भाकृअनुप
ICAR

Annual Report 2015-16

जैविक खेती पर नेटर्वक परियोजना

Network Project on Organic Farming

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

ICAR- IIFSR

ICAR-Indian Institute of Farming Systems Research (IIFSR) (formerly Project Directorate for Farming Systems Research-PDFSR), was established by Indian Council of Agricultural Research, New Delhi in April, 1989 at Modipuram, Meerut (Uttar Pradesh).

Vision

Management of natural resources for holistic improvement of small and marginal farmers through Integrated Farming Systems

Mission

Improve food, nutrition, livelihood and financial security of small and marginal households through climate smart Integrated Farming Systems (to make marginal and small households as bountiful)

Mandate

- Research in integrated farming systems on production technologies for improving productivity and resource use efficiencies.
- Develop efficient, economically viable and environmentally sustainable integrated farming system models for different farming situations.
- On-farm testing, verification and refinement of system-based farm production technologies.
- Coordinate and monitor integrated farming systems research in the country.

All India Coordinated Research project on Integrated Farming Systems (AICRP on IFS) is an integral part of ICAR-IIFSR with 75 centres to undertake on-station main (25 no's), on-station sub (12 no's), on-station voluntary (6 no's) and on-farm research (32 no's) spread across length and breadth of the country. The institute is also leading a Network Project on Organic Farming (NPOF) with 20 centres.

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Important Notes:

- This compilation is a joint contribution of all the scientists involved in Network Project on Organic Farming (NPOF) at 13 centres and ICAR-IIFSR, Modipuram (report writing, compilation, editing and printing).
- The AnnualReport 2015-16 is based on experimental data generated during *kharif*, *rabi* and *summer* seasons of 2014-15. The other details are relevant up to 31 March 2016.
- The report includes both processed and semi-processed data, generated in different experiments under Network Project on Organic Farming (NPOF) and as such no material/ data should be reproduced in any form without prior written permission of the Director, ICAR-Indian Institute of Farming Systems Research and due credit to the concerned scientist (s).

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ACKNOWLEDGEMENT

Network Project on Organic Farming (NPOF) initiated in 2004 is operating with 13 co-operating centres in 12 states. During XII plan in the year 2015-16, the numbers of centres have been increased to 20 from 13. Presently, the scheme covers 16 states by involving 11 State Agricultural Universities, 7 ICAR institutes and 1 deemed (special heritage) university. The results of the experiments conducted during 2014-15 at 13 co-operating centres are processed and compiled in the Annual Report 2015-16 of the scheme. I take this opportunity to record my sincere thanks to **Dr. T. Mohapatra**, Secretary, Department of Agricultural Research and Education and Director General, Indian Council of Agricultural Research, New Delhi for offering critical comments and guidance for improving the activities of the scheme constantly. I extend my gratitude to **Dr. K. Alagusundaram**, Acting Deputy Director General (Natural Resource Management) for his constant support extended to the scheme. The time to time guidance and specific inputs on technical and administratve matters of the scheme received from **Dr. S. Bhaskar**, Assistant Director General (Agronomy, Agroforestry and Climate Change) for improving the performance and output of the scheme is duly acknowledged. Scientific inputs received from **Quinquennial Review Team (QRT), Research Advisory Committee (RAC)** and **Institute Management Committee (IMC)** are thankfully acknowledged as those inputs provided valuable help in taking new initiatives, shaping and improvement of the programmefor practical applications.

I am highly thankful to each and every one of the scientists and research fellows involved in the scheme at 13 centres for putting the meticulous effort to conduct the field experiments, lab analysis and generating data. The sincere efforts put forth by **Dr. N. Ravisankar**, Principal Scientist and National Principal Investigator deserves appreciationfor overall super vision of preparing the report. I also extend my appreciation to **Dr. M. Shamim,** Scientist and **Dr. Vipin Kumar**, Chief Technical Officer for their sincere efforts in compilation of the data, its statistical analysis, drafting and proof correction. Thanks and appreciations are also due to **Dr. J.P. Singh**, Former Director (Acting) for extending the cooperation in preparation of report.

The contributions of all the other scientific, technical, administrative and skilled supporting staff either directly or indirectly at various levels during preparation of this report are also acknowledged. I am sure; the significant findings obtained from the experiments especially varietiesfor various crops for organic production system and Integrated Organic Farming System (IOFS) models are of practical in nature and can be adopted by organic growers.

(AS Panwar)
Director

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lkjk'k

जैविक खेती पर नेटवर्क परियोजना के अंतर्गत वर्ष 2014–15 के दौरान किए गए मुख्य शोध निष्कर्ष नीचे दिये गये है।

1- tfod] jlk;fud vkj ,dh—r ¼tfod dh vkj½ mRiknu ç.kkyh¸k¨ dk eY;kdu

- **ckt kjk ¼fgekpy çn'k½** में ग्रीष्मकालीन टमाटर (12840 कि0ग्रा0/है0), फ्रेंचबीन (7860 कि0ग्रा0/है0), उडद (970 कि0ग्रा0/है0), भिंडी (10510 कि0ग्रा0/है0) और ग्रीष्मकालीन कददू (14970 कि0ग्रा0/है0) की अधिकतम उपज एकीकृत प्रबंधन (50% प्रत्येक जैविक और अजैविक) के तहत पाई गई जिसके बाद जैविक पैकेज की ओर (75% जैविक+25% अजैविक) प्रबंधन के साथ उच्च उपज 11620 और 7130, कि0ग्रा0/है0 क्रमशः फ्रेंचबीन और ग्रीष्मकालीन कददू मे दर्ज की गई। रबी मे फूलगोभी और मटर, खरीफ में उडद और भिंडी और ग्रीष्मकालीन फ्रेंचबीन में क्रमशः 24.9, 14.3, 2.3, 17.9 और 20.6% की वृद्धि 25% कम जैविक खाद के रूप में पोषक तत्वों के साथ दर्ज हुई है।

- **Hkkiky ¼e/;çn'k½** में सोयाबीन–सरसों प्रणाली में 100% जैविक प्रबंधन के तहत सोयाबीन की उच्च उपज (666 कि0ग्रा0/है0) दर्ज की गई थी जो अजैविक और एकीकृत प्रबंधन की तुलना में 32.3 और 25.2% अधिक थी। 75 और 100% जैविक पोषक तत्वों के माध्यम से जैविक खाद के साथ क्रमशः सोयाबीन, गेहूं, सरसों, चना और अलसी की उपज में 9.0, 4.1, 8.4, 5.9% का अन्तर पाया गया।

- **dkyhdV ¼djy½** में हल्दी की उच्च उपज (27117 कि0ग्रा0/है0) एकीकृत पैकेज (50% जैविक+50% अजैविक) के साथ दर्ज कि गयी हालांकि, जैविक खादों के माध्यम से 75% पोषक तत्वों के प्रयोग जैविक खाद के माध्यम से अभिनव प्रयोग के परिणामस्वरूप हल्दी की उपज (16758 कि0ग्रा0/है0) और जैविक खाद के माध्यम से 100% पोषक तत्वों की आपूर्ति के साथ जैविक प्रबंधन की तुलना में हल्दी की उच्च पैदावार (19375 कि0ग्रा0/है0) पाई गईं ।

- **dk;EcVj ¼rfeyukMq½** में कपास, मक्का, मिर्च, सूरजमुखी और चुकंदर में राज्य सिफारिश पैकेज के अंतर्गत 100% पोषक अजैविक स्रोतों के जरिए प्रयोग की तुलना में जैविक प्रबंधन की ओर (75% जैविक+25% अजैविक) के साथ अधिक उपज दर्ज की गयी है और कपास, मक्का, मिर्च, सूरजमुखी और चुकंदर के लिए क्रमशः 25.6, 19.7, 22.4, 18 और 11.6% की वृद्धि दर्ज की गई ।

- **/kkjokM ¼dukVd½** में राज्य सिफारिश पैकेज के तहत लोबिया, कुसुम, मूंग, ज्वार, मूंगफली और कपास की उच्च उपज (314, 2672, 445, 3141, 1677 और 1835 कि0ग्रा0/है0 क्रमशः) दर्ज की गईं। अरहर और

चने ने 50% जैविक+50% अजैविक स्रोत के साथ एकीकृत प्रबंधन पैकेज के तहत अधिकतम उपज (2305 और 1394 कि0ग्रा0/है0) दर्ज कीं गई। 100% जैविक प्रबंधन के साथ गेहूं, कुसुम, अरहर, मूंग, ज्वार, मूंगफली, कपास और मक्का मे 9.2, 51.5, 5.4, 77.3, 19.4, 13.8, 56.1 और 44.7 प्रतिशत की गिरावट अजैविक प्रबंधन की तुलना मे पाई गई।

- **tcyij ¼e/; çn'k½** में धान (3274 कि0ग्रा0/है0) और मटर (2249 कि0ग्रा0/है0) की उच्च उपज 100% जैविक प्रबंधन के साथ थी, जबकि गेहूं (3710 कि0ग्रा0/है0), मक्का चारा (42000 कि0ग्रा0/है0), बरसीम बीज और चारा (273 और 68810 कि0ग्रा0/है0), ज्वार चारा (44690 कि0ग्रा0/है0) की उपज 100% अजैविक प्रबंधन के साथ दर्ज की गई।

- **dtV ¼egkjk"V½** में धान की अधिकतम पैदावार (3761 कि0ग्रा0/है0) 100% अजैविक प्रबंधन प्रथाओं को अपनाने के साथ दर्ज की गई थी, जबकि जैविक खादों से 75% पोषक तत्वों+अभिनव प्रयोग के तहत न्यूनतम अनाज उपज 3596 कि0ग्रा0/है0 प्राप्त हुई । अन्य फसलों की अधिक उपज जैसे कि मक्का, सरसों और डोलिकस बीन, अजैविक स्रोतों के जरिए 100% पोषक तत्व आपूर्ति प्रबंधन के साथ दर्ज हुई।

- **yf/k;kuk ¼ijrkc½** में राज्य सिफारिश पैकेज के तहत बासमती धान–चना–हरी खाद प्रणाली में अधिकतम बासमती धान उपज 4730 कि0ग्रा0/है0 अजैविक प्रबंधन के साथ दर्ज की गयी थी। अरहर की अधिकतम उपज (570 कि0ग्रा0/है0) 100% जैविक पैकेज के तहत दर्ज की गई। राज्य सिफारिश पैकेज के तहत चने (220 कि0ग्रा0/है0) का प्रदर्शन बेहतर पाया गया। गेहूं की उच्च उपज (5180 कि0ग्रा0/है0) एकीकृत पैकेज में 50% प्रत्येक जैविक और अजैविक प्रबंधन के साथ दर्ज की गई थी।

- **ekndhije ¼mUkj çn'k½** में धान, गेहूं, जौ, मूंग और मक्का (पॉपकॉर्न) में उच्च उपज क्रमशः 4860, 4460, 4450, 974 और 2140 कि0ग्रा0/है0 (75% जैविक+25% अजैविक पोषक तत्व स्रोतों) जैविक की ओर एकीकत प्रबंधन के तहत दर्ज की गई। जबकि मक्का (मीठी मकई) की अधिकतम उपज (11730 कि0ग्रा0/है0) जैविक और अजैविक प्रत्येक 50% (एकीकत प्रबंधन) के साथ दर्ज हुई। आलु, भिंडी और सरसों की उच्च उपज 23240, 7600 और 2070 कि0ग्रा0/है0 क्रमशः जैविक प्रबंधन के तहत जैविक स्रोतों के जरिये 100% पोषक तत्वों के साथ दर्ज की।

- **iruxj ¼mUkjk[kM½** में बासमती धान (4223 कि0ग्रा0/है0) की अधिकतम उपज 100% जैविक पैकेज के साथ थी, इसके बाद अजैविक और एकीकृत प्रबंधन की तुलना में 75% जैविक+अभिनव प्रथाओं के साथ (4068 कि0ग्रा0/है0) पाई गई। रबी मे गेहूं की पैदावार 4915 कि0ग्रा0/है0 सबसे अधिक एकीकृत प्रबंधन (प्रत्येक 50% जैविक और अजैविक) के साथ थी इसके बाद 75% जैविक +25% अजैविक जैविक उत्पादन प्रणाली के अंतर्गत उपज आना इसका बेहतर प्रदर्शन दर्शाता है। फसल जैसे चना, सब्जी

मटर और आलू की अधिकतम उपज जैविक प्रबंधन के तहत क्रमशः 1301, 5046 और 13760 कि0ग्रा0/है0 दर्ज की गई।

- **jk;iqj ¼NÙkhlx<½** में सोयाबीन ने राज्य सिफारिश के साथ उच्च पैदावार 2090 कि0ग्रा0/है0 दर्ज की, इसके बाद 25% कम जैविक खाद (75% जैविक+ 25% अजैविक) के साथ 2046 कि0ग्रा0/है0 दर्ज की। अन्य फसलों जैसे मक्का, मटर, मिर्च और प्याज ने राज्य सिफारिश पैकेज के तहत उच्च पैदावार क्रमशः 11795, 7246, 9556, 9555 और 16208 कि0ग्रा0/है0 दर्ज की। अजैविक पैकेज की तुलना मे 100% जैविक के तहत सोयाबीन, मक्का, मटर, मिर्च और प्याज के साथ उपज का अंतर क्रमशः 6.1, 2.0, 5.1, 2.6 और 8.4% पाया गया।

- **jkph ¼>kj[kaM½** में धान–आलू प्रणाली में चावल की उच्च उपज 4177 कि0ग्रा0/है0 75% जैविक पोषक तत्वों के साथ जैविक पैकेज मे दर्ज की गई। गेहूं की अधिकतम उपज 2835 कि0ग्रा0/है0 100% अजैविक पोषक तत्वों के साथ अजैविक पैकेज के तहत दर्ज हुई। आलू और अलसी की उच्च उपज क्रमशः 16254 और 821 कि0ग्रा0/है0 जैविक स्रोतों के साथ 100% जैविक प्रबंधन के साथ दर्ज की गई। मसूर की उच्च उपज 250 कि0ग्रा0/है0 एकीकृत पैकेज (50% जैविक+50% अजैविक) के तहत पाई गई।

- **mfe;e ¼e?kky;½** में धान की उच्च उपज 4180 कि0ग्रा0/है0 उच्चीकृत क्यारी में एकीकृत पैकेज (50% जैविक+50% अजैविक) के साथ दर्ज की गई, इसके बाद 3760 कि0ग्रा0/है0 उपज 100% जैविक प्रबंधन के साथ दर्ज की। धँसी क्यारी में चावल की किस्म शहशारंग–1 ने अधिकतम उपज (4670 कि0ग्रा0/है0) का उत्पादन किया, उसके बाद लम्पाना (4380 कि0ग्रा0/है0) की उपज है, जबकि चावल की उच्च अनाज उपज धँसी क्यारी में एकीकृत पोषक प्रबंधन (4540 कि0ग्रा0/है0) के साथ दर्ज हुई। गाजर और आलू ने 75% पोषक तत्व के साथ एकीकृत पैकेज के तहत 14500 और 14900 कि0ग्रा0/है0 अधिकतम उपज दर्ज की, जबकि फ्रेंचबीन और टमाटर ने उच्चीकृत क्यारी मे अधिकतम उपज 9500 और 14700 कि0ग्रा0/है0 100% पोषक तत्वों के साथ जैविक पैकेज के अंतर्गत दर्ज की थी।

2- tfod [krh dh fy;s e[; Qly dh fdLeksa dh çfrfØ;k dk eY;kdu

- खरीफ में टमाटर की किस्म हीम सोहना और गर्मियों मे टमाटर की किस्म रेड गोल्ड की अधिकतम फल उपज (क्रमशः 1033 और 131914 कि0ग्रा0/है0) उच्च फलों की संख्या/पौधों (5.0 और 9.0) के साथ दर्ज की गई इसके उपरांत खरीफ के दौरान टमाटर की किस्मों आरके–123 (990 कि0ग्रा0/है0, रेड सोना (986 कि0ग्रा0/है0), नवीन–2000 (970 कि0ग्रा0/है0) और गर्मियों में संकर–7730 (12547 कि0ग्रा0/है0), मनीषा (11860 कि0ग्रा0/है0) ने उच्च उपज दर्ज की। मटर की किस्म टेन प्लस द्वारा अन्य किस्मों की तुलना में पौधों की ऊँचाई (86.78 सेंटीमीटर), फलिया की संख्या/पौधा (12.17), बीज

संख्या/फली (7.10) और छिलका प्रतिशत (66.70%) के साथ उल्लेखनीय रूप से अधिकतम उपज 4687 कि0ग्रा0/है0 दर्ज की थी। अन्य किस्मों की तुलना में भिंडी की चमेली–015 और इंद्राणी किस्मों की उच्च फल उपज (क्रमशः 12607 और 12100 कि0ग्रा0/है0) दर्ज की गई है। संकर फूलगोभी यूएस–178 ने उल्लेखनीय रूप से उच्च फूल उपज 10201 कि0ग्रा0/है0 दर्ज की इसके बाद चंद्रमुखी (10000 कि0ग्रा0/है0) और महारानी (9946 कि0ग्रा0/है0) की उपज दर्ज की गई जबकि पाम उपहार के फूल का वजन (458 ग्रा) उल्लेखनीय रूप से ctkjk ¼fgekpy çn'k½ में काफी अधिक पाया गया।

- सोयाबीन की किस्म आर.वी.एस.–2002–4 ने अधिकतम उपज (1236 कि0ग्रा0/है0) उल्लेखनीय रूप दर्ज की हैं। गेहूं की उल्लेखनीय रूप से उच्च अनाज उपज (3317 कि0ग्रा0/है0) एचआइ–8498 प्रजाति के साथ दर्ज की गई थी। मक्का की किस्म कन्चन की अधिकतम अनाज और पुआल उपज (2764 और 5998 कि0ग्रा0/है0) के साथ दर्ज की गयी । चने की किस्म जेजी–130 में उच्च बीज पैदावार (1707 कि0ग्रा0/है0) थी इसके अनुरूप जैवउपज पैदावार 4541 कि0ग्रा0/है0 Hkkikiky ¼e/; çn'k½ में दर्ज की गयी थी।

- प्रबंधन प्रणालियों में, कार्बनिक स्रोतों के माध्यम से एकीकृत प्रणाली के साथ 50% कार्बनिक 50% अकार्बनिक स्रोतों के माध्यम से अधिकतम हल्दी की उपज 27000 कि0ग्रा0/है0 dkyhdV ¼dqjy½ में दर्ज की गई। हल्दी की किस्मों, केदाराम और प्रभा ने क्रमशः 23300 और 23400 कि0ग्रा0/है0 अधिकतम उपज जैविक प्रबंधन प्रथाओं के अंतर्गत दर्ज की थी।

- dk;Ecvj ¼rfeyukM½ में मूल्यांकन किए गए अन्य सभी किस्मों में धान की किस्म सीबी–05022 का प्रदर्शन बेहतर पाया गया है। इसने अधिकतम पैदावार 4100 कि0ग्रा0/है0 दर्ज की है ।

- खरीफ के दौरान कार्बनिक प्रबंधन की तुलना में अकार्बनिक प्रणाली के तहत अधिक पौधे की ऊंचाई (158.3 सेमी), 1000 दानों का वजन (19.4 ग्रा) अनाज उपज (3429 कि0ग्रा0/है0), चारा (17500 कि0ग्रा0/है0) की दर से ज्वार का उत्पादन हुआ। इसी तरह अजैविक पद्धति से पैदा हुई चने की किस्म एमएबीसी–37 की उपज 5582 कि0ग्रा0/है0) जैविक की तुलना में अधिकतम दर्ज की गई। /kkjokM ¼dukVd½ में रासायनिक गेहूं का उत्पादन 3565 कि0ग्रा0/है0 से जैविक उपज की तुलना में 3587 कि0ग्रा0/है0 किया गया।

- tcyiqj ¼e/; çn'k½ में धान के किस्मों पीएस–3 (3090 किलो), उसके बाद जेआर–201 (2878 किग्रा), पुसा बासमती–1 (2874 किग्रा), आईआर–36 (2592 किलो) और पीएस–4 (2551 कि0ग्रा0/है0) में अनाज की पैदावार उल्लेखनीय रूप से अधिक थी। उल्लेखनीय रूप से उच्च गेहूं की उपज एचआई–1500 (4796 कि0ग्रा0/है0) के साथ दर्ज किया गयी थी इसके बाद एचआई–1418 (4733 कि0ग्रा0/है0) और जेडब्ल्यू–3173 (4629 कि0ग्रा0/है0) की दर्ज की गई।

- **dtV ¼egkjk"V½** में धान और पुआल की अधिकतम उपज किस्म सहयाद्री–4 (4110 और 5650 कि0ग्रा0/है0) के साथ अगेती बुआई की दशा में उल्लेखनीय रूप से दर्ज की गई। सह्याद्री–5 की उपज (4857 कि0ग्रा0/है0) देर से बुआई की दशा में दर्ज की गयी। सूखी मूंगफली की उच्च पैदावार कोंकण गौरव में 2414 कि0ग्रा0/है0 दर्ज की गई।

- **yf/k;kuk ¼iatkc½** में बासमती चावल की पैदावार 3587 से 5586 कि0ग्रा0/है0 तक पाई गई। बासमती धान की किस्म पुसा–1592 की पैदावार 5586 कि0ग्रा0/है0 के हिसाब से दर्ज किया गयी, के अनुसरण में पूसा बासमती–1121 4886 कि0ग्रा0/है0) प्राप्त की। गेहूं बीडब्ल्यूएल–0134 की उल्लेखनीय रूप से उच्च उपज (4278 कि0ग्रा0/है0) देखी गई।

