+Sulphur treated Urea, T_3S_1 -DSR(Dry)+Urea, T_3S_2- DSR (Dry)+Neem Coated Urea, T_3S_3- DSR (Dry)+Sulphur treated Urea, T_4S_1- SRI+Urea, T_4S_2- SRI+Neem Coated Urea, T_4S_3- SRI+ Sulphur treated Urea.

Methane and nitrous oxide flux was monitored by using the manual closed chamber method.

Methane emission: The methane flux varied from 0.83mg m^{-2} h^{-1} to 1.23 mg m^{-2} h^{-1} in different rice establishment methods with the effect of different types urea fertilizer. Methane emission followed almost similar pattern in fertilizer-treated plots although the magnitude of emissions varied. There is a sharp peak of methane emission during the tillering and panicle initiation stage. It was evident from our study that the microbial activity both in terms of extracellular enzyme activity and populations (for example methanogens, heterotrophs) were the highest during tillering and panicle initiation stage. The first peak was dominantly resulted by decomposition of soil organic matter which provide carbon source for methanogenic activity. The methane emission from direct seeded rice (Wet) with neem coated urea showed lessamount of methane emission as compared to other establishment methods irrespective of different source of nitrogen, which is statistically ($p<0.05$) significant also. It has been suggested that neem coating may have some inhibitory effect on CH_4 oxidation in soil probably due to higher conservation of ammonium in soil, leading to an increase in population of nitrifiers relative to methanotrophs and thus the overall reduction in CH_4 oxidation, as nitrifiers oxidize CH4 less efficiently than methanotrophs. Among the different establishment methods, the Conventional with normal Urea is very vulnerable to the emission of methane. The methane emission from T_3S_3 was at par with the emission from T_2S_4treatments. Cumulative methane emissions were in the order of $T_2S_2 < T_3S_2 < T_3S_3 = T_2S_3 < T_2S_1 < T_3S_1 = T_4S_2 < T_4S_3 < T_1S_2 = T_4S_3 = T_4S_1 < T_1S_3 < T_1S_1$. The application of neem coated urea in the conventional treatment reduced 23.8 % emission of methane whereas sulfur treated Urea reduced 11.16 % methane emission. The methane emission was 28.7% , 26.58 and 17.74 % less when normal urea was applied in direct seeded rice (Wet),direct seeded (Dry) and SRI system, respectively. In case of Neem coated urea, the methane emission was less 15.73%, 14.76% and 6.73% from the T_2, T_3 and T_4treatments respectively. Among the different paddy establishment methods, application of sulfur treated urea in direct seeded (Dry) plot emits 21.76 % less methane as compare to the conventional plot treated with same types of Urea. Duncan's Multiple Range Test (DMRT) at the 0.05 level of probability, it was found that direct seeded rice with neem coated urea is the best treatment combination and conventional method with normal urea plots is the poorest performing treatment.

Nitrous Oxide Emission: Significantly lower N_2O emissions were recorded in the application of neem coated urea in conventional methods of paddy cultivation. The emission of N_2O from T_4S_1, T_2S_3 and T_3S_3 was also statistically ($p<0.05$) at par. The nitrous oxide emission varied from 0.04 mg m^{-2} $h^{-1}$to 0.05mg $m^{-2}h^{-1}$ $_{under}$ different establishment method of paddy with different source of nitrogen.Application of neem coated urea reduced the nitrous oxide emission by 16.4%, 14.07%, 8.67% and 12.9% as compared to normal urea under conventional, DSR(dry), DSR(wet) and SRI method of paddy cultivation, respectively. Application of sulfur treated urea in SRI reduced 7.29 % N_2O emission as compared to normal urea where as in conventional plots sulfur treated urea reduced 11.84% nitrous oxide emission as compared to normal urea. The emission of nitrous oxide from sulfur treated urea was statistically at par in DSR (Wet) and DSR (Dry). Application of Neem coated urea treatment in Direct seeded Rice establishment methodis the best treatment and normal urea application in conventional method and Direct seeded Rice (Wet) has the poorest among the treatments studied.

Global warming potential (GWP) and carbon equivalent emission (CEE): Global warming potential in terms of gaseous carbon emission varied significantly ($p < 0.05$) with various treatments between 1252.61 kg CO_2 equivalent ha^{-1} in the conventionally paddy cultivation plots treated with normal urea to 932.34kg CO_2 equivalent ha^{-1} after application of neem coated urea in DSR (Wet). GWP on CO_2 equivalent basis in DSR (Dry) and DSR (Dry) establishment method with neem coated urea has the best treatment in respect of

global warming. The GWP values is statistically ($p<0.05$) at par in both the cases. The effect of neem coated urea in conventionally cultivated plots is also statistically at par with the plots under SRI systems and also from sulfur treated urea applied plots of DSR (Wet). There was a good effect of neem coated urea in all the four establishment methods of paddy. Neem coated urea reduces the GWP values of the order of 20.96%, 7.46%, 8.84% and 10.16 % in all the four methods of paddy establishment in comparison to normal urea application in respective different rice establishment methods . In case of carbon equivalent emission, best treatments is the DSR (Dry) treated with neem coated urea which is statistically at par with the same treatment under DSR(wet). Among the treatments highest value of CEE was recorded in conventional treatment with normal urea (Table 34).

APSFarm approach- A participatory whole farm modeling approach to understand impacts and increase preparedness to climate change

A participatory whole farm modeling approach to understand impacts and increase preparedness to climate change -APSFarm approach-followed in Meerut District.To represent the diverse farming systems and socio-economic situations for crop management, livestock management, socio-economic aspects 30 farms selected were selected. Parameterize APSFarm – a whole farm dynamic simulation model and create virtual representation of each farm. Model validation – an iterative process - participating farmers are asked whether they agreed with model outputs in terms of expected crop yields, gross margins, profits and their variability.

Table 34: Total methane and nitrous oxide emission and other characteristics of emission under different treatments (Average of two years)

Treat-ments	Methane Emission (kg ha^{-1})	Nitrous Oxide Emission (kg ha^{-1})	Carbon Equivalent Emission (Kg C ha^{-1})	Yield of crop (kg ha^{-1})	Total carbon fixed (kg ha^{-1})	Carbon Efficiency Ratio
T_1S_1	37.14^{h}	1.52^{f}	341.62^{h}	4318.00	2048.36	6.99
T_1S_2	30.00^{f}	1.16^{ad}	270.01^{bc}	4432.66	2099.12	7.77
T_1S_3	33.41^{g}	1.34^{c}	304.75^{g}	4621.33	2188.25	7.18
T_2S_1	26.78^{d}	1.50^{ef}	280.50^{ef}	4366.66	2069.72	7.38
T_2S_2	25.28^{a}	1.35^{d}	259.56^{a}	4493.33	2129.66	8.20
T_2S_3	26.41^{c}	1.45^{e}	274.62^{cd}	4546.00	2153.00	7.84
T_3S_1	27.27^{e}	1.45^{e}	278.92^{de}	4443.33	2105.09	7.55
T_3S_2	25.57^{b}	1.27^{b}	254.27^{a}	4854.66	2296.82	8.06
T_3S_3	26.14^{c}	1.37^{d}	265.64^{b}	3868.00	1835.22	6.91
T_4S_1	30.55^{f}	1.47^{ef}	299.41^{f}	5034.66	2386.65	7.67
T_4S_2	27.98^{e}	1.28^{cb}	268.96^{b}	4618.00	2185.79	8.13
T_4S_3	29.41^{f}	1.37^{d}	284.91^{f}	4826.65	2286.23	8.02
SEm±	0.02	0.01	0.86	60.52	28.60	0.14
LSD (P=0.05)	0.22	0.06372	10.73	753.09	355.93	1.77

In each column the mean values followed by common letters are not significantly ($p<0.05$) different between treatments by Duncan's multiple range test (DMRT)

Under 2050s cenario, due to lot of variability in monsoon rainfall – the farmers may shift rice to sugarcane/ fodder/ mustard in future. There is a chance to increase the livestock population – so fodder area may increase at the cost of rice/sugarcane. Since wheat yield also affected every year due to climatic variability – may shift from wheat to sugarcane/fodder. No change for the mustard area – because he is using the mustard for his own purpose.

Preliminary results of climate impact on future production system:

More allocation for sugarcane, mustard, fodder – Water will be diverted from rice to these crops. More allocation for livestock - may not affect the crops directly – however need more water, which is extra from the baseline scenario.

Strengthening Simulation Approaches for Understanding, Projecting and Managing Climate Risks in Stress-prone Environments across the Central and Eastern Indo-Gangetic Basin

This AgMIP-ICAR collaborative international project apply simulation tools in the major production ecologies of the central and eastern Indo-Gangetic Basin (India, Nepal, Bangladesh) in order to understand the integrated assessment of climate change impact on agricultural productivity. It will also assess the value of adaptation strategies under current and projected climatology by considering whether simulation tools and approaches and adequately capture the potential of different strategies for building resilience. The effort aims to fortify an existing network for agricultural simulation modeling while broadening it to include stronger linkages to climate and socioeconomic scientists. During the year 2016-17, the following research activities done;

Trade-off Analysis of Climate Change Impacts

This study was based on the farm survey (2012) data relating to 76 rice-wheat growing farmers. The average family size of the sample households was 6.32. Rice-wheat and sugarcane-wheat are the predominant

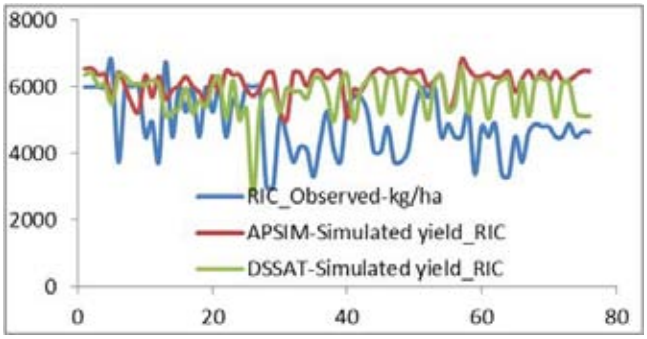


Fig. 31. Scatter plot of Rice observed yields and simulated yields

cropping system with livestock being an integral component of the existing farming system of sample households. The study site has excellent irrigation facilities with almost 99 percent cultivable area having irrigation facilities. To assess the sensitivity of current agricultural production systems to climate change (Q1), five climate scenarios and multi-crop model (APSIM and DSSAT) outputs were generated for the mid-century (2040-2069). The estimated model outputs (APSIM & DSSAT) showed wide variation in management efficiency at farm level, as indicated by the simulated yields of rice by APSIM (6167 kg ha^{-1}) and DSSAT (5758 kg ha^{-1}) models as compared to the rice survey yield (4870 kg ha^{-1}). Similarly, the simulated yields of wheat by APSIM was 4688 kg ha^{-1} in comparison to wheat survey yield (4011 kg ha^{-1}). The gap in observed and simulated rice yields seems to be substantially higher for APSIM as

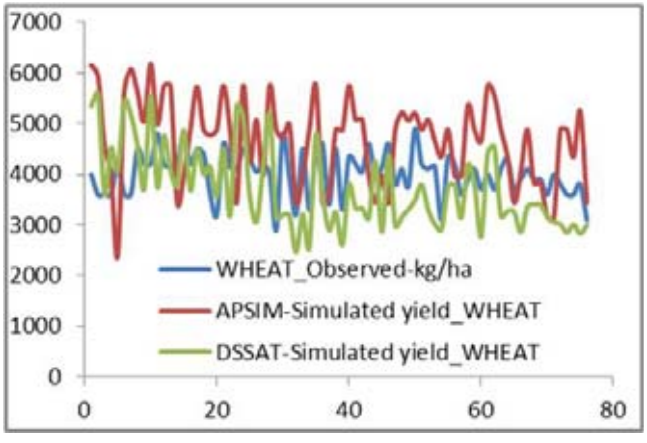


Fig. 32. Scatter plot of Wheat observed yields and simulated yields

compared to DSSAT. Using these yield simulations, survey data, historic data on rice and wheat yields, the TOA-MD model was set up for trade-off analysis. The results are summarized in the following section (Fig. 31 & 32).

Sensitivity of Current Agricultural Production Systems to Climate Change

The current production system under climate change would experience a decline in mean net farm returns ranging from 2–8% under RCP4.5 scenario, and 1–9% under RCP8.5 scenario, except one climate scenario with DSSAT (DSSAT-L). Impact of climate change on rice yield under both scenarios (RCP4.5 & RCP 8.5) is not uniform. In both the scenarios, rice yield witnessed increase as well as decrease with both the models (APSIM & DSSAT). However, wheat yield declines 1– 23% under both RCP4.5 & RCP8.5 scenario with both the models (APSIM & DSSAT), except one climate scenario under RCP 4.5 (APSIM –L). On the basis of available empirical evidences on climate change impact on livestock sector, it was assumed that milk yield is likely to decline by 10% under climate change. Overall, the per capita income would decline and, as expected, the population poverty rates would increase marginally under climate change. Although the magnitude of decline in per capita income and consequent increase in poverty rates may look small but it will have bearing on a large proportion of population (52 -70%). The results of integrated assessment of current production system under both scenario (RCP4.5 & RCP8.5) are given in Tables 35 & 36.

Table 35: Climate sensitivity of current production system (Rice-wheat) under RCP4.5 in Meerut

	% House-holds vulnerable	Grains (%)	Losses (%)	Net Impact (%)	NR without CC	NR with CC	PCI without CC	PCI with CC	Poverty without CC (%)	Poverty with CC (%)
APSIM-L	53.54	16.52	-17.91	-1.39	36025	35337	11909	11771	82.09	82.27
DSSAT-L	69.79	12.92	-20.68	-7.76	36023	32250	11909	11151	82.09	83.98
APSIM-M	71.30	12.61	-20.99	-8.38	36023	31956	11909	11092	82.09	84.17
DSSAT-M	69.34	13.00	-20.56	-7.57	36023	32340	11909	11169	82.09	83.94
APSIM-Q	70.32	12.79	-20.76	-7.96	36023	32152	11909	11132	82.09	84.05
DSSAT-Q	70.82	12.73	-20.92	-8.19	36023	32045	11909	11110	82.09	84.10
APSIM-S	64.45	13.85	-19.40	-5.55	36023	33304	11909	11363	82.09	83.44
DSSAT-S	65.44	13.80	-19.80	-6.00	36023	33087	11909	11319	82.09	83.51
APSIM-Y	65.07	13.76	-19.57	-5.81	36023	33178	11909	11338	82.09	83.49
DSSAT-Y	67.93	13.29	-20.29	-6.99	36023	32611	11909	11224	82.09	83.78

(DSSAT; Decision Support System for Agro-Technology Transfer, APSIM; Agricultural Production Simulator; NR; Net Returns, PCI; Per Capita Income, CC; Climate Change, L;L = inmcm4, M = IPSL-CM5A-LR, Q = MPI-ESM-LR, S = MRI-CGCM3, Y = HadGEM2-AO)

Table 36: Climate sensitivity of current production system (Rice-wheat) under RCP8.5 in Meerut

	% House-holds vulnerable	Grains (%)	Losses (%)	Net Impact (%)	NR without CC	NR with CC	PCI without CC	PCI with CC	Poverty without CC (%)	Poverty with CC (%)
APSIM-L	64.96	13.77	-19.52	-5.76	36023	33203	11909	11343	82.09	83.49
DSSAT-L	36.51	22.34	-16.33	6.01	36049	38985	11914	12504	82.07	80.19
APSIM-M	69.39	12.93	-20.48	-7.55	36023	32345	11909	11171	82.09	83.97
DSSAT-M	53.92	18.24	-19.96	-1.71	36033	35195	11911	11743	82.08	82.14
APSIM-Q	66.67	13.40	-19.81	-6.42	36023	32885	11909	11279	82.09	83.68
DSSAT-Q	52.31	18.94	-19.96	-1.02	36036	35536	11912	11811	82.08	81.94
APSIM-S	71.75	12.55	-21.15	-8.59	36023	31858	11909	11073	82.09	84.21
DSSAT-S	57.15	16.96	-19.98	-3.02	36028	34547	11910	11613	82.08	82.53
APSIM-Y	62.64	14.19	-19.03	-4.84	36023	33647	11909	11432	82.09	83.25
DSSAT-Y	52.30	19.01	-20.04	-1.02	36037	35537	11912	11811	82.08	81.93

Developing and Targeting Climate Smart Agriculture Practices Portfolios in South Asia

CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) and the International Maize and Wheat Improvement Centre (CIMMYT) in close collaboration with Indian Council of Agricultural Research (ICAR)- Indian Institute of Farming Systems Research (IIFSR), Modipuram initiated the climate smart village programme in Gangadhari village belonging to Khatauli Block of Muzaffarnagar district of Uttar Pradesh, India falling under Western plain zone. Baseline information of the Gangdhari village was collected. The baseline survey revealed that sugarcane-ratoon-wheat system is the main cropping system of the region while dominant farming system of the region was found to be Crop+ Livestock or Crop+ Livestock+ Horticulture. Deteriorating ground water table, low resource recycling, disappearance of pulse crops from the cropping systems, lack of crop diversification were the major constraints identified in the survey. Climatic information of the study site was studied using meteorological data from the agro-meteorological observatory of ICAR-IIFSR, Modipuram located near to the experimental site. The average annual rainfall is 747 mm, and nearly 80 % of the total rainfall is received through the southwest monsoon during June–September. August receives the highest rainfall followed by July and contributes 29.7 and 25.1 %, respectively, to annual rainfall. Survey also revealed that, small, marginal or landless farmers constituted 87.93 % of households. Complete absence of large farmers (land holding > 10.0 ha) in the surveyed sample is an indication of defragmentation of land holdings. Representation of medium (4-10 ha) category of farmers was also very poor in the surveyed sample (Fig. 33). Average land holding size of small farm holders was found to be 1.34 ha where as the average land holding size of marginal farmers was found to be 0.66 ha (Fig. 34). The average number of members per household in the surveyed village was found to be 6 members per household (Fig. 35) with minimum family size of 1 member to maximum family size with 13 members. The households in the surveyed village derive their livelihood from diverse sources. Agriculture is the mainstay of livelihood for most of the households. Livestock rearing along with field crops is the primary source of livelihood. Cultivation of cut flowers like Rajnigandha and Gladiolus is also another important source of livelihood in the surveyed villages. Survey of livestock in the households revealed that 52.45 % households were having cow only, 18.03