- **eknhi;e ¼mÙkj çn'k½** में मक्का पीएमएच–3 की पैदावार 6330 कि0ग्रा0/है0 पायी गयी, इसके अनुसरण में सीड टेक–2324 की उपज 5830 कि0ग्रा0/है0) और एचक्यूपीएम–5 की उपज 5170 कि0ग्रा0/है0 दर्ज की गयी। विभिन्न सरसों की किस्मों के दरमयान, उच्च बीज उपज आरजीएन–229 1970 कि0ग्रा0/है0 के साथ दर्ज की गयी थी और यह आरएच–0406 उर्वशी, एनआरसीएचबी–506, पूसा बोल्ड और आरजीएन–48 (क्रमशः 1950,1910,1830) के साथ सांख्यिकीय रूप से समान पाई गयी।

- **iwokaxy ¼mÙkjk[kM½** मोटे चावल की किस्मों में, एनडीआर–359 (6058 कि0ग्रा0/है0) में अधिक अनाज उपज देखा गयी जबकि बासमती धान की अन्य किस्मों में पंत बासमती–1 (4425 कि0ग्रा0/है0) ने उल्लेखनीय रूप से उच्च चावल अनाज उपज प्राप्त की थी। गेहूं की अन्य किस्मों की तुलना में यूपी–1109 (4427 कि0ग्रा0/है0) ने गेहूं का उल्लेखनीय रूप से उच्च अनाज उपज दर्ज की जो यूपी–2565 (4108 कि0ग्रा0/है0) के साथ बराबरी पर थी।

- **jk;iqj ¼NÙkhlx<½** में सुगंधित चावल की अधिकतम उपज जयगुंडी (4256 कि0ग्रा0/है0) के साथ दर्ज की गयी जो अन्य सभी प्रकार की किस्मों से अधिक श्रेष्ठ थी सिवाय गोपालभोग, जीराफूल, तुलसी मंझारी, सीआर सुगंधा धान–907 को छोड़कर, जिन्होनें 3678, 3972, 3683 और 3661 कि0ग्रा0/है0 की दर से पैदावार दर्ज की थी ।

- **jkph ¼>kj[kM½** में चावल की अधिकतम अनाज उपज (4200 कि0ग्रा0/है0) किस्म एमटीयू–10 के साथ प्राप्त की गई जो ललत (4067 कि0ग्रा0/है0), बिरसामती (3989 कि0ग्रा0/है0), पूसा सुगंध (3771 कि0ग्रा0/है0), नवीन (3889 कि0ग्रा0/है0) और बिरसा विकास धान–203 (3733 कि0ग्रा0/है0) से बेहतर थी। विभिन्न प्रकार के किस्मों में बीवीडी–110 ने की कम अनाज उपज प्राप्त हुई। गेहूं की किस्मों में, के–0307 में उच्च उपज (3233 कि0ग्रा0/है0) दर्ज की गई जो कि राज–4229 (3104 कि0ग्रा0/है0), जीडब्ल्यू–366 (2967 कि0ग्रा0/है0), डीबीडब्ल्यू–39 (2960 कि0ग्रा0/है0) और बीजी–3 (2844 कि0ग्रा0/है0) के साथ सांख्यिकीय रूप से बराबरी पर थी।

- **mfe;e ¼e?kky;½** में डीए–61–ए में अधिकतम मक्का अनाज उपज (3390 कि0ग्रा0/है0) दर्ज की गई है, इसके अनुसरण में आरसीएम–76 की पैदावार 3290 किलो प्रति हेक्टेयर थी। टमाटर किस्म एमटी–2 की उच्च उपज (22450 कि0ग्रा0/है0) दर्ज की किया गयी जो कि सांख्यिकीय रूप से पंत टी–10 (1890 कि0ग्रा0/है0), एमटी–9 (18780 कि0ग्रा0/है0), एमटी–11 (18600 कि0ग्रा0/है0) और एमटी–3 (17270 कि0ग्रा0/है0) से समान थी। फ्रेंचबीन में अधिकतम उपज नागा स्थानीय में 8700 कि0ग्रा0/है0 दर्ज की गई के अनुसरण में आरसीएम–एफबी–18 (7810 कि0ग्रा0/है0) और आरसीएम–एफबी–19 (5500 कि0ग्रा0/है0) ने सबसे ज्यादा हरी फली की उपज दर्ज की थी।

3- tlo mRiknu ç.kkfy;ksa d vrxr tlo&lâku ekukFk Qly ç.kkfy;k dk eY;kdu

- **/kkjokM ¼dukVd½** में भूमि विन्यास तकनीकों में, फसल अवशेष के समावेशन बिना परंपरागत फ्लैटबेड पर सभी फसल पद्धति के अंतर्गत अधिकतम उपज दर्ज की गई। कपास की पैदावार (669 कि0ग्रा0/है0), ज्वार (2775 कि0ग्रा0/है0) और अरहर (1232 कि0ग्रा0/है0) की उपज भूमि में फसल अवशेषों समावेशन के साथ चौडीं क्यारी और कूंड विधि के साथ दर्ज की गयी। उल्लेखनीय रूप से प्रणाली समतुल्य उपज सोयाबीन–गेहूं प्रणाली (3650 कि0ग्रा0/है0) में दर्ज की गई थी और यह सोयाबीन+अरहर (3629 कि0ग्रा0/है0) के साथ बराबरी पर थी। फसल के अवशेषों के साथ रोपण की पारंपरिक फ्लैटबेड विधि ने उच्च शुद्व मौद्रिक प्रतिफल और लाभ लागत अनुपात (क्रमशः रू. 76,665/है0 और 3.16) का उत्पादन किया गया, इसके अनुसरण में फसल अवशेषों के समावेशन के साथ चौडीं क्यारी और कूंड (बीबीएफ) ने क्रमशः रू. 73,342/है0 और 3.02, का शुद्व मौद्रिक प्रतिफल और लाभ लागत अनुपात प्राप्त किया ।

- **lkruxj ¼mÙkjk[kaM½** में सभी अन्य संसाधन संरक्षण प्रथाओं पर धान गहनता पद्धति (एस.आर.आई.)–गेंहूॅ–ढेंचा ने उल्लेखनीय ढंग से धान की उच्च उपज 3944 कि0ग्रा0/है0 दर्ज की थी। गेंहूॅ की अधिकतम उपज 3322 कि0ग्रा0/है0 धान की सीधी बुवाई (डी0एस0आर)–गेंहूॅ–मूंग में चौडी क्यारी और कूंड विधि (बी0बी0एफ0) के साथ दर्ज हुई थी जबकि न्यूनतम उपज 3048 कि0ग्रा0/है0 धान–गेंहॅू–ढेंचा के साथ दर्ज की। मटर की हरी फली की उच्च उपज 9249 कि0ग्रा0/है0 डी0एस0आर–मटर –लोबिया के साथ चौडीं क्यारी और कूड पर धान की सीधी बुआई (डी0एस0आर)+सोयाबीन–मटर–सरसों 7462 कि0ग्रा0/है0 की तुलना में उच्च उपज प्राप्त की थी। डी0एस0आर–चना–मूंग फसल क्रम में चने की उपज बी0बी0एफ0 में 1524 कि0ग्रा0/है0 के साथ डी0एस0आर–चना–मूंग में दर्ज की गई थी। गेंहॅू की उल्लेखनीय समतुल्य उपज 10042 कि0ग्रा0/है0 चौडीं क्यारी और कूड पर डी0एस0आर–चना–मूंग के साथ पाई गई थी जो डी0एस0आर–मटर–लोबिया के साथ बराबरी पर थी। शुद्व मौद्रिक प्रतिफल (रु. 2,10,485/है0) और लाभ लागत अनुपात (4.35) डीएसआर+सोयाबीन– मटर+सरसों में चौडीं क्यारी और कूंड विधि के साथ दर्ज किया गया था। न्यूनतम मौद्रिक प्रतिफल और लाभ लागत अनुपात

चावल–अरहर–लोबिआ+भिंडी प्रणाली में (रु. 52345/है0) और (1.53) के साथ उच्चीकृत क्यारी विधि में देखा गया था। बासमती समतुल्य उपज के मामले में उल्लेखनीय रूप से उच्च उत्पादकता (8968 कि0ग्रा0/है0) डीएसआर+सोयाबीन–मटर+सरसों में देखी गई थी।

- mfe;e ¼e?kky;½ में धँसी क्यारी में चावल की उत्पादकता 3290 से 4470 कि0ग्रा0/है0 के बीच दर्ज की गई थी। चावल की किस्मों में, शाहसरंग–1 ने सबसे अधिक उपज (4470 कि0ग्रा0/है0) दर्ज की थी, इसके बाद चावल–मटर फसल अनुक्रम के तहत लंपना (4210 कि0ग्रा0/है0) के साथ दर्ज की गई। रबी के दौरान मसूर दाल की उपज चावल (विवेक धान–82)–मटर (1110 कि0ग्रा0/है0) प्रणाली में सबसे ज्यादा दर्ज की गई थी। सबसे ज्यादा मटर का उत्पादन (4700 कि0ग्रा0/है0) चावल (विवेक धान–82)–मटर में दर्ज किया गया था, इसके बाद धान (लंपना) – मटर प्रणाली मे (4400 कि0ग्रा0/है0) पाई गई। उच्चतम धान समतुल्य उपज (13070 कि0ग्रा0/है0), धान (लम्पना)–मटर के तहत दर्ज की गई जिसके बाद चावल (वीडी–82) – मटर 12660 कि0ग्रा0/है0 दर्ज की थी। आलू, फ्रेंचबीन और गाजर की उपज उच्चीकृत क्यारी पर क्रमशः 15000, 7200 और 14200 कि0ग्रा0/है0 थी। खरीफ सीजन के दौरान भिंडी की पैदावार 7900 से 8300 कि0ग्रा0/है0 थी और 8300 कि0ग्रा0/है0 के साथ भिंडी की उपज फ्रेंचबीन–भिंडी प्रणाली में सबसे अधिक पाई गयी जबकि धान समतुल्य उपज गाजर–भिंडी फसल प्रणाली के तहत (34400 कि0ग्रा0/है0) अधिकतम दर्ज की गयी।

4- lefdr tSfod –f"k ç.kkyh ¼IOFS½ e,My dk fodkl

- एक एकड़ में मसाला आधारित समेकित जैविक कृषि प्रणाली मॉडल जिसमें हल्दी (0.2 है0), केला (0.01 है0), अनानास (0.02 है0), सब्जी लोबिया (0.01 है0) और चाराघास यानि CO-3, CO-4 संकर नेपियर, कोगोंजिनल (0.14 है0) और डेयरी (दो गाय, 0.02 है0) को स्थापित किया जा रहा है। हल्दी, अदरक, चाराघासे, कोगोंजिनल, याम्स, टैपियोका, केला और अनन्नास का रोपड़ किया गया। चाराघासे (686 किग्रा), टैपियोका (80 किग्रा) और सब्जी लोबिया (8 किग्रा) की उपज प्राप्त की गयी। रू 79631/एकड़ का शुद्ध लाभ समेकित जैविक कृषि प्रणाली के साथ dkyhdV ¼djy½ में प्राप्त किया गया।

- एक एकड़ समेकित जैविक कृषि प्रणाली मॉडल जिसमें (0.12 है0) में फसल प्रणाली भिण्डी+धनिया पत्ती–मक्का चारा+लोबिया (0.12 है0), हरी खाद–कपास–ज्वार (0.12 है0) और चाराघास COCN(4) *डैसमेन्थस* (0.1 है0)+कृषि वानिकी (ढैंचा, *थैसपिसिया पोपिलिनिया, ल्यूसीमिया ल्यूकोसेफला* 0.03 है0) + डेयरी (दो गाय एक बछड़ा 0.01 है0) + वर्मीकम्पोस्ट (0.01 है0) + सीमावर्ती पेड़ (*डेसमेन्थस*, केला, *ग्लाईरिसीडिया*) + समर्थन क्षेत्रफल (खाद गढ्ढा, खलिहान फर्श, 0.01 है0) को dk;EcVj ¼rfeyukM½ में स्थापित

किया गयाहै। IOFS मॉडल 1.76 लाभ लागत अनुपात के साथ शुद्ध लाभ रू. 94,288 प्रति एकड़ उत्पन्न कर सका है। शुद्ध लाभ पशुपालन का योगदान रू. 66308 पाया गया है।

- mfe;e ¼e?kk y;½ में एक 0.43 है0 समेकित जैविक कृषि प्रणाली मॉडल में खेती की कुल लागत रु. 55839 दर्ज की गई थी। कुल लागत का अधिकतम 48% मॉडल के फसल घटकों में खर्च किया गया था। डेयरी यूनिट के साथ एक वयस्क गाय और एक बछड़ा के लिये कुल लागत का 36% दर्ज किया गया, जबकि मत्स्य पालन घटक के लिये कुल लागत का 9% दर्ज किया गया। 72 वर्ग मीटर क्षेत्र की वर्मी कंपोस्टिंग इकाई और पंक्ति रोपण, अवशिष्ट रीसाइक्लिंग, रॉक फॉस्फेट प्रयोग और चूनाकरण जैसे अन्य महत्वपूर्ण कार्यों को बनाए रखने के लिए रु. 3700 खर्च किए गए जो कि कुल लागत का 7% व्यय है। प्रति वर्ष रुपये 62,531 का कुल शुद्ध लाभ मॉडल के तहत प्राप्त किया गया था जो एक रूपी फसल चावल या चावल–सब्जियों प्रणाली में क्षेत्र के किसानों की सामान्य प्रथाओं से बहुत अधिक है। मॉडल के कुल शुद्ध प्रतिफल के लिए सबसे ज्यादा योगदान फसल घटकों (61%) द्वारा किया गया, इसके बाद डेयरी (25%) और मत्स्यपालन घटक (20%) का योगदान रहा है। मछली का उत्पादन 136 किलो था। डेयरी घटक से शुद्ध लाभ की गणना केवल दूध के उत्पादन की दृष्टि से गई थी क्योंकि गाय के गोबर के उत्पादन को मॉडल में वापस पुनर्नवीनीकरण किया गया था जिसका उपयोग फसल उत्पादन के लिए खाद के रूप में किया गया। मॉडल से कृमि खाद का उत्पादन सालाना 1500 किलोग्राम था और यह खेत में फसलों को पोषक तत्व पूरक के लिए इस्तेमाल किया गया था।

ABSTRACT

Network project on Organic Farming (NPOF) started in 2004-05 with 13 cooperating centres covering 12 states. The salient research achievements are presented below.

1. Evaluation of organic, inorganic and integrated production systems

- **Bajaura (Himachal Pradesh):** Among the crops evaluated, summer tomato (12840 kg/ha) and frenchbean (7860 kg/ha) recorded higher yield under integrated management followed by towards organic package comprising of 75% organic+25% inorganic (11620 and 7130 kg/ha, respectively). Response of black gram (970 kg/ha) and okra (10510 kg/ha) was found to be higher with 50% organic+50% inorganic management approach. Summer squash registered higher yield with integrated management (14210 kg/ha) and 75% organic+25% inorganic management (14210 kg/ha and 14790 kg/ha). In *rabi*, cauliflower and pea and in *kharif* black gram and okra, in *summer* french bean the yield is increase by 24.9, 14.3, 2.3 and 17.9, 20.6% was observed with 25% reduced application of nutrients in the form of organic manures under integrated management.

- **Bhopal (Madhya Pradesh):** Higher yield of soybean (666 kg/ha) was recorded under 100% organic management in soybean-mustard cropping system and it was found to be higher by 32.3% and 25.2% compared to inorganic and integrated package. The yield difference was between 75 and 100% nutrients application through organic manures under organic management by 9.0, 4.1, 8.4, 5.9, and 7.5% for soybean, durum wheat, mustard, chickpea and linseed respectively.

- **Calicut (Kerala):** Turmeric recorded higher yield (27117 kg/ha) with integrated package consisting of 50% organic +50% inorganic. However, among the organic management, reduced application of nutrients 75% through organic manures resulted in higher yield of turmeric (19375 kg/ha) than organic management with 100% nutrients supply through organic (16758 kg/ha).

- **Coimbatore (Tamilnadu):** Crops such as cotton, maize, chillies, sunflower and beetroot recorded higher yield under integrated package with 75% organic +25% inorganic followed by state recommendation by applying 100% nutrients through inorganic sources. The yield increase was found to be 25.6, 19.7, 22.4, 18 and 11.6% for cotton, maize, chillies, sunflower and beetroot respectively.

- **Dharwad (Karnataka):** Cowpea, safflower, greengram, sorghum, groundnut and cotton recorded higher yield (314, 2672, 445, 3141, 1677 & 1835 kg/ha respectively) under state recommendation. Pigeonpea and chickpea recorded maximum yield (2305 and 1394 kg/ha) under integrated management package with 50% organic + 50% inorganic sources The yield reduction under 100% organic management found in cowpea, safflower, pigeonpea, greengram, sorghum, groundnut, hybrid cotton and maize were 9.2, 51.5, 5.4, 77.3, 19.4, 13.8, 56.1& 44.7 % respectively over inorganic packages.

- **Jabalpur (Madhaya Pradesh):** Grain yield of rice was higher under organic package (3274 kg/ha) with 100% organic management, whereas wheat (3710 kg/ha), maize fodder (42000 kg/ha), berseem seed and fodder (273 and 68810 kg/ha), sorghum fodder (44690 kg/ha) were recorded higher under inorganic package with 100% inorganic management. Vegetable pea recorded higher yield (2249 kg/ha) under 100% organic sources.

- **Karjat (Maharashtra):** Yield of rice (3761 kg/ha) was recorded with adoption of 100% inorganic management practices while, adoption of organic with 75% nutrient from organic manures +innovative practices recorded lowest grain yield (3596 kg/ha). Other crops such as maize, mustard and dolichos bean, recorded higher yield with inorganic package having 100% nutrient supply through inorganic sources.

- **Ludhiana (Panjab):** Maximum basmati rice yield (4730 kg/ha) was recorded with inorganic management under state recommendation in basmati rice-chickpea-green manure system. Pigeon pea (570 kg/ha) recorded higher yield under 100% organic package. Chickpea (220 kg/ha) performed better under state recommended package. Wheat recorded higher yield (5180 kg/ha) in integrated package with 50% each organic and inorganic management.

- **Modipuram (Uttar Pradesh):** Rice, wheat, barley, greengram, and maize (popcorn) recorded higher yield (4860, 4460, 4450, 974 and 2140 kg/ha respectively) under integrated management with 75% organic + 25% inorganic nutrient sources while maize (sweet corn) recorded maximum (11730 kg/ha) with 50% of each organic and inorganic management package. Potato, okra and mustard recorded higher yield (23240, 7600 and 2070 kg/ha respectively) under organic management with 100% nutrient supply through organic sources.

- **Pantnagar (Uttrakhand):** Grain yield of basmati rice (4223 kg/ha) was higher with 100% organic package followed by 75% organic +innovative practices (4068 kg/ha) compared to inorganic and integrated management. In *rabi* wheat yield (4915 kg/ha) was highest under integrated (50% each organic and inorganic) followed by 75% organic +25% inorganic, indicating better performance with towards the organic production system. Crops like chickpea, vegetable pea and potato recorded higher yield of 1301, 5046 and 13760 kg/ha respectively under organic management respectively.

- **Raipur (Chhatisgarh):** Yield of soybean was recorded higher with state recommendation (2090 kg/ha) followed by reduced dose of organic manure 75% organic +25% inorganic (2046 kg/ha). Other crops such as maize, pea, chilli and onion recorded higher yield (11795, 7246, 9055 and 16208 kg/ha respectively) under state recommendation. The yield differences under inorganic package (from 100% organic to state recommendation) were found to be 6.1, 2.0, 5.1, 2.6 and 8.4% with soybean, maize, pea, chili and onion respectively.

- **Ranchi (Jharkhand):** Higher yield of rice (4177 kg/ha) was recorded with organic package with 75% organic nutrient sources in rice-potato system. Wheat recorded highest yield (2835 kg/ha) under inorganic package with 100% inorganic nutrients. Potato and linseed recorded higher yield (16254& 821 kg/ha) under organic package of nutrient respectively with 100% through organic sources. Lentil recorded higher yield (250 kg/ha) under integrated package (50% organic+50% inorganic).

- **Umiam (Meghalaya):** Higher rice grain yield (4180 kg/ha) on raised bed was recorded with integrated package having 50% organic+50% inorganic sources followed by 100% organic (3760 kg/ha). On sunken bed, rice variety Shahsharang-1 produced maximum grain yield (4670 kg/ha) followed by Lampnah (4380 kg/ha), whereas higher grain yield of rice was recorded under integrated (4540 kg/ha) nutrient management. Carrot and potato recorded higher yield 14500 and 14900 9400 kg/ha under

integrated nutrient package with 75% nutrient while, french bean and tomato recorded higher yield (9500 and 14700 kg/ha) under organic package with 100% organic grown on raised bed.

2. Evaluation of response of different varieties of major crops for Organic Farming

- **Bajaura (Himachal Pradesh):** Maximum fruit yield of tomato was recorded in variety Heem Sohna (1033 kg/ha) in *kharif* and Red gold (13914 kg/ha) in *summer* with higher no of fruits/plant (5.0 and 9.0) followed by varieties RK 123 (990 kg/ha), Red gold (986 kg/ha) Naveen 2000 (970 kg/ha) in *kharif* and hybrid 7730 (12547 kg/ha), Manisha (11860 kg/ha) in *summer*. The lowest fruit yield (503 kg *kharif* and 3872 kg/ha *summer*) was recorded in variety Sioux and Best of all.Significantly higher pod yield of pea (4687 kg/ha) was recorded in variety Ten Plus, also attained significantly higher plant height (86.78cm), number of pods/plant (12.17), number of seeds/pod (7.10) and shelling percentage (66.67%) compared to other varieties. Longest pods were found in variety Palam Priya (8.87cm). Variety Chameli 015 and Indranil of okra recorded significantly higher fruit yield (12607 & 12100 kg/ha, respectively) in comparison to other. Variety Palam Komal of okra recorded significantly lower fruit yield (9783 kg/ha). Cauliflowerhybrid US 178 recorded significantly higher curd yield (10201 kg/ha) followed by Chandramukhi (10000 kg/ha) and Maharani (9946 kg/ha). The Curd weight was significantly higher in PalamUphar (458g).