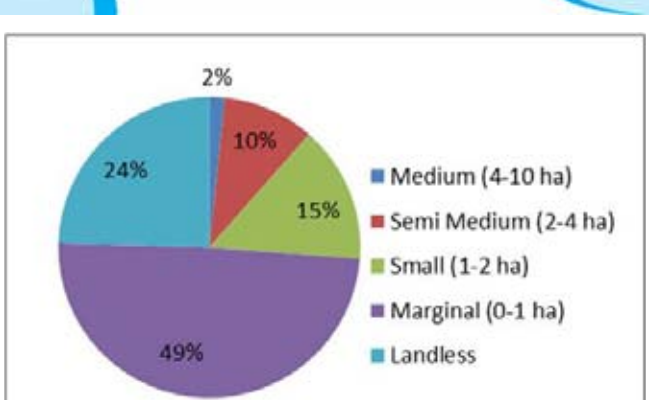


Fig. 33: Percentage composition of different category of farm households based on operational land holdings in Gangdhari village

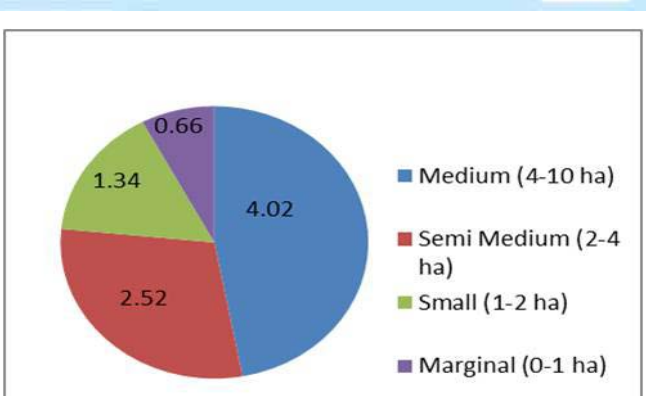


Fig. 34: Average land holding size of different category of farm households in Gangdhari village

Fig. 35: Family composition of different category of farm households

% were having buffalo only while 11.47 % households were having both cow and buffalo. Few households were having poultry, piggery and gotary as their livestock resources. It was found that households having cow had about 1.5 cows per households while average no. of buffalo population among the families having buffalo was approximately 1 buffalo per household. There was not much difference among average production of milk in terms of litre per day observed as average milk production per cow was 7.5 litre/day while it was 7.66 litre/day. Major changes made in last decade in livestock rearing as revealed from study were growing off season fodder, indigenous breeds and feed management. Majority of the farmers reported that water demand for crops have been increased due to increased day temperature and decrease in water availability due to extreme weather situations of late onset of monsoon, sudden downpour of rain etc. Most of the households in the surveyed village were having smaller piece of lands belonging to marginal and smallholder subsistence farmers. Survey revealed that 73.77 % of households have access (either owned or rented) to less than one hectare of land and rest of the households have access between one and five hectares while no households among the surveyed population of households in the village was having access to land over 5.0 hectare. Based on these findings, potential climate smart agricultural practices (CSAP's) were identified viz. diversification of cropping systems, increasing nutrient use efficiency, increasing water

Plate 23: Intercropping of legumes in sugarcane for crop diversification

productivity, livestock production efficiency and resilience, efficient management of manure and conservation Agriculture. Accordingly, diversification of sugarcane system with legumes as intercrops, introduction of high yielding varieties, line sowing, fertilizer management etc. were field demonstrated. High Yielding varieties of wheat, PBW- 725 (Timely sown) and PBW- 658 (Late sown) released in August, 2016 by PAU, Ludhiana were introduced in the village for higher productivity and better climate resilience.

Plate 24: Field demonstration of high yielding variety of wheat

Ensuring Food and Nutritional Security through Integrated Farming Systems in Western Plain Zone of Uttar Pradesh (Farmers First Programme)

Farmer First programme (FFP) funded under ICAR KVK scheme is being implemented by ICAR-Indian Institute of Farming Systems Research, Modipuram in 3 selected villages of western Uttar Pradesh. This project is being executed for ensuring food and nutritional security through Integrated farming systems with the objectives of food and nutritional security of farm households through increasing the farm productivity and profitability. Under this programme 1000 households belonging to 3 contiguous villages i.e, Bhengi-Bhangela, Satheri and Soanta were choosen for technological intervention in different modules of farming system. Preliminary information of 1000 households was completed before initiation of technological interventions.Detailed benchmark survey of households (300 no.) of village Bhengi Bhanghela was completed using a structured interview schedule. Survey revealed that mean holding size of the households to be 0.97 ha. Small and marginal households constituted about 83% of the surveyed households while medium farm households (2-4 ha) constituted only 17% of the total households. Sugarcane, paddy, wheat, sorghum (fodder) were the major crops being cultivated in the region. Crops along with livestock and horticulture was observed to be the dominant farming system of the region with preference for 1-2 buffalos with 1 cow among livestock. On-farm trials of sowing of wheat with ferti-seed drill along with weed management and nutrient management was demonstrated at 239 farmers' fields. Improved variety of wheat *viz*. DBW-71, PBW 590, PBW 658 were promoted in the region through on-farm demonstration for higher productivity and better climate resilience. Diversification of sugarcane based cropping systems through intercropping of legumes viz. chick pea in autumn planted sugarcane and black gram (PU 31) in spring planted sugarcane was carried out at 50 farmer fields. Under horticulture module improved package of practices for vegetable production was demonstrated at 250 farmer fields for higher profitability. Introduction of exotic vegetables was demonstrated at 5 farmer fields. Promotion of nutritional kitchen gardening through cultivation of seasonal vegetables was carried out among all the households. High value fruit crops such as strawberry were also promoted under horticulture module.

Plate 25: Comparative performance of conventional broadcasting Vs line sowing of wheat

Infertility and nutrition management in milch animals was carried out through mineral mixture supplementation, artificial insemination besides feed and fodder management which resulted in increase in milk yield. Diversification of livestock module through inclusion of backyard poultry, piggery was also carried out at selected households based on farmer preference. Capacity building programmes, public awareness campaigns on improved package of practices of different rabi crops was carried out during the reporting period. Farmers were also exposed to new age technologies through exposure visits to Krishi Melas, exhibitions.

Plate 26: Livestock health management

Integrated Farming System for improvement of nutrition and livelihood of farm women under different agro eco system (Network Project, ICAR-CIWA)

The study was conducted to know the nutritional and diet diversity status, pre-dominant farming systems in the farm households of Western Plain Zone (WPZ) of Uttar Pradesh. The total sample comprised of 100 farm households using cluster sampling approach. Mandora and Jamalpur Goma of Sardhana block has been selected as a study cluster from WPZ. Anthropometric data using body mass indices (BMI) (Garrow 1981) hemoglobin level and household dietary diversity score (HDDS) using semi-structured questionnaire on consumption of thirteen food groups during a 24 hour recall period were administered. Results of the study showed more vulnerability of women to under-nutrition as compared to men. Data on anthropometry revealed out of total 223 individuals 22 percent as underweight (BMI <18.5). Prevalence of chronic energy deficiency was found more in women (27 %) as compared to men (18.5%). On the other hand prevalence of obesity was found more in women (5.8%) as compared to men (1%) (BMI <30). The mean value for hemoglobin level was found 8.97 ± 0.27 gm/dl in Mandora village, whereas the mean value for Jamalpur Goma was found to be 8.13 ± 0.09 gm/dl which depicted the moderate level of anemia in both the villages amongst women farmers. In terms of diet diversity it was found that mean household dietary diversity score in marginal land holder families (<1 ha) was lower (5.56) as compared to small land holder families (<1 ha) (7.66). Gender differences in diet diversification pattern were also noticed which was depicted by their lower HDDS in women headed families (6.28) as compared to men headed families (6.61). The study of farming systems further revealed that the farmers lacking pulse, oilseed, vegetables and fruit component in their farming system and also they are using higher chemical and fertilizers under various crop grown.

For this systematic interventions were planned for improving the nutritional and livelihood security of the farm women. In this series for improving the crop component, demonstration trials on introduction of pulse crop along with sesamum as border crop were conducted at the identified farmers' field. This helps in

Plate 27: Value addition of Jaggery

the increasing the pulse and oil production for family consumption and improvement of soil conditions due to nitrogen fixing capabilities of legumes. On an average 4.5 q ha^{-1} urd was obtained along with 4.0 q ha^{-1} sesamum seed. The farmers were encouraged to adopt Vermicomposting for maintaining their soil, environmental and human health. Through the efforts a women framer produced around 15 quintal of vermicompost in 10 months out of which she utilized 5 quintal at her on farm and remaining sold for Rs. 4000. For improvement in hemoglobin level of women farmers vegetables including green vegetables and fruit component were encouraged to adopt kitchen gardening and fruit plantation on space available inside the house boundary.

Plate 28: Demonstration on value addition of Jaggery

An awareness program was organized in study cluster regarding improvement in animal health and milk yield. Importance of regular use of mineral mixture in animal diet was highlighted to all women farmers. Mineral mixture was distributed to livestock based women farmers. After fifteen days of treatment increase in milk yield was reported in range of half to one litre per day, Milk quality was also improved as indicated by SNF content, it increased from 80 to 85 % consequently increase in price of milk was reported @ 4 to 7 Rs per litre. Effect of mineral mixture on animal health was also reported.

A demonstration cum training programme was conducted on "Value addition in Sugarcane: Iron enriched jaggary" for up gradation of skill in enriched jaggary preparation. In the same programme awareness on nutrition education was given to the women farmers.

Development of Package of Machineries for Complete Mechanization of Small land holders under different Farming Systems Situation

The level and constraints of mechanization was analyzed through survey using stratified random sampling technique in Western Plain Zone of Uttar Pradesh. It was found that mechanization level in all crops was found low except tillage operation (80-90%). In sowing of cereal crops (rice, wheat) mechanization was found only 10-15%. The planting of sugarcane crop was found to be done through manual sett dropping but furrow making being done through tractor ridger. However, planting of potato crop was done by semi-automatic potato planter by 80-90 %. The intercultural operation of sugarcane crop was being done by animal drawn implement (cultivator), whereas in cereal crops it was found to be done manually by using traditional tools. Around 10-15% harvesting of cereal crops (rice, wheat) was found to be done by reaper and rest being done manually using traditional tools. Potato harvesting and digging was being performed by semi-automatic potato digger (80-85%). Sugarcane harvesting was found to be done manually by using traditional tools (100%). The farmers perceived very high cost of improved farm implements and machines as a major cause of non-adoption of mechanization. Based on the survey Village- Pahadpur, block-Mawana, District - Meerut was selected for developing the mechanization village model due to comparatively low mechanization and crop diversification level amongst the surveyed villages.

Interventions of mechanization were given in rabi season through trainings and demonstrations. Multi crop zero till seed drill (Inverted-T type furrow opener) was demonstrated to the farmers in the selected village. Line sowing of mustard crop (area-2 hectare) and wheat crop (area - 5 hectare) were demonstrated to 10 and 20 farmers respectively in the selected village. The

Plate 29: Line sowing of mustard using seed drill

Plate 30: Line sowned mustard crop

mustard crop (variety RH 749) was sown in the field by seed drill with row spacing of 40 cm at seed rate of 4 to 5 kg ha^{-1} about 10 farmers (*i.e.* 2 ha). The first time line sowing demonstration was introduced in this village at farmers' field. The farmers are very excited about the line sown crop. The comparative study of plant growth of line sown and farmer practice of mustard and wheat crop is given Table 37. The line sown mustard crop has higher plant height (189.27 cm) and number of branches (17.26) as compared to farmers practices field (i.e. 178.19 cm & 15). The plant population in line sown crop (13.83) was lower than broad casting method (20.67). The line sowing of wheat (variety PBW 658 & PBW 725) crop was done by seed cum ferti drill with row spacing of 20 to 22 cm and seed rate of 75 to 80 kg/ha in November sown about 20 farmers (i.e. 5 ha). And late sown crop (i.e. January) the seed rate was about 110 to 120 kg/ha. As per comparative study, the higher tillers number/m^2 (613), plant height (42 cm) and lower count of weed population/m^2 (8) was observed in line sown wheat crop than broad casted field (farmers' practice).

Improved small tools (developed by IISR, Lucknow) related to sugarcane crop (harvesting and de-trashing) were demonstrated among the farmers in the field. Knowledge and skill enhancement of farmers was done through training and demonstration programme ondevelopment of nutritionally enriched jaggary using metallic frame in the selected village and vegetable sowing and transplanting through transplanter and dibbler. Mechanized sugarcane planting are being promoted in farmers' field by automatic sugarcane planter (developed by IISR, Lucknow) through custom hiring.

Soil Quality Assessment Indices for Major Soil and production Regions

Geo-referenced surface soil samples were collected employing multistage random sampling procedure, in which the first stage of sampling in a particular Agro-ecological sub-region (AESR) was cropping system. Under each cropping system, soil samples were collected covering small, marginal and large farmers and depending on availability, from irrigated and rain fed conditions.The grid points were selected at 20 Km interval. The samples were subjected to laboratory analysis for key plant nutrient status and soil quality. The AESR 4.1, 4.3 and 9.1

Table 37: Plant growth parameters of mustard and wheat crop

S.No.	Particulars	Mustard			Wheat		
		Plants m^{-2}	Plant height (cm)	Branches $plant^{-1}$	Tillers m^{-2}	Plant height (cm)	Weed (nos. m^{-2})
1.	Line sown	13.83	189.27	17.26	613.13	41.84	7.71
2.	Farmers practice	20.67	178.19	15.00	449.60	40.20	21.53

covers the western pain zone of Uttar Pradesh. Chemical analysis of key plant nutrient was done to assess the soil fertility as well as soil quality. Analysis report was plotted as per coordinated of the GPS and generated the fertility status map as a whole of WPZ of Uttar Pradesh. The pH of the WPZ of Uttar Pradesh soil have tendency towards alkalinity. Generally an EC (1:5) water extract <0.15 dsm^{-1} will not affect the plant growth , but most of the soil sample collected have the EC value >0.25 dsm^{-1}. The Organic carbon status of the northern part of WPZ of Uttar Pradesh was > 0.5% but most of the collected soil shows the organic carbon content below the critical value of the organic matter content. The available Potassium status of this region varies 63 to 299 Kg ha^{-1}but the available Potassium status is in low range. The available nitrogen content in the soil ranges in medium to higher level. The distribution of Boron in soil is in satisfactory level and plant response to the boron does not show any deficiency symptoms in respect of crop productivity. The micronutrient status in soil of WPZ of Uttar Pradesh. Among the micronutrient, Zinc concentration in soil is very critical, ranges from 0.2 to 3.0 ppm. But the most of the soil shows low concentration in the soil extract, where the other micronutrient concentration in soil is in sufficient range. Plant does not show any micronutrient deficiency symptom except Zinc.

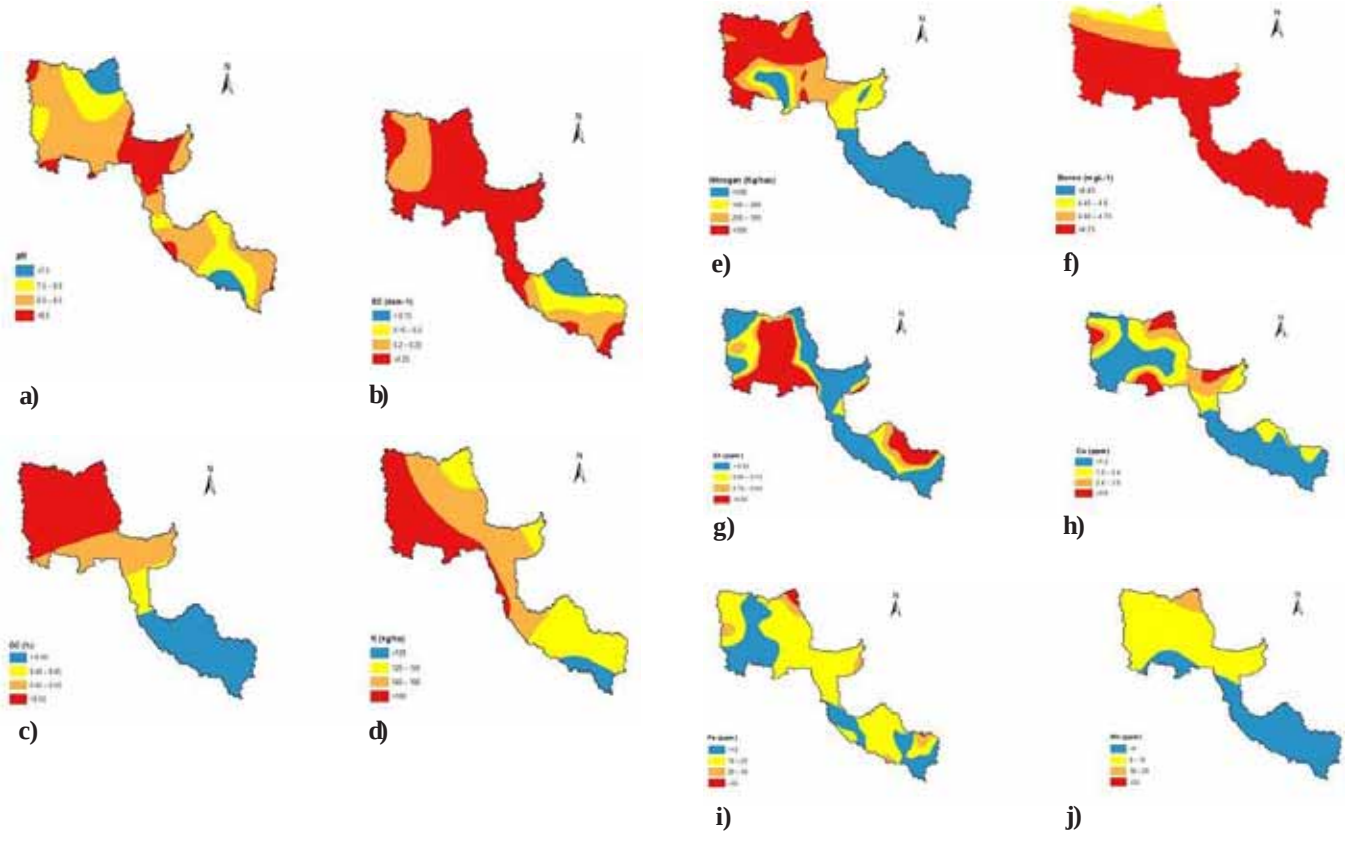


Plate 31: Fertility status viz., a) pH, b) EC, c) OC, d) K_2O, e) N, f) B, g) Zn, h) Cu, i) Fe and j) Mn map of soils of Western Plain Zone of Uttar Pradesh

RESEARCH COORDINATION AND MANAGEMENT

30th Meeting of Institute Research Committee

The 30th meeting of institute research committee (IRC) of institute was held during 16– 17September, 2016 at ICAR-IIFSR, Modipuram. The meeting was chaired by Dr A. S. Panwar, Director, ICAR-IIFSR while Dr. S. Bhaskar, ADG (AAF and CC), NRM Division, ICAR, New Delhi was special invitee. During the meeting, action taken report of 29th IRC meeting; results of on-going research projects as well as exploratory studies were discussed. Dr. Peyush Punia, Member Secretary, 30th IRC meeting, welcomed the Chairman, ADG and all the members of the IRC. Dr A. S. Panwar, Director during his remarks, welcomed ADG, Dr. S. Bhaskar and all the member scientists. He suggested that, number of projects should be reduced without affecting the mandate of the Institute. There should be a main programme for each division as per divisional mandate and suitable activities under the main programme should be taken up as sub-projects under the divisional programme in farming systems perspective to achieve the goals of the Institute. Small farmers and their overall components (enterprises) need to be kept in mind while designing the research programmes so as to come up with some solid outputs.Dr. S. Bhaskar suggested that, individual scientist (PI and Co-PI) must contribute significantly to enhance the output of the project. He emphasized to merge all small-small experiments to form a result oriented project so that, meaningful results can be drawn.Dr. A. K. Prusty presented the action taken report of the 29th IRC proceeding and research highlights of on-going projects in brief. All the scientists presented findings of their projects and presentations were followed by exhaustive discussions for further improvements in the projects.