- **Bhopal (Madhya Pradesh):** Among the varieties of soybean grown under similar nutrient source and doses, RVS-2002-4 resulted in significantly higher yield (1236 kg/ha) owing to higher pods/plant (38.1) while, JS 20-34 recorded lowest soybean yield (631 kg/ha). Significant higher grain yield of wheat (3317 kg/ha) was recorded with variety HI 8498 among the wheat varieties. Maximum grain and straw yield of maize was recorded with Kanchan (2764 and 5989 kg/ha) and minimum in variety sweet corn (837 kg/ha and 1942 kg/ha). Chickpea variety JG 130 recorded higher seed yield (1707kg) ha^{-1} and correspondingly higher biomass yield 4541 kg/ha.

- **Calicut (Kerala):** Among management systems, integrated system with 50% through organic sources + 50% through inorganic sources recorded maximum turmeric yield (27000 kg/ha). In Varieties, Sudarshana recorded highest turmeric yield (32500 kg/ha) followed by Suguna (31400 kg/ha) under integrated management practice. Varieties, Kedaram and Prabha recorded maximum yield under organic management practices (100%) of 23300 and 23400 kg/ha.

- **Coimbatore (Tamilnadu):** In all the varieties evaluated, CB 05022 outperformed and superior over all the cultivars evaluated. It produced more grains/panicle with more filled grains and correspondingly recorded higher rice yield (4100 kg/ha). The grain yield of rice was obtained in the range of 2010 to 4100 kg/ha,

- **Dharwad (Karnataka):** Among the management packages, inorganic system produced significantly higher plant height (158.3 cm), 1000 grains weight (19.4 g) grain yield (3429 kg/ha), stover yield (17500 kg/ha) of sorghum compared to organic management during *kharif*. Similarly, inorganically grown chickpea variety MABC 37 recorded higher seed yield (5582 kg/ha) compared with organically grown chickpea. Crop grown inorganically produced higher grain yield of wheat (3587 kg/ha) as compared to organically grown (3565 kg/ha) of wheat.

- **Jabalpur (Madhaya Pradesh):** Grain yield of rice was observed from 2063 kg/ha in BVD-109 to 3090 kg/ha in PS-3 being followed by JR-201, (2878 kg), Pusa basmati-1 (2874 kg) IR-36 (2592 kg) and PS 4 (2551 kg) ha^{-1}. The lowest yield was recorded in BVD-109 (2063 kg/ha). Significantly higher wheat yield was recorded with HI 1500 (4796 kg/ha) followed by HI 1418 (4733kg) and JW-3173 (4629 kg). Wheat variety HI 1531 recoded lowest yield.

- **Karjat (Maharashtra):** Significantly higher grain and straw yield of rice was recorded by Sahyadri-4 (4110 and 5650 kg/ha respectively) under early sown conditions. Sahyadri-3outperformed better under mid-late sown condition with the yield of 3858 kg/ha. Variety sahyadri-5 (4857 kg/ha) recorded maximum grain yield under late sown condition. Lowest grain yield was recorded by Karjat-4 (2933 kg/ha). Significantly higher dry pods of groundnut yield (2414 kg/ha) recorded in Konkan Gaurav followed by TG 26 and RHRD 6083. Variety JL 501 produced lower yield (1711 kg/ha).

- **Ludhiana (Punjab):** Grain yield of basmati rice varied from 3587-5586 kg/ha with a maximum variation of 55.7%. Basmati rice variety Pusa 1592 outperformed significantly higher grain yield of 5586 kg/ha followed by Pusa basmati-1121 (4886 kg/ha) while, Pusa Basmati-2 recorded lowest grain yield (3587 kg/ha). Significant higher grain yield of wheat (4278 kg/ha) was observed in BWL -0134. The lowest grain yield was recorded with C-306 (2722 kg/ha).

- **Modipuram (Uttar Pradesh):** Grain yield of maize found to be higher in PMH-3 (6330 kg/ha) followed by seed tech-2324 (5830 kg/ha) and HQPM-5 (5170). Vivek QPM-9 (3830 kg/ha) recorded lowest maize yield producer. Among the mustard varieties, significantly higher seed yield was recorded with RGN-229 (1970 kg/ha) and it was statistically at par with RH- 0406, urvashi, NRCHB-506, Pusa Bold and RGN-48 (1950, 1910, 1910, 1870 and 1830 kg/ha respectively). Variety DRMRIJ 31 gave minimum yield of 1530 kg/ha.

- **Pantnagar (Uttarakhand):** Among coarse grain rice varieties, significantly higher grain yield was observed in NDR-359 (6098 kg/ha). Significantly higher grain yield among fine grain rice varieties was observed in Pant Basmati-1(4425kg/ha). Significantly higher grain yield of wheat was recorded in (4427 kg/ha) in UP-1109 and was at par with UP- 2565 (4108 kg/ha), compared to other wheat varieties.

- **Raipur (Chhatisgarh):** The highest grain yield of scented rice was recorded in Jayagundi (4256 kg ha-1) which was significantly superior over rest of the varieties except Gopalbhog, Jeeraphool, Tulsimanjari, CR Sugandha dhan-907 which produced 3678, 3972, 3683, and 3661 kg/ha^{-1} respectively. The lowest grain yield of scented rice was observed in Lalu 14 (1522 kg ha^{-1}).

- **Ranchi (Jharkhand):** The maximum grain yield of rice (4200 kg/ha) was obtained with rice variety MTU-10 which was significantly superior over all the rice varieties except Lalat (4067 kg/ha), Birsamati (3989 kg/ha), Pusa sugandha (3771 kg/ha), Naveen (3889 kg/ha) and Birsavikash dhan-203 (3733 kg/ha). Variety BVD 110 resulted in significantly lower grain yield among the variety. Among the wheat varieties, K-0307 recorded the higher yield (3233 kg/ha) which was statistically similar to Raj-4229 (3104 kg/ha), GW-366 (2967 kg/ha), DBW-39 (2960 kg/ha) and BG-3 (2844 kg/ha).

- **Umiam (Meghalaya):** DA 61-A (3390 kg/ha) recoded maximum grain yield of maize followed by RCM-76 (3290 kg/ha). Lower grains yield was recorded in the variety local white (2670 kg/ha) followed by

RCM-1-2 (2940 kg/ha). Among the twenty four cultivars of tomato evaluated under organic production system, MT-2 (22450 kg/ha) recorded higher yield which were statistically at par with cultivars Pant T-10 (18990 kg/ha), MT-9 (18780 kg/ha), MT-11 (18600 kg/ha) and MT-3 (17270 kg/ha). The lowest yield was found in the cultivar H-86 (5920 kgha). In French bean, the highest green pod yield was recorded in Naga local (8700 kg/ha) followed by RCM-FB-18 (7810 kg/ha) and RCM-FB-19 (5500 kg/ha). Lowest green yield was recorded in Maram (980 kg/ha).

3. Evaluation of bio-intensive complimentary cropping systems under organic production systems

- Among the land configuration techniques, conventional flatbed without residue recorded higher yield among the cropping system. Yield of cotton (669 kg/ha), sorghum (2775 kg/ha) and pigeon pea (1232 kg/ha) was recorded higher under broad bed furrow with crop residue. Significantly higher system equivalent yield was recorded in soybean-wheat system (3650 kg/ha) and it was on par with soybean +pigeon pea (3629 kg/ha). Conventional flatbed method of planting with crop residue produced higher net monetary returns and B:C ratio (Rs. 76,665/ha and 3.16 respectively) followed by broad-bed and furrow (BBF) with crop residues (Rs. 73,342/ha and 3.02, respectively) at **Dharwad (Karnataka).**

- System rice intensification (SRI)-wheat-sesbania system recorded significantly higher grain yield (3944 kg/ha) over all other resource conservation practices. Maximum grain yield of wheat (3322 kg/ha) was observed in DSR-wheat-moong on broad bed and furrow system while, lowest grain yield (3048 kg/ha) was observed in SRI-wheat–sesbania. Green pod yield of vegetable pea recorded higher (9249 kg/ha) in DSR-vegetable pea-cowpea on broad bed and furrow system compared to DSR+soybean-vegetablepea+mustard (7462 kg/ha). Chickpea yield recorded higher (1524 kg/ha) under DSR-chickpea-moong on broad-bed and furrow system. Significantly higher wheat equivalent yield (10042 kg/ha) was observed in DSR-chickpea-moong on broad bed and furrow system which was at par with DSR-vegetable pea –cowpea on broad bed and furrow system. Maximum net returns (Rs.2,10,485 /ha) and B:C ratio (4.35) was recorded in DSR + soybean –vegetable pea + mustard in broad bed and furrow system. Minimum net returns (Rs. 52345 /ha) and B: C ratio (1.53) was observed in rice-pigeon pea–cowpea + okra under furrow raised bed system. Significantly higher system productivity (8968 kg/ha) in terms of basmati grain equivalent was observed in DSR+ soybean –vegetable pea + mustard in furrow irrigated raised-bed system at **Pantnagar (Uttrakhand).**

- The rice productivity in sunken beds ranged from 3290 to 4470 kg/ha under different sequences. Among the rice varieties, Shahsarang-1 recorded the highest yield (4470 kg/ha) followed by Lampnah (4210 kg/ha) under rice-pea cropping sequence. During *rabi* the highest lentil yield was recorded in rice (Vivek dhan-82) -lentil (1110 kg/ha) system. The highest pea yield was recorded in rice (Vivek dhan-82) - pea (4700 kg/ha) followed by pea after lampnah (4400 kg/ha) system. The highest rice equivalent yield was recorded under rice (Lampnah)–pea (13070 kg/ha) followed by rice (VD-82) –pea 12660 kg/ha. Potato, French bean and carrot recorded yield on raised bed of 15000, 7200 and 14200 kg/ha respectively. The yield of okra during *kharif* season ranged from 7900 to 8300 kg/ha and was highest under french bean- okra cropping system (8300 kg/ha) whereas rice equivalent yield was recorded higher under carrot–okra cropping system (34400 kg/ha) at **Umiam (Meghalaya).**

4. Development of Integrated Organic Farming System (IOFS) models

- One acre spices based IOFS model was established at Chelavoor farm. Crop component comprises of turmeric (2000 m^2), fruit crop banana (100 m^2), pineapple (200 m^2), vegetable cow pea (100 m^2) and fodder grasses viz., CO-3 (500 m^2), hybrid Napier (200 m^2), CO4 (500 m^2) and Congo signal (200 m^2). Turmeric, ginger, fodder grasses (Congo signal grass, CO-3, CO-4), yams, tapioca, banana and pineapple were planted and established. Fodder grasses (686 kg) Tapioca (80 kg) and vegetable cowpea (8 kg) was harvested. A profit of Rs. 79, 631/- was obtained from integrated organic farming system/acre at **Calicut (Kerala).**

- One acre IOFS model comprising of cropping systems okra+leafcoriander-maize+cowpea (fodder) in 0.12 ha, green manure –cotton- sorghum in 0.12 ha, and fodder grasses CO CN (4) and desmanthus in 0.10 ha + agroforestry (*Sesbania grandiflora*, *Thespesia populnea, Luceamaleu cocephala* in 0.03 ha) + dairy (2 cows, with calf in 0.01 ha + vermicompost in 0.01 ha +boundry planttaions (desmanthus, banana, *glyricidia*) + supporting area (manure pit, threshing floor) in 0.01 ha has been established at **Coimbatore (Tamil Nadu).** The IOFS model couldgenerate net return of Rs. 94288 with B:C ratio of 1.76 in lady finger-maize ststem. The contribution of livestock to net return was Rs. 66308/year.

- A 0.43 ha IOFS model comprising of cereals (rice, maize) pulses/oilseeds (soybean, lentil, pea), vegetables (frenchbean, tomato, carrot, okra brinjal cabbage, potato broccoli, cauliflower chilli, coriander), fruits (Assam lemon, papaya), livestock (dairy 1 cow 1 calf), fishery and fodder has been established at **Umiam (Meghalaya).** The total cost of cultivation was recorded at Rs. 55,839/- per year under the IOFS model with an area of 0.43 ha. Maximum expenditure was incurred in crop component of the model with 48% of the total cost of cultivation. Dairy unit with one adult cow and one calf recorded 36% of the total cost of cultivation, while fishery component recorded 9% of the total cost of cultivation. For maintaining vermicomposting unit of 72 m^2 area and other important operations like hedgerow planting, residue recycling, rock phosphate application and liming, the expenditure incurred was Rs. 3700/- which account to 7 % of the total cost. A total net return of Rs. 62,531/- per year was obtained under the IOFS model which is much higher than the region's farmer common practices of rice monocropping or improved practice of rice-vegetables cropping system. The highest contribution towards the total net return was contributed by crop component of the model (61%) followed by dairy (25%) and fishery component (20%). The fish production was 136 kg. The net return from dairy component was calculated only in terms of milk production since the cow-dung produced was recycled back into the model which was used as manure for crop production. The production of vermin-compost from model was 1500 kg annually and it was used in the farm itself for nutrient supplement to crops.

1. INTRODUCTION

The total factor productivity (TFP) growth score prepared by National Institute of Agricultural Economics and Policy Research has revealed that technology-driven growth has been highest in Punjab and lowest in Himachal Pradesh. It implies that some of the states like Himachal Pradesh, Uttarakhand, Madhya Pradesh, Rajasthan, Jharkhand and north-eastern region of India have not been influenced much by the modern inputs of agriculture like chemical fertilizers and pesticides. India's average fertilizer and pesticide consumption stands at 128.3 kg/ha and 0.31 kg a.i./ha, respectively. Moreover, despite all technological advancements, the nutrient use efficiency is on lower side (33% for N, 15% for P and 20% for K and micronutrients). On the other hand it has been proved scientifically and convincingly that integrated use of organic manures with chemical fertilizers improves the use efficiencies of the latter owing to concurrent improvement of soil physical, chemical and biological properties. The water holding capacity of the soil also gets improved on account of regular use of organic manures. A critical appraisal reveals that organic farming systems offer some solutions to the problems, currently besetting the agricultural sector of industrialized/ green revolution countries.

Growth of organic farming

Organic agriculture is practiced in 179 countries and 50.9 m ha of land are managed organically by 2.4 million farm households (World of Organic Agriculture, 2015). The regions with the largest areas of organically managed agricultural land are Oceania (12.1 million hectares of 33 percent of the global organic farmland), Europe (10.6 million hectares or 29 percent of the global organic farmland) and Latin America (6.8 million hectares or 23 percent). On a global level, the organic agricultural land area increased by 14.7 percent compared with 2014. The countries with the most organic agricultural land are Australia (22.7 million hectares), Argentina (3.1 million hectares) and the United States (2.0+ million hectares). The countries with the highest numbers of producers are India, Ethopia and Mexico. The number of organic producers has increased by 7.2 percent compared with 2014.

Emerging from 42,000 ha under certified organic farming during 2003-04 in India, the organic agriculture has grown almost 29 fold during the last 5 years. By 2015-16, India has brought more than 5.71 million ha area under organic certification process. Out of this cultivated area accounts for 1.49 million ha while remaining 4.22 million ha is wild forest harvest collection area. Madhya Pradesh has highest area under organic farming followed by Maharashtra and Rajasthan besides these states Meghalaya has committed to have 2 lakh ha of certified land by 2020 and Sikkim is the first organic state of the country which was declared by Hon'ble Prime Minister of India during January 2016.

Organic is more of a description of the agricultural methods used on a farm, rather than food itself and those methods combine tradition, innovation and science. Two approaches namely integrated crop management (50 % nutrients through chemical fertilizers and rest through organic manures with no use of synthetics for pest management) and organic management practices as per National Programme of Organic Production (NPOP) standards were evaluated in crops grown in cropping systems across India under Network Project on Organic Farming (NPOF).

In order to develop a package of practices for organic farming in a system mode, a Network Project on Organic Farming (NPOF) was initiated during 2004-05 by Indian Council of Agricultural Research (ICAR),

New Delhi with ICAR-Indian Institute of Farming Systems Research (IIFSR) as lead centre. Intitally, the project was operating with 13 centres covering 12 states. During XII plan, the number of centres of has been increased to 20. Presently the scheme covers 16 states. The results of one study on geo-referenced characterization of organic farmers, four on-station experiments and one farmer participatory experiment under TSP undertaken at various locations are presented in the report.

The policy of accelerated adoption of **"towards organic"** (integrated crop management) approach for intensive agricultural areas (food hubs) and **"certified organic farming"** with combination of tradition, innovation and science in the de-facto organic areas (hills) and rainfed/ dryland regions has been recommended during the year from the findings of the scheme which will contribute towards safe food security and climate resilience, besides increased income of farm households. This approach will also positively contribute to the cause of human, livestock and eco-system health, the basic objective of organic agriculture. Scientific organic farming needs to be promoted in the high intensive areas to keep the yield of crops at comparable level with chemical management. In rainfed/hilly areas, organic agriculture with scientific packages will result in significant improvement in productivity of crops.

Package of practices for organic production of crops and cropping systems developed through NPOF network

2. OBJECTIVES AND METHODOLOGY

Scheme Objectives

- To study productivity, profitability, sustainability, quality and input-use-efficiencies of different crops and cropping systems under organic farming in different agro-ecological regions
- To develop efficient crop and soil management options for organic farming
- To develop need-based cost-effective new techniques for farm-waste recycling

Methodology

The experiments in the project have been designed mainly to evaluate the relative performance of location-specific, important cropping systems under organic and conventional (chemical) farming, and assess agronomic efficiency of different production systems. Cropping systems, which are under evaluation, involve cereal crops (mainly basmati rice, coarse rice, *durum* and *aestivum* wheats, sorghum, barley and maize), pulsesand oilseeds (blackgram, cowpea, pigeonpea, chickpea, lentil, linseed, green gram, soybean, mustard, sunflower , safflower and groundnut), spices (black pepper, ginger, turmeric, chillies, onion, and garlic), vegetables (potato, okra, baby corn, cowpea, pea, tomato, frenchbean, summer squash, beetroot, carrot, dolichos bean, coriander and cauliflower), cotton and fodder crops (sorghum, maize, cow pea and berseem) in location-specific cropping systems. During 2014-15, following six experiments/study were undertaken at different centers:

- Geo-referenced charecterization of organic farmers
- Evaluation of organic, inorganic and integrated production systems for crops and cropping systems
- Evaluation of response of different varieties of major crops for organic farming
- Evaluation of bio-intensive complimentary cropping systems under organic production systems
- Development of Integrated Organic Farming System models
- Tribal Sub Plan (TSP) activities in farmers field

The objectives, locations and treatment details of each experiment at various locations are presented in chapter 7 and at respective tables. General guidelines and standards for the production of organic production, as suggested under National Standards for Organic Production (NSOP), forms the basis for raising the experimental crops in the project. A compact block of land has been earmarked at each of the cooperating centres for experimental purposes, as far as possible. The plot identified was in general, free from hazards of erosion, sediments, chemical pollutants and contaminants. Shelterbelts have been developed by planting multi-purpose trees/shrubs etc. such as *Subabul*, *Sesbania* spp. etc. around the field. The individual centre has been advised to select organic sources of nutrients depending upon the local availability and also in suitable combination(s) to fulfill the entire requirement of nitrogen and 80-90% requirement of phosphorus and potassium for each cropping system. Cooperating centers have also been advised that each centre should select only those crops for organic farming research in which effective organic (non-chemical) measures are available for plant protection to avoid failure of crops at later stages. Bulky manures were prepared within the premises of cooperating centres under the project itself or under any other project going on at university/institute/ centre in order to ensure proper quality of inputs. Inputs related to plant protection, bio-fertilizers etc are procured from reliable sources only. Adequate care has also been taken by the centres that seeds purchased from outside are not treated with any chemical seed dresser.

3. LOCATION

Multi-location experiments were conducted during 2014-15 at 13 research centers of SAUs/ ICAR Institutes in 12 states. Statewisedetails of centres are given below in the order of results presented in the chapter 7.

Sl. No.	Location of centre	State	Address of SAU/ICAR institute
1.	Bajaura	Himachal Pradesh	CSK HPKVV Hill Agri. Res. &Extn. Centre, Bajaura-175 125
2.	Bhopal	Madhya Pradesh	ICAR-Indian Institute of Soil Science, NabiBagh, Berasia Road, Bhopal – 462 038
3.	Calicut	Kerala	ICAR-Indian Institute of Spices Research, P.B. No. 1701, Marikunnu PO, Calicut – 673 012
4.	Coimbatore	Tamil Nadu	Tamil Nadu Agricultural University, Coimbatore – 641 003
5.	Dharwad	Karnataka	University of Agricultural Sciences, Yettinagudda Campus, Krishinagar, Dharwad-580 005
6.	Jabalpur	Madhya Pradesh	Jawaharlal Nehru KrishiViswaVidyalaya, Jabalpur-482 004
7.	Karjat	Maharashtra	Dr. Balasaheb Sawant Konkan Krishi Vidypeeth, RARS, Karjat, Dist. Raigad – 410 201
8.	Ludhiana	Punjab	Punjab Agricultural University, Ludhiana-141 004
9.	Modipuram	Uttar Pradesh	ICAR-Indian Institute of Farming Systems Research, Modipuram, Meerut -250 110
10.	Pantnagar	Uttarakhand	G.B.Pant University of Agriculture Sciences and Technology, Pantnagar, Udham Singh Nagar – 263 145
11.	Raipur	Chhattisgarh	Indira Gandhi KrishiVishwavidyalaya, Raipur-492 012
12.	Ranchi	Jharkand	Birsa Agricultural University, Kanke, Ranchi – 834 006
13.	Umiam	Meghalaya	ICAR Research Complex for NEH Region, Umiam – 737 102

4. MANPOWER

No regular posts, in any category, have been provided and the responsibility was assigned to a scientist, nominated as Principal Investigator of NPOF, by the parent institute/ university (Names and contact addresses of PIs are given in Annexure). The scientists of related disciplines were also involved in the research programme by the respective institution. In addition, two senior research fellows (as contractual staff) have been provided at each centre.

5. SOIL AND CLIMATE

Soil type, weather parameters and initial values of soil physico- chemical properties at various locations are presented below.

Soil type, weather, latitude and longitude of the various centres

S. No.	Name of centre	Soil Type	Weather				Latitude (N)	Longi-tude (E)
			Rainfall (mm)	Tempera-ture (°C)		R.H (%)		
				Max.	Min.			
1.	Bajura	Silty loam	922.3	25.3	10.2	71.3	31.8°	77°.0'
2.	Bhopal	Vertisols, Clayey Montmorillonite/ smectite type	1080	32.0	22.0	71	23°18'	77°24'
3.	Calicut	Clay loam, usticHumitropept	4121	31.8	22.0	68	11°34'	75°48'
4.	Coimbatore	Udic, Rhodustalfs, fine loamy red and sandy soil	789	29.8	21.3	86	11°	77°.0'
5.	Dharwad	Verticinceptisoles	741	31.1	17.9	63	15°26'	75°07'
6.	Jabalpur	Vertisoils, Chromusterts	1461	29.6	17.2	64.7	23°90'	79°90'
7.	Karjat	Haplustultsudic-fluvents, red soil	3295	34 .0	21.0	69	18°33'	77°03'
8.	Ludhiana	Ustochrepts-Usticpramments association, alluvial, sandy & sandy loam	466	30.0	17.4	65	30°56'	75°52'
9.	Modipuram	Alluvium soilsTypicustochrept	511	29.9	16.3	71	29°4'	77°46'
10.	Pantnagar	Hapludolls, very deep alluvium coarse loomy soils	2119	29.4	17.0	71	29°08'	79°05'
11.	Raipur	Ochraquals association, deep black soil	1361	32.9	20.4	56	21°16'	81°36'
12.	Ranchi	Ultic Palesustalfs, very deep soils	1020	29.6	15.6	72	23°17'	85°19'
13.	Umiam	Clay loam	3085	20.6	4.6	75	25°41'	91°54'

Initial nutrient status of soil (2003-04)

Centre	OC%	N (kg/ha)	P (kg/ha)	K (kg/ha)	S (ppm)	Fe (ppm)	Zn (ppm)
Experiment 1							
Bajaura	0.45	146	43.3	121	22.4	30.0	1.20
Bhopal	0.53	154	12.7	530	4.9	5.5	0.74
Calicut	2.40	220	24.6	264	-	72	3.80
Coimbatore	0.60	269	17.9	690	-	66.0	10.0
Dharwad	0.41	250	23.0	330	20.0	7.5	0.80
Jabalpur	0.70	264	12.6	282	9.8	2.37	0.32
Karjat	1.10	234	30.0	350	-	-	1.72
Ludhiana	0.34	278	36.3	134	-	-	-
Modipuram	0.59	-	-	-	-	-	-
Pantnagar	0.65	238	16.7	156	65.0	30.24	0.84
Raipur	0.64	237	13.0	274	-	-	-
Ranchi	0.44	320	48.0	270	-	59.8	1.22
Umiam	1.32	186	10.4	165	-	-	-

6. BUDGET

A total budget of Rs. 100 lakhs was released to 13 centres during 2014-15. The centre wise allocation of funds are given below.

(Rs. in lakhs)

Sl. No.	Name of Centre	T. A.	Cont. Service	Other Cont.	TSP general	Total
1.	HAREC, Bajaura	0.20	2.83	5.07	0.00	8.10
2.	ICAR-IISS, Bhopal	0.23	2.84	4.07	0.00	7.14
3.	ICAR-IISR, Calicut	0.25	2.39	4.07	0.00	6.71
4.	TNAU, Coimbatore	0.25	4.92	3.07	1.05	9.29
5.	UAS, Dharwad	0.25	3.68	5.02	0.33	9.28
6.	JNKVV, Jabalpur	0.23	2.83	4.97	0.50	8.53
7.	ARS, Karjat	0.18	1.33	2.57	0.50	4.58
8.	PAU, Ludhiana	0.16	3.05	5.11	0.00	8.32
9.	ICAR-IIFSR, Modipuram	0.20	2.10	5.90	0.00	8.20
10.	GBPUA&T, Pantnagar	0.25	3.05	5.07	0.00	8.37
11.	IGKV, Raipur	0.13	0.91	0.42	0.50	1.96
12.	BAU, Ranchi	0.18	2.33	3.57	0.50	6.58
13.	ICAR-RC-NEH, Umiam	0.20	1.50	2.58	8.66	12.94
	Total	2.71	33.76	51.49	12.04	100.00

7. RESEARCH RESULTS

7.1 Geo-referenced characterization of organic farmers

In order to understand the successful practices and constraints of organic farmers, a study on Geo-referenced characterization of organic farmers was initiated during 2014-15. A minimum of 30 farm households was fixed as target for collection of information. However somecentres have collected information from less or more number of farmers depending on the resources. The objectives of the study was

- To understand and characterize the practices and constraints of organic farmers
- To assess the technological gaps of organic farmers

Bajaura

Geo-referenced characterization of organic clusters involving 33 households in Khakhrola, Kalana and Theda villages of Rampur tehsil of Shimla district have been done.

- **Herbal spray (method used for extract)**: 3-4 kg leaves of each *Urticadioica*, *Meliaazedarch*, *Calotropisprocera*alongwith ½ kg of each onion, garlic, ginger and chillies were put in clay pot with 15 litres of water capacity. The pot was buried in soil for 40 days to undergo fermentation of the material. The mix was periodically stirred for 40 days and thereafter, it was filtered through cotton cloth. The extract thus obtained was stored and used as foliar spray @ 1-1.5 litre/15 litres of water.
- **Vermiwash preparation**: Plastic bucket was taken and small gravels were added as first layer. Thereafter sand was spread as second layer, 8-10 kg of FYM was added as third layer and approximately 500 earthworms were put over the FYM. The water was added daily to keep proper moisture. The material turned into vermicompost after 45-50 days and to those materials, sufficient quantity of water is added and the extract was collected by making hole at the end of bucket. This extract was used in 1:10 ratio as foliar nutrition and management of pests.
- **Seed treatment for transplanted vegetable crops (bacterial diseases) :**The seeds were treated using hot water+ *Trichodermaviride*+ash+salt and small quantity of herbal extracts and then dried in shade before use. The soil was treated with this mixture before sowing.
- **Other techniques adopted by farmers:**Tree spray oil (TSO also known as mineral oil) spray in plum in alternate year effectively control all pests. Two herbal spray were found sufficient for the control of all pests of mango. Two herbal sprays followed by one spray with butter milk effectively controlled pests of tomato and capsicum. Apart from applying FYM and vermicompost in the field, migratory flock of buffalo are kept for three months in the fields which improve fertility due to their droppings.

Bhopal

Geo-referenced organic cluster survey was conducted in the villages viz., PerwaliaSadak and Rati Bar at Bhopal District. A total of 20 organic farmer fields were visited/surveyed. The survey results indicated

that soybean-wheat/gram is the most dominant cropping system followed in these villages. Vermicompost was the single most important nutrient used for fertilizing the organic crops and could be included in the organic package of practices. However, the use of farmyard manure is also in vague for those farmers who have just initiated the organic farming. Further, neem oil and buttermilk based preparations are prevalent in the region for crop pest and disease management. Still, manual weeding is the only way to control weeds in the production system. The major lacunae are the unavailability of organized market or premium price for the farm produce which is hindering the further growth organic farming in the area.

Karjat

Geo-referenced characterization of organic clusters revealed that most of the farmers have sufficient quantity of FYM available with them. However, some organic mango growers purchased organic manures from the market. The farmers expressed that organic produce fetches premium price. Major constraint was non-availability of laborers.

Ludhiana

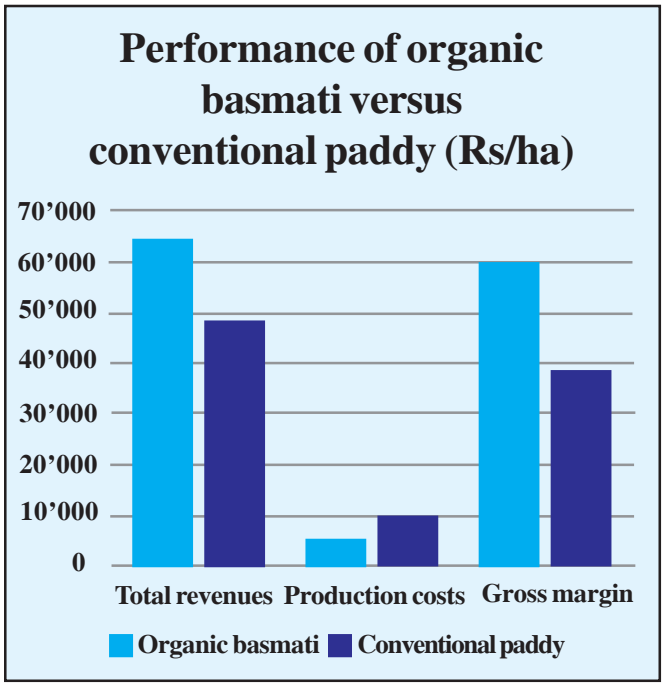
Geo-referenced survey in Nabha block of Patiala district in Punjab revealed that organic farmers own 6-8 animals/household. Basmati rice and wheat are dominant crops grown by farmers. Green manure in *kharif*and FYM in *rabi* are major organic inputs used by farmers for nutrition. Marketing of organic produce and availability of labour are the major constraints.

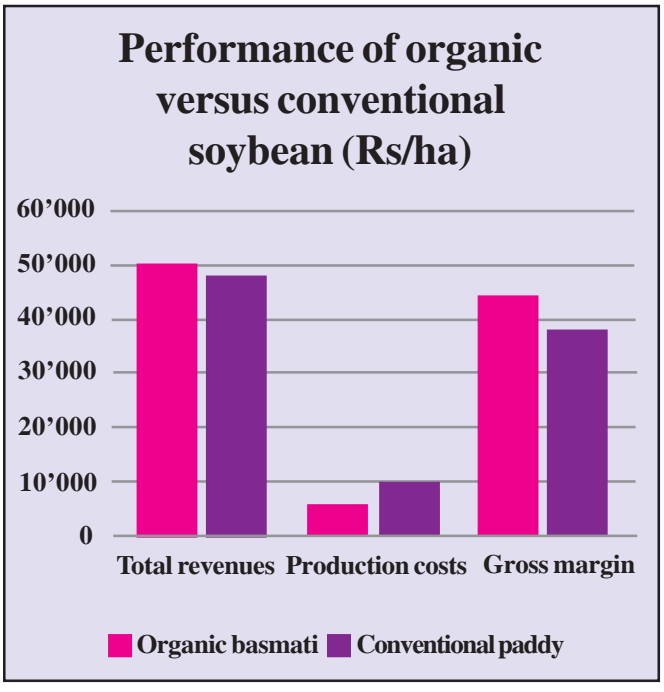
Modipuram

Geo-referenced characterization of 27 farmers was done. 25 per cent of farmers adopted organic farming on their entire land holding. Area under organic cultivation various from 0.40 ha to 10 ha. Out of 27 farmers 43% farmers discontinued organic farming within 2-3 years. Lower yields, lack of technical awareness, non-availability of vermi-compost and other manures in sufficient quantities were the major constraints responsible for discontinuation. Out of 21 farmers growing paddy organically, 10 farmers recorded paddy yield over 4000 kg/ha and two of them even beyond 6000 kg/ha, whereas nine farmers recorded paddy yield between 3000 to 4000 kg/ha and two between 2000 to 3000kg/ha. During *rabi*, wheat was the major crop grown organically and majority (74%) of the farmers recorded wheat yield over 3000 kg/ha.

Pantnagar

Basmati had 50% lower yields as hybrid paddy, but achieved a 170% higher price. Organic soy beans achieved the same yield as in conventional farms, but a 7% higher price.Organic basmati had 50% lower





production costs and achieved 54% higher gross margin than conventional hybrid paddy. Organic soy had 40% lower production costs and achieved 17% higher gross margin than conventional soy bean.

Umiam

Survey results of geo-referenced characterization carried out in 130 households in Umsning block of Ri-Bhoi district of Meghalaya was also presented.

Synthesized information of all the centres are presented in Table 7.1.

Table 7.1. Land holding and type of farm of characterized organic farmers in various locations

S. No.	Centre	Farmer category	No. of farmers	Farming situation	Average land holding (ha)	Average land holding under organic farming (ha)	Percent area under organic farming (%)	Type of farm
1.	Bajaura	Marginal	18	Rainfed (2)/ Irrigated (16)	0.59	0.53	93.6	Certified (17), Uncertified (1)
		Small	9	Rainfed (3)/ Irrigated (6)	1.42	1.42	100.0	Certified
		Medium	2	Irrigated	2.6	2.6	100.0	Certified
		Large	4	Irrigated	5.93	3.89	66.5	Certified
2.	Bhopal	Marginal	2	Irrigated	1	1	100.0	Uncertified
		Small	5	Irrigated	1.8	0.92	50.4	Uncertified
		Medium	6	Irrigated	3.23	1.55	45.8	Uncertified
		Large	7	Rainfed (1)/ Irrigated (6)	10.36	3.74	34.2	Uncertified
3.	Calicut	Marginal	30	Irrigated (6)/ Rainfed (24)	0.62	0.59	96.1	Certified

S. No.	Centre	Farmer category	No. of farmers	Farming situation	Average land holding (ha)	Average land holding under organic farming (ha)	Percent area under organic farming (%)	Type of farm
		Small	15	Irrigated (5) / Rainfed (10)	1.44	1.25	86.8	Certified
		Medium	5	Irrigated (3)/ Rainfed (2)	2.52	2.21	87.4	Certified
		Large	2	Rainfed				Certified
4.	Coimb-atore	Marginal	7	Irrigated	0.78	0.78	100.0	Uncertified
		Small	18	Irrigated	1.64	1.50	89.6	Certified (3) / Uncertified (15)
		Medium	10	Irrigated	2.86	2.14	78.3	Certified (3)/ Uncertified (7)
		Large	15	Irrigated	11.81	9.73	76.3	Certified (3)/ uncertified (12)
5.	Karjat	Marginal	23	Irrigated (4)/ Rainfed (19)	0.41	0.33	84.5	Uncertified
		Small	4	Irrigated (2)/ Rainfed (2)	1.7	0.95	61.2	Uncertified
		Large	3	Rainfed	7.27	2.6	38.5	Uncertified
6.	Ludhiana	Marginal	2	Irrigated	0.65	0.625	96.8	Certified
		Small	8	Irrigated	1.975	0.87	44.7	Certified
		Medium	18	Irrigated	3.128	0.86	26.9	Certified
		Large	22	Irrigated	9.918	1.22	17.1	Certified
7.	Modipuram	Marginal	4	Irrigated	0.69	0.4	62.5	Uncertified
		Small	5	Irrigated	1.63	1.38	80.1	Uncertified
		Medium	4	Irrigated	3.5	1.5	39.1	Uncertified (3), certified (1)
		Large	8	Irrigated	7.34	4.19	57.1	Uncertified (7), certified (1)
8.	Pantnagar	Marginal	35	Irrigated	0.59	0.54	89.9	Certified
		Small	2	Irrigated	1.82	1.11	61.1	Certified
		Medium	3	Irrigated	2.97	0.88	30.5	Certified
9.	Raipur	Marginal	20	Rainfed (3)/ Irrigated (17)	0.724	0.654	91.5	Uncertified
		Small	17	Rainfed (1)/ Irrigated (16)	1.631	0.835	51.6	Uncertified
		Medium	3	Irrigated	2.43	.6	24.4	Uncertified
10.	Ranchi	Marginal	18	Irrigated	0.8	0.8	100	Certified
		Small	31	Irrigated	1.37	1.37	100	Certified
		Medium	1	Irrigated	2.2	2.2	100	Certified
11.	Umiam	Marginal	52	Rainfed	0.427	0.427	100.0	uncertified
		Small	8	Rainfed	1.315	1.315	100.0	uncertified
12.	Over all in India	Marginal	211	-	0.576	0.52	91.6	Uncertified (194), Certified (252)
		Small	122	-	1.541	1.233	81.9	-
		Medium	52	-	2.971	1.441	50.2	-
		Large	60	-	9.692	4.783	47.7	-

7.2 Evaluation of organic, inorganic and integrated production systems for crops and cropping systems

Title of the experiment: Evaluation of management packages for crops and cropping systems and its influence on crop productivity and soil health.

Objectives

The experiment was conducted at all the 13 locations with the following objectives.

- To study the impact of organic, conventional and integrated management practices on crop productivity and soil health
- To study the impact of various management practices on microbial population of soil and economics

Year of start: The experiment was originally planned during 2004-05. However, the year of start varied with the centres depending upon the establishment of infrastructure for conducting the experiments. All the centres started the experiment during 2004-05 except Modipuram and Umiamwhere it was started during 2005-06.

Treatments: The experiment was conducted in strip plot design as un-replicated trial. However, Karjat and Umiam centre have conducted the experiment with three replications in split plot design. The experiment stands modified by dividing the organic, inorganic and integrated plots divided into two for each cropping systems. The treatments imposed in main plots are given below.

Main Plot	Organic management ***(Organic)***	1. Supply of 100% nutrients through organic sources and complete organic management
		2. Supply of only 75% nutrients through organic sources + innovative inputs (any two of cow urine @10%, Panchagavya, PGPR and vermiwash @10%) and complete organic management
	Inorganic management ***(Chemical)***	3. 100% inorganic nutrients and management
		4. Either state recommendation or farmers package (Choice to centres)
	Integrated management ***(Towards organic)***	5. 50% organic +50% inorganic source of nutrients and management
		6. 75% organic +25% inorganic source of nutrients and management
Sub Plots	Cropping Systems	Location specific cropping system 1
		Location specific cropping system 2
		Location specific cropping system 3
		Location specific cropping system 4

The cropping system was selected, as per suitability for the location and was assigned to the sub plots. The number of cropping systems ranged from 3 (Calicut and Coimbatore) to as high as 5 (Dharwad) in various centres. The details of cropping systems are given in Table 1 along with experimental results. Nutrient package for the organic and integratedmanagement packages were formulated based on recommended nitrogen dose of each system.

Locations: The experiment was conducted in five eco-systems as mentioned below. These locations represent the different ecological regions of Agro-ecological zone.

Eco-system	Centre (State)
Arid	Dharwad (Karnataka) Ludhiana (Punjab)
Semi-Arid	Coimbatore (Tamil Nadu)
Sub-Arid	Modipuram (Uttar Pradesh) Raipur (Chhattisgarh) Bhopal (Madhya Pradesh) Jabalpur (Madhya Pradesh) Pantnagar (Uttarakhand) Ranchi (Jharkhand)
Humid	Bajaura (Himachal Pradesh) Umiam (Meghalaya)
Coastal	Calicut (Kerala) Karjat (Maharashtra)

The details of inputs used for organic nutrient management and their nutrient content at various locations are given below.

Source of nutrient inputs and their NPK content at various locations

Centre	Nutrient Sources	NPK contents on dry weight basis (%)		
		N (%)	P (%)	K (%)
Bajaura	Vermicompost	0.90	0.50	0.75
	FYM	1.15	0.50	1.00
	Urea	46.00	-	-
	SSP	-	16.00	-
	MOP	-	-	60.00
	Rock phosphate	-	34.0	-
Bhopal	Vermicompost	1.14	0.72	0.68
	Neem cake	4.17	0.92	1.04
	Sesbania rostrata	2.90	0.7	1.54
Calicut	Farm Yard Manure	0.69	0.38	0.54
	Neem cake	1.62	0.34	1.41
	Ash	-	0.23	6.6
	Vermi-compost	0.89	0.28	0.65
	Green leaf manure	2.22	0.13	0.85
	Rajphos	-	18.5	-
	Urea	46	-	-
	MOP			58
Coimbatore	Vermicompost	1.14	0.72	0.68
	Neem cake	4.17	0.92	1.04
	Sesbania rostrata	2.90	0.7	1.54

Centre	Nutrient Sources	NPK contents on dry weight basis (%)		
		N (%)	P (%)	K (%)
Dharwad	Enriched compost	0.70	0.40	0.80
	Vermicompost	1.00	0.86	0.98
	Gliricidia	0.50	0.32	1.15
	FYM	0.50	0.35	0.50
	Urea	46	-	-
	SSP	-	16	-
	MOP	-	-	60
Jabalpur	GM (Sunhemp)	0.66	0.13	0.50
	FYM	0.54	0.20	0.26
	VC	1.8	0.75	1.00
	Neem oil Cake	5.2	1.10	1.50
	Non-edible oil Cake (NEOC)	5.20	1.10	1.50
	Urea	46.0	-	-
	SSP	-	16.0	-
	MOP	-	-	60.0
Karjat	F.Y.M.	0.50	0.25	0.50
	Neem cake	5.20	1.00	1.40
	Vermi-compost	1.50	1.00	1.50
	Glyricidia green leaves	2.74	0.50	1.15
	Paddy straw	0.61	0.16	1.14
Ludhiana	Urea	46.0	-	-
	DAP	18.0	46.0	-
	MOP	-	-	60.0
Modipuram	FYM	0.51	0.30	0.65
	VC	1.28	0.47	1.39
	Sesbania	2.25	0.41	3.01
	Urea	46.0	-	-
	DAP	18.0	46.0	-
	MOP	-	-	60.0
Raipur	Enriched compost	0.40	0.30	0.60
	Cow dung manure	0.60	0.30	0.70
	NEOC – Non edible oil cake	3.0	0.70	1.70
	Rock phosphate		23	
Ranchi	FYM	0.5	0.3	0.5
	VC	1.2	0.45	1.4
	KC	4.0	1.0	1.0
	Urea	46.0	-	-
	SSP	-	16.0	-
	MOP	-	-	60.0
Umiam	F.Y.M.	0.72	0.29	0.61
	Vermicompost	1.50	0.62	1.00
	Rock phosphate	-	18.00	-
	Tephrosia spp	3.31	0.44	1.46

Results

The parameter wise result of 2014-15 for each centre are presented and discussed.