Plate 32: Dr. S. Bhaskar, ADG (AAF and CC), NRM Division, ICAR addressing the scientists during 30th IRC

XI Annual Group Meeting of Network Project on Organic Farming organized at ICAR-IISS, Bhopal

The XI Annual Group Meeting of Network Project on Organic Farming (NPOF) was organized at ICAR-Indian Institute of Soil Science, Bhopal during 17-19 August 2016. Prof. M. Premjit Singh, Vice Chancellor, Central Agricultural University, Imphal inaugurated the group meeting as Chief Guest. Dr. S. Bhaskar, Assistant Director General (AAF & CC), ICAR and Guest of Honour highlighted the importance of the organic farming and stated that, organic farming is a climate resilient production system and it should be promoted particularly in rainfed and hill ecology. Dr Ashok Kumar Patra, Director, ICAR-Indian Institute of Soil Science, Bhopal welcomed all the guests and participants and informed that ICAR-IISS, Bhopal has developed many composting techniques which are part of organic farming. While presenting the brief scheme report, Dr. A.S. Panwar, Director, ICAR-Indian Institute of Farming Systems Research, Modipuram highlighted that presently 16 states are covered through NPOF and 666 practicing organic farmers have been studied

Plate 33: Dr. A.S. Panwar, Director addressing to scientists during NPOF group meeting

during the year for understanding the constraints of organic growers. Besides, these, he also highlighted that best performing varieties under organic farming for 20 crops have been identified and Integrated Organic Farming System (IOFS) models have been developed at Meghalaya and Tamil Nadu which promises to increase the income by 2 to 3 times and meet inputs up to 85-90% within the farm.

During the first two days, review of on-going programmes and modification of technical programme was taken up beside a round table discussion on researchable issues in IOFS. On 19 August 2016, interface meeting of NPOF and selected AICRP on IFS centres with ICAR-Directorate of Weed Research, Jabalpur was held to discuss the issues related to weed management under organic farming. Based on the deliberations, an experiment on weed management under organic farming was formulated which will be implemented at NPOF and selected AICRP on IFS centres.Based on the overall performance, *Coimbatore (TNAU)* centre of NPOF was selected as best centre and a certificate were issued in the plenary session.

Plate 34: Release of publications by dignitaries during NPOF group meeting

Biennial Workshop of AICRP-IFS organized

The IV Biennial workshop of ICAR-AICRP on Integrated Farming Systems was organized during 20-23 December, 2016 at Sher-E-Kashmir University of Agricultural Sciences & Technology (SKUAST-J), Chatha, Jammu (Jammu and Kashmir) in which review of on-going research programmes of on-station and on-farm centres including Tribal Sub Plan, discussion and finalization of new experiments, administrative, financial issues and special lectures on identified topics were undertaken.Prof. P.K. Sharma, Vice Chancellor, SKUAST-Jammu was chief guest during inaugural session. In his address Dr. Sharma confirmed that IFS models developed by AICRP on IFS centres are good income earners for farmers as he himself witnessed from his university IFS model depositing around Rs.3 lakhs/ha in to university account. Dr. S. Bhaskar, ADG (AAFCC)in his address, informed that the present government is concentrating on schemes such as doubling of farmers income through soil health, more from less resources (input use efficiency), *har khetko pani* (water management), *har med me pad* (Agroforestry), national *gokul* mission etc. and farming system models should include all these things during its formulation. Dr. A.S. Panwar, Director, ICAR-IIFSR also welcomed the delegates and gave brief scheme report. He apprised the participants that although 84 % of farm households in India have crop and dairy together, their recycling is very low (< 25 %) and depend for markets for their farm inputs including meeting the family food and nutritional requirement. Generating sustainable and regular income (round the year) from farm is a major challenge for farmers in the present day context. Session wise recommendations were presented by Dr. L.R.Meena, Principal Scientist, Dr. Debashis Dutta, Senior Scientist, Dr. Peyush Punia, Principal Scientist, Dr. R.P. Mishra, Principal Scientist, Dr. Amit Nath, Principal Scientist, Dr. M. Shamim, Scientist, Dr. Amit Kumar, Scientist and Dr. N. Ravisankar, Principal Scientist. The recommendations were discussed and finalized.

Plate 35: Release of important publications by dignitaries during AICRP-IFS workshop

Third meeting of 7th Research Advisory Committee

The third meeting of the 7th Research Advisory Committee of ICAR-Indian Institute of Farming Systems Research, Modipuram was held on 22-23 June, 2016. Chairman of the Committee Dr. I. P. Abrol, and members Dr. S. Bhashkar, ADG (Agronomy, Agroforestry and Climate Change), ICAR, Dr. ArunVerma, Dr. Karikanthimath, Sh. Naresh Sirohi, fermer's representative Sh. Rajesh Kumar Garg and scientists of the Institute participated in the meeting. Member Secretary, Dr. N. Ravisankar presented the action taken report on the recommendations of last RAC meeting and the Committee was satisfied with the action taken report. He also presented in brief, the research achievements of AICRP-IFS. Dr. Azad Singh Panwar, Director, ICAR-IIFSR welcomed the Chairman and Members of RAC and presented the overall progress and vision of the Institute. He also briefed about the activities being undertaken by the Institute for economic empowerment and livelihood improvement of small farming communities in the country. In his opening remarks, Chairman pointed out that the basic aim of farming systems research should be to provide the technologies actually needed by the farming communities. The Programme Facilitators and Heads of different sections presented the highlights of research achievements of the respective sections. The Chairman and the members of the RAC expressed their critical views during the presentations made by the concerned scientists/team and given their valuable inputs and directions for the improvement of IFS research and IIFSR in the future.

Plate 36: 7th Research Advisory Committee Meeting

India-National RAPs Technical Experts Consultation Meeting organized

One day National Level Technical Experts consultation meeting was organised on 26th May 2016 at JaypeeSiddharth Hotel, New Delhiby AgMIP South Asia Regional Research Teams. The broad objectives of the meeting were to document AgMIP National RAPs that will serve as a base for future research, understanding the expectations of stakeholders from AgMIP research, opportunities for integrating the AgMIP results into National and regional policy decision making and exploring the possibilities for a larger AgMIP-India programme.

Plate 37: RAPs meeting under AgMIP

At the outset, Dr A. S. Panwar, Director, ICAR-IIFSR welcomed the participants and appealed to all the participants to take stock of the RAPs narratives in Indian context. Dr. A.K. Sikka, Ex-DDG (NRM), ICAR and IWMI, India Representative emphasized that the AgMIP protocols are very robust and hence the drivers/ indicators selected to construct the RAPS are very likely to capture the ground realities. He cautioned that the sample size/ coverage of study area is inadequate and hence to derive meaningful conclusion or for up scaling the process/product, the sample size/ coverage has to be increased. Dr. N. Subash, the Principal Investigator (IGB-RRT) andDr. V. Geethalekshmi (SI-RRT) presented an introduction of AgMIP activities, integrated assessment methodology, and highlighted how the AgMIP activities are different from the similar on-going initiatives in the region. Dr.Harbir Singh, Co-PI of the IGB-RRT project explained the narratives and indicators under RAPs2 (Business-As-Usual) scenario.

HUMAN RESOURCE DEVELOPMENT (HRD)

Trainings/seminars/symposia/workshops organized

Training on Carbon sequestration and GHG measurement in IFS models of AICRP on Integrated Farming Systems from 2-4th August, 2016

A three days training on "Carbon sequestration and greenhouse gas (GHG) emission measurement in IFS models of AICRP on Integrated Farming Systems" was organized by ICAR-Indian Institute of Farming Systems Research (IIFSR), Modipuram in collaboration with ICAR-Indian Agricultural Research Institute, New Delhi during 2-4th August, 2016. A total of 46 participants from 23 states representing 25 main, 6 sub and 5 voluntary centres of AICRP on IFS participated in the training. Resource persons and experts in the field of Carbon Sequestration and GHG from ICAR-NDRI (Karnal), ICAR-CAFRI (Jhansi), ICAR-CIFA (Bhubaneswar) ICAR-IISWC (Dehradun) trained participants on various methodologies of measurement of carbon sequestration and GHG in various components of farming system.First day training was held at ICAR-IIFSR, Modipuram while second and third day training was organized at ICAR-IARI, New Delhi. Practical hands on training were imparted at Centre of Environmental Science and Climate Resilient Agriculture (CESCRA), ICAR-IARI, New Delhi. Dr. A.S. Panwar, Director, ICAR-IIFSR made it clear that specific programme will be developed for measurement of carbon sequestration and GHG in all the on-station IFS models for which this training is a first step. Chief Guest of Valedictory function Dr. S.K. Choudhari, ADG (SWM), NRM division distributed the certificates to participants and highlighted that focused short term trainings to AICRP scientists are essential to upgrade the skills. He also said, IFS plays a critical role in addressing several issues of climate change and the outcome of the training will lead to measurement of carbon sequestration rate and Photo: Dignitaries observing IIFSR-CIMMYT demonstrations on IFS at farmer's field GHG emission in various IFS models. As an outcome of the training, measurement of carbon sequestration and GHG in on-station IFS models of AICRP on IFS will be taken up using empirical (IPCC) and closed chamber methods.The training was organized by Dr. N. Ravisankar as Course Director and Dr. Debashis Dutta as Course Coordinator.

Plate 38: Training on Carbon sequestration and GHG measurement in IFS models

Refresher Course on Farm Management from 19-24 September, 2016

A six days refresher course on farm management was organized by the Institute during 19-24 September, 2016 in which 21 trainees from 17 ICAR Institutes representing 11 states participated. Out of the 21 trainees, 8 were attending the training programme for the first time after joining their service. During the six days training course, a total of 21 resource persons delivered their lectures, out of which 5 topics were specially designed for practical aspects. The course curriculum was designed to suit to the needs of farm managers dealing with several enterprises as well as human resource. For this purpose the course curriculum was grouped into 3 major aspects viz., management, biological aspects and natural resources. There were 6 topics related to management, economics and organizational behaviour. Similarly, there were 8 topics related to biological aspects and another 7 topics related to natural resource management. A field/study visit was also conducted for the trainees for one day during the

training programme during which the trainees were given exposure to farm management aspects of different institutions of agricultural importance located in Meerut city and in the vicinity area. The training was organized by Dr.Anil Kumar as Course Director and Dr.Poonam Kashyap as Course Coordinator.

Plate 39: Participants of training programme on Farm Management held during 19-24, September, 2017

Vigilance Awareness cum Sensitization workshop on "Public participation in promoting Integrity and eradicating corruption" organized during 31 October to 5 November 2016

ICAR-Indian Institute of Farming Systems Research, Modipuram organized the Vigilance Awareness cum Sensitization workshop on "Public participation in promoting Integrity and eradicating corruption" during 31 October to 5 November 2016. Various activities such as administering the pledge to staff and public representatives, school principals, debate competition for staff, sensitization workshop on procedures of organization and preventive vigilance, slogan/drawing competition for school children's were organized during the week by the institute. The concluding programme was held on 5 November 2016 in which Dr Manoj Kumar, Joint Director, CPRI-Campus, Modipuram distributed the certificates to participants and awardees in various programmes. He emphasized that public participation is very much essential for improving the integrity and eradicating the corruption. The slogan/drawings made by school children's on ""Anti-Corruption" can be viewed in http://iifsr.res.in/sites/all/themes/iifsr/gallery/vigi4.htm . Based on the activities and commitment made by ICAR-IIFSR in the form of pledges, sensitization workshops and various other activities, Central Vigilance Commission (CVC) has issued Certificate of Commitment to ICAR-IIFSR. Dr AS Panwar, Director, ICAR-IIFSR emphasized on preventive vigilance and committed that ICAR-IIFSR will try to fulfill the more and more public participation in promoting integrity among citizens. Team of Scientists comprising of Dr N. Ravisankar, Dr. M. Shamim and Dr. Amit Kumar coordinated the event.

Plate 40: Administering vigilance pledge to staff and public representatives by Director, ICAR-IIFSR

ICAR-IIFSR-CIMMYT collaborative workshop on 'Optimization of resources in farming system using quantitative analysis tools from 27-29th November, 2016

A review workshop on, 'Optimization of resources in farming system using quantitative analysis tools' was organized at ICAR-IIFSR, Modipuram during 27-29 November, 2016 under the aegis of ICAR-CIMMYT collaborative project entitled Developing and targeting climate smart agricultural practices portfolios in South Asia. The workshop was attended by Dr. Santigao Lopez, Cropping Systems Analyst, CIMMYT, Mexico, Dr. M. L. Jat, Cropping Systems Analyst, CIMMYT, India and researchers involved in farming systems Dr. H. S. Jat (CCSRI, Karnal), Dr. J. P. Tetarwal (AICRP-IFS, Kota centre), Dr. P. C. Ghasal (ICAR-IIFSR). The workshop was organized by Dr. A. K. Prusty, Dr. Vipin Kumar as Course Coordinator. As a part of this workshop a field visit to project implementation site was conducted on 2nd day of the workshop.

Plate 41: Review workshop on optimization of resources using quantitative analysis tools

XVIIIth National Conference of Agricultural Research Statisticians from 16-17 December, 2016

The XVIII national conference of agricultural research statisticians of ICAR institutes, Directorates, Agricultural universities, State department of agriculture, animal husbandry and fisheries was jointly organized by ICAR-Indian Institute of Farming Systems Research, Modipuram and ICAR-Indian Agricultural Statistical Research institute during 16-17, December, 2016 on the themes of National Priorities in Agricultural Statistics and Informatics.

Plate 42: XVIIIth National Conference of Agricultural Research Statisticians

Training cum Workshop on "Potential applications of quantitativeanalysis tools in farming system using farm design" during17-18 March, 2017

Two day Training cum Workshop on "Potential applications of quantitativeanalysis tools in farming system using farm design" was organized during 17-18 March, 2017 under the aegis of CGIAR research program on climate change, CCAFS. 38 researchers engaged in farming systems research and agricultural development across India with participants from 11 states (Haryana, Meghalaya, Tamil Nadu, Gujarat, Telengana, Uttarakhand,Uttar Pradesh, West Bengal, J&K, Bihar and Rajasthan) attended the training programme.

Plate 43: Training cum workshop on potential application of quantitative analysis tools in farming systems using FarmDesign

Event was inaugurated by Dr Gaya Prasad, Vice Chancellor, SBP University of Agriculture andTechnology, Meerut, India.Dr. B. P. Bhatt, Director, ICAR-RCER, Patna graced the occasion as chief guest of the function.Dr. A. S. Panwar, Director, ICAR-IIFSR welcomed the guests and briefed the gathering about thedifferent farming system models developed for different agro-ecological regions of India and itsimportance in changing climatic scenario for enhancing productivity and profitability as well aslivelihood security of farming community.On this occasion Dr. M. L. Jat, Project Leader, CIMMYT-CCAFS spoke about the complexities of and diverse nature of farming systems which needs to be managed efficiently so as to satisfy multiplicityof goals sustainable intensification. Dr. Santiago L. Ridaura, Farming system modeller, CIMMYT, presented Farming systems analysis andmodeling for sustainable intensification. Dr. T Satyanarayana, Director, IPNI and Dr. Kaushik Majumdar, Vice President, IPNI highlighted importance of precision nutrient management in relation to small holder farming systems. The programme was organized by Dr. A. K. Prusty, Scientist and PI of the project as

Course coordinator and Dr. Peyush Punia, Dr. Poonam Kasyap, Dr. P. C. Ghasal as Co-coordinator.

Training programme on "Improved Techniques of Raising Oilseeds in Farming Systems"during 21-22 March, 2017

A two day training programme on "Improved Techniques of Raising Oilseeds in Farming Systems" for extension workers of State Agric. Deptt. and input dealers was conducted during 21-22 March 2017 at ICAR-Indian Institute of Farming Systems. 20 participants attended the training programme and learnt about improved techniques of raising oilseeds crops. The training programme was organized by Dr. Poonam Kashyap as Course Coordinator and Dr. Chandra Bhanu, Dr. Sanjeev Kumar and Dr. Anil Kumar as Co-coordinator.