Influence of organic management package with reduced dose of organic manures, integrated and inorganic nutrient management packages on economic yield, straw yield and system equivalent yield of important crops and cropping systems (Table 1-3)

Table 1. Influence of organic, inorganic and integrated package on grain yield (kg ha^{-1}) of crops at various locations

Locations/Treatments	Organic						Inorganic						Integrated management (towrsd organic)					
	100% organic			75% organic + innovative organic practices			100% in organic			State recommendation			50% organic + 50% inorganic			75% organic + 25% inorganic		
	Kharif	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*
Bajaura																		
Tomato-cauliflower-french bean	820	8840	5910	940	9080	6600	740	8580	4400	820	9320	5990	920	11090	7860	870	10220	7130
Cauliflower-tomato		7560	10860		8000	11980		6870	7130		8560	7770		9490	12840		9440	11620
Black gram-cauliflower-summer squash	880	8090	10100	810	8300	11070	700	6990	9450	850	7230	10530	970	8960	14210	900	8360	14790
Lady finger-pea	7990	5740		8350	6360		6540	4740		6960	5190		10510	7010		9420	6560	
Bhopal																		
Soybean-durum wheat	639	3004		594	2881		528	2546		537	2580		564	2758		591	2803	
Soybean- mustard	666	1156		608	1059		452	930		489	970		499	1021		601	1122	
Soybean- chickpea	570	1511		611	1422		487	1237		515	1307		532	1389		613	1448	
Soybean- linseed	638	1521		574	1407		479	1255		504	1244		488	1387		576	1446	
Mean	628			597			487			511			521			595		
Calicut																		
Turmeric Prathibha	16700			19600			16000						26000			28100		
A.S	21500			21300			15400						26300			27000		
Varna	15700			16200			16200						18000			23600		
Sobha	19100			16900			17000						17700			24900		
Sona	16900			13300			12700						15400			23600		
Kanthi	17300			15000			17700						16800			29200		
Suvarna	16000			13000			19400						16300			22900		
Suguna	21200			20300			12100						23000			31400		
Sudarsana	22000			18900			12600						25700			32500		
Kedaram	23300			15100			13200						18000			28700		
Prabha	23400			14800			14900						18000			26500		
Mean	19400			16700			15600						20100			27000		
(CD=0.05) T	900																	
(CD =0.05)V	1300																	
Coimbatore																		
Cotton - maize	1280	5399		1447	6103		1453	6008		1640	6238		1433	5861		1720	6389	
Chillies - sunflower	5327	1409		5805	1518		5500	1421		6580	1579		5522	1531		6864	1718	
Beetroot - maize	20500	4650		21300	5050		21100	4980		22100	5510		21400	4950		23200	6108	
Dharwad																		
Cowpea-safflower	285	1307		214	1281		310	2348		314	2672		303	2165		264	1971	
Pigeon pea (Sole)	1951			1430			2010			2063			2305			2124		
Green gram-sorghum	101	2533		89	2369		434	2403		445	3141		374	2639		280	2452	

Locations/Treatments	Organic						Inorganic						Integrated management (towrsd organic)					
	100% organic			75% organic + innovative organic practices			100% in organic			State recommendation			50% organic + 50% inorganic			75% organic + 25% inorganic		
	Kharif	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*
Groundnut + hybrid cotton (2:1)	1446 806			1243 556			1573 1502			1677 1835			1683 951			1480 779		
Maize-chickpea	4136	1359		3999	1254		7494	1350		7477	1331		5825	1394		4206	1223	
Jabalpur																		
Basmati rice–durum wheat-green manure	3080	3307		2739	2625		3253	3710		2918	3072		3018	3542		2892	2895	
Basmati rice–chick pea - maize fodder	3499	failed	38900	2862	failed	37100	3287	failed	42000	3124	failed	35700	3008	failed	39700	2771	failed	38200
Basmati rice–ber seem (fodder and seed)	3406	260S 67880F		2928	220S 72513F		3088	273S 68810F		2971	229S 66958F		3459	215S 68545F		2862	200S 66032F	
Basmati rice–vege table pea- sorghum (fodder)	3184	2249	44000	2840	1786	40500	3068	2017	46900	2913	2116	35800	3329	1852	41100	2911	1257	48100
Karjat																		
Rice-groundnut	3926	2429		3960	2028		3953	2325		3805	2215		3942	2257		3984	2384	
Rice-maize (sweet corn for cob)	3512	14707		3402	14227		3533	15082		3517	14380		3570	14901		3605	14595	
Rice-mustard	3540	776		3430	715		3806	696		3721	778		3830	812		3612	946	
Rice-dolichos bean (for green pod vegetable)	3750	5644		3591	5451		3750	5965		3608	5638		3669	5940		3689	5651	
Ludhiana																		
Basmati rice-chick pea-GM	4570	20		4460	20		4590	190		4730	220		4490	10		4500	20	
Basmati rice-wheat-GM	4360	3850		4240	3350		4570	3980		4500	4020		4230	4400		4290	4300	
Moong-wheat	40	4580		50	4550		90	4550		60	4980		100	5120		100	5120	
Pigeon pea -wheat	570	4520		520	4520		520	4520		420	4820		500	5180		350	4980	
Modipuram																		
Basmati rice– wheat (*durum*) - *Sesbania* green manure	4590	4130		4430	4430		3100	2640		3760	3600		4690	4230		4860	4460	
Rice– barley (*malt*) – green gram	4220	3930	875	4080	4080	895	3110	2820	593	3650	3390	822	4270	4290	930	4410	4450	974
Maize (*pop corn*) – potato– okra + *Sesbania* green manure	1850	23240	7600	1920	21860	6960	1440	16420	5430	1620	19040	7460	2000	19840	6890	2140	20810	6700

Locations/Treatments	Organic						Inorganic						Integrated management (towrsd organic)					
	100% organic			75% organic + innovative organic practices			100% in organic			State recommendation			50% organic + 50% inorganic			75% organic + 25% inorganic		
	Kharif	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*
Maize (*sweet corn*) – mustard - *Sesbania* green manure	13320	2070		14520	2320		11790	1500		11810	2250		15150	1870		15080	1990	
Pantnagar																		
Basmati rice-wheat - *sesbania*	4223	4723		4068	4633		3695	4643		3509	4696		4018	4915		3874	4883	
Basmati rice -chick pea + coriander- *sesbania*	4223	1301		4068	1214		3695	1144		3509	1202		4018	1101		3874	973	
Basmati rice -vege table pea +coriander- *sesbania*	4223	5021		4068	5039		3695	4351		3509	4864		4018	4926		3874	5046	
Basmati rice -potato- *sesbania*	4223	13760		4068	13234		3695	11143		3509	10695		4018	12841		3874	12032	
Raipur																		
Soybean-maize	1967	11565		1855	10841		1999	11265		2092	11795		2018	10499		2070	10863	
Soybean-pea	1973	6875		1772	6529		2006	6953		2111	7246		2025	6608		2038	7051	
Soybean-chilli	1941	8821		1781	8190		1993	9034		2089	9055		2047	7521		2048	7474	
Soybean-onion	1970	14846		1772	14106		2038	15080		2068	16208		2038	14769		2027	14547	
Ranchi																		
Rice -Wheat	3927	2453		4034	2324		3427	2835		2678	1988		3606	2702		3784	2767	
Rice -Lentil	3784	166		4034	130		2999	193		2678	86		3534	233		3677	250	
Rice -potato	3963	16254		4177	14837		3534	11263		2820	9564		3784	12349		3963	13805	
Rice -linseed	3749	821		3998	785		3249	571		2892	503		3463	739		3641	768	
Umiam																		
Rice based systems *on raised bed*																		
Rice -carrot	3550	13100		3410	11900		3380	11400					4210	14500				
Rice - potato	3530	14200		3110	12900		3220	12200					4110	14900				
Rice -french bean	4080	9500		3970	8100		3800	7700					4240	9400				
Rice -tomato	3870	14700		3360	12900		3550	12400					4160	14200				
Rice- fallow system *on sunken bed*																		
Megha aromatic 2– fellow	4090																	
Ngoba –fellow	4040																	
Lampnah –fellow	4380																	
Shasharang –fellow	4670																	
B. Nutrient sources	4390			4050			4200						4540					

Table 2. Influence of organic, inorganic and integrated package on straw yield (kg ha^{-1}) of crops at various locations

Locations/Treatments	Organic						Inorganic						Integrated management (towrsd organic)					
	100% organic			75% organic + innovative organic practices			100% in organic			State recommendation			50% organic + 50% inorganic			75% organic + 25% inorganic		
	Kharif	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*
Bajaura																		
Tomato-cauliflower-french bean	600		20800	6800		21500	5200		20600	6200		23900	6500		26200	6500		23600
Cauliflower-tomato																		
Black gram-cauliflower-summer squash	16000			15800			14400			18200			20500			20000		
Lady finger-pea	7280			7320			6380			6940			8150			7560		
Bhopal																		
Soybean-durum wheat	2299	6722		2284	6655		1983	6287		2016	6209		2195	6410		2285	6615	
Soybean- mustard	2546	3818		2320	3575		1806	3216		1939	3372		2107	3462		2241	3793	
Soybean- chickpea	2298	4004		2302	3941		1796	3348		1982	3526		2128	3752		2296	3983	
Soybean- linseed	2388	3510		2292	3413		1875	3213		2006	3155		2191	3283		2301	3453	
Coimbatore																		
Cotton - maize	3132	5288		3155	5883		2975	5609		3095	5975		3168	5726		3293	6209	
Chillies - sunflower	4668	4123		4532	4562		4308	4382		4802	4831		4787	4461		4989	5031	
Beetroot - maize		5042			5470			5195			5798			5214			6245	
Dharwad																		
Cowpea-safflower	2156	1354		1894	1447		3510	1438		4141	1575		3275	1480		2804	1291	
Pigeon pea (Sole)	8222			8841			9849			10167			9817			8804		
Green gram-sorghum	1175	4645		1258	4454		3112	4225		3158	4840		2049	4833		1892	4367	
Groundnut + hybrid	2708			1833			2824			3492			4131			2043		
cotton (2:1)	1716			2271			3277			3617			1674			2150		
Maize-chickpea	6118	1252		5847	1224		10417	1176		13527	1306		8982	1237		6395	1276	
Jabalpur																		
Basmati rice–durum wheat-green manure	4686	4960		4289	3412		5184	5194		4207	4300		4765	4604		4526	4053	
Basmati rice–chick pea - maize fodder	4568	failed		4242	failed		4782	failed		4117	failed		4426	failed		4245	failed	
Basmati rice–berseem (fodder and seed)	4371	-		4174	-		4577	-		4028	-		4375	-		4155	-	
Basmati rice–vegetable pea- sorghum (fodder)	4401	-		4022	-		4577	-		4126	-		4426	-		4147	-	
Karjat																		
Rice-groundnut	4672	3449		4391	2880		4705	3302		4528	3145		4691	3206		4741	3385	
Rice-maize (sweet corn for cob)	4074	18678		3946	18069		4098	19154		4080	18263		4142	18924		4182	18535	

Locations/Treatments	Organic						Inorganic						Integrated management (towrsd organic)					
	100% organic			75% organic + innovative organic practices			100% in organic			State recommendation			50% organic + 50% inorganic			75% organic + 25% inorganic		
	Kharif	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*
Rice-mustard	4141	1346		4013	1215		4453	1203		4354	1372		4481	1445		4229	1735	
Rice-dolichos bean (green pod vegetable)	4425	2333		4238	2254		4425	2472		4258	2337		4329	2462		4353	2342	
Ludhiana																		
Basmatti rice-chickpea	7480			7530			7990			7820			7370			7710		
Basmati rice-wheat	7610	4230		7640			7740	4640		7210	4730		7620	5100		7550	4730	
Moong-wheat		5830						5850			5930			5680			5530	
Pigeon pea -wheat	10100	5820		10230			11460	5880		11020	5530		10580	5850		8400	5740	
Modipuram																		
Basmati rice– wheat (*durum*) - *Sesbania* green manure	7180	6860		7200	6780		5280	4880		6070	6240		7580	6680		7500	6920	
Rice– barley (*malt*) – green gram	6580	6560	2840	6600	6690	2950	5220	4970	2270	5870	5470	3060	6860	7220	3350	6880	7270	3450
Maize (*pop corn*) – potato– okra + *Sesbania* green manure	3090			3320			2570			2790			3440			3580		
Maize (*sweet corn*) – mustard - *Sesbania* green manure	13320	7920		14520	8470		11790	6080		11810	8200		15150	7220		15080	7340	
Pantnagar																		
Basmati rice-wheat - *sesbania*	5984	6166		5698	5909		5502	5864		5065	5961		5427	7124		5211	5406	
Basmati rice -chickpea + coriander-*sesbania*	5984	3122		5698	2646		5502	2642		5065	2584		5427	2301		5211	2432	
Basmati rice -vegetable pea +coriander-*sesbania*	5984			5698			5502			5065			5427			5211		
Basmati rice -potato-*sesbania*	5984			5698			5502			5065			5427			5211		
Raipur																		
Soybean-maize	3362			3231			3648			3756			3141			3201		
Soybean-pea	3230			2865			3401			3678			3393			3418		
Soybean-chilli	3203			3224			3518			3639			3418			3294		
Soybean-onion	3383			3240			3167			3590			3701			3218		
Ranchi																		
Rice-wheat	6069	3526		6105	3450		5676	3770		5426	3056		5926	3588		6033	3641	
Rice -lentil	6033	668		6283	536		5391	709		5069	452		5748	816		5926	875	
Rice -potato	6176	2406		6248	2228		5641	1792		5284	1614		5998	1899		6105	2110	
Rice -linseed	6033	1482		6140	1432		5569	1103		5284	982		5783	1382		5891	1403	

Table 3. Influence of organic, inorganic and integrated package on systems productivity (kg ha^{-1}) at various locations

Cropping Systems/ Management practice	Organic		Inorganic		Integrated (towards organic)		Mean
	100% organic	75% organic+ innovative organic practices	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic+ 25% inorganic	
Bajaura							
Tomato-cauliflower-french bean	16333	17668	13775	16795	21028	19230	17472
Cauliflower-tomato	18420	19980	14000	16330	22330	21060	18687
Black gram-cauliflower-summer squash	25337	25355	21690	24450	30073	29020	25988
Lady's finger-pea	13730	14710	11280	12150	17520	15980	14228
Mean	18455	19428	15186	17431	22738	21323	
Bhopal							
Soybean-durum wheat							2049
Soybean-mustard							1700
Soybean- chickpea							1940
Soybean- linseed							2103
Mean	2155	2027	1747	1801	1910	2049	
Calicut							
Turmeric Prathibha	16700	19600	16000		26000	28100	21280
A. Supreme	21500	21300	15400		26300	27000	22300
Varna	15700	16200	16200		18000	23600	17940
Sobha	19100	16900	17000		17700	24900	19120
Sona	16900	13300	12700		15400	23600	16380
Kanthi	17300	15000	17700		16800	29200	19200
Suvarna	16000	13000	19400		16300	22900	17520
Suguna	21200	20300	12100		23000	31400	21600
Sudarsana	22000	18900	12600		25700	32500	22340
Kedaram	23300	15100	13200		18000	28700	19660
Prabha	23400	14800	14900		18000	26500	19520
Mean	19400	16700	15600		20100	27000	
(CD=0.05) T	900						
(CD =0.05)V	1300						
Dharwad							
Cowpea-safflower	1160	1072	1882	2102	1753	1584	1592
Pigeon pea	1951	1430	2010	2063	2305	2124	1981
Sorghum-green gram	2851	2651	337	4551	3322	3339	2842
Groundnut+hybrid cotton (2:1)	2460	1989	3189	3550	2651	2414	2709
Maize-chickpea	2647	2500	3685	3660	3209	2533	3039
Mean	2214	1928	2221	3185	2648	2399	
Jabalpur (REY)							
Basmati rice – wheat (durum) – green manure	6682	5615	7309	6281	6830	6092	6468
Basmati rice – chickpea – maize fodder	5186	4465	5101	4669	4718	4416	4759
Basmati rice – berseem (fodder and seed)	7698	7487	9843	9339	9914	9022	8884
Basmati rice – vegetable pea–sorghum (fodder)	6853	5989	6568	6049	6481	5865	6301
Mean	6605	5889	7205	6585	6986	6349	
Karjat							
Rice-groundnut	24405	20998	18925	18072	18499	19318	20036
Rice-maize (sweet corn for cob)	26640	25777	21772	20937	21607	21292	23004
Rice-Mustard	10341	9777	8177	8498	8807	9243	9141

Cropping Systems/ Management practice	Organic		Inorganic		Integrated (towards organic)		Mean
	100% organic	75% organic+ innovative organic practices	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic+ 25% inorganic	
Rice-dolichos bean (for green pod vegetable)	21630	20846	18032	17020	17879	17249	18776
Mean	20754	19350	16727	16132	16698	16776	
Ludhiana							
Basmati rice-chickpea	11300	11200	14300	14000	12300	11900	12500
Basmati rice-wheat	15000	15000	18400	17400	15300	15400	16083
Moong-wheat	5400	5400	5900	5900	5200	4800	5433
Pigeon pea -wheat	6100	6700	7800	7600	6100	6100	6733
Mean	9450	9575	11600	11225	9725	9550	
Modipuram							
Basmati rice– wheat (durum) - *sesbania* green manure	8691	8828	5722	7335	8891	9289	8126
Rice– barley (malt) – green gram	10352	10402	7345	9097	10803	11217	9869
Maize (popcorn) – potato– okra + *sesbania* green manure	8608	8202	6239	7650	7930	8150	7797
Maize (sweet corn) – mustard - *sesbania* green manure	19737	21712	16440	18785	20947	21249	19812
Mean	11847	12286	8937	10717	12143	12476	
Pantnagar							
Rice-wheat -*sesbania*	6963	6756	6388	6233	6869	6707	6653
Rice-chickpea + coriander-*sesbania*	7865	7461	6898	6872	7101	6598	7132
Rice-vegetable pea+ coriander-*sesbania*	6284	6487	6306	6427	6382	6644	6422
Rice-potato-*sesbania*	7408	7131	6228	5940	6990	6659	6726
Mean	7130	6959	6455	6368	6836	6652	
Raipur							
Soybean-maize	10872	10203	10673	11174	10102	10434	10576
Soybean-pea	9879	9280	10001	10444	9624	10147	9896
Soybean-chilli	10408	9644	10665	10782	9268	9224	9998
Soybean-onion	10581	9953	10785	11469	10539	10465	10632
Mean	10435	9770	10531	10967	9883	10067	
Ranchi							
Rice(Birsamati) -wheat (K 9107)	6216	6203	6073	4533	6128	6367	5920
Rice (Birsamati) -lentil (PL 406)	4115	4293	3386	2850	4000	4178	3804
Rice(Birsamati) -potato (Kufri Ashoka)	14799	14068	11043	9196	12017	13166	12382
Rice (Birsamati) -linseed (Shekhar)	4773	4979	3962	3520	4385	4599	4370
Mean	7476	7386	6116	5025	6633	7078	
Umiam							
Rice-carrot							20640
Rice-potato							17030
Rice-french bean							18520
Rice-tomato							21810
Mean	20540	18330	17710		21420		

Bajaura: Vegetable based cropping systems were evaluated. Among the crops evaluated, summer tomato (12840 kg/ha) and french bean (7860 kg/ha) recorded higher yield under integrated management followed bytowards organic package comprising of 75% organic+25% inorganic (11620 and 7130 kg/ha, respectively). Crops such as cauliflower and pea in *rabi* also registered higher yield with integrated package consisting of 50% each of organic and inorganic and towards organic package. Response of black gram (970 kg/ha) and okra (10510 kg/ha) was also found to be higher with 50% organic+50% inorganic management approach. Summer squash registered higher yield with integrated management (14210 kg/ha) and 75% organic+25% inorganic management (14210 kg/ha and 14790 kg/ha). It is also important to note that *kharif* and *summer* tomato, summer french bean, *rabi* cauliflower, *summer* squash and *rabi* pea recorded higher yield with integrated or towards organic crop management with only 75% nutrients supplied through organic manures, thus implying possibility of reduced manure application after building up of soil organic carbon. However, in case of *rabi* cauliflower and pea, *kharif* black gram and okra, *summer* french bean, yield is increase of 24.9 and 14.3, 2.3 and 17.9, 20.6% was observed with 25% reduced application of nutrients in the form of organic manures under integrated management. Residues yield of crops also followed the similar trend. In terms of system equivalent yield, black gram-cauliflower-summer squash resulted in higher system equivalent yield (25988 kg/ha) among the cropping systems. Among the different management practices, integrated management with 50% organic+50% inorganic dose of nutrients resulted in higher equivalent yield (22738 kg/ha) across the cropping systems and it is on par with application of 75% nutrients only through organic manures (21323 kg/ha).