Plate 44: Training programme on improved techniques of raising oilseeds in farming systems

Trainings/seminars/symposia/workshops attended by Scientists and other staff of the Institute

Title of training/seminar/ symposia/ workshop	Period	Venue	Name of participant
National workshop on DST's knowledge Network on Climate Change and Agriculture	28-29.04. 2016	NASC Complex, New Delhi	Dr. P.C. Ghasal
Brain Storming meeting on "Future Thrust Strategies in Agril. Meteorological Research, Education and Extension in India"	29-30.04. 2016	ICAR-CRIDA, Hyderabad	Dr. M. Shamim
AgMIP National RAPS Technical Experts consultation meeting	26.05.2016	Hotel Jaypee Siddharth, New Delhi	Dr. N. Subash
Quality seed production	26 – 28.05. 2016	ICAR-Indian Institute of Wheat and Barley Research, Karnal	Dr. Devendra Kumar
Workshop to review the status of nutrient use efficiency (NUE) in different crops	21.06. 2016	Krishi Bhawan, ICAR, New Delhi	Dr N. Ravisankar
AgMIP6 Global Workshop "Seeking Sustainable Agricultural Solutions"	28-30.06. 2016	Le Corum, Montpellier, France	Dr. N.Subash
Farming Systems Analysis: Quantitative tools to explore future farming systems options and formalize trade-offs and synergies for their sustainable intensification in South Asia	4-7.07.2016	Wageningen University, Netherlands	Dr. A. K. Prusty Dr. Vipin Kumar
Carbon sequestration and greenhouse gas (GHG) emission measurement in IFS models of AICRP on Integrated Farming Systems	02-04.08.2016	ICAR-IIFSR, Modipuram and ICAR-IASRI, New Delhi	Dr. NishaVerma Dr. Poonam Kashyap Dr. Vipin Kumar Dr. L.K. Meena Dr. P.C. Ghasal

Title of training/seminar/ symposia/ workshop	Period	Venue	Name of participant
23rd annual group meeting of All India Coordinated Research Project on Rapeseed-Mustard	05-07.08. 2016	DUVASU, Mathura (U.P.)	Dr. D. Kumar Dr. L. K. Meena
Professional Attachment Training	16-20.08.2016	Division of Agronomy, ICAR-IARI, New Delhi	Dr. Amit Kumar
11th Annual Group Meeting of NPOF	17-19.08. 2016	ICAR-IISS, Bhopal	Dr Vipin Kumar
A review work shop on under the collaborative project entitled "Integrated farming System for Improvement of nutrition and livelihood of farm women under different agro-ecosystems"	20.08. 2016	CIWA, Bhubneshwer	Dr. Sanjeev Kumar
NICRA Financial Review Meeting	02-03.09. 2016	CRIDA, Hyderabad	Dr. N. Subash
All India Farmers fair and agro-industrial exhibition	05-07.10. 2016	SVP University of Agriculture & Technology, Meerut	Dr. M. P. Singh Dr. A. L. Meena Dr. L. K. Meena
Integrated solution for weather and climate information system and services incorporating agriculture knowledge base	06.10. 2016	KAB II, ICAR, Pusa, New Delhi	Dr. M. Shamim
CAFT training on Advances in Experimental Data Analysis	06-26.10. 2016	ICAR-IASRI, New Delhi	Dr. P.C. Ghasal
National Conference on Natural Resources Management for Sustainable Agriculture (NRMSA)	25.10.2016	Baraut, Baghpat (U.P.)	Dr. A. S. Panwar Dr. J. P. Singh Dr. A. K. Prusty Dr. Poonam Kashyap Mr. Sunil Kumar Dr. Vipin Kumar
Zonal Level Project Review and Orientation Meeting of farmers FIRST	12.11. 2016	ICAR-ATARI, Kanpur	Dr. A. K. Prusty Dr. M. Shamim
National symposium "Agrochemicals for food and environmental safety"	15-17.11. 2016	ICAR –IARI, New Delhi	Dr. Debashis Dutta
4th International Agronomy Congress "Agronomy for Sustainable Management of Natural Resources, Environment, Energy and Livelihood Security to Achieve Zero Hunger Challenge	22-26.11.2016	IARI, New Delhi	Dr. A. S. Panwar Dr. N. Ravisankar Dr. M. P. Singh Dr. A. K. Prusty Dr. M. Shamim Dr. L. K. Meena Dr. Poonam Kashyap Mr. Sunil Kumar Dr. Vipin Kumar Dr. Sanjeev Kumar Dr. P. C. Ghasal Dr Amit Kumar

Title of training/seminar/ symposia/ workshop	Period	Venue	Name of participant
International Conference on Global Agriculture and Innovation Conference (GAIC-2016)	27-29.11.2016	Noida International University, Greater Noida (U.P.)	Dr. D. Kumar Dr. S. A. Kochewad Dr. Sanjeev Kumar
International conference on climate change adaptation and biodiversity: ecological security and natural resource management for livelihood	8-10.12. 2016	ICAR-CIARI, Port Blair	Dr. VP Chaudhary Dr. M. Shamim
5th Annual workshop of NICRA	9-10.12.2016	NASC, New Delhi	Dr. N. Subash Dr. D. Dutta
American Geophysical Union Fall meeting -2016	12-16.12.2016	Moscone Convention Center, San Francisco, USA	Dr. N. Subash
XVIII National conference of agricultural research statisticians	16-17.12.2016	ICAR-IIFSR, Modipuram	Dr. A. K. Prusty Dr Poonam Kashyap Dr. Chandra Bhanu Dr. Nisha Verma
IV (XXXII of Project) Biennial workshop of AICRP on Integrated Farming Systems	20-23.12.2016	SKUAS&T, Jammu	Dr. A.S. Panwar Dr. N. Ravisankar Dr. J. P. Singh Dr. N. Subhash Dr. Peyush Punia Dr. Amit Nath Dr. Debashis Dutta Dr. M. Shamim Dr. Amit Kumar Dr. Vipin Kumar Dr. Brij Mohan Mr. D. Tripathi
Brainstorming session on "Consortia on Fish Diseases" and "Indigenous Ornamental Fishes of NER"	22.12.2016	Central Agricultural University (CAU), Agartala, Tripura	Dr. A. K. Prusty
AgMIP-ICAR Meeting	09-10.01.2017	Columbia University and New York University, New York, USA	Dr. A. S. Panwar Dr. N. Subash
AgMIP Economic Summit	16-17.01.2017	ICRISAT, Hyderabad	Dr. N. Subash
Second Half yearly foreign aided projects review meeting	18 .01. 2017	NRM Division, ICAR, KAB-II, New Delhi	Dr. N. Subash Dr. A. K. Prusty
25th workshop of AICRP on Dryland Agriculture	19.01. 2017	Dr. PDKV, Akola	Dr N. Ravisankar
Second Workshop of Nodal Officers of KRISHI	24-25.01.2017	NASC, New Delhi	Dr. N. Subash
Nutrition-Sensitive Agriculture:Changing role of Extension	28-30.01.2017	ICAR-NAARM, Hyderabad	Dr. A. S. Panwar Dr. Peyush Punia Dr. NishaVerma

Title of training/seminar/ symposia/ workshop	Period	Venue	Name of participant
AgMIP Phase 2 Winners' Circle Workshop	30.01.2017 – 03.02.2017	Safari Park Hotel in Nairobi, Kenya	Dr. N. Subash
DST, Govt of India Sponsored National Training Programme on Entrepreneurship Development and Management for Women Scientists and Technologists working in Govt. Sector	06-10.02.0217	Entrepreneurship Development Institute of India, Ahmedabad, Gujarat	Dr Poonam Kashyap
6th International Conference on Emerging Trends on Science, Engineering, Technology and Management: Research and development	17.02. 2017	Shobhit University, Meerut & Shobhit University, Gangoh	Sunil Kumar
XIII Agriculture Science Congress	21-24.02. 2017	UAS, GKVK, Bengaluru	Dr. Debashis Dutta Dr. M Shamim
National Conference on Agriculture Renewal for Evergreen Revolution: Concepts and Approaches	10.03.2017	Gochar Mahavidyalaya, Rampur Maniharan, Saharanpur (U.P.)	Dr. Chandra Bhanu
National Conference- Intervention of Climate Change in Sustainable Development of Agriculture, Food and Nutrition Security and its Amelioration	24-25.03. 2017	Swami Vivekananda Subharti University, Meerut (U.P.)	Dr. S. A. Kochewad
Krishi Unnati Mela	15-17.03. 2017	ICAR-IARI, New Delhi	Dr. S. A. Kochewad

Lectures delivered and other academic acticvities

Topic of lecture/Talk	Venue	Date	Resource Person
Linkages of Information Technology and farmers in Farmers' Field School	Mirapur Dalpat, Muzaffarnagar	25.05.2016	Mr. Sunil Kumar
Improved Animal husbandry practices.	Sadarpur, Morkhurd and Mohamedpur Saket, Muzaffarnagar	28.07.2016	Dr. S.A. Kochewad
Carbon Sequestration and Green House Gas estimation in IFS model in Carbon sequestration and greenhouse gas measurement in IFS models of AICRP on Integrated farming System	ICAR-IIFSR, Modipuram	2-4.08.2016	Dr. Debashis Dutta
Improved management practices in dairy animals for enhancing the production.	Paoti village, Muzaffarnagar	10.08.2016	Dr. S.A. Kochewad
Lecture cum live demonstration on Drudgery reduction technologies for farm women	Paoti Khurd, Tihai village, Muzaffarnagar District	10.08.2016	Dr. Nisha Verma
Improved management practices in dairy animals for enhancing the production.	Badhaikala village, Muzaffarnagar	11.08.2016	Dr. S.A. Kochewad
Lecture cum live demonstration on Drudgery reduction technologies for farm women	Paoti Khurd, Tihai village, Muzaffarnagar District	12.08.2016	Dr. Nisha Verma

Topic of lecture/Talk	Venue	Date	Resource Person
Improved management practices in dairy animals for enhancing the production.	Tihai village, Muzaffarnagar	12.08.2016	Dr. S.A. Kochewad
Organic and towards organic farming approaches for safe and secured food production in India in ICAR Summer school on Recent innovations in management of Organic Production systems	ICAR-IARI, New Delhi	12.08.2016	Dr. N. Ravisankar
Fish farming for nutritional secuirty.	Kisan Gosthi Kelawada village, Muzaffarnagar	23.08.2016	Dr. A.K. Prusty
Renovation of old ponds	Kisan Gosthi Mubarakpur, Muzaffarnagar	09.09.2016	Dr. A.K. Prusty
Supervision of farm operations and manpower in the training principles & practices of farm management programme on "Farm Management"	ICAR-IIFSR, Modipuram	19.09.2016	Dr. A.S. Panwar
Gender sensitive farm tools in Refresher Course on Farm Management	ICAR-IIFSR, Modipuram	20.09.2016	Dr. Nisha Verma
Breeding, Feeding and Health Care Management in Poultry in Refresher course on "Farm Management"	ICAR-IIFSR, Modipuram	20.09.2016	Dr. S. Malik
Principles of selection of enterprises for multi-enterprise farm in Refresher course on Farm Management	ICAR-IIFSR, Modipuram	22.09.2016	Dr. N. Ravisankar
Importance of weather on mustard production in field day on mustard	Kherigani Village, Muzaffarnagar	23.09.2016	Dr. M. Shamim
Contingency Planning in Crop Management under Abiotic Stress in Refresher course on Farm Management	ICAR-IIFSR, Modipuram	23.09.2016	Dr. M. Shamim
Optimization of Resource Use and Income Generation in Integrated Farming Systems in Model Training Course on, Farm Management	ICAR-IIFSR, Modipuram	23.09.2016	Dr. A.K. Prusty
Modern Techniques of Farm Management in Refresher course on Farm Management	ICAR-IIFSR, Modipuram	23.09.2016	Dr. Poonam Kashyap
Career oppurtunities in Fisheries Science in Agricultural Education Day	ICAR-IIFSR, Modipuram	03.12.2016	Dr. A.K. Prusty
Career opportunities in field of Home Science in Agricultural Education day	ICAR-IIFSR, Modipuram	03.12.2016	Dr. Nisha Verma
Career oppurtunities in Horticulture Sector in Agricultural Education day	ICAR-IIFSR, Modipuram	03.12.2016	Dr. Poonam Kashyap
Protected cultivation of horticultural crops from Department of Horticulture in Krishak gosthi	Circuit House, Modipuram, Meerut	20.12.2016	Dr. Poonam Kashyap
Importance of quality seed materials for enchancing productivity of rabi crops in Kisan Gosthi organized under Farmers FIRST Programme	Saunta village, Muzaffarnagar	28.12.2016	Dr. A.S. Panwar

Topic of lecture/Talk	Venue	Date	Resource Person
Importance of water management and cultural practices keeping in view of anticipated weather for enhancing farm productivity crops in Kisan Gosthi organized under Farmers FIRST Programme	Sathedi, village, Muzaffarnagar	04.01.2017	Dr. M. Shamim
Importance of timely harvest and post harvest management for enhancing farm profitability crops in Kisan Gosthi organized under Farmers FIRST Programme	Sathedi, village, Muzaffarnagar	04.01.2017	Dr. M.P. Singh
Organic and towards organic farming approaches for safe and secured food production in India in Model training course on Recent Innovations in Organic Farming	ICAR-IARI, New Delhi	06.01.2017	Dr. N. Ravisankar
Importance of balanced nutrition for maintaining animal health in Animal health camp organized under Farmers FIRST Programme	Bhangela village, Muzaffarnagar	09.03.2017	Dr. S. Malik
Best management practices (BMPs) for livestock health management in Animal health camp organized under Farmers FIRST Programme	Bhangela village, Muzaffarnagar	09.03.2017	Dr. S.A. Kochewad
INM and IPM in mustard and sugarcane crops in Field Day on Mustard	Khardauni Village, Meerut	09.03.2017	Dr. Chandra Bhanu
'Modern communication technologies for extension of improved oilseeds production practices' in the training programme in "Improved scope & importance of oilseeds techniques of raising oilseeds in farming	ICAR-IIFSR, Modipuram	22.03.2017	Dr. A.S. Panwar
Nutrition composition of mustard and its by-products in farming system in two days training programme on Improved techniques of raising oilseeds in Farming systems	ICAR- IIFSR, Modipuram	22.03.2017	Dr. Poonam Kashyap
INM and IPM in mustard and sugarcane crops in Field Day on Mustard	Kherigani Village, Muzaffarnagar	24.03.2017	Dr. Chandra Bhanu
INM and IPM in sugarcane crops in Kisan Gosthi under Farmer First Programme	Sonta Village, Muzaffarnagar	25.03.2017	Dr. Chandra Bhanu
Raising the vegetable nursery through improved techniques in Kisan gosthi	Bhayangi-Bhangela, Muzzafarnagar	29.03.2017	Dr. S. Malik
INM and IPM in sugarcane crops in Kisan Gosthi	Rasulpur Jatan village, Muzaffarnagar	29.03.2017	Dr. Chandra Bhanu

EVENTS ORGANIZED

A. Swachh Bharat Abhiyan

Cleanliness Drive in Campus and Adjoining Residential Area: Although ICAR-IIFSR was conducting activities like Swachhata pledge and cleanliness drive since 2nd October, 2014 with the launch of Swachh Bharat Mission, the activities got intensified during the year 2016-17 when the institute undertook this programme on a wider scale with active participation of diverse groups like students, farmers, traders and public representatives. The Institute organized cleanliness awareness camp on 2nd October, 2016 in which the local shopkeepers of Chauhan market (Modipuram) were got involved to spread the message. On this occasion Sardhana MLA, Sh. Sangeet Som administered the oath of cleanliness to the shopkeepers and other public gathered at a central place in the market. All the staff members of IIFSR, Modipuram participated in collecting the garbage thrown in front of different shops and ensured their proper disposal. The staff members approached each and every shopkeepers of the market one by one and made them to commit for maintaining cleanliness in the market area. Sh. Sangeet Som himself took the broom and guided others to dispose the garbage in dustbins.

Swachhata Pledge: In order to reiterate the commitment of officers and staff of the Institute to Swachh Bharat, oath taking ceremony was organized on several occasions during 2016-17. All the staff

Plate 45: Swachhta Pledge led by Shri Sangeet Som Hon'ble MLA, Sardhana, in Modipuram

Plate 46: Swachhta Pledge led by Dr. A. S. Panwar, Director, ICAR-IIFSR at IIFSR campus

members of ICAR-IIFSR, traders of nearby market area and general public gathered on 2nd October, 2016 at a common place and took the Swachhata Pledge in the presence of Shri. Sangeet Singh Som, MLA from Sardhana Tehsil in UP Legislative Assembly. On 17th October, 2016, the Director of the Institute, Dr. A. S. Panwar administered the swachhata pledge to all the staff members of ICAR-IIFSR. A similar pledge was also taken up by the Institute staff on 29th December, 2016 in the workshop on clean air clean city organized by the Institute.

Swachhata Pakhwara organized: The Institute organized '*Swachhata Pakhwara*' during 16-31 October, 2016 in which a series of cleanliness activities were organized to create awareness among different sections of society. These activities included cleanliness drive in the Institute premises and surroundings, cleanliness drive in the local market, residential area, schools in the city and a mega event in the Institute. In all the activities public representatives/ local leaders were involved to ensure the reach of cleanliness message among wider sections of the masses.

On 17th October, 2016 the Institute had organized campus cleaning programme in which all the staff members of IIFSR, Modipuram undertook the brooming work in the campus and outside the boundary. The tree litters and other wastes lying in the campus area were collected and sent for recycling at appropriate

Plate 47: Cleanliness drive by IIFSR staff on NH-58, Meerut-Haridwar Road on 17-10-2016

Plate 48: Visit of Shri Rajendra Agrawal, Hon'ble Member of Parliament from Meerut to ICAR-IIFSR on 27-10-2016

location. The obnoxious weeds grown outside the boundary were also uprooted in order to make the surroundings of the campus absolutely clean. On this occasion the Director of ICAR-IIFSR, Dr. A.S. Panwar expressed the need to maintain general cleanliness in the campus for health and hygiene, and called upon the staff members of the Institute to contribute significantly towards the Clean India Mission.

The Institute also organized a mega event on 'Clean India Awareness Camp' in its campus on 27th October, 2016. In this event about 200 students from different schools of Meerut participated in the campaign. For the school children, a painting competition on the theme 'Clean City Clean India' was organized and prizes were given to the 10 best paintings adjudged under different categories of the students. In this event the local Member of Parliament from Meerut, Sh. Rajendra Agrawal was the Chief Guest. The school children alongwith the staff members of the ICAR-IIFSR and the Chief Guest participated in general cleanliness activities on the national highway adjoining the IIFSR campus. The Chief Guest himself took the broom and inspired others for maintaining cleanliness in the surroundings. In his keynote address Sh. Rajendra Agrawal highlighted the need for proper disposal and treatment of city garbage so as to make the city clean and green. He appreciated the efforts made by IIFSR, Modipuram towards implementing the Clean India Mission on a wider scale.