Cauliflower under organic management at Bajaura

Summer squash under integrated management at Bajaura

Bhopal: Four Soybean based cropping systems were evaluated. All the crops evaluated in cropping systems recorded higher yield under organic management compared to integrated and inorganic management practices. Organic management practices with 75% nutrients only through organic manures+innovative practices recorded comparable yield with that of organic management with 100% nutrients through manures. Higher yield of soybean (666 kg/ha) was recorded under 100% organic management in soybean-mustard cropping system and it was found to be higher by 32.3% and 25.2% compared to inorganic and integrated package. The yield difference observed between 75 and 100% nutrients application through organic manures under organic management was 9.0, 4.1, 8.4, 5.9, and 7.5 % for soybean, durum wheat, mustard, chickpea and linseed respectively. These findings are very

important, as it gives scope to reduce the 25% manure application thus directly reducing the cost of cultivation under organic management, than all the other management practices such as inorganic (100% inorganic management and state recommendation) and integrated (50% inorganic + 50% organic, 75% organic, 25% inorganic) crop management. Straw yield of crops also recorded similar trend. In terms of system (soybean) equivalent yield, organic management registered higher yield (2156 kg/ha) with 100% nutrients through organic manures than integrated and inorganic management packages. The system equivalent yield was increased with organic management of 18.9 and 11.4% over inorganic and integratedmanagement practices, where in 75% nutrient supply was made through organic manure +innovative practices and 75% through organic manure+ 25% inorganic under integrated management recorded on par equivalent yield. Among the systems, soybean-linseed recorded higher yield (2103 kg/ha) followed by soybean-chickpea (2049 kg/ha).

Calicut: Spices crops such as ginger, turmeric and black pepper were evaluated under different management packages. Turmeric recorded higher yield (27117 kg/ha) with integrated package consisting of 50% organic +50% inorganic. However among the organic management, reduced application of nutrients (75% and 100%) through organic manures resulted in higher yield of turmeric (19375 kg/ha) than organic management with 100% nutrients (16758 kg/ha). Among varieties, sudarshana recorded highest yield (32500 kg/ha) followed by suguna (31400 kg/ha) under integrated management practice (50+50%). Among the varieties, kedaram and prabha recorded maximum yield under organic management practices (100%). All the turmeric varieties performed better with integrated package of 75% organic+25% inorganic, Ginger crop was lost due to heavy incidence of diseases.In case of black pepper, maximum yield (2800 kg/ha) was with variety Sreekara followed by Panniyur-1.

Coimbatore: Crops such as cotton, maize, chillies, sunflower and beetroot were evaluated in 3 cropping systems. All the crops recorded higher yield under integrated package with 75% organic+25% inorganic followed by state recommendation of applying 100% nutrients through inorganic sources. Among the organic management, all the crops also registered higher yield under reduced application of manures (75% nutrients only through organic manures with complete organic management) compared to 100% nutrients supply through organic sources. The yield increase was found to be 25.6, 19.7, 22.4, 18 and 11.6% for cotton, maize, chillies, sunflower and beetroot respectively. Residues/straw yield also exhibited the similar trend.

Dharwad: All the crops except pigeon pea (sole)and chickpea recorded higher yield under state recommendations consisting of organic and inorganic.Cowpea, safflower, greengram, sorghum, groundnut and cotton recorded higher yield (314, 2672, 445, 3141, 1677 & 1835 kg/ha respectively) under state recommendation of nutrient supply. Pigeonpeaand chickpea recorded maximum yield (2305 and 1394 kg/ha) under integrated nutrient management package with 50% organic + 50% inorganic nutrient sources which was at par with inorganic nutrient packages. Among the organic nutrient management, all the crops in cropping systems performed better with integrated nutrient management 50% organic+50% inorganic package. The yield reduction under 100%organic management found in cowpea, safflower, pigeonpea, greengram, sorghum, groundnut, hybrid cotton and maize were 9.2, 51.5, 5.4, 77.3, 19.4, 13.8, 56.1 & 44.7 % respectively over inorganic nutrient packages. The straw yield also gave similar trend. The system equivalent yield was found to be higher (3185 kg/ha) under state recommendation. Among the cropping systems, maize-chickpea recorded higher yield (3039 kg/ha) among all the cropping systems followed by sorghum-green gram (2842 kg/ha) cropping system.

Jabalpur: Rice based cropping system with crops such as wheat (duram), chickpea, maize (fodder), berseem,vegetablepea and sorghum were evaluated. Rice cv. Pusabasmati was grown in all 4 cropping systems during in kharif. Mean grain yield of rice was higher under organic package with 100% organic nutrient supply (3274 kg/ha).Whereas wheat (3710 kg/ha), maize fodder (42000 kg/ha), berseemseed and fodder (273 and 68810 kg/ha), sorghum fodder (44690 kg/ha) were recorded higher under inorganic nutrient package with 100% inorganic nutrient management. Vegetable pea recorded higher yield (2249 kg/ha) under 100% organic nutrient sources. The yield increase of wheat, maize fodder, berseem seed and vegetable pea in organic management with 100% nutrients based organic management was found to be 14.2, 2.1, 30 and 78.9 % respectively over75% nutrients through organic manure. Straw yield also recorded same trend. Rice equivalent yield of system were found to be higher (7205 kg/ha) with management package having 100% inorganic management followed by 6986 kg/ha with 50% organic and 50% inorganic nutrient sources. In terms of cropping systems, higher rice equivalent yield (8884 kg/ha) were found with rice-berseem (fodder & seed) followed by basmati rice-wheat (6468 kg/ha) because of the chickpea crop failed due to continuous rain at the time of maturity.

Basmati rice under inorganic management at Jabalpur

Berseem under inorganic management at Jabalpur

Karjat: Rice based cropping system were evaluated. Among the different crops, irrespective of cropping systems higher mean yield of rice (3761 kg/ha) was recorded with adoption of 100% inorganic management practices while, adoption of organic with 75% nutrient from organic manures along with innovative practices recorded lowest grain yield (3596 kg/ha) and found to be on par with integrated nutrient management. Other crops such asmaize, mustard and dolichos bean, recorded higher yield with inorganic nutrient package having 100% nutrient supplythrough inorganic sources and yield reduction was found only 2.5 and 1.2% with 100% organic and integrated nutrient management. Inorganic nutrient management practices were found to be better for maize, mustard and dolichos bean while, groundnut performed better under organic management with 100% nutrient supply through organic sources and increase in yield to the tune of 2.5% was observed over inorganic package. Straw yield also gave to be similar trend. Rice-maize (sweet corn for cob) system grown with organic package of 100% nutrient by organic sources produced maximum rice equivalent yield (26640 kg/ha) was compared to other treatments followed by same system grown under 75% organic + innovative practices (25777 kg/ha). Among the management package, organic management with 100% nutrient supply through organic sources recorded higher REY (20754 kg/ha) and it was significantly higher 19.4% over inorganic and integrated.

Ludhiana: Chickpea, wheat, green gram and pigeon pea were evaluated in basmati rice based cropping systems. In case of basmati rice, organic, inorganic and integrated managementdid not influence, however maximum basmati rice yield (4730 kg/ha) was recorded with inorganic management under state recommendation in basmati rice-chickpea-green manure system.Among the crops evaluated, pigeon pea (570 kg/ha) recorded higher yield under 100% organic package and it was on par with integrated and inorganic packages. chickpea (220 kg/ha) performed better under state recommended package. Wheat recorded higher yield (5180 kg/ha) in integrated package with 50% each organic and inorganic management with mean yield of 4900 kg/ha.About 10% less yield was recorded with 100% organic management over towards organic managementwith 75% nutrient supply with organic sources +25% from inorganic sources. Residue yield of all the crops also resulted in similar trend. In terms of system equivalent yield, integrated management with 50% organic +50% inorganic source of nutrient resulted in higher wheat equivalent yield (11600 kg/ha) as compared to other nutrient packages. Among the cropping systems, wheat equivalent yield was found higher (16083 kg/ha) in basmati rice- wheat.

Modipuram: Different crops such as wheat, green gram, barley, potato, mustard in *rabi* and okra in *summer* were evaluated in rice and maize based cropping systems. Rice, wheat, barley, greengram, and maize (popcorn) recorded higher yield (4860, 4460, 4450, 974 and 2140 kg/ha respectively) under integrated management with 75% organic + 25% inorganic nutrient sources while maize (sweet corn) recorded maximum (11730 kg/ha) with 50% of each organic and inorganic nutrient management package. Potato, okra and mustard recorded higher yield (23240, 7600 and 2070 kg/ha respectively) under organic management with 100% nutrient supply through organic sources.Among the nutrient management, the yield of wheat and barley was reduced by 7.4 and 11.7% with organic management over integrated with 75% organic + 25%. Straw yield also gave similar trend.The system equivalent yield were higher (12476 kg/ha) in integrated packages with 75% organic and 25% inorganic nutrients and on par with 50% each organic and inorganic nutrient supply. Among the cropping systems, higher system equivalent yield (19812 kg/ha) was recorded with maize (sweet corn)-mustard-*sesbania* system owing to higher yield of sweet corn and good premium price.

Pantnagar: Rice based cropping system was evaluated under different management packages.Grain yield of basmati rice (4223 kg/ha) was higher with 100% organicpackage followed by 75% organic+innovative practices (4068 kg/ha) as compared to inorganic and integrated management. In *rabi* wheat yield (4915 kg/ha) was highest under integrated (50% each organic and inorganic) followed by 75% organic +25% inorganic, indicating better performance with towards the organic production system. Crops like chickpea, vegetable pea and potato recorded higher yield of 1301, 5046 and 13760 kg/ha respectively under organic management respectively. The yield increase was found to be 9.0, 33.7 and 14.4 % in rice, chick pea and

Performance of Basmati rice (Pusa Basmati-1) under oraganic, inorganic and integrated management at Pantnagar

Performance of Wheat (UP-2572) under oraganic, inorganic and integrated management at Pantnagar

potato respectively and yield reduction in wheat was found to be 3.3 % under 100% organic management over 75% organic sources. Straw yield also gave similar trend. The rice equivalent yield of system was found to be higher (7130 kg/ha) with organic management having 100% nutrients followed by 75% organic nutrients +innovative practices (6959 kg/ha). Among all the cropping systems, higher system equivalent yield was recorded with rice-chickpea +coriander-*sesbania* system (7132 kg/ha) while rice-vegetable pea +coriander-*sesbania* system recorded lowersystem yield (6422 kg/ha).

Basmati rice-chickpea+coriander (4:2) at Pantnagar

Basmati rice-wheat-potato system at Pantnagar

Raipur: Soybean based cropping systems were evaluated including maize, pea, chilli, and onion under organic, reduced dose of organic manures, integrated and inorganic management packages. Not much variation was observed in soybean yield as influenced by management practice whereas, mean yield of soybean was recorded higher with state recommendation (2090 kg/ha) followed by reduced dose of organic manure 75% organic +25% inorganic (2046 kg/ha). Other crops such as maize, pea, chilli and onion also recorded higher yield (11795, 7246, 9055 and 16208 kg/ha respectively) under state recommendation. The yield differences under inorganic package (from 100% organic to state recommendation) were found to be 6.1, 2.0, 5.1, 2.6 and 8.4% with soybean, maize, pea, chili and onion respectively. The straw yield of all crops was also found to be in same trend. Among the cropping systems, soybean-onion registered higher system equivalent yield (10632 kg/ha) compared to other cropping systems which recorded on par with soybean-maize system.

Ranchi: Different crops such as wheat, potato, linseed, & lentil were evaluated in basmati rice based cropping system. In rice, higher yield (4177 kg/ha) was found with organic package of nutrient with 75% organic nutrient sources in rice-potato system. Wheat recorded highest yield (2835 kg/ha) under inorganic package with 100% inorganic nutrients which was at par with integrated nutrient package. Potato and

Performance of Rice under oraganic, inorganic and integrated management at Ranchi

linseed recorded higher yield (16254 & 821 kg/ha) under organic package of nutrient respectively with 100% nutrient supply through organic sources. Lentil recorded higher yield (250 kg/ha) under integrated package (50% organic+50% inorganic). The yield was found to be higher in potato (17.7 & 44.3%) and linseed (6.9 & 43.8%) of under organic (100% organic) andyield reduction in wheat was recorded up to 2.4 & 15.6% under organic management over integrated with 75% organic and inorganic nutrient package (100% to state recommendation). The straw yield also gave similar trend. Rice equivalent yield in term of systems was higher (7476 kg/ha) with organic nutrient package with 100% organic source of nutrients. Among the cropping systems, rice-potato recorded higher system equivalent yield (12382 kg/ha) while rice-lentil recorded lower equivalent yield (3804 kg/ha).

Linseed under organic management at Ranchi

Lentil towards organic management at Ranchi

Umiam: Two different experiments ofrice based cropping system including different varieties of crops were evaluated with raised and sunken bed planting method. The higher rice grain mean yield (4180 kg/ha) on raised bed was recorded with integrated package having 50% organic+50% inorganic sources followed by 100% organic (3760 kg/ha).In case of sunken bed,rice, varieties, Megha Aromatic 2, Ngoba, Lampnah and Shahsarang-1 were grown. Among the rice varieties, Shahsharang-1 produced maximum

grain yield (4670 kg/ha) followed by Lampnah (4380 kg/ha), whereas higher grain yield was recorded under integrated (4540 kg/ha) nutrient management. Carrotand potato recorded highest yield 14500 and 14900 9400kg/ha under integrated nutrient package with 75% nutrient supplied through organic manures while, french bean and tomato recorded highest yield (9500 and 14700 kg/ha) under organic package with 100% organic manures grown on raised bed. Straw yield of crops was also found to be in similar trend. The rice equivalent yield in term of system on raised bed recorded higher (21420 kg/ha) under integrated nutrient package with 50% organic+50% inorganic. In case of cropping system, highest yield was recorded with rice-tomato system (21810 kg/ha).

Rice in sunken bed at Umiam

Carrot on raised bed at Umiam

Influence of organic management package with reduced dose of organic manures, integrated and inorganic nutrient management packages on soil physical and chemical properties (Table 4-7)

Physical and chemical characteristics of soil in terms of bulk density, electrical conductivity, pH, organic carbon, available N, P and K have been estimated and reported by all centres except Karjat, Ludhiana and Ranchi.

Bajaura: pH, organic carbon, available N, P and K were estimated. The soil pH under different cropping systems as influenced by nutrient management was higher under organic management with 75% nutrient supply through organic manure+innovative organic practice (3 sprays of vermiwash @10%) and integrated with 75% organic+ 25% inorganic whereas lower soil pH was observed in inorganic management.The soil pH indicated normal range of 6.20 -7.40 in all the treatments. Different cropping systems recorded maximum improvement in soil organic carbon ranging from 0.91 to 1.28% under100% organic production system and with reduced dose of organic manures 75% organic+3 sprays of vermiwash @10%).Organic management with 100% nutrients through organic manures recorded higher organic carbon (1.13%) followed by organic management with 75% nutrients through organic manure +innovative practices which is 82.2 and 69.3% higher than 100% inorganic management. Availability of residual N in soil was higher with integrated nutrient management practices at the end of cropping cycle than inorganic management but at par with 100% organic and reduced dose of organic (75%). Around 11.7 and 12.6% higher soil available N was recorded under organic and integrated than inorganic management. Due to the presence of leguminous crop of pea in lady finger-pea system, higher soil available N was noticed in this system. In term of soil available phosphorous, integrated management recorded higher available phosphorous (70.7 and 65.3 kg/ha) under integrated package with 50% organic+50% inorganic or 75% nutrients through

Table 4. Influence of organic, inorganic and integrated package on soil physico-chemical properties (bulk density and electrical conductivity) at the end of cropping cycle at various locations

Treatments / Management practice	Bulk density (g/cc)							Soil EC (d/m)						
	Organic		Inorganic (towards organic)		Integrated		Mean	Organic		Inorganic (towards organic)		Integrated		Mean
	100% organic	75% organic + innovative organic practices	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic + 25% inorganic	
Bhopal														
Soybean- wheat								0.22	0.22	0.29	0.25	0.26	0.22	0.24
Soybean- Mustard								0.22	0.27	0.26	0.24	0.24	0.22	0.24
Soybean- Chickpea								0.25	0.22	0.22	0.26	0.26	0.24	0.24
Soybean- Linseed								0.22	0.22	0.23	0.27	0.28	0.26	0.25
Mean								0.23	0.23	0.25	0.26	0.26	0.24	
Dharwad														
Cowpea-safflower	1.19	1.20	1.28	1.23	1.25	1.24	1.23	0.22	0.21	0.20	0.18	0.19	0.21	0.20
Pigeonpea (Sole)	1.16	1.21	1.26	1.22	1.24	1.21	1.22	0.22	0.21	0.22	0.21	0.19	0.24	0.22
Greengram-sorghum	1.19	1.20	1.26	1.22	1.23	1.25	1.23	0.23	0.20	0.20	0.20	0.18	0.19	0.20
Groundnut + hybrid cotton (2:1)	1.18	1.21	1.24	1.22	1.22	1.22	1.22	0.19	0.20	0.20	0.20	0.22	0.20	0.20
Maize-chickpea	1.19	1.20	1.24	1.23	1.23	1.22	1.22	0.20	0.23	0.20	0.21	0.22	0.21	0.21
Mean	1.18	1.20	1.26	1.22	1.23	1.23		0.21	0.21	0.20	0.20	0.20	0.21	
Jabalpur														
Basmati rice –wheat (duram)-green manure	1.27	1.27	1.39	1.38	1.31	1.30	1.32	0.57	0.58	0.71	0.70	0.65	0.63	0.64
Basmati rice – chickpea - maize fodder	1.29	1.28	1.41	1.41	1.32	1.30	1.34	0.56	0.56	0.66	0.64	0.59	0.58	0.60
Basmati rice – berseem (fodder and seed)	1.28	1.26	1.41	1.40	1.32	1.31	1.33	0.54	0.55	0.66	0.65	0.60	0.59	0.60
Basmati rice – vegetable pea- sorghum (fodder)	1.28	1.27	1.39	1.37	1.31	1.29	1.32	0.58	0.59	0.63	0.63	0.64	0.62	0.62
Mean	1.28	1.27	1.40	1.39	1.32	1.30		0.56	0.57	0.67	0.66	0.62	0.61	
Ludhiana														
Basmati rice-chickpea-GM								0.24	0.21	0.27	0.24	0.26	0.22	0.24
Basmati rice-wheat-GM								0.19	0.21	0.26	0.28	0.22	0.25	0.24
Moong-wheat-GM								0.21	0.20	0.24	0.22	0.22	0.25	0.22
Pigeonpea -wheat								0.18	0.19	0.26	0.24	0.22	0.24	0.22
								0.21	0.20	0.26	0.25	0.23	0.24	
Modipram														
Basmati rice– wheat - *sesbania* green manure								0.12	0.12	0.12	0.12	0.12	0.13	0.12

Treatments / Management practice	Bulk density (g/cc)							Soil EC (d/m)						
	Organic		Inorganic		Integrated (towards organic)		Mean	Organic		Inorganic		Integrated (towards organic)		Mean
	100% organic	75% organic + innovative organic practices	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic + 25% inorganic	
Rice– barley (malt) – green gram								0.12	0.09	0.11	0.12	0.11	0.11	0.11
Maize (pop corn) – potato– okra + *sesbania* green manure								0.17	0.16	0.16	0.32	0.3	0.33	0.24
Maize (sweet corn) – mustard - *sesbania* green manure								0.25	0.31	0.16	0.26	0.29	0.26	0.26
Mean								0.17	0.17	0.14	0.21	0.21	0.21	
Pantnagar														
Rice-wheat -*sesbania*								0.32	0.319	0.264	0.306	0.343	0.352	0.32
Rice-chickpea + coriander-*sesbania*								0.284	0.256	0.293	0.322	0.36	0.268	0.30
Rice-vegetable pea + coriander-*sesbania*								0.29	0.227	0.273	0.3	0.339	0.274	0.28
Rice-potato-*sesbania*								0.258	0.164	0.246	0.285	0.226	0.229	0.23
Mean								0.29	0.24	0.27	0.30	0.32	0.28	
Umiam														
Raised bed systems														
Rice-carrot							1.10							
Rice-potato							1.12							
Rice-french bean							1.09							
Rice-tomato							1.12							
Mean	1.09	1.12	1.16		1.11									
CD (P=0.05) CS	0.02													
CD *(P=0.05)* Nutrient sources	0.03													
Interaction CD *(P=0.05)*	0.04													
Sunken Bed **(Rice-fellow system)**														
Megha aromatic 2							1.12							
Ngoba							1.10							
Shahsarang-1							1.14							
Lumpnah							1.11							
Mean	1.09	1.11	1.15		1.11									
CD *(P=0.05)* Cropping systems	0.03													
CD *(P=0.05)* Nutrient sources	0.02													
Interaction CD *(P=0.05)*	NS													

Table 5. Influence of organic, inorganic and integrated package on soil chemical properties (pH and organic carbon) at the end of cropping cycle at various locations

Treatments / Management practice	pH							Organic carbon (%)						
	Organic		Inorganic (towards organic)		Integrated		Mean	Organic		Inorganic (towards organic)		Integrated		Mean
	100% organic	75% organic + innovative organic practices	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic + 25% inorganic	
Bajura (%)														
Tomato-cauliflower-french bean	7.2	7.1	6.4	6.9	7.1	7.2	7.0	1.28	1.14	0.59	0.73	0.80	0.84	0.90
Tomato-cauliflower	7.2	7.2	6.4	7.0	7.2	7.4	7.1	1.05	1.01	0.65	0.70	0.85	0.88	0.86
Black gram-cauliflower-summer Squash	7.0	7.2	6.2	7.0	7.2	7.3	7.0	1.24	1.15	0.62	0.65	0.86	0.87	0.90
Lady finger-pea	7.3	7.4	6.3	7.0	7.3	7.4	7.1	0.95	0.91	0.60	0.67	0.84	0.86	0.81
Mean	7.2	7.2	6.3	7.0	7.2	7.3		1.13	1.05	0.62	0.69	0.84	0.86	
Bhopal														
Soybean-durum wheat	7.52	7.60	7.56	7.55	7.57	7.67	7.58	1.10	0.93	0.70	0.72	0.92	0.98	0.89
Soybean- mustard	7.64	7.58	7.52	7.5	7.57	7.59	7.57	0.99	0.93	0.66	0.64	0.95	0.99	0.86
Soybean- chickpea	7.66	7.57	7.66	7.50	7.52	7.47	7.56	0.92	0.81	0.69	0.65	0.81	0.98	0.81
Soybean- linseed	7.72	7.66	7.66	7.58	7.47	7.51	7.60	0.90	0.86	0.72	0.58	0.91	0.94	0.82
Mean	7.64	7.60	7.60	7.53	7.53	7.56		0.98	0.88	0.69	0.65	0.90	0.97	0.85
Calicut														
Ginger Mahima							5.46							2.11
120DAP Rejatha							5.62							2.08
Varada							5.69							2.26
Mean	6.3	6.4	4.7		5.3	*5.2*		2.0	2.6	2.0		2.2	*1.9*	
Turmeric Prathibha							4.59							2.05
A.S							4.62							1.99
Varna							4.51							2.04
Soba							4.65							2.23
Sona							4.66							2.10
Kanthi							4.67							1.97
Suvarna							4.67							1.95
Suguna							4.67							2.10
Sudarsana							4.65							2.23
Kedaram							4.59							2.16
Prabha							4.59							2.19
Mean	5.0	4.6	4.4		4.6	4.5		2.5	2.2	1.5		2.5	1.7	
Dharwad								(g/kg)						
Cowpea-safflower	7.20	7.24	7.27	7.28	7.21	7.26	7.24	6.80	6.38	5.30	6.38	6.08	5.90	6.14
Pigeon pea	7.17	7.17	7.28	7.27	7.20	7.28	7.23	6.63	6.00	5.93	5.95	6.30	5.78	6.10
Sorghum-green gram	7.25	7.21	7.22	7.28	7.20	7.21	7.23	6.65	6.13	5.38	5.78	5.68	5.45	5.84

Treatments / Management practice	pH							Organic carbon (%)						
	Organic		Inorganic		Integrated (towards organic)		Mean	Organic		Inorganic		Integrated (towards organic)		Mean
	100% organic	75% organic + innovative organic practices	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic + 25% inorganic	
Groundnut + hybrid cotton (2:1)	7.15	7.17	7.27	7.26	7.22	7.34	7.24	6.75	6.10	5.63	6.05	6.18	6.03	6.12
Maize-chickpea	7.19	7.20	7.24	7.30	7.20	7.27	7.23	6.48	6.20	5.80	5.90	5.88	5.63	5.98
Mean	7.19	7.20	7.26	7.28	7.21	7.27		6.66	6.16	5.61	6.01	6.02	5.76	
Jabalpur														
Basmati rice –wheat-green manure	7.21	7.22	7.22	7.21	7.21	7.2	7.21	8.12	8.09	7.06	7.00	7.99	7.85	7.69
Basmati rice – chickpea - maize (fodder)	7.20	7.22	7.20	7.28	7.25	7.23	7.23	7.72	7.67	6.66	6.45	7.39	7.30	7.20
Basmati rice – berseem (fodder and seed)	7.24	7.25	7.22	7.20	7.25	7.21	7.23	7.62	7.59	6.56	6.45	7.49	7.32	7.17
Basmati rice – vegetable pea- sorghum (fodder)	7.26	7.26	7.27	7.26	7.27	7.25	7.26	7.92	7.85	6.96	6.80	7.59	7.46	7.43
Mean	7.23	7.24	7.23	7.24	7.25	7.22		7.85	7.80	6.81	6.68	7.62	7.48	
Ludhiana														
Basmati rice-chickpea-GM	7.45	7.42	7.52	7.44	7.40	7.48	7.45	0.60	0.57	0.44	0.42	0.56	0.52	0.52
Basmati rice-wheat-GM	7.50	7.45	7.38	7.40	7.48	7.52	7.46	0.57	0.54	0.44	0.42	0.52	0.51	0.50
Moong-wheat-GM	7.40	7.36	7.50	7.46	7.32	7.42	7.41	0.60	0.56	0.42	0.41	0.58	0.52	0.52
Pigeonpea -wheat	7.60	7.52	7.45	7.60	7.48	7.50	7.53	0.62	0.60	0.48	0.46	0.56	0.58	0.55
Mean	7.49	7.44	7.46	7.48	7.42	7.48		0.60	0.57	0.45	0.43	0.56	0.53	
Modipuram														
Basmati rice– wheat - *sesbania* green manure	8.2	8.2	8.4	8.3	8.3	8.3	8.3	0.77	0.74	0.62	0.73	0.73	0.70	0.72
Rice– barley (malt) – green gram	8	8.1	8.7	8.4	8.2	8.2	8.3	0.50	0.44	0.40	0.43	0.43	0.40	0.43
Maize (pop corn) – potato–okra + *sesbania* green manure	7.6	7.5	7.8	7.4	7.4	7.6	7.6	0.55	0.50	0.35	0.44	0.55	0.53	0.49
Maize (sweet corn) – mustard - *sesbania* green manure	7.8	7.4	7.9	7.3	7.5	7.5	7.6	0.62	0.46	0.40	0.44	0.59	0.52	0.51
Mean	7.9	7.8	8.2	7.85	7.85	7.9		0.61	0.54	0.44	0.51	0.58	0.54	
Pantnagar														
Rice-wheat -*sesbania*	7.10	6.62	7.65	6.52	7.23	6.82	6.99	1.26	1.15	0.77	0.88	1.05	1.18	1.05
Rice-chickpea + coriander-*sesbania*	6.80	6.67	7.50	6.90	7.52	6.83	7.04	1.35	1.13	0.74	0.92	1.07	1.16	1.06

Treatments / Management practice	pH							Organic carbon (%)						
	Organic		Inorganic (towards organic)		Integrated		Mean	Organic		Inorganic (towards organic)		Integrated		Mean
	100% organic	75% organic + innovative organic practices	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic + 25% inorganic	
Rice-vegetable pea + coriander-*sesbania*	6.33	7.12	7.66	7.23	7.09	6.89	7.05	1.48	1.25	0.71	0.83	1.09	1.13	1.08
Rice-potato-*sesbania*	6.40	7.05	7.75	7.04	7.44	6.18	6.98	1.29	1.14	0.66	0.86	1.08	1.1	1.02
Mean	6.66	6.87	7.64	6.92	7.32	6.68		1.35	1.17	0.72	0.87	1.07	1.12	
Raipur														
Soybean-maize								0.70	0.67	0.63	0.70	0.67	0.65	0.67
Soybean-pea								0.72	0.70	0.62	0.67	0.65	0.64	0.67
Soybean-chilli								0.68	0.65	0.64	0.68	0.64	0.64	0.66
Soybean-onion								0.69	0.68	0.62	0.68	0.67	0.62	0.66
Mean								0.70	0.68	0.63	0.68	0.66	0.64	
Ranchi														
Rice -wheat							5.94							0.56
Rice-lentil							6.00							0.57
Rice-potato							5.91							0.55
Rice- linseed							5.86							0.54
Mean	6.29	6.25	6.06	6.00	5.49	5.46		0.69	0.67	0.58	0.57	0.44	0.39	
Umiam														
Raised bed systems														
Rice-carrot							5.21							3.06
Rice-potato							5.12							3.05
Rice-french bean							5.29							3.16
Rice-tomato							5.23							3.07
Mean	5.34	5.15	5.08		5.28			3.29	3.15	2.80		3.19		
CD *(P=0.05) Cropping systems*	0.06							NS						
CD *(P=0.05)* Nutrient sources	0.08							0.14						
Interaction CD *(P=0.05)*	NS							NS						
Rice-fellow system *Sunken Bed*														
Megha aromatic 2							5.34							2.53
Ngoba							5.51							2.66
Shahsarang-1							5.28							2.46
Lumpnah							5.37							2.54
Mean	5.31	5.25	5.36		5.60			2.72	2.31	2.46		2.70		
CD *(P=0.05) Cropping systems*	0.04							0.07						
CD *(P=0.05)* Nutrient sources	0.06							0.04						
Interaction CD *(P=0.05)*	0.08							0.14						

Table 6. Influence of organic, inorganic and integrated package on soil available nitrogen and phosphorus at the end of cropping cycle at various locations

Treatments / Management practice	Available nitrogen (kg ha^{-1})							Available phosphorus (kg ha^{-1})						
	Organic		Inorganic (towards organic)		Integrated		Mean	Organic		Inorganic (towards organic)		Integrated		Mean
	100% organic	75% organic + innovative organic practices	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic + 25% inorganic	
Bajaura														
Tomato-cauliflower-french bean	253.8	251.5	226.6	233.3	245.5	243.4	242.4	64.5	60.0	36.1	40.3	67.4	58.7	54.5
Cauliflower-tomato	245.5	243.2	240.5	245.8	228.0	225.8	238.1	69.8	63.5	38.4	41.3	75.3	64.5	58.8
Black gram-cauliflower-summer squash	239.0	233.7	204.7	213.6	261.1	258.9	235.2	67.6	66.7	34.8	39.0	72.1	68.9	58.2
Lady finger-pea	261.0	258.6	222.9	226.6	272.8	268.4	251.7	69.5	68.0	36.5	39.8	68.2	69.3	58.6
Mean	249.8	246.8	223.7	229.8	251.9	249.1		67.8	64.5	36.4	40.1	70.7	65.3	
Bhopal														
Soybean-durum wheat	117.6	83.1	71.9	97.1	96.1	90.5	92.7	34.7	18.1	15.6	30.1	31.2	16.4	24.3
Soybean- mustard	10.5	91.5	88.7	89.6	87.7	96.1	93.2	20.6	15.6	14.5	27.7	20.0	20.7	19.8
Soybean- chickpea	77.5	96.1	110.1	82.1	87.7	93.3	91.2	20.2	24.5	18.6	17.8	18.7	31.0	21.8
Soybean- linseed	86.8	97.1	97.1	83.1	91.5	80.3	89.3	19.2	17.0	20.1	12.6	16.5	27.1	18.7
Mean	96.8	91.9	91.9	88.0	90.8	90.1		*23.7*	18.8	17.2	22.1	21.6	23.8	
Calicut														
Ginger- Mahima														35.1
Fellow Rejatha														30.8
Varada														35.8
Mean								32.5	30.5	23.2		42.2	40.0	
Turmeric - Prathibha							224.9							39.5
Fellow A.S							218.7							38.5
Varna							223.4							37.8
Soba							240.7							34.4
Sona							226.7							39.0
Kanthi							216.4							34.6
Suvarna							211.5							30.6
Suguna							227.2							31.8
Sudarsana							237.5							37.4
Kedaram							234.7							34.6
Prabha							235.8							37.6
Mean	271.9	237.2	163.2		275.2	187.7		52.0	20.3	41.1		40.9	25.7	
Coimbatore														
Cotton - maize	266	271	249	253	282	279	266.7	11.7	13.2	13.3	12.6	12.8	12.2	12.6
Chillies - sunflower	281	275	223	251	346	359	289.2	12.3	11.0	13.1	12.1	9.8	11.2	11.6
Beetroot - maize	216	221	213	226	220	228	220.7	9.3	10.2	8.8	10.1	10.0	11.0	9.9
Mean	254	256	228	243	283	289		11.1	115	11.7	11.6	10.9	11.5	

Treatments / Management practice	Available nitrogen (kg ha^{-1})							Available phosphorus (kg ha^{-1})						
	Organic		Inorganic (towards organic)		Integrated		Mean	Organic		Inorganic (towards organic)		Integrated		Mean
	100% organic	75% organic + innovative organic practices	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic + 25% inorganic	
Dharwad														
Cowpea-safflower	282.4	276.8	159.3	282.1	274.4	270.8	274.3	30.6	27.1	24.3	28.8	25.4	26.6	27.1
Pigeon pea (sole)	280.7	275.7	263.2	276.4	271.6	266.8	272.4	28.1	26.8	24.2	27.4	24.9	24.7	26.0
Sorghum-green gram	281.0	277.2	265.2	277.8	275.0	275.2	275.2	27.4	24.5	27.3	26.3	24.1	26.7	26.1
Groundnut + hybrid cotton (2:1)	277.8	279.2	262.6	274.3	273.6	272.7	273.4	28.2	25.2	26.1	25.4	24.4	26.3	25.9
Maize-Chickpea	279.6	275.1	262.5	276.4	274.1	269.9	272.9	29.1	28.1	23.5	29.2	28.4	27.9	27.7
Mean	280.3	276.8	273.7	271.1	262.6	277.4		28.7	26.4	25.5	26.5	25.1	27.4	
Jabalpur														
Basmati rice –wheat (duram)-green manure	294.0	291.0	280.0	275.0	284.0	281.0	284.2	15.1	14.8	13.7	13.0	14.5	14.1	14.2
Basmati rice – chickpea - maize fodder	277.0	273.0	278.0	273.0	278.0	275.0	275.7	14.9	14.5	12.4	11.9	13.6	13.2	13.4
Basmati rice – berseem (fodder and seed)	291.0	288.0	279.0	276.0	291.0	288.0	285.5	14.2	14.0	13.5	13.0	14.3	14.0	13.8
Basmati rice – vegetable pea- sorghum (fodder)	282.0	276.0	265.0	261.0	272.0	270.0	271.0	14.3	14.0	12.9	12.1	14.2	19.8	14.6
Mean	286.0	282.0	275.5	271.3	281.3	278.5		14.6	14.3	13.1	12.5	14.2	15.3	
Ludhiana														
Basmati rice-chickpea-GM	362.6	345.4	277.8	280.2	340.5	330.2	322.8	52.9	50.7	40.6	40.8	48.8	42.5	46.1
Basmati rice-wheat-GM	350.2	346.8	290.2	292.8	348.2	340.1	328.1	50.6	48.2	40.1	41.6	46.4	42.6	44.9
Moong-wheat-GM	356.2	348.6	290.2	300.6	345.2	346.1	331.2	56.2	52.6	41.6	42.8	50.1	48.8	48.7
Pigeonpea -wheat	368.4	352.6	300.8	298.6	364.2	345.2	338.3	54.2	48.8	40.6	42.2	45.6	42.8	45.7
Mean	359.4	348.4	289.8	293.1	349.5	340.4		53.5	50.1	40.7	41.9	47.7	43.7	
Modipuram														
Basmati rice– wheat (*durum*) - *sesbania* GM								40.8	42.2	26.2	28.2	28.9	27.7	32.3
Coarse rice– barley (*malt*) – green gram								51.4	49.2	28.4	31.7	42.2	43.4	41.1
Maize (*pop corn*) – potato– okra + *sesbania*								27.6	34.9	16.7	17.5	25.5	25.2	24.6
Maize (*sweet corn*) – mustard - *sesbania* GM								49	25.9	12.3	12.5	23	22.5	24.2
Mean								42.2	38.1	20.9	22.5	29.9	29.7	
Pantnagar														
Rice-wheat -*sesbania*	384	318	382	368	385	382	370	68.6	51.3	38.5	45.8	61.0	53.5	53.1

Treatments / Management practice	Available nitrogen (kg ha^{-1})							Available phosphorus (kg ha^{-1})						
	Organic		Inorganic		Integrated (towards organic)		Mean	Organic		Inorganic		Integrated (towards organic)		Mean
	100% organic	75% organic + innovative organic practices	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic + 25% inorganic	
Rice-chickpea + coriander-*sesbania*	417	367	398	365	395	395	390	63.4	55.9	37.4	62.4	60.4	56.3	56.0
Rice-vegetable pea + coriander-*sesbania*	429	388	391	376	276	383	374	67.7	58.7	40.2	47.8	62.0	49.7	54.4
Rice-potato-*sesbania*	399	395	375	398	388	370	388	67.6	60.0	53.0	58.0	58.3	54.5	58.6
Mean	407	367	387	378	361	383		66.9	56.5	42.3	53.5	60.4	53.5	
Raipur														
Soybean-maize	236	233	246	247	239	232	239	13.5	13.0	13.4	14.8	13.0	14.8	13.8
Soybean-pea	231	232	242	248	238	232	237	14.4	13.9	13.8	14.2	14.1	14.2	14.1
Soybean-chilli	231	233	243	249	239	230	238	15.6	13.2	14.2	14.7	13.7	14.3	14.3
Soybean-onion	236	234	240	247	236	234	238	15.3	15.0	15.7	15.7	14.1	14.1	15.0
Mean	234	233	243	248	238	232		14.7	13.8	14.3	14.9	13.7	14.4	
Ranchi														
Rice -wheat	311.9	296.5	258.8	252.5	285.3	272.7	279.6	57.4	56.6	59.6	57.2	54.9	54.4	56.7
Rice-lentil	333.0	320.9	269.5	243.5	293.0	275.0	289.2	51.5	50.2	56.9	54.9	53.4	54.7	53.6
Rice-potato	310.4	307.5	287.6	255.2	300.8	299.0	293.4	58.4	57.2	61.3	59.1	55.7	55.2	57.8
Rice- linseed	307.0	293.3	255.3	225.3	282.0	256.7	269.9	56.6	55.2	57.7	56.3	55.7	54.1	55.9
Mean	315.6	304.5	267.8	244.1	290.3	275.9		56.0	54.8	58.9	56.9	54.9	54.6	
Umiam														
Raised bed systems														
Rice-Carrot							245.5							19.7
Rice-Potato							240.8							19.3
Rice-French bean							257.2							21.4
Rice-Tomato							248.4							20.2
Mean	258.4	247.1	240.3		246.2			22.4	19.5	16.4		22.4		
CD *(P=0.05)* Cropping systems	9.84							1.52						
CD *(P=0.05)* Nutrient sources	10.1							2.51						
CD *(P=0.05)* Interaction	NS							3.04						
Rice-fellow system *Sunken Bed*														
Megha aromatic 2							224.9							17.7
Ngoba							237.2							19.6
Shahsarang-1							228.4							16.9
Lumpnah							227.9							18.3
Mean	240.3	218.4	220.9		238.9			20.1	16.9	13.9		21.6		
CD *(P=0.05) Cropping systems*	6.17							1.52						
CD *(P=0.05)* Nutrient sources	2.98							1.06						
Interaction CD *(P=0.05)*	12.35							3.05						

Table 7. Influence of organic, inorganic and integrated package on soil available potassium at the end of cropping cycle at various locations

Cropping Systems/ Management practice	Available Potassium (kg ha^{-1})						Mean
	Organic		Inorganic		Integrated (towards organic)		
	100% organic	75% organic+ innovative organic practices	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic+ 25% inorganic	
Bajura							
Tomato-cauliflower-french bean	236.9	246.4	120.2	127.3	239.9	237.4	201.4
Cauliflower-tomato	240.5	250.6	135.8	141.5	247.7	253.5	211.6
Black gram-cauliflower-summer squash	243.5	222.2	116.4	123.6	254.8	241.5	200.3
Lady finger-pea	225.3	216.5	120.7	126.2	235.4	230.3	192.4
Mean	236.6	233.9	123.3	129.7	244.5	240.7	
Bhopal							
Soybean-durum wheat	221.7	248.0	234.3	240.7	202.0	169.3	219.3
Soybean- mustard	195.7	264.0	221.0	234.7	193.0	180.0	214.7
Soybean- chickpea	185.3	221.3	204.7	231.7	253.7	205.3	217.0
Soybean- linseed	186.3	202.3	187.3	225.0	238.3	217.3	209.4
Mean	197.3	233.9	211.8	233.0	221.8	193.0	
Calicut							
Ginger-fellow Mahima							155.4
Rejatha							160.7
Varada							171.2
Mean	183.5	214.4	185.8		123.2	105.2	
Turmeric-fallow Prathibha							160.9
A.S							177.3
Varna							156.5
Soba							156.3
Sona							171.1
Kanthi							194.7
Suvarna							160.6
Suguna							152.0
Sudarsana							167.2
Kedaram							163.7
Prabha							157.7
Mean	121.8	110.9	250.2		180.9	162.5	
Coimbatore							
Cotton - maize	443	442	430	439	463	469	448
Chillies - sunflower	478	475	463	481	498	487	480
Beetroot - maize	459	468	477	469	472	480	471
Mean	460	462	457	463	478	479	
Dharwad							
Cowpea-safflower	395.13	380.70	303.03	386.00	369.80	374.30	369.16
Pigeonpea	383.30	379.48	315.58	378.00	362.83	376.81	365.93
Sorghum-green gram	400.30	380.75	308.43	379.26	373.75	363.68	367.64
Groundnut + hybrid cotton (2:1)	396.85	379.35	307.35	376.70	367.55	368.75	366.09
Maize-chickpea	387.08	378.96	326.00	377.80	366.45	362.80	366.51
Mean	392.53	379.85	368.08	369.13	312.08	379.55	

Cropping Systems/ Management practice	Available Potassium (kg ha^{-1})						Mean
	Organic		Inorganic		Integrated (towards organic)		
	100% organic	75% organic+ innovative organic practices	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic+ 25% inorganic	
Jabalpur							
Basmati rice –wheat (durum)-Green manure	269	267	252	250	266	265	261.5
Basmati rice – chickpea - maize fodder	268	267	248	245	260	257	257.5
Basmati rice – berseem (fodder and seed)	268	266	249	244	263	260	258.3
Basmati rice – vegetable pea- sorghum (fodder)	267	265	236	230	259	255	252.0
Mean	268.0	266.3	246.3	242.3	262.0	259.3	
Ludhiana							
Basmati rice-chickpea-GM	152.6	140.2	136.5	142.2	145.6	140.6	143.0
Basmati rice-wheat-GM	160.8	154.6	146.1	144.6	158.2	148.2	152.1
Moong-wheat-GM	170.2	166.5	142.8	144.6	164.6	158.2	157.8
Pigeonpea -wheat	170.5	162.6	140.8	144.8	158.2	150.6	154.6
Mean	163.5	156.0	141.6	144.1	156.7	149.4	
Modipuram							
Basmati rice– wheat (durum) - *sesbania* green manure	317.0	310.2	182.6	197.1	241.9	247.5	249.4
Rice– barley (malt) – green gram	337.1	328.2	321.4	317.0	283.4	277.8	310.8
Maize (pop corn) – potato– okra + *sesbania* green manure	300.2	310.2	274.4	287.8	317.0	297.9	297.9
Maize (sweet corn) – mustard - *sesbania* green manure	336.0	350.6	256.5	379.7	292.3	376.3	331.9
Mean	322.6	324.8	258.7	295.4	283.7	299.9	
Pantnagar							
Rice-wheat -*sesbania*	221	230	220	222	237	245	229
Rice-chickpea + coriander-sesbania	235	235	234	271	223	253	242
Rice-vegetable pea + coriander-sesbania	247	222	223	285	271	270	253
Rice-Potato-sesbania	241	242	236	250	247	243	243
Mean	236	232	228	257	244	253	
Raipur							
Soybean-Maize	282.2	291.0	275.0	296.0	292.7	274.3	285.2
Soybean-Pea	286.7	289.2	274.9	304.3	296.7	277.3	288.2
Soybean-Chilli	281.7	287.4	280.4	301.1	290.7	282.3	287.3
Soybean-Onion	294.3	272.4	276.4	284.0	283.3	281.0	281.9
Mean	286.2	285.0	276.7	296.4	290.9	278.7	

Cropping Systems/ Management practice	Available Potassium (kg ha^{-1})						Mean
	Organic		Inorganic		Integrated (towards organic)		
	100% organic	75% organic+ innovative organic practices	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic+ 25% inorganic	
Ranchi							
Rice (Birsamati) -wheat	221.9	219.5	154.4	150.6	186.2	182.8	185.9
Rice (Birsamati) -potato	229.2	224.5	152.9	147.9	168.5	164.3	181.2
Rice (Birsamati) -linseed	204.1	197.0	158.0	149.2	177.2	173.0	176.4
Rice (Birsamati) -lentil	228.4	221.8	162.1	153.7	193.1	181.8	190.2
Mean	220.9	215.7	156.8	150.3	181.2	175.5	
Umiam							
Raised bed systems							
Rice-Carrot							274.3
Rice-Potato							273.6
Rice-French bean							284.3
Rice-Tomato							275.7
Mean	279.4	271.4	265.6		291.4		
CD (P=0.05) Cropping systems	5.86						
CD (P=0.05) Nutrient sources	6.78						
Interaction CD(P=0.05)	11.7						
Rice-fellow system *Sunken Bed*							
Megha aromatic 2							276.4
Ngoba							283.6
Shahsarang-1							274.7
Lumpnah							278.4
Mean	287.3	272.4	269.6		283.8		
CD (P=0.05) Cropping systems	4.91						
CD (P=0.05) Nutrient sources	3.73						
Interaction CD(P=0.05)	9.82						

organic manure+25% inorganic as compared to inorganic packages. Not much variation was recorded among the cropping systems. Similarly, the higher content of soil available K_2O (254.8 kg/ha) was recorded in blackgram-cauliflower-summer squash system under integrated (50% organic+50% inorganic).

Bhopal: The soil electrical conductivitydid not change much due to different nutrient management and varied from 0.23 to 0.26 dsm^{-1} whereas bulk density showed significant variation from 1.18 with 100% organic management by organic sources as lower to 1.26 in 100% inorganic nutrient management. The pH range varied from 7.74 with 100% organic nutrient management to 7.53 under state recommendation across the cropping system. Soil organic carbon content in soybean-wheat system varied from 0.70 as lowest under 100% inorganic management to 1.10% with 100% organic management and it was 57 and 19.6 % higher than inorganic and integrated packages respectively.Among the cropping systems, higher soil organic carbon was recorded in soybean-wheat system followed by soybean-mustard and soybean-linseed. The soil available N varied from 77.5 to 117.6 mg kg^{-1} with 100% organic management with mean

value of 96.8 mg kg^{-1}. Minimum N was available in the soil with the state recommendation.Similarly, the variation in P was observed 17.2 to 23.8 mg/kg. Significantly, higher K was recorded with 75% organic+25% innovative practice (264.0 mg/kg) in soybean-mustard.

Calicut: Acidic condition of soil was found at Calicut. The pH range in ginger crop was recorded from 4.7 (100% inorganic) to 6.4 (75% organic +innovative practices). In term of soil organic carbon, higher OC (2.6%) was recorded under organic package with 75% nutrient through organic manure in ginger crop. It was found to be 30 and 18.2 % higher than inorganic and integrated packages. Similarly, in turmeric crop variation in soil pH was in the range of 5.0 (100% organic) to 4.4 (inorganic) whereas organic carbon was in range of 1.5 in (inorganic) to 2.5% (100% organic and integrated). Among the turmeric varieties higher soil organic carbon was noticed in Sobha and Sudersana. Significantly higher available nitrogen (275.2 kg/ha) was recorded under Integrated management (50% organic+50% inorganic) followed by organic management with 100% organic nutrient through manure in turmeric crop. 100% organic management perform of significantly better in terms of available P (52.0 kg/ha) whereas if organic manure application is reduced by 25% the reduction of available P in soil was found to be up to 60%. Available K was recorded higher (214.4 kg/ha) under organic package with 75% organic nutrient supply in ginger while in turmeric and it was higher with inorganic (250 kg/ha) and integrated(181 kg/ha). In term of varietal permanence, ginger variety verda recorded higher K availability in the soil (171 kg/ha), while, Kanthivariety of turmeric recorded significantly higher available K in the soil followed by Aleppey Supreme and Sona.

Coimbatore: Higher available N was recorded under integrated management with 75% organic through manure and 25% inorganic(289 kg/ha). The reduction in availability of nitrogen in soil was found to be 12.1 and 21.1% comparedto organic and inorganic respectively. Chilli-sunflower recorded higher available N in the soil at the end of cropping cycle (289.2 kg/ha) among the system.Higher available P (11.7 and 11.6 kg/ha) was recorded under inorganic management with 100% inorganic as well as state recommendation. Higher available K was recorded (479 kg/ha) under integrated management package with 75% organic+25%inorganic and it was at par with organic and inorganic management package. In term of cropping systems, chili-sunflower performedbetter.

Dharwad: At end of cropping cycle, physical and chemical properties namely bulk density, soil pH and electrical conductivity did not differ significantly due to either management or cropping systems. The bulk density andelectrical conductivityin the soil did not change due to different management and varied from 1.18 (organic) to 1.26 (inorganic)andvariation in electrical conductivity werefrom 0.20 to 0.21 dsm^{-1} at different management options. Maximum soil organic carbon content wasobserved in cowpea-safflower system. Among management package, 9.6 and 15.8% higher organic carbon was found with organic management of 100% nutrients supplied through manurethan integrated and inorganic respectively.Higher available N, P and K (280.3, 28.7 and 392.5 kg/ha respectively) was recorded under organic management with 100% nutrient supply through organic manureand it was found to be higher by 6.2 and 20.5% than inorganic and integrated management respectively. Among the cropping systems, chilli-sunflower recorded higher available N (275 kg/ha) while P was higher in maize-chickpea system (27 kg/ha). Higher available K (369 kg/ha) was recorded in cowpea-safflower.

Jabalpur: The soil electrical conductivitydid not change much due to different nutrient management and varied from 0.56 to 0.67 dsm^{-1} whereas bulk density showed significant variation from 1.27 with organic

management (75% organic +innovative practices) as lower to 1.40 in 100% inorganic nutrient management.Cropping systems did not influence each other for electrical conductivity and bulk density. The pH range varied from 7.25 to 7.27and was neutral in reaction. Soil organic carbon in basmati rice-wheat system varied from 7.00 g/kg under 100% inorganic management to 8.12 g/kg with 100% organic. Organic management recorded 12.1 and 4.2% higher organic carbon in the soil compared to inorganic and integrated management respectively. The N contents showed rising trend under all cropping system with 100% organic. Available nitrogen and potassium were higher under organic package of nutrient with 100% nutrient through manure (286 kg/ha and 268 kg/ha respectively)whereas, the available phosphorous was higher under integrated nutrient management practice (15.3 kg/ha).

Ludhiana: Soil organic carbon, pH, EC, available N, P and K were estimated at the end of cropping cycle. Soil organic carbon in organic package (100% nutrient through manure) was higher by 25% over inorganic and 6.7% than integrated management. Available N, P and K were higher under organic management and found to be higher (N 19.4 and 2.8%), (P 23.9 and 10.8 %) and (K 13.4 and 4.2%) than inorganic and integrated package respectively. Among the cropping systems, basmati rice-chick pea-green manure recoded higher electrical conductivity whereas, pH, organic carbon and available N was higher in pigeon pea-wheat system. Greengram-wheat-green manure recorded higheravailable P and K among all the cropping systems.

Modipuram: Soil EC, pH, organic carbon, available phosphorus and potassium were estimated. Among the different production systems higher soil organic carbon, available P and K after completion of crop cycle was found under organic production system followed by integrated crop management. Organic carbon content was recorded significantly higher (0.77%) in rice-wheat–*sesbani*a (green manure) system with 100% organic management. It was 27.9% higher compared to inorganic. Higher pH was recorded with inorganic crop management (8.2) whereas soil pH was reduced by increasing intensity of organic management while, electric conductivity varied from 0.14 (inorganic condition) to 0.21 in integrated nutrient condition. In term of cropping systems, significantly lower EC was recorded in rice-barley-green gram system (0.11). Available phosphorus and potassium was also higher under organic production system(42.2 and 324.8 kg/ha). In term of cropping systems, highest available P was noted in rice-barley-green gram (41.1 kg/ha) while, K was recorded under maize-mustard-*sesbania* system.

Pantnagar: Electric conductivity, pH, organic carbon, available N,P,K and S were estimated after completion of crop cycle. Lower EC (0.27 dsm^{-1}) was recorded under organic package with 75% nutrient through organic manure as compared with other packages. Rice-potato system recorded lowest EC (0.25 dsm^{-1}). pH varied from 6.65-7.68 among management option. Soil organic carbon was influenced by different management option and the maximum carbon content (1.35%) was recorded under organic package with 100% through manure followed by integrated (75% organic+25% inorganic) (1.12%) which was 46.7% higher than inorganic. Among the cropping systems, rice-vegetable pea+ coriander recorded higher organic carbon (1.08%). The maximum available N and P was recorded under organic management (100% organic) (407.0 and 66.9 kg/ha). Among the cropping systems, maximum N was recorded in basmati rice-chickpea (388 kg/ha) whereas P was higher in rice-potato system (58.6 kg/ha). The availability of potassium was found higher in integrated management (50% organic+50% inorganic) in rice-vegetable pea+ coriander (253 kg/ha).

Raipur: The soil analysis at end of crop cycle indicated that organic carbon content was significantly higher in 100% organic (0.70%) nutrient supply system over other the management except 25% reduced organic manure and state recommendation which were on par. However, various cropping systems did not showed any significant influence on carbon content in soil.The available N content in soil after harvest of the crops were found significantly higher with the state recommendation (242.75 kg ha^{-1}). Soybean-pea and soybean–onion system recorded significantly higher N in soil after succeeding *rabi* crops.The available P and K content of soil were not significantly influenced due to various management package howvere, soybean-pea resulted in significantly higher K in the soil (288.18 kg/ha).

Ranchi: pH, organic carbon, available N, P & K was estimated. 100% organic followed by 75% organic + innovative practices managementrecorded remarkably higher pH value (6.29), organic carbon (0.69%), available N (315.56 kg/ha), P (55.95 kg/ha) and K (220.89 kg/ha). Lower pH was recorded under state recommendation. Among the cropping system, pH and organic carbon was higher in rice-lentil, available N and P in rice-potato and K was higher with rice-linseed system.

Umiam: Bulk density in both raised and sunken bed was slightly decreased compared to initial year (1.19 g/cm^3 and 1.25 g/cm^3 respectively). Soil organic carbon (SOC) increased over the initial status in all the management options. Organic carbon in raised beds methodwas observed higher compared to sunken beds. Under raised bed condition, 100% organic management (3.29 %) recorded maximum organic carbon followed by integrated (3.19 %) compared to inorganic and 75% organic. Among the cropping systems, rice-frenchbean recorded higher organic carbon followed by rice-tomato under raised bed method. Maximum available N and P was found under 100% organic (258.4 kg/ha and 22.4 kg/ha, respectively) whereas, maximum K were found under integrated management (291.4 kg/ha). In case of sunken beds, available N and K were also found higher under 100% organic (240.2 kg/ha and 287.2 kg/ha, respectively) while available P was higher under integrated (21.6 kg/ha).

Influence of organic management package with reduced dose of organic manures, integrated and inorganic management packages on available micronutrient status in soil (Table 8-9)

Bajaura: Soil available micronutrients such as iron, manganese, zinc and copper were estimated. Higher available iron and zinc (14.12 and 3.60 ppm) were recorded under organic package with 100% organic management while manganese and copper recorded higher under integrated package (50% each organic and inorganic) of 11.41 and 2.85 ppm. Available Fe and Zn was found to be higher (51.7 & 50.3 %) compared to inorganic whereas Mn and Cu (47.6 & 56 %) was higher than inorganic management respectively. In terms of cropping system, all cropping systems performed well under different management practices but there was not much variation recorded with micronutrients. Among the cropping systems, black gram-cauliflower-summer squash recorded higher available Fe and Zn in the soil. Cauliflower tomato recorded higher available Mn (9.69 ppm) while ladyfinger-pea recorded higher copper (2.36 ppm) availability in the soil.

Calicut: Higher available iron (42.25 ppm) was recorded under integrated management with 75% organic+25% inorganic nutrient whereas, manganese was recorded higher (17.4 ppm) under inorganic package after ginger. Higher zinc and copper (2.43 and 14.62 ppm) recorded under organic management package. Among the ginger varieties, availability of iron and zinc in soil was higher with rajatha variety. Turmeric recorded higher available iron, manganese and copper (38.6, 20.3 & 1.5 ppm) under integrated

Table 8. Influence of methods of organic, inorganic and integrated package on soil available micronutrients at the end of cropping cycle at different locations

Cropping systems/ Management practice	Soil available Iron (ppm)							Soil available Manganese (ppm)						
	Organic		Inorganic (towards organic)		Integrated		Mean	Organic		Inorganic (towards organic)		Integrated		Mean
	100% organic	75% organic + innovative practices	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative practices	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic + 25% inorganic	
Bajura														
Tomato-cauliflower-french bean	12.95	10.80	6.02	8.23	12.53	10.72	10.21	10.23	8.50	6.23	7.08	11.99	8.60	8.77
Cauliflower-tomato	14.20	11.00	7.60	9.32	12.25	11.12	10.92	11.15	9.90	6.08	8.40	12.80	9.83	9.69
Black gram-cauliflower-summer squash	16.41	12.36	6.85	9.09	14.96	12.68	12.06	10.70	7.70	5.50	7.00	10.00	9.24	8.36
Lady finger-pea	12.92	11.97	6.82	8.40	15.00	12.70	11.30	11.50	9.60	6.12	8.40	10.84	9.26	9.29
Mean	14.12	11.53	6.82	8.76	13.69	11.81		10.90	8.93	5.98	7.72	11.41	9.23	
Calicut														
Ginger - fallow Mahima							37.95							15.59
Rejatha							38.55							14.85
Varada							36.15							15.86
Mean	36.25	33.25	35.33		40.67	42.25		13.70	14.00	17.40		15.50	16.40	
Turmeric - fallow Prathibha							36.44							16.00
Alleppey supreme							36.83							18.00
Varna							35.12							15.73
Soba							36.25							16.68
Sona							34.17							15.03
Kanthi							36.22							15.08
Suvarna							35.31							15.07
Suguna							36.97							15.07
Sudarsana							36.25							15.07
Kedaram							33.47							17.00
Prabha							38.73							15.80
Mean	37.3	29.8	37.8		38.6	36.4		15.2	16.3	15.2		12.3	20.3	
Dharwad														
Cowpea-safflower	9.30	9.14	8.95	9.22	9.09	9.05	9.12	12.16	12.02	11.35	12.21	11.54	11.94	11.87
Pigeon pea (sole)	9.38	9.32	9.04	9.34	9.18	9.35	9.26	12.41	12.05	11.52	12.34	11.95	11.93	12.02
Sorghum-green gram	9.35	9.32	9.10	9.32	9.24	9.27	9.27	13.02	12.14	11.13	12.76	12.17	11.94	12.19
Groundnut + hybrid cotton (2:1)	9.49	9.32	9.09	9.33	9.34	9.26	9.30	13.13	12.87	11.88	12.59	12.65	11.43	12.42
Maize-chickpea	9.38	9.21	9.05	9.37	9.29	9.23	9.26	12.24	12.64	11.05	12.03	12.15	11.52	11.94
Mean	9.37	9.26	9.23	9.23	9.05	9.31		12.59	12.34	12.09	11.73	11.38	12.39	
Pantnagar														
Rice-wheat -*sesbania*	58.1	61.8	43.2	52.6	46.1	35.3	49.5	11.5	10.4	11.3	11.3	9.1	10.7	10.7
Rice-chickpea + coriander-*sesbania*	59.4	62.3	45.3	52.0	46.8	38.6	50.7	13.3	11.2	12.4	13.5	8.7	9.4	11.4
Rice-vegetable pea + coriander-*sesbania*	51.3	61.3	47.5	58.5	44.6	36.9	50.0	16.2	11.3	12.1	11.4	10.5	8.3	11.6
Rice-potato-*sesbania*	50.4	62.8	43.3	59.8	44.4	37.2	49.7	13.3	14.9	13.6	12.4	9.1	10.0	12.2
Mean	54.8	62.1	44.8	55.7	45.5	37.0		13.6	12.0	12.4	12.2	9.4	9.6	

Table 9. Influence of methods of organic, inorganic and integrated package on soil available micronutrients at the end of cropping cycle

Cropping sytems / Management practice	Zinc (ppm)							Copper (ppm)						
	Organic		Inorganic (towards organic)		Integrated		Mean	Organic		Inorganic (towards organic)		Integrated		Mean
	100% organic	75% organic + innovative practices	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative practices	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic + 25% inorganic	
Bajaura														
Tomato-cauliflower-french bean	3.90	2.80	1.88	1.60	3.00	2.80	2.66	2.10	1.66	0.90	1.40	2.30	1.70	1.68
Cauliflower -tomato	3.30	2.80	1.68	2.04	3.00	2.80	2.60	3.10	1.80	1.00	1.60	3.70	2.37	2.26
Black gram-cauliflower-summer squash	3.70	3.00	1.80	2.80	2.81	2.70	2.80	1.11	0.94	0.82	0.93	1.61	1.42	1.14
Lady finger-pea	3.50	2.50	1.80	2.20	4.00	2.70	2.78	3.50	2.10	0.91	1.40	3.80	2.45	2.36
Mean	3.60	2.78	1.79	2.16	3.20	2.75		2.45	1.63	0.91	1.33	2.85	1.99	
Calicut														
Ginger Mahima							1.63							13.54
Rejatha							1.67							12.91
Varada							1.67							12.95
Mean	2.38	2.43	0.45		1.42	1.62		14.62	14.07	10.30		12.70	13.98	
Turmeric Prathibha							1.18							1.34
A.S							1.31							1.38
Varna							1.18							1.24
Soba							1.17							1.07
Sona							1.22							1.15
Kanthi							1.13							0.99
Suvarna							1.26							1.21
Suguna							1.16							1.25
Sudarsana							1.38							1.15
Kedaram							1.26							0.92
Prabha							1.18							1.09
Mean	1.70	1.20	0.60		1.50	1.10		1.30	1.00	1.10		0.90	1.50	
Dharwad (mg/kg)														
Cowpea-safflower	0.77	0.76	0.62	0.71	0.69	0.72	0.71	1.36	1.37	1.34	1.33	1.34	1.33	1.24
Pigeon pea (sole)	0.75	0.71	0.68	0.76	0.65	0.69	0.71	1.41	1.41	1.31	1.39	1.37	1.36	1.26
Sorghum-greengram	0.75	0.65	0.72	0.69	0.65	0.62	0.68	1.40	1.32	1.30	1.34	1.35	1.33	1.22
Groundnut + hybrid cotton (2:1)	0.79	0.75	0.72	0.73	0.78	0.69	0.74	1.45	1.43	1.32	1.36	1.39	1.33	1.27
Maize-chickpea	0.75	0.75	0.68	0.70	0.75	0.63	0.71	1.31	1.40	1.28	1.35	1.36	1.33	1.22
Mean	0.76	0.72	0.68	0.72	0.70	0.67		1.39	1.39	1.31	1.35	1.36	0.67	
Pantnagar														
Rice-wheat -*sesbania*	1.4	1.5	1.0	0.9	1.3	0.9	1.2	4.5	4.5	3.6	3.6	4.4	4.9	4.3
Rice-chickpea + coriander-*sesbania*	1.4	1.6	0.9	1.0	1.3	1.1	1.2	4.5	4.9	3.5	3.7	4.4	4.6	4.3
Rice-vegetable pea + coriander-*sesbania*	1.6	1.5	1.0	1.0	1.2	1.2	1.2	4.4	4.5	3.5	3.5	4.4	4.5	4.1
Rice-potato-*sesbania*	1.5	1.3	1.0	0.9	1.0	1.1	1.1	4.4	4.6	3.4	3.8	4.7	4.5	4.2
Mean	1.5	1.5	1.0	1.0	1.2	1.1		4.5	4.6	3.5	3.7	4.5	4.6	

management while zinc recorded higher under 100% organic package. Among the turmeric varieties, not much variation was found. Iron ranged from 33.47-38.73 ppm while, Mn ranged from 15.03 -18.0 ppm. Available Zn in soil ranged from 1.13-1.38 ppm.

Dharwad: Micronutrient availability in the soil was not influenced by the management package including and cropping systems. Higher available iron was recorded (9.37 ppmunder integrated management with 75% organic+25% inorganic nutrient and it was at par with inorganic and organic management. Similarly, higher available manganese and copper (20.3and 1.50 ppm) was also recorded under integrated management. Higher available zinc (1.70 ppm) was recorded under organic nutrient management and at par with other management practices. In terms of cropping systems