In the closing ceremony of '*Swachhata Pakhwara*' on 31-10-2016, the Superintendent of Police (Traffic), Meerut, Ms. Kiran Yadav visited ICAR-IIFSR and praised the general cleanliness of the campus. In her valedictory address, Ms. Yadav commended the efforts of ICAR-IIFSR toward 'Clean India Campaign' and stressed upon the need for working in a sustained manner in order to meet the objectives of the campaign.

Plate 49: First prize received by the student of group 'A' under 'Clean India Awareness Camp'

Plate 50: First prize received by the student of group 'B' on the theme 'Clean India Green India'

Plate 51: Second prize received by the student of group 'A'

Plate 52: Second prize received by the student of group 'B'

Plate 53: Third prize received by the student of group 'A' under 'Clean India Awareness Camp'

Plate 54: Third prize received by the student of group 'B' on the theme 'Clean India Green India'

Swachhata Workshop organized: The efforts of ICAR-IIFSR towards Swachh Bharat Abhiyaan got recognition when several NGOs of Meerut approached the Institute for carrying out the activity jointly and proposed to organize a Workshop on 'Clean Air Clean City' (Fig.13). Consequent upon this proposal, the Institute organized a workshop on 29 December, 2016 in which the representatives of Arunodaya Society, Meerut and Indian Pollution Control Association, New Delhi were the resource persons for making the audience aware about the need for having clean air. The experts from Meerut and New Delhi in their deliberations highlighted the status of pollution level of air in the city and the consequent harmful effects on human health especially on children (Fig.14). This workshop was attended by all the staff members of ICAR-IIFSR and about 100 students from the nearby schools.

Cleanliness Drive in Adopted Villages

During the '*Swachhata Pakhwara*', the Institute also organized cleanliness activities in the adopted villages on almost everyday. The major activities were concentrated in the villages adopted by the Institute under 'Mera Gaon Mera Gourav' (MGMG) programme. It is pertinent to mention that the Institute has adopted 50 villages under MGMG programme and these villages have been grouped into ten clusters of adjoining villages being monitored under 10 different teams of scientists. It was felt appropriate to link these villages with the cleanliness programme of the Institute so that the message could be easily disseminated on account of already developed rapport with the villagers.

For this purpose the village schools were selected as key sites where the school children were involved in

Plate 55: Workshop on 'Clean Air Clean City' organized jointly by ICAR-IIFSR & NGOs

Plate 56: Delegates of Workshop on 'Clean Air Clean City' organized on 29-12-2016

the programme in consultation with the school principal and village pradhan. A module of activities was chalked out which included painting competition for school children on the topic 'Swachh Gaon Swachh Bharat', cleaning of school premises and surroundings, and gosthi on general cleanliness in the village. In order to encourage the efforts of the children, 10 prizes were given for best paintings in each school. Besides, each school was donated a dustbin, 20 brooms and cleaning material by ICAR-IIFSR in order to motivate the students and teachers towards maintaining cleanliness.

In this series the first programme was organized in Assa village of Mawana block, Meerut district on 24th October, 2016 followed by similar programmes on 28th October, 2016 in Jaitpur village of Budhana block, Muzaffarnagar district, Palri village of Barnauli block, Baghpat district and Mohamandpur village of Narsan Block, Haridwar district. In each of these programmes about 200 school children and about 100 village elders participated and the team of scientists from ICAR-IIFSR guided in maintaining general cleanliness in school and villages.

It is pertinent to mention that Jaitpur village of Budhana block in Muzaffarnagar district is one of the adopted villages by ICAR-IIFSR, Modipuram which is about 38 kms from Modipuram. This village inhabits a large population of vulnerable groups where the technology dissemination and adoption were found to be very low. After adopting this village, the Institute carried out several technology transfer activities comprising supply of critical inputs, on farm trials and rendering of advisory services. Besides, the Institute also undertook cleanliness activities intensively in this village as a result of which, this village have been

Plate 57: Primary School students of Mohammadpur village participating in painting competition

Plate 58: Prize distribution to winner student of painting competition at Assa village, Mawana block, Meerut

Plate 59: Donation of dustbin and other cleaning material to Primary school of Jaitpur village, Budhana block, Muzaffarnagar dist.

Plate 60: Goshthi on cleanliness in Mohammadpur village, Narsan block, Hardwar District

categorized under Open Defecation Free (ODF) village. This case exemplifies that through concerted efforts and monitoring, it is not difficult to achieve the mission goals within the specified time period.

Agricultural Education Day organized

Institute celebrated Agriculture Education Day on 3rd December, 2016 to disseminate the informations

Plate 61: Cleaning of school srroundings by the students of Primary School, Assa village

Plate 62: Goshthi on cleanliness in Assa village, Mawana block, Meerut district

Plate 63: Swachhata Jagrookta Abhiyan at Jaitpur village

Plate 64: Cleaning drive during swachta abhiyaan at Jaitpur village

about scope of Agriculture Education in carrier building. The programme was inaugurated by the Director, Dr. A.S. Panwar. About 70 students of nearby schools and colleges, and staff members of the Institute participated in the function. A special session on 'carrier counseling for students' was organized during the programme in which, selected scientists from different disciplines of Agriculture deliberated on the educational and employment opportunities in the respective disciplines available in the country. This was an interactive session by which the participating students got acquainted with the latest development and opportunities in Agriculture.

Plate 65: Agricultural Education Day

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भारतीय कृषि प्रणाली अनुसंधान संस्थान, मोदीपुरम, मेरठ में दिनांक 21/06/2016 को अंतर्राष्ट्रीय योग दिवस मनाया गया। कार्यक्रम का शुभारंभ संस्थान के निदेशक डा. आजाद सिंह पँवार ने किया। उन्होंने मुख्य योग प्रशिक्षक डा. शंभू दत्त धीमान एवं सभी सहभागियों का स्वागत करते हुए अंतर्राष्ट्रीय योग दिवस की महत्ता के बारे में विस्तार से जानकारी दी। डा. पँवार ने यह भी बताया कि, योग हमारी भारतीय संस्कृति एवं परंपरा का अभिन्न हिस्सा रहा है तथा यह मनुष्य को स्वस्थ्य एवं निरोग रखने में महत्वपूर्ण भूमिका निभाता है।

योग प्रशिक्षक डा. शंभू दत्त धीमान ने योग के महत्व का वर्णन करते हुए बताया कि योग आत्मा को परमात्मा से जोड़ता है तथा शरीर के विकारों को दूर भगाता है। उन्होंने योग के विभिन्न स्तंभों जैसे सूक्ष्म यौगिक व्यायाम, आसन, प्राणायाम, सामान्य व्यायाम, अष्टचक्र, यम, नियम आदि के बारे में विस्तार से जानकारी दी तथा सूक्ष्म व्यायाम व विभिन्न प्रणायाम जैसे शस्त्रिका, कपाल भाति, वाह्य प्राणायाम, अनुलोम–विलोम, भ्रामरी, प्रलव आदि का प्रशिक्षण भी दिया। डा. धीमानजी ने प्रत्येक आसन व प्राणायाम की उपयोगिता व उन्हें करने के दौरान अपनायी जाने वाली सावधानियों के बारे में भी बताया। कार्यक्रम के दौरान मास्टर वैभव ने कुछ विशेष आसन जैसे सूर्य नमस्कार, धनुर्आसन, सर्वांगआसन, मकरासन आदि का प्रदर्शन भी किया। कार्यक्रम में संस्थान के अधिकारियों एवं कर्मचारियों ने बढ़–चढ़कर,परिवार सहितभाग लिया। कार्यक्रम का संचालन डा. प्रेम सिंह, प्रधान वैज्ञानिक ने किया। कार्यक्रम के अंत में निदेशक डा. आजाद सिंह पंवार ने सभी कर्मचारियों से योग को अपने दैनिक जीवन का अभिन्न अंग बनाने व इसके निरंतर प्रयोग में लाने की अपील की। योग प्रशिक्षक डा. शंभू दत्त धीमान को संस्थान की ओर से सम्मानित किया गया।

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TRANSFER OF TECHNOLOGY

Regional Agriculture Fair "*Krishi Kumbh*-2016"organized by ICAR-IIFSR from 28-30 November, 2016

ICAR-Indian Institute of Farming Systems Research, Modipuram, Meerut (Uttar Pradesh) organized a three days Regional Agriculture Fair "***Krishi Kumbh*-2016**" from 28-30 November, 2016 in the Government Inter College ground of district Muzaffarnagar, Uttar Pradesh. The programme was inaugurated by Hon. Minister of State for Water Resources, River Development and Ganga Rejuvenation, Govt. of India, Dr. Sanjeev Kumar Balyan on 28.11.2016. About 10000 farmers from seven states *viz.* U.P., Uttarakhand, Punjab, Haryana, Gujarat, Jammu and Kashmir and Telangana participated in the Fair. Dr. J.S. Sandhu, DDG (Crop Science), ICAR, New Delhi, Chaudhary Naresh Tikait, President, *Bhartiya Kisan Union*, Shri Ghashiram Nain, Hon. M.P. Shri Raju Shetty, Shri V.M. Singh and Hon. MLC Shri Kapildev were Guests of Honour during the inaugural function. In his inaugural speech, Hon. Minister Dr. Sanjeev Kumar Balyan expressed his pleasure for organizing such a big farmers fair in the agriculturally prosperous district of Muzaffarnagar and thanked Dr. A.S. Panwar and his team for the same. He also appealed farmers to get maximum benefit of the innovative agricultural technologies being demonstrated in the *Krishi Kumbh*. Dr. J.S. Sandhu, DDG (Crop Science), ICAR, New Delhi explained about newer technological development in the field of agriculture and requested farmers to make use of those for their prosperity and livelihood security. Dr. Azad Singh Panwar, Director, IIFSR welcomed all the guests and farmers in the *Krishi Kumbh* 2016 and explained about the activities being conducted by the Institute for economic empowerment and livelihood security of the farmers in the region.

Plate 67: Inauguration of *Krishi Kumbh* 2016

To encourage the local stockmen, a separate category of animal show was also organized. Separate competition was organized in different categories for the improved breeds of Cattles (cows and bulls), Buffalos (he and she buffalos), Equine etc. He buffalo (buffalo bull) "Yuvraj" of Shri Karnvir Singh from Haryana was awarded first prize in its category. He buffalo (buffalo bull) "Modi" of Shri Manoj Mandi from Morna was awarded first prize in U.P. category. An award distribution ceremony for stockmen was also organized on 29.11.2016. Progressive farmers, farm women, social workers and winners Stockmen of the Animal Show were felicitated and awarded by Chairman and Guest of Honour during the function.

Total 102 stalls including 57 stalls from ICAR demonstrated their technologies to farmers. There were 100 stalls by the stockmen and dairy companies. New and innovative technologies were demonstrated on farming systems management; soil and water management and conservation; dry and rain-fed farming; hill agriculture; seed production and storage; improved production technologies of food grains, oilseeds, sugarcane potato and other cash crops; improved technologies of orchard crops, roof top gardening and vegetable production; fruits and vegetable preservation and processing for small scale industry; plant protection chemicals, fertilizers, micronutrients, equipments etc; small implements for small land holdings, big implements and tractors; protection techniques from wild animals; *Khadi* and *Gramodyog*, agricultural extension techniques by KVKs and other organizations; improved livestock production and management technologies; dairy technology; improved

management techniques for cattle, buffalo, sheep, goat, poultry, apiary and fish by the national and international, public and private organizations. Thousands of farmers took active participation in the fair and also purchased newly released and improved varieties of seeds of different crops, plant protection chemicals and equipments and other products.

Kisan Gosthis were organized in four different Technical Sessions *viz.* 'Improved seed production technologies for economic and environmental sustainability', 'Sustainable orchard management and processing technologies for enhancing income and employment generation', 'Animal resource and Dairy trade management' and 'Management of natural resources for agriculture under changing climatic scenario' in which stalwarts from the National and International organizations made a face to face interaction with farmers and gave practical tips to them. Farmers took active participation in all sessions of *Kisan Gosthi* and found the instant solutions of their problems related to agriculture and livestock production. A quiz and general knowledge competition was also organized for farmers during the *gosthi* and winner farmers were also awarded.

Valedictory session of *Krishi Kumbh 2016* was organized on 30.11.2016 which was chaired by social activist Sh. Surendra Singh. In his valedictory remarks, Sh. Surendra Singh expressed his pleasure for organizing such a big farmer's fair in the district Muzaffarnagar and thanked Dr. A.S. Panwar and the 'Team IIFSR' for the same. The best stalls from all the categories were awarded with prize during the function.

Plate 68: Director, IIFSR addressing the gathering in *Krishi Kumbh* 2016

"Farmer's Fair and Farm Field School" organized at Navala village of district Muzaffarnagar (U.P.) on 07.05.2016

Institute organized one day "Farmer's Fair and Farm Field School" at Navala village of district Muzaffarnagar (U.P.) on 07.05.2016. Dr. Sanjeev Baliyan, Hon'ble Union State Minister of Agriculture and Farmer's Welfare, Govt. of India, was the chief guest and inaugurated the function. Dr. A. K. Singh, Deputy Director General (Extension) of Indian Council of Agricultural Research, New Delhi was special guest of the programme. Thousands of farmers belonging to different villages of Western U.P. participated in the programme. Dr. Azad Singh Panwar, Director, IIFSR welcomed chief guest including all the dignitaries and farmers participants. He highlighted the programmes being operated by the Institute for economic and livelihood security of farmers in the region. Dr. Panwar has also elaborated about the schemes which are being operated for farmer's welfare by the Government of India i.e. Soil Health Card Scheme, Prime Minister's Crop Insurance Scheme, Prime Minister's Agriculture Irrigation Scheme and National Agriculture Market etc.

The chief guest Honorable Dr. Sanjeev Baliyan expressed his pleasure for organizing such a big Farmer's Fair in village Navala and congratulated to Dr. Azad Singh Panwar and his team. He has requested farmers to adopt improved technologies in cultivation of sugarcane on the line of Maharashtra for achieving higher yield level of 1200-1500 q ha^{-1}. He also emphasized about depletion and pollution of

Plate 69: Farm Field School at Navala village

groundwater which is a serious issue in western U.P. and appealed to all the farmers to conserve the water for agriculture and its purity for drinking purpose to safeguard the availability for future generations. He advocated for custom hiring of improved implements being used in cultivation of sugarcane through co-operative society in the village for making agricultural operations easier and faster which will also generate employment opportunities for youths in the villages. Dr. A. K. Singh, DDG Extension introduced about the schemes being operated under the programme of agricultural extension. He also emphasized that there is need for improving the soil productivity and to enhance the profitability of sugarcane based farming system and livestock production in the region. Dr. Rabinder Kaur, Director, Indian Agricultural Research Institute, New Delhi appreciated such kind of Scientist-Farmers interaction meet and appealed the farmers to get maximum benefit of it.

A practical demonstration was organized on automatic mechanical planting of sugarcane before the chief guest and all the participants. Eight leaflets developed by IIFSR on various improved technologies *viz.* management of mango orchards, integrated nutrient and pest management in sugarcane, women friendly agricultural implements, गेहूँ की उन्नत खेती, सरसों की उन्नत खेती, समन्वित मछली पालन and schemes recently launched by Government of India such as soil health card scheme, Prime Minister's crop insurance scheme, Prime Minister's agricultural irrigation scheme, national agricultural market scheme were also released by the chief guest during the function. Practical demonstrations and lectures useful for the farmers were delivered on various subjects by different subject matter specialists.

"Farmer's Fair and Farm Field School" organized at MeerapurDalpat village of district Muzaffarnagar (U.P.) on 25.05.2016

Institute also organized one day "Farmer's Fair and Farm Field School" at Meerapur Dalpat village of district Muzaffarnagar (U.P.) on 25.05.2016. Honorable Union Minister of State for Agriculture and Farmer's Welfare, Govt. of India, Dr. Sanjeev Baliyan inaugurated the function and graced the occasion as chief guest. Shri Vijay Pal Singh Tomar, President Rashtriya Kisan Morcha, Shri Chandra Pal Fauji, Leader Bhartiya Kisan Union were Guests of Honour during the function. More than two thousand farmers belonging to different villages (11Nos.) of Western U.P. participated in the programme. Eleven exhibition stalls of ICAR Institutes, SVBPUA and Tech, Meerut and Private firms displayed their technologies to the visiting farmers.

Dr. Azad Singh Panwar, Director, ICAR-IIFSR welcomed the chief guest and all the dignitaries and farmer participants. He highlighted the programmes being implemented by the Institute for livelihood security of farmers in the region. He expressed his concern on depletion and pollution of groundwater and appealed all the farmers to use different conservation measures to save the water. Dr. Panwar also briefed about the schemes which are being implemented for farmer's welfare by the Government of India i.e. Soil Health Card Scheme, Prime Minister's Crop Insurance Scheme, Prime Minister's Agriculture Irrigation Scheme and National Agriculture Market etc.

The chief guest Dr. Sanjeev Baliyan expressed his pleasure for organizing such a big Farmer's Fair in Meerapur Dalpat village and thanked to Dr. Azad Singh Panwar and his team. He worried about depletion and pollution of groundwater which has become a serious issue in western U.P. He stressed the need for judicious

Plate 70: Farm Field School at Meerapur Dalpat village

use of groundwater and to adopt water conservation measures so that, the future generations may not face any hardship of water scarcity.

Earlier a field demonstration was organized by Dr. L.R. Meena in Meerapur Dalpat village on trench and pit method of sowing and micronutrient application in sugarcane in the presence of Honorable Minister and other visitors. During technical session, Dr. Anil Kumar, Principal Scientist elaborated the farmers about Soil Health Card Scheme, Prime Minister's Crop Insurance Scheme, Prime Minister's Agriculture Irrigation Scheme and National Agriculture Market etc. 'Kisan Suvidha App' an useful program was downloaded in the mobiles of more than hundred farmers by Sh. Sunil Kumar Scientist. Lectures and practical tips were given on integrated nutrient and pest management in sugarcane, rice and pulses by Dr. Chandra Bhanu; Management of mango orchards by Dr. Dushyant Mishra, Infertility and low conception rate problems and their management in livestocks by Dr. Sanjeev Kumar Kochewad, scientists from IIFSR, Meerut.

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संस्थान में दिनांक 05/12/2016 को ''विश्व मृदा दिवस'' मनाया गया। इस उपलक्ष पर संस्थान द्वारा अंगीकृत मंडौरा गाँव के किसानों के लिए 'मृदा स्वास्थ्य कार्ड वितरण' कार्यक्रम का आयोजन भी किया गया। कार्यक्रम का उद्घाटन माननीय विधायक (सरधना विधान सभा क्षेत्र) एवं मुख्य अतिथि श्री संगीत सोमजी ने किया।

कार्यक्रम में मंडौरा गाँव के 55 किसानों व शांति निकेतन विद्यापीठ के 70 से अधिक छात्रों व अध्यापकों सहित लगभग 250 लोगों ने भाग लिया। मुख्य अतिथि ने अपने संबोधन में मृदा स्वास्थ्य को बनाये रखने हेतु संसाधनों व रसायनिक पदार्थो के समुचित उपयोग व जल प्रदूषण को रोकने पर जोर दिया। उन्होंने मेरठ क्षेत्र में किसानों की मृदा के उचित प्रबंधन व स्वास्थ्य को बनाये रखने हेतु कृषि प्रणाली संस्थान द्वारा किये जा रहे प्रयासों की सराहना की तथा इसके लिए निदेशक डा. आजाद सिंह पँवार व उनकी टीम को धन्यवाद दिया। संस्थान के निदेशक डा. आजाद सिंह पँवार ने सभी अतिथियों का स्वागत किया तथा किसानों से देश की खाद्य एवं पोषण सुरक्षा को सुदृढ़ बनाने हेतु मृदा के भौंतिक, रसायनिक व जैविक गुणों में सुधार करने, संसाधनों के समुचित उपयोग, जीवांश पदार्थों के अधिकाधिक प्रयोग व प्रदूषण नियंत्रण की अपील की। अपने संबोधन के दौरान उन्होनें छात्रों को मृदा स्वास्थ्य की आधारभूत जानकारियाँ दी तथा भविष्य में इसे सुरक्षित रखने के उपाय भी बताये। कार्यक्रम में मंडौरा गाँव के लगभग 200 किसानों के लिए संस्थान द्वारा तैयार 'मृदा स्वास्थ्य कार्ड' भी मुख्य अतिथि के करकमलों द्वारा वितरित किये गये। इस दौरान शांति निकेतन विद्यापीठ के छात्रों व अध्यापकों ने भी' विश्व मृदा दिवस' के ऊपर अपनी–अपनी प्रस्तुतियाँ दी। डा. जगपाल सिंह, डा. महेन्द्रपाल सिंह आर्य ने अपने–अपने विचार रखे। कार्यक्रम के बाद किसानों, अध्यापकों व छात्रों को प्रक्षेत्र व प्रयोगशालाओं का भ्रमण कराया गया तथा मृदा स्वास्थ्य की जाँच में प्रयोग होने वाले विभिन्न उपकरणों की विधिवत् जानकारी भी दी गयी। डा. आर. पी. मिश्र, कार्यक्रम के समन्वय करहे। कार्यक्रम का संचालन डा. चन्द्रभानु ने किया। डा. देवाशीष दत्ता, डा. अमृत लाल मीना, डा. संजीव कुमार, डा. प्रकाश चंद, श्री आर. बी. तिवारी, डा. विनोद कुमार, कुमारी शिखा, पूजा व श्रीमती श्वेता आदि का सहयोग रहा।

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IIFSR IN THE SERVICE OF FARMER'S

Field day on management of mango orchard

On-farm training-cum-demonstration was organized on the management of shoot gall psylla in mango in Kailawara Kalan village of district Muzaffarnagar on 23.08.2017. Thirty five mango farmers and contractors participated in the training. Lectures were delivered on biology and management of shoot gall psylla; integrated nutrient and pest management in mango by the experts of the Institute. A live demonstration for the safe use of pesticides for managing mango shoot psylla was also organized during the training.

Plate 72: Training and demonstration on management of mango shoot gall psylla to orchard owners and contractors by ICAR-IIFSR

Front line demonstrations (FLDs) conducted

As per the MOU with ICAR-Directorate of Rapeseed and Mustard Research, IIFSR is running 100 front line demonstrations (FLDs) on improved varieties of mustard (RH 749 and RH 406) with the aim to increase the yield of oilseed in the region. Two hundred demonstrations were also laid during current *rabi* season on improved varieties of Mustard (RH 749, RH 406 and NRCDR 2) and Yellow Sarson (YSH 401) in about fifty adapted villages under MGMG programme and 10 other villages in Meerut, Muzaffarnagar and Haridwar Districts of U.P. and Uttarakhand. Ten demonstrations were laid on the use of balanced nutrient application and IPM in mustard. Eighteen demonstrations each on improved varieties of wheat (DBW 71 for late sown condition) and barley (BH 946 for timely sowing) were also laid on farmer's field in collaboration with ICAR-Indian Institute of Wheat and Barley Research (IIWBR), Karnal.

Field day on mustard

A field dayon Mustard was organized at village Khardauni in Meerut on 9th March, 2017 in which 150 farmers participated. The objective of the field day was to enlighten the farmers about improved package of practices of mustard cultivation including balanced nutrient application and IPM in mustard. Dr. Manoj

Plate 73: Field day on mustard at Khardauni village, Meerut

Kumar, Joint Director, CPRI Modipuram and Dr. J. P. Singh, Principal Scientist and PF, IIFSR graced the occasion and interacted with farmers.The programme was coordinated by Dr. Poonam Kashyap and Dr. Chandra Bhanu.

Kisan Gosthi on integrated farming systems

A *Kisan Gosthi* was organized in Kailawara Kalan village of Distt. Muzaffarnagar on 23rd Aug. 2016 in which, 219 farmers participated. Scientists of different disciplines of the Institute delivered the lectures on different aspects crop production and protectionin sugarcane, rice, mustard and pulses, integrated orchard management, management of low conception rate and infertility problem in dairy animals, mortality in calves and Prime Minister's/ Central Govt. Schemes for farmers.

Plate 74: Kisan Gosthi at Kailawara Kalan village, Muzaffarnagar

Other programmes organized for farmers

Name of events	No. of participants	Title of Training	Venue	Duration and Date	Contributors
Front Line Demons-tration on Oilseeds	50	08 FLDs (3.2 ha) on oilseeds (Mustard) were conducted in the selected village of Muzaffarnagar	Luhsana, Kherigani, Sangri, Jaitpur and Bitawda	2016-17 (*Rabi*)	M. Shamim N. Ravisankar
MGMG	20	Distributed high quality mustard (cv. RH-406) seeds among the farmers	Field visit at Village-Sonta, Muzzafarnagar	04.10.2016	A. K. Prusty Vipin Kumar
MGMG	85	Identification of villages and meeting with village pradhans regading initiation of activities of MGMG	Luhsana, Kaitpur, Kherigani, Sangri and Bitawda	18.04.2016	N. Ravisankar Poonam Kashyap M. Shamim
MGMG	100	Interacted with farmers for technological inputs for the rabi season and discussed about on farm training of the farmers	Luhsana, Jaitpur, Kherigani, Sangri and Bitawda	05.10.2016	N. Ravisankar Poonam Kashyap M. Shamim
MGMG	25	Visited the villages and extended the need based advisories to farmers.	Luhsana, Jaitpur, Kherigani, Sangri and Bitawda	27.06.2016	N. Ravisankar
कृषिक दिवस	210	कृषिक दिवस ''समन्वित कृषि प्रणाली अंतर्गत उन्नत कृषि विधियां''	ग्राम पाऊटी, ब्लॉक– चरधवाल, मुजफ्फरनगर	10.08.2016	जे.पी. सिंह अमित नाथ वी.पी. चौधरी डी. दत्ता निशा वर्मा

Name of events	No. of participants	Title of Training	Venue	Duration and date	Contributors
MGMG	50	Monitored the fodder sorghum in other four villages, interacted with farmers for technological inputs for the current season	Luhsana, Jaitpur, Kherigani, Sangri and Bitawda	10.08.2016	M. Shamim
MGMG	100	Distributed the PoPs pamphlets on wheat production and wheat seeds (normal and late sown Cvs.)	Luhsana, Jaitpur, Kherigani and Sangri	10.11.2016	N. Ravisankar Poonam Kashyap M. Shamim
MGMG	100	Provided technological inputs in relation to package of practices of *rabi* crops to farmers and also provided Mustard seeds to selected farmers under FLDs on oilseeds	Luhsana, Jaitpur, Kherigani, Sangri and Bitawda	17.10.2016	N. Ravisankar M. Shamim
Cleanliness drive	100	Swachhata gram jagrukta abhiyan under Swach Bharat Abiyan	Prathamic Vidalaya Jaitpur	28.10. 2016	M. Shamim N. Ravisankar Poonam Kashyap
MGMG	125	Swachh School Abhiyan	Mohammadpur Vill., Haridwar	28.10.2016	MPS Arya Anil Kumar Chandra Bhanu
प्रशिक्षण	166	प्रशिक्षण ''विभिन्न कृषि उत्पादों में मूल्य संवर्धन''	ग्राम बधाई कलान, मुजफ्फरनगर	11.08.2016	जे.पी. सिंह अमित नाथ वी.पी. चौधरी डी. दत्ता निशा वर्मा
प्रशिक्षण एवं प्रदर्शन	209	प्रशिक्षण एवं प्रदर्शन ''छोटे एवं मध्यम कृषि यंत्र तथा कृषि उत्पादों के उचित' प्रबंधन की तकनीकी''	ग्राम तिहाई, मुजफ्फरनगर	12.08.2016	जे.पी. सिंह अमित नाथ वी.पी. चौधरी डी. दत्ता
Kisan Gosthi	150	Dissemination of technological inputs in relation to package of practices of *rabi* crops and also to provide wheat seeds to selected farmers of Saunta Village	Saunta	28.12.2016	M.P. Singh M. Shamim Sunil Kumar
प्रशिक्षण एवं प्रदर्शन	100	फ्रेम द्वारा स्वास्थ वर्धक गुड तैयार करने हेतु प्रदर्शन एवं प्रशिक्षण	ग्राम पहाड़पुर, मेरठ	10.03.2017	वी.पी. चौधरी निशा वर्मा
Two days Farmer's Fair	250+250 (500)	Pradhan mantra Krishi Sinchai Yojajan and National Mission on Oilseeds and Oil Palm	DD Agric. Office, Meerut	16-17.03.2017	Dushyant Mishra Chandra Bhanu
Traning on Value addition	20	Value addition in Sugarcane : Iron enriched jaggary	Post Harvest Technology Lab, Modipuram, Meerut	21.03.2017	Nisha Verma Amith Nath Dushyant Mishra

Name of events	No. of participants	Title of Training	Venue	Duration and date	Contributors
Field Day	75	Field Day on Mustard	Kherigani	24.03.2017	M. Shamim N. Ravisankar
प्रशिक्षण एवं प्रदर्शन	100	उन्नत यंत्रो द्वारा सब्जियों की बुवाई एवं रोपाई	ग्राम पहाड़पुर, मेरठ	24.03.2017	वी.पी. चौधरी निशा वर्मा
Training on Drudgery reduction	100	Drudgery reduction technologies for women farmers in vegetable sowing and transplanting	Bhayingi-Bhangella village, Muzaffarnagar	29.03.2017	Nisha Verma Poonam Kashyap M.P. Singh Sunil Kumar Ashish Prusty M. Shamim S. Malik
Kisan Goshthi	200	Dissemination of technological inputs in relation to package of practices of *rabi* crops and also to provide wheat seeds to selected farmers of Saunta Village	Satheri Village	04.01.2017	M.P. Singh S. Malik M. Shamim Sunil Kumar Nisha Verma
Field Day	30	Field Day on Mustard	Khardauni, Meerut	09.03.2017	Poonam Kashyap
MGMG	50	Provided technological inputs in relation to management practices of *rabi* crops to farmers and also provided vegetable seeds to selected farmers	Luhsana, Jaitpur, Kherigani and Sangri	10.01.2017	N. Ravisankar Poonam Kashyap M. Shamim
Demonstration on value addition	70	Processing of nutritionally enriched jaggary using metallic frame developed by ICAR-IISR, Luknow	Pahadpur Village, Meerut	10.03.2017	Nisha Verma V.P. Chaudhary Amit Nath

Technology/ products assessed and transferred to client

Technology developed/assessed and recommended for upscaling	Contributors
Quantitative analysis tool FarmDesign was parameterized for its application in IFS modelling.	A. K. Prusty
A fish based farming system model in 0.9 ha area having fish pond of 0.5 ha and rice-wheat cropping system in 0.4 ha was evaluated at farmers field in Dabathuwa village in Meerut district. The fish based farming system model could provide a net return of Rs. 99395 from 0.9 ha area with fish component realizing Rs. 63462 from 0.5 ha fish pond and Rs35933 from rice wheat cropping system in 0.4 ha area which contributed to 63.85 % and 36.15 % of total net income respectively.	A. K. Prusty
Organic production systems with 100% supply of nutrients through organic sources and complete organic management as per NPOP standards for Mustard in Vindhya Plateau Agroclimatic region of Madhya Pradesh under extreme (high and deficit) seasonal rainfall	M. Shamim N. Ravisankar
Identified climate resilient *rabi* crop (chickpea) with organic production systems (supply of 100% nutrients through organic sources and complete organic management as per NPOP standards) for Vindhya Plateau Agroclimatic Region of Madhya Pradesh under high seasonal rainfall.	M. Shamim N. Ravisankar

Technology developed/assessed and recommended for upscaling	Contributors
Climate resilient production package (supply of 100% nutrients through organic sources and complete organic management as per NPOP standards) and cropping system (Soybean-Chickpea) under extreme (high and deficit) rainfall situations for Vindhya Plateau Agroclimatic Region of Madhya Pradesh.	M. Shamim N. Ravisankar
Alternate efficient farming Systems (08 nos.) for 08 NARP Zones *viz.*,North Gujarat Zone (Gujarat), East And South Eastern Coastal Plain Zone (Odisha), Coastal Saline Zone (West Bengal), Central Plain Zone (Uttar Pradesh), north-western zone (Tamil Nadu), Sub Humid Southern Plain Zone (Rajasthan), Western Maharashtra Plain Zone (Maharashtra) and Central Maharashtra Plateau Zone (Maharashtra) for higher production, marketable surplus, profit and nutrition.	N. Ravisankar M. Shamim Brijmohan Garg
Scientific organic production for 42 cropping systems suitable for 11 states.	N. Ravisankar M. Shamim
Land configuration based resource conservation practices for organic farming identified for Karnataka, Uttrakhand and Meghalaya	N. Ravisankar M. Shamim
Manual cane stripper cum detopper and cane cutting knife developed by ICAR-IISR was assessed for its efficiency and ergonomic comfort for both men and women at Pahadpur village, Mawana block, District Meerut.	NishaVerma V.P. Chaudhary
A three tier horticulture based system comprising strawberry, capsicum, sponge gourd based system was developed and evaluated at farmer's field for profit maximization and efficient use of vertical and horizontal space.	Poonam Kashyap
Alternative efficient vegetable based cropping system Broccoli-Tomato-Chilli was evaluated under climatic condition of western plain zone of Uttar Pradesh at farmers field, which provided a net return of Rs. 75000/- ha^{-1}.	Poonam Kashyap
Intercropping of medicinal plants of lemon grass and basil in broccoli was evaluated at farmers field in western UP and results revealed that an additional amount of Rs. 55000/- ha^{-1} could be realized through intercropping of medicinal plants as compared to sole cropping of broccoli.	Poonam Kashyap
Raising of seedlings of fruits and vegetables in low-cost protected structures for off-season production.	Poonam Kashyap
Enhancing resource efficiency (working efficiency, fertilizer use, and seed rate) for improving seedling establishment of vegetable crops using improved transplanter (Tomato) and dibbler (Okra).	V.P. Chaudhary NishaVerma

Laboratories/Facility developed

Facility	Contributors
Data Repository Cell (DRC) in the Coordination unit for AICRP on Integrated Farming Systems (IFS) and Network Project on Oranic Faming (NPOF) scheme	Dr. M. Shamim Dr. N. Ravisankar
A fish pond of 0.09 ha was developed in the Siwaya farm of ICAR-IIFSR for integration of fisheries with horticulture based farming systems	Dr. A. K. Prusty Dr. Peyush Punia Dr. Poonam Kashyap

AWARDS AND RECOGNITIONS

Awards

- Dr. A. K. Prusty received best oral presentation award for paper entitled, "Optimization of Resources in Farming Systems Using Mathematical Modelling- A Case study on application of FarmDESIGN" in National Conference on Natural Resources Management for Sustainable Agriculture (NRMSA)" on 25 October, 2016 at Conference Hall, Janta Vedic College, Baraut, Baghpat (U.P.)

- Dr. Anil Kumar, Dr. Poonam Kashyap, Dr. Chandra Bhanu and Dr. Sanjeev Kumar and management team received Letter of Appreciation from ADG (HRD) for successful organization of Training programme entitled Refresher Course on Farm Management held during 19-24 September, 2016.

- Dr. Chandra Bhanu received 'Young Scientist Award' 2017 of Gochar Educational and Welfare Society, Saharanpur (U.P.) for outstanding contribution in Plant Pathology during National Conference on Agriculture Renewal for Evergreen Revolution: Concepts and Approaches, organized at Department of Plant Pathology, Gochar Mahavidyalaya, Rampur Maniharan, Saharanpur (U.P.) on 10 March, 2017.

- Dr. Devendra Kumar received Kunwar Saxena Bahadur SRDA Award-2016 for outstanding contribution and recognition in the field of plant breeding on the occasion of International Conference on Global Agriculture & Innovation Conference (GAIC 2016), Noida International University, Greater Noida during 27-29 November, 2016 by Society for Recent Development in Agriculture.

- Dr. Dushyant Mishra, Senior Scientist received "Best Performance Award" and "Appreciation Certificate" by Honorable Governor of Himanchal Pradesh Sri Devvrat ji on 3rd July 2016 during 25th National Seminar on Mango cum Mango Mela organized by Haryana Government at Pinjor Garden, Panchkula (Haryana)

- Dr. L.K. Meena, received first prize in Antakshari (Group) competition organized at ICAR-IIFSR on the occasion of Hindi Pakhwada from 14-28 September, 2016.

- Dr. M. Shamim Scientist received Certificate of Commitment from Central Vigilance Commission for adopting the Integrity Pledge.

- Dr. N. Ravisankar Principal Scientist received Reviewer Excellence Award as reviewer of Indian Journal of Agricultural Research and Legume Research: An International Journal from Agricultural Research Communication Centre (ARCC).

- Dr. Poonam Kashyap received first prize in oral presentation on the topic,"Role of vegetables in ensuring livelihood security of farmers of western Uttar Pradesh" from Agricultural technology Development Society, Ghaziabad, Uttar Pradesh on the occasion of National Conference on Natural Resources Management for Sustainable Agriculture organised by October 25, 2016.

- Dr. Poonam Kashyap received second prize in Swarachit Kavya Path competition on the occasion of Hindi Pakhwadaorgainsed by ICA-IIFSR Modipuram from 14-28 Sept, 2016 at IIFSR Campus.

- Dr. Poonam Kashyap received Young Scientist Award- 2016 from Agricultural technology Development Society, Ghaziabad, Uttar Pradesh on the occasion of National Conference on Natural Resources Management for Sustainable Agriculture organised by October 25, 2016.

- Dr. S.A. Kochewad win second prize in poster presentation International Conference on Global Agriculture and Innovation Conference (GAIC-

Plate 75: Dr. A. K. Prusty receiving best oral presentation award during National conference at Baghpat

Plate 76: Dr. Dushyant Mishra receiving Award from Honorable Governor of Himanchal Pradesh

2016). Nov 27-29 2016, Noida organized by Hitech Horticulture Society Meerut, India.

- Dr. Sanjeev Kumar received "SRDA Gold Medal Award-2016" from Society for recent development in agriculture, Meerut.
- Dr. Sanjeev Kumar secured 2nd prize for best poster presentation award in international conference on Global Agriculture & Innovation Conference held at Noida during 27-29 November, 2016.
- Dr. Sunil Kumar, Dr NK Jat, Dr Prem Singh, Dr Poonam Kashyap, Dr AK Prusty and Dr M. Shamim received 2nd best poster presentation award in hindi pakwarda on 26 Sepetmebr, 2016.
- Team of ICAR-IIFSR received 1st Prize in ICAR/ GOI category during All India Farmers' Fair (North Zone) and Agro-industrial Exhibition organized by Sardar Vallabhai Patel University of Agriculture & Technology, Meerut, from 5-7 October, 2016.
- Mr. Sunil Kumar received Young Scientist Award (2016), for outstanding contribute in the field of Agriculture Statistics on the occasion of National Conference on natural resources management for sustainable agriculture organized by agricultural technology development society (ATDS) Ghaziabad, (U.P) scheduled to be held during Tuesday, 25 October, 2016 at conference hall, Janta Vedic College Baraut, Baghpat (U.P).
- Mr. Sunil Kumar, (2016) received 2nd Award in Oral presentation on "Impact of organic farming systems on household income of Sikkim farmers" organized by agricultural technology development society (ATDS) Ghaziabad, (U.P) scheduled to be held during Tuesday, 25 October, 2016 at conference hall, Janta Vedic College Baraut, Baghpat (U.P).

Plate 77: Dr. Poonam Kashyap receiving Young scientist Award by Agricultural technology development society

Plate 78: Dr. Chandra Bhanu, Scientist receiving Young Scientist Award

- Mr. Sunil Kumar, N.K. Jat, Prem Singh, A.K. Pursty, M.Shamim, Pyuesh Punia and Poonam Kashyap (2016) received 1st position award for poster presentation on "Present status and future prospectus of organic farming in sikkim " conferred by Agricultural technology development society (ATDS) Ghaziabad, (U.P) held on 25 October, 2016 at Janta Vedic College Baraut, Baghpat (U.P).

Recognitions

- Dr. A. K. Prusty acted as reviewer for Aquaculture Nutrition (Springer) and Aquaculture Reports (Science Direct) journal during the year
- Dr. Amit Nath, Principal Scientist (Food Technology) acted as an Editorial panel members for "Nutrition and Food Toxicology Journal" Published by *Scientia Ricerca* an International peer reviewed Journal, Published from 14160 Red Hill Ave, Tustin, CA 92780, USA. ©2017 scientia ricerca Web site: http://scientiaricerca.com/nuft-eb.php
- Dr. Amit Nath, Principal Scientist (Food Technology) acted as rapporteurs for the technical session, Va: "Review of On-station Research" during AICRP-IFS Biennial workshop held at SKUAS&T, Jammu during 20-23rd December, 2016.
- Dr. Chandra Bhanu invited for lead lecture on "Educational and Policy Reforms for Green Technologies in Agriculture" during National Conference on Agriculture Renewal for Evergreen Revolution: Concepts and Approaches, organized at Department of Plant Pathology, Gochar Mahavidyalaya, Rampur Maniharan, Saharanpur (U.P.) on 10 March, 2017.
- Dr. Debashis Dutta acted as rapporteurs for the technical session: "Research Highlights, conclusions and recommendations" during AICRP-IFS Biennial workshop held at SKUAS&T, Jammu during 20-23rd December, 2017.
- Dr. M. Shamim, Scientist acted as Rapporteur in round table discussion on researchable issues in organic farming and integrated organic farming systems of 11th Annual Group Meeting on NPOF organized by ICAR-IISS, Bhopal and ICAR-IIFSR, Modipuram during 17-19 August, 2016.
- Dr. M. Shamim, Scientist monitored the experiments conducted under the aigies of AICRP on IFS (On-station, On –Farm and NPOF) centers located at Indore, Bhopal, Powarkheda, Katni, Dindori, Rewa and Jabalpur in Madhya Pradesh during 01-10 March, 2017.
- Dr. M. Shamim, Scientist recorded and presented the proceding of the Technical Session-Vb (Review of Tribal Sub Plan activities) of IV (XXXII) Biennial Workshop of AICRP on IFS during 20-23 December, 2016 at SKAUST, Jammu as Rapporteurs of the session
- Dr. M. Shamim, Scientist recorded and presented the proceding of the Inaugural session of the 11th Annual Group Meeting on NPOF organized by ICAR-IISS, Bhopal and ICAR-IIFSR, Modipuram during 17-19 August, 2016.
- Dr. M. Shamim, Scientist recorded the recommendations as Rapporteurs of Technical Session VII: Admin and Financial issues, finalization of workshop recommendation of IV (XXXII) Biennial Workshop of AICRP on IFS during 20-23 December, 2016 at SKAUST, Jammu
- Dr. M. Shamim, Scientist acted as Rapporteur of the plenary session of IV (XXXII) Biennial Workshop of AICRP on IFS during 20-23 December, 2016 at SKAUST, Jammu.
- Dr. M. Shamim, Scientist was invited by the ADG (AAF &CC), NRM, ICAR, New Delhi to participate in the meeting with Metro France representative on integrated solution for weather and climate information system and services incorporating agriculture knowledge base held on 6th Oct. 2016 at KAB II, ICAR New Delhi.

- Dr. M. Shamim, Scientist was invited by the In charge Project Coordinator (AICRPAM), ICAR-CRIDA, Hyderabad to participate in the XIV Biennial Workshop of AICRP on Agrometeorology at PAU, Ludhiana during 5-7 December, 206 for providing valuable inputs in improving the research programs of the Project

- Dr. N. Ravisankar, Principal Scientist and Dr. M. Shamim, Scientist guided Dr Amit Kumar, Scientist (Agronomy) during Orientation Training programme.

- Dr. N. Ravisankar, Principal Scientist & National PI, NPOF is Member of the Committee constituted by Government of India, Ministry of Agriculture to examine the issues relating to Biological Products/ Bio fertilizers.

- Dr. N. Ravisankar, Principal Scientist & National PI, NPOF is Member of Organic World Congress-2017 Science track paper review committee.

- Dr. N. Ravisankar, Principal Scientist served as the External Examiner for M.Sc thesis evaluation to Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu. During the year, evaluated 1 M.Sc thesis for award of degree.

- Dr. Poonam Kashyap acted as Judge for evaluation of post-harvest products at Exhibition stalls of Agricultural fair organised by Sardar VallabhBhai Patel University of Agriculture and Technology from 5-7 October, 2016.

- Dr. Poonam Kashyap acted as reviewer for Indian Journal of Horticulture and Journal of Environmental biology journal during the year.

- Dr. Poonam Kashyap delivered a lead lecture on Scope and Importance of Horticulture in Farming systems" during National conferenece on Natural Resources Management for Sustainable Agriculture organized by Agricultural Technology Development Society on 25 October, 2016 at Janta Vedic College, Baghpat, UP.

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भारतीय कृषि प्रणाली अनुसंधान संस्थान, मोदीपुरम, मेरठ में राजभाषा हिंदी के अधिकाधिक प्रयोग को बढ़ावा देने एवं समस्त कार्यालय कर्मियों में राजभाषा हिंदी के प्रति अभिरूचि पैदा करने के उद्देश्य से 14–28 सितंबर 2016 तक हिंदी पखवाड़े का आयोजन किया गया। इस दौरान हिंदी से संबंधित विभिन्न कार्यक्रमों/प्रतियोगिताओं जैसे निबंध लेखन, टिप्पण एवं प्रारूप लेखन, यूनीकोड से हिंदी टंकण, हिंदी सामान्य ज्ञान, वाद–विवाद, अंत्याक्षरी, वैज्ञानिक कार्यशाला एवं स्वरचित काव्य पाठ आदि का आयोजन किया गया। सभी प्रतियोगिताओं के विजयी प्रतिभागियों को प्रथम, द्वितीय, तृतीय एवं प्रोत्साहन पुरस्कार देकर सम्मानित किया गया। इसके अतिरिक्त वर्ष 2015–16 के दौरान हिंदी में अधिक से अधिक कार्य करने वाले कर्मियों को भी पुरस्कृत किया गया। उक्त प्रतियोगिताओं में सभी संवर्ग के अधिकारियों एवं कर्मचारियों ने बढ़–चढ़ कर प्रतिभागन किया। संस्थान के निदेशक डॉ. आजाद सिंह पँवार ने विजयी प्रतिभागियों को बधाई देते हुए सभी वैज्ञानिकों एवं अधिकारियों से अपने अधिक से अधिक कार्यालयीन कार्यों को हिंदी में करने तथा शोध कार्यों को हिंदी के माध्यम से किसानों तक पहुँचाकर उनकी समस्याओं का समाधान करने की सलाह दी।

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1	हिंदी कार्यशाला	एक दिवसीय/21.06.2016	कार्यालय कर्मी एवं आमंत्रित अथिति
2	हिंदी कार्यशाला	एक दिवसीय/29.09.2016	कार्यालय कर्मी एवं आमंत्रित अथिति
3	हिंदी कार्यशाला	एक दिवसीय/31.12.2016	कार्यालय कर्मी एवं आमंत्रित अथिति
4	हिंदी कार्यशाला	एक दिवसीय/25.03.2017	कार्यालय कर्मी एवं आमंत्रित अथिति

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(क) रा.भा.का.स. की प्रथम त्रैमासिक बैठक, दिनांक 16.05.2016

(ख) हिंदी कार्यशाला का आयोजन, दिनांक 21.06.2016

(ग) रा.भा.का.स. की द्वितीय त्रैमासिक बैठक, दिनांक 06.08.2016

(घ) हिंदी पखवाड़ा का आयोजन, दिनांक 14–28 सितंबर, 2016

(ङ) हिंदी कार्यशाला का आयोजन, दिनांक 29.09.2016

(च) रा.भा.का.स. की तृतीय त्रैमासिक बैठक, दिनांक 16.12.2016

(छ) हिंदी कार्यशाला का आयोजन, दिनांक 31.12.2016

(ज) रा.भा.का.स. की चतुर्थ त्रैमासिक बैठक, दिनांक 21.03.2017

(झ) हिंदी कार्यशाला का आयोजन, दिनांक 25.03.2017

SUCCESS STORY

Integrated nutrient and pest management (INPM) technology for boosting sugarcane production in Kailawara village of Western U.P.

Village KailawaraKalan is located in Khatauli Block of District Muzaffarnagar (U.P.). The total geographical area of the village is 510 ha with net cultivated area of 415 ha. Total population of village is 8200 with 752 households. Out of total 752 households, 67.82 % are having cultivated lands and falling under large small and marginal categories. Maximum cultivated area (38%) of the village is owned by small farmers. The major cropping systems of the village sugarcane (plant crop)-sugarcane (ratoon crop)- wheat. Sugarcane is major crop of the village occupying about 90% of net cultivated area among crops and main source of income and livelihood security of the farmers. The yield of sugarcane was comparatively medium and ranged between 60-75 t ha^{-1}. Two varieties of sugarcane Co 0238 and CoJ 88 are occupying most of the cultivated area by sugarcane. The major problem of sugarcane identified through PRA was its lower productivity due to imbalance use of fertilizers, higher incidence of insect-pests and diseases. In sugarcane, farmers have been found to apply 2-2.5 times higher doses of nitrogen through urea as compared to the recommended one (150 kg ha^{-1}). Application of phosphorus was more or less in the range of recommended range (60 kg ha^{-1}). However, there was almost nil application of potash and micronutrients (sulphur, zinc, and iron). Sugarcane is a heavy feeder crop and exhaust heavy amount of potash and other major and micronutrients from the soil which need to be replaced in the soil through additional application of the nutrients for maintaining higher productivity. Imbalanced use of fertilizers was also linked with heavy infestation of insect-pests and diseases in sugarcane. The major insect-pests of sugarcane were early shoot borer (*Chiloinfuscatellus*) and top borer (*Scirpophaga excerptalis*) were responsible for heavy damage of crop and ultimately the yield losses to the tune of 20-30%. Recently a new emerging disease of sugarcane known as *Pokkahboeng* was also noticed in many fields of sugarcane. Farmers of the village were helpless in managing the pests and were dependent on local pesticide dealers whose major intension was to make profit by providing substandard quality of pesticides without giving any recommended advisory. This also led to the heavy application of pesticides by the farmers with lower degree of pest control.

Plate 80: Training for application of INPM Technology

Keeping above problems in view and need of sustainable pest management ICAR-IIFSR under the leadership of Dr. B.K. Sharma, Pr. Scientist planned to incorporate integrated nutrient and pest management (INPM) package in ratoon and plant crop of sugarcane in an area of about 60 ha along with need based advisory to the farmers under On-farm Integrated Farming Systems Management programme. Recommended doses of NPK (150, 60, 60 kg/ha) and other nutrients i.e. sulphur (25 kg ha^{-1}), zinc sulphate (25 kg ha^{-1}) and ferrous sulphate (8 kg ha^{-1}) were applied in the plant crop and 25% higher doses of these fertilizers in case of ratoon crop. For managing early shoot borer, a basal application of carbofuran 3% CG was done. For controlling top borer and other borers in advance stage of crop four releases of *Trichogramma chilonis* (@75000 parasitized eggs/ ha) were made during end of July, Ist and IInd fortnight of August and mid-September. The affected field with *pokkahboeng* disease was sprayed with 1% carbendazim. Observations on the incidence of insect-pests and diseases and yield of sugarcane were recorded at end of the season. Views of farmers were also taken on the visible results of the interventions. There was tremendous increase in the yield of sugarcane due to application of integrated nutrient and pest management technology. On an average, yield of plant crop increased to 90 t ha^{-1} from 70 t ha^{-1} (28.57%). The impact of technology was much more visible in case of ratoon crop (37.5% increases in yield) where it reaches to 1100 q/ha in INPM fields when compared to 800 q/ha in non-INPM fields. In plant crop, average cane length and weight recorded were 272cm and 1.52 kg in INPM fields against 233 cm and 1.18 kg in non-INPM fields. Likewise in ratoon crop, average cane length and weight recorded were 305 cm and 1.84 kg in INPM fields against 285 cm and 1.61 kg in non-INPM fields. On an average, the net benefit of Rs. 50000 to Rs. 80000/ha was recorded with additional Rs. 4000-5000/ha expenditure on INPM package. The green top weight was also increased in the INPM fields which assures green fodder supply to animals. There was 50 to 100% decrease in the attack of different borers and *pokkahboeng*disease in sugarcane crop with INPM package. Farmers of the village are very much impressed with the INPM technology in sugarcane and it has also changed the mindset of farmers for adopting the technology. The success of the INPM technology in Kailawara village conveys the message that, there is scope for increasing the productivity of sugarcane in a sustainable way in the region to the tune of 25-35%.

Plate 81: Release of Trichocards in Sugarcane

Plate 82: Demonstration of Trichocard Preparation

FARMER'S FIRST

Plate 83: Kisan Gosthi on PoP's of Rabi crops at Village – Soanta, Muzzafarnagar

Plate 84: Kisan Gosthi on PoP's of Rabi crops at Village – Sathedi, Muzzafarnagar

Plate 85: Animal health camp organized at Village – Bhangela, Muzzafarnagar

Plate 86: Exposure visit of farmers to Krishi Unnati Mela at IARI, New Delhi

Plate 87: Small farm tools for drudgery reduction in women farmers

Plate 88: Demonstration on vegetable transplanting using small farm implements for drudgery reduction

DISTINGUISHED VISITORS

1. Shri Chhabilendra Roul, Additional Secy. (DARE) & Secy. (ICAR), New Delhi and Dr. A. K. Singh, DDG (Agric. Extension), ICAR, New Delhi visited IIFSR on 20.12.2016

Plate 89: Shri Chhabilendra Roul and Dr. A. K. Singh visiting IIFSR Research Farm

Plate 90: Shri Chhabilendra Roul and Dr. A. K. Singh observing experiments and interacting with Scientists on IIFSR Research Farm

2. Shri Suresh Chandel, Member, Governing body, ICAR and Ex. M.P. visited ICAR-IIFSR from 20-21 September, 2016

Plate 91: Plantation of fruit plant byShri Suresh Chandel at IIFSR Research Farm

Plate 92: ADG (AAF&CC), NRM, ICAR New Delhi monitoring field experiments of ICAR-IIFSR

ICAR-IIFSR IN MEDIA

खतौली तहसील के गांव सेंटा में आयोजित किसान गोष्ठी को संबोधित करते वक्ता।

कम खर्च में पाएं अधिक पैदावार : डा. आजाद

दिन में बढ़ा तापमान रात को हुई ठंड

19 साल में सबसे गर्म रही 24 की दोपहर

अगले 48 घंटे में शीतलहर और पाले का कहर

दिन में गर्मी, रात में धूल भरी आंधी

मौसम बिगड़ने से बेनूर हुई नौचंदी, कई इलाकों की बिजली गुल

एक फरवरी से बदलेगा मौसम

दो दिन बाद बारिश की संभावना

तीन दिनों तक बारिश के आसार, बढ़ेगी ठंड

बदलेगा मौसम

गेहूं के लिए उपयुक्त, आलू के लिए नुकसानदेह

दो डिग्री गिरा दिन का तापमान

सर्दी से राहत, दिन और रात का पारा चढ़ा

पांच साल में सबसे गरम रहा बुधवार

पारा@26.2°

यह ग्लोबल वार्मिंग का असर

आज से कोहरे की संभावना, बढ़ेगी सर्दी

मौसम वैज्ञानिकों ने कहा- अभी ऐसे ही बना रहेगा मौसम का मिजाज

सामान्य से नीचे गया पारा

सात दिनों का तापमान

तारीख	अधिकतम	न्यूनतम
11	17.2	5.5
12	18.1	4.9
13	20.1	5.2
14	19.6	5.1
15	22.5	8.4
16	20.2	8.2
17	15.1	7.2

115 साल में 2016 सबसे गर्म

1901 की तुलना में 2016 में तापमान में 0.9 डिग्री सेल्सियस की बढ़ोतरी

संगम 8 घंटे लेट, समय पर हुई रवाना

शीत ऋतु में मेरठ का औसत तापमान

एक फरवरी से बदलेगा मौसम

वेस्ट यूपी में तीन से फिर बदलेगा मौसम

मई में प्री मानसून ने धो डाला 5 साल का रिकॉर्ड

मई में पांच साल में बारिश का रिकॉर्ड

वर्ष	बारिश
2012	शून्य
2013	41.9
2014	43.03
2015	33.3
2016	51.7

(नोट : बारिश मिमी में)

तापमान से ज्यादा तप रही ये गर्मी

40.6°

पहुंचा तापमान

मंगलवार को दिल्ली और आसपास आ सकती है आंधी

10 जून से पहले राहत मिलने की नहीं है संभावना

ग्लोबल वार्मिंग का असर

दो दिन और रहेगा कोहरा, फिर करवट लेगा मौसम

पांच डिग्री उछला पारा

गर्मी, लू के थपेड़ों ने किया बेहाल

गर्मी ने किया हलकान, निकल रही 'जान

40° तक पहुंचा पारा

तीन दिन से फिर बढ़ गई गर्मी

सोमवार से तीन दिन तक आंधी के साथ बारिश की संभावना

तारीख	अधिकतम	न्यूनतम
जून 2015 में तापमान		
1	38.1	24.
2	37.9	25.
3	35.0	23.
जून 2016 में तापमान		
1	38.6	23.
2	39.7	26.
3	40.0	26.2

(नोट : तापमान डिग्री सेल्सियस में)

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ON-GOING RESEARCH PROJECTS

Institute Projects

S. No.	Project Title and Code	PI	Co PI's	Duration	Code
1.	Development of cost effective and sustainable Integrated Farming System Models for livelihood improvement of small farm holders.	Dr. J.P. Singh	Dr. Dusyant Mishra Dr. A. K. Prusty Dr. S. Malik	2010-2017	**NRMAPDFSRSIL201100200120**
2.	On-Farm value addition for livelihood improvement of small farm households in Western Plain Zone of Uttar Pradesh	Dr. Amit Nath	Dr. M. P. Singh Dr. D. Dutta Dr. R.P. Mishra Dr. Poonam Kashyap Dr. Nisha Verma	2013- 2018	**NRMAPDFSRSIL201400100135**
3.	Evaluation of fodder based cropping system for sustained production and livelihood improvement of marginal farmers Convert in full project in 28th IRC	Dr. L. R. Meena	Dr.R. S. Yadav Dr. Sanjeev Kumar Dr. Lalit K. Meena	2015-18	**NRMAPDFSRSIL201500600153**
4.	Development of fruit crop based high density farming systems for higher productivity and profitability under small farm conditions	Dr. Dushyant Mishra	Dr. J.P. Singh Dr. Amit Nath Dr. Chandra Bhanu Dr. L.K. Meena	2014-2024	**NRMAPDFSRSIL201400600140**
5.	Development of fish based farming system model for marginal farmers	Dr. A. K. Prusty	Dr. J.P. Singh Dr. S. Malik Dr. Amit Nath Dr. P. Kashyap Dr. Peyush Punia Dr. M. Shamim	2015-2020	**NRMAPDFSRSIL201501300160**
6.	Development of web based integrated information system for Indian farming systems research	Mr. Vipin Kumar Choudhary		2015-2017	**NRMAPDFSRSIL201500500152**
7.	Comparative study of role of women in predominant farming systems of Western plain zone of UP and Hill zone of Uttarakhand	Dr. Nisha Verma	Dr. M.P.S. Arya Dr. M.P. Singh Dr. Poonam Kashyap Dr. Amit Nath	2013-2016	**RMAPDFSRSIL201400400138**
8.	Assessment of climate change impact on integrated Farming Systems through Modelling	Dr. N. Subash	Dr. M. Shamim Dr. J.P. Singh Dr. A.K. Prusty Dr. S. Malik	2013-2016	**NRMAPDFSRSIL201300300132**
9.	Studies on Persistence of Pesticides Residues in the agricultural produce of intensively cultivated farming situations in peri–urban areas of Western Plain Zone of Uttar Pradesh	Dr. Debashish Dutta	Dr. Prem Singh Dr. Amit Nath Dr. D. Mishra Dr. Nisha Verma	2013-2018	**NRMAPDFSRSIL201400200136**

S. No.	Project Title and Code	PI	Co PI's	Duration	Code
10.	Evaluation of sugarcane – wheat varieties under sugarcane-ratoon-wheat cropping system under organic and inorganic conditions	Dr. Devendra Kumar	Dr. Sanjeev Kumar Mr. Lalit K. Meena Mr. Amrit Lal Meena	20015-2017	**NRMAPDFSRSIL201500400151**
11.	Development of Year round production module of mushroom for small and marginal farmers	Dr. Chandra Bhanu	Dr. J.P. Singh Dr. Amit Nath	2013-2016	**NRMAPDFSRSIL201300500134**
12.	Estimation of greenhouse gas emission from IFS modules and models under AICRP-IFS	Dr. N. Subash	Dr. J.P. Singh Dr. L.R. Meena Dr. Vinod Kumar Dr. Dushyant Mishra	2014-2017	**NRMAPDFSRSIL201400900143**
13.	Effect of RCT and Potassium application on soil health, productivity and quality of produce in Integrated Farming system	Dr. Sanjeev Kumar	Dr. L.K. Meena Dr.Vinod Kumar Dr. V.P. Choudhary Dr. A.L. Meena Dr. L.R. Meena	2015-2020	**NRMAPDFSRSIL201501400161**
14.	System based proven technologies in farming system perspective under demonstration in Technology park	Dr. M.P. Singh	Dr. Prem Singh Dr. R.P. Mishra	2014- 2018	**NRMAPDFSRSIL201400500139**
15.	On-farm validation of ICAR-IIFSR developed IFS modules for marginal and small farm house holds	Dr. M.P. Singh	Dr. Sanjeev Kumar Dr. Vinod Kumar Dr. A.K. Prusty Dr. Poonam Kashyap Dr. Chander Bhanu Dr. Peyush Punia	2015-2020	**NRMAPDFSRSIL201501500162**
16.	Characterization and mapping of Farming Systems in India	Dr. Harbir Singh	Dr. Vinod Kumar Mr. Raghuveer Singh Dr. NishaVerma Dr. S. Malik Dr. L.R. Meena	2014-2016	**NRMAPDFSRSIL201401000144**
17.	Diversification of existing farming systems through integration of poultry for improving livelihood of marginal and landless farmers	Dr. Suresh Malik	Dr.Vinod Kumar Dr. A.K. Prusty	2014-2018	**NRMAPDFSRSIL201400700141**
18.	On-Farm Integrated Farming Systems Management	Dr. B.K. Sharma	Dr. Anil Kumar Dr. Chandra Bhanu Dr. D. Mishra Dr. Prem Singh	2015-2018	**NRMAPDFSRSIL201500800155**
19.	Productivity and economic evaluation of horticulture based farming systems	Dr. Poonam Kashyap	Dr. Harbir Singh Dr. R.S. Yadav	2011-2020	**NRMAPDFSRSIL201100200121**
20.	Weed utilization evaluation for supplementary farming system productivity	Dr. T. Ram	Dr. Prem Singh Dr. V. P. Choudhary	2016-2017	**NRMAPDFSRSIL201600500167**
21.	Long term influence of Resource Conservation Technologies in Rice-Wheat system	Dr. V. P. Choudhary		2004-2016	**NRMAPDFSRSIL200400100058**

S. No.	Project Title and Code	PI	Co PI's	Duration	Code
22.	Development of suitable resource conservation modules to mitigate the ill effects of climate change	Dr. V. P. Choudhary	Dr. M .Shamim Dr. Chandra Bhanu	2013-2017	**NRMAPDFSRSIL201300400133**
	Coordination Unit (CU)				
20.	AICRP on IFS : On-station Research (All India)	Dr. A.S. Panwar (Project Coordinator) Dr. N. Ravisankar PF (CU)	Dr. J.P. Singh Dr. Prem Singh Dr. Harbir Singh Dr. R.P. Mishra Dr. Debashis Dutta Dr. N. Subash Dr. M. Shamim	2016-2020	
21.	AICRP on IFS : On-farm Research (All India)	Dr. N. Ravisankar	Dr. Raghuveer Singh Dr. Amit Kumar	2017-2020	
22.	NPOF (All India)	Dr. N. Ravisankar (National PI)	Dr. M. Shamim Dr. R.P. Mishra	2016-2020	

Externally Funded Projects

S. No.	Project Title and Code	PI	Co PI's	Duration	Code
1.	Network Project on Organic Farming (NPOF).Modipuram Centre	Dr. R.P Mishra w.e.f.31/08/2016	Dr. Chandra Bhanu Dr. Amit Nath Dr. Debashis Dutta Dr. P.C. Ghasal Dr. A.L. Meena	2005-2017	**NRMAPDFSRCOL200500100064**
2.	AICRP on Integrated Farming Systems (On-station, Modipuram)	Dr. J. P. Singh	Dr. D. Mishra Dr. S. Malik Dr. Chandrabhanu	2010-2017	**NRMAPDFSRCOL201000700113**
3.	AICRP on Integrated Farming Systems (OFR- Modipuram)	Dr. L. R. Meena		2014-2017	**NRMAPDFSRSIP201401300147**
4.	On-farm precision nutrient prescr-iption under pre-dominant cereal-cereal cropping system using Nutrient Expert ®. IPNI Project	Dr. R. P. Mishra		2014-2016	**NRMAPDFSRSOL201401100145**
5.	Adaptation and mitigationpotential throughconservation agriculture andIFS modules (NICRA).	Dr. N. Subhash	Dr. M. P. S. Arya Dr. V. P. Choudhary Dr. Debashis Dutta Dr. Sanjeev Kumar Dr. P.C. Ghasal	2011-2017	**NRMAPDFSRSOL201100500124**
6.	Integrated spatial farming systems analysis techniques with remote sensing and ancillary data (INFARM)	Dr. N. Ravi-sankar	Dr. M. Shamim	2013-2016	**NRMAPDFSRCOP201300200131**
7.	Integrated organic farming systems project (consultancy mode with UCOB)	Dr. N Ravisankar		2014-2016	**NRMAPDFSRSCL201401200146**

S. No.	Project Title and Code	PI	Co PI's	Duration	Code
8.	Agri-CRP project on Conservation Agriculture	Dr. M. P. S. Arya	Dr. A. L. Meena Dr. Sanjeev Kumar	2015-2017	**NRMAPDFSRSOP201500100148**
9.	Efficient ground water management for enhancing adaptive capacity to climate change in sugarcane farming system	Dr. Prem Singh	Dr. V. P. Choudhary Dr. N. Subash	2015-2017	**NRMAPDFSRSOP201500200149**
10.	Integrated farming system research for improvement of nutrition and livelihood of farm women under different agro ecosystem	Dr. Dushyant Mishra	Dr. Nisha Verma Dr. Sanjeev Kumar	2015-2018	**NRMAPDFSRSIL201400600140**
11.	Development of Package of Machineries for complete Mechanization of small land holders under different farming systems situations (Extra mural)	Dr. V. P. Choudhary	Dr. Nisha Verma	2016-18	**NRMAPDFSRSOL201600100163**
12.	Soil quality assessment and developing indices for major soil and production regions of India	Dr. D. Dutta	Dr. T. Ram	May2016-18	**NRMAPDFSRSOL201600200164**
15.	Ensuring food and nutritional security through Integrated Farming System in Western Uttar Pradesh (Farmer's First)	Dr. A.S. Panwar	Dr. M.P. Singh Dr. S. Malik Dr. Poonam Kashyap Dr. A.K. Prusty Dr. M. Shamim Mr. Sunil Kumar Dr. Nisha Verma	2016-2018	**NRMAPDFSRSOL201600400166**

Foreign Aided Projects

S. No.	Project Title and Code	PI	Co PI's	Duration	Code
1.	Global Yield Gap and Water Productivity	Dr. N. Subash		2013-16	**NRMAPDFSRCOP201300100130**
2.	Strengthening Simulation Approaches for Understanding, Projecting and Managing Climate Risks in Stress-prone Environments Across the Central and Eastern Indo Gangetic Basin.(Phase II)	Dr. N. Subash	Harbir Singh	2015-2017	**NRMAPDFSRSOP201500300150**
3.	Developing and defining climate smart agriculture practices portfolios in South Asia	Dr. A.K. Prusty	Dr. P.C. Ghasal Dr. Vipin Kumar	2016-2018	**NRMAPDFSRSOP201600300165**

DETAILS OF PERSONNEL (AS ON 31.03.2017)

Name of the Institute : ICAR-Indian Institute of Farming Systems Research, Modipuram, Meerut-250 110

Name of the Director : Dr. A. S. Panwar

A. Scientific Staff

S. No.	Name of the Scientist	Designation	Discipline
	Principal Scientist		
1	Dr. M.P. Singh	Pr. Scientist	Agric. Extension
2	Dr. Vinod Kumar	Pr. Scientist	Animal Nutrition
3	Dr. Prem Singh	Pr. Scientist	Agronomy
4	Dr. Peyush Punia	Pr. Scientist	Fisheries Resource Management
5	Dr. Anil Kumar	Pr. Scientist	Agric. Extension
6	Dr. L. R. Meena	Pr. Scientist	Agronomy
7	Dr. Harbir Singh	Pr. Scientist	Agric. Economics
8	Dr. N. Ravisankar	Pr. Scientist	Agronomy
9	Dr. S.P. Singh	Pr. Scientist	Agric. Economics
10	Dr. Suresh Malik	Pr. Scientist	Poultry Science
11	Dr. Amit Nath	Pr. Scientist	Food Technology
12	Dr. R. P. Mishra	Pr. Scientist	Agronomy
13	Dr. N. Subash	Pr. Scientist	Agric. Meteorology
	Senior Scientist		
15	Dr. V.P. Chaudhary	Sr. Scientist	FMP
16	Dr. Dushyant Mishra	Sr. Scientist	Fruit Science
17	Dr. Debasish Dutta	Sr. Scientist	Agric. Chemicals
18	Dr. Devendra Kumar	Sr. Scientist	Plant Breeding
19	Dr. T. Ram	Sr. Scientist	Agronomy
	Scientist		
20	Shri Vipin Kumar Chaudhary	Scientist	Computer Application
21	Dr. Chandra Bhanu	Scientist	Plant Pathology
22	Dr. Poonam Kashyap	Scientist	Fruit Sceince
23	Dr. A. K. Prusty	Scientist	Aquaculture
24	Dr. Sanjeev Kumar Kochewad	Scientist	LPM

S. No.	Name of the Scientist	Designation	Discipline
25	Dr. M. Shamim	Scientist	Agric. Meteorology
26	Shri Sunil Kumar	Scientist	Agric. Economics
27	Dr. Sanjeev Kumar	Scientist	Agronomy
28	Dr. Nisha Verma	Scientist	Home Science
29	Shri Raghuveer Singh*	Scientist	Agronomy
30	Dr. Lalit Krishan Meena	Scientist	Plant Physiology
31	Shri Amrit lal Meena*	Scientist	Soil Science
32	Dr. P.C. Ghasal	Scientist	Agronomy
33	Dr. Amit Kumar	Scientist	Agronomy

* On study leave

B. Technical Staff

S. No.	Name of the Officers	Designation
1	Shri Yogendra Singh	CTO
2	Shri D. Tripathi	CTO
3	Shri Krishan Pal	CTO
4	Shri Vipin Kumar	CTO
5	Shri K. V. Anand	ACTO
6	Shri Brij Mohan	ACTO
7	Shri Om Kumar Tomar	ACTO
8	Shri Naval Singh	ACTO
9	Shri P. P. Mishra	ACTO
10	Shri S. P. Singh	ACTO
11	Shri S. K. Duhoon	STO
12	Shri R. B. Tewari	STO
13	Shri Vinod Kumar	STO
14	Shri D. P. Singh	STO
15	Shri A. P. Dwivedi	TO
16	Shri D. K. Pandey	TO
17	Shri Krishan Kumar	TO
18	Shri Uma Shankar Pandey	STA
19	Shri Ashok Kumar	STA
20	Smt. Anju Verma	Sr. Technician
21	Shri Raj Kumar Meena	Sr. Technician

C. Administrative staff

S. No.	Name of the Officers	Designation
1	Shri Ravinder Singh	Senior Admn. Officer
2	Shri T. C. Sharma	Finance& Accounts Officer
3	Shri Surya Kant	P. S. to Director
4	Shri Attar Singh	P.A.
5	Shri Rai Bahadur	P.A.
6	Smt. Jailata Sharma	P.A.
7	Smt. Alka Jain	Assistant
8	Shri Sanjay Kumar Gupta	Assistant
9	Shri S. K. Bansal	P. A.
10	Shri Rajesh Kumar	P. A.
11	Shri Brij Beer singh	P. A.
12	Smt. Sheela Devi	Assistant
13	Shri Jata Kant	Assistant
14	Shri Ravi Kant	U.D.C.
15	Shir Prem Singh	U.D.C.
16	Sh. Rajender Kumar	L.D.C.
17	Sh. Permanand	L.D.C.

D. Supporting Staff

S. No.	Name of the Officers	Designation
1	Shri Anand Singh	SSS
2	Shri Prem Kumar	SSS
3	Shri Rakesh Kumar	SSS
4	Shri Kripa Shankar Pandey	SSS
5	Shri Ayodhya Prasad Dubey	SSS
6	Shri Prem Singh	SSS
7	Shri Mahavir Singh	SSS
8	Shri Siddh Kumar	SSS
9	Shri Harshnath Singh	SSS
10	Shri Sada Ram	SSS

NOTES

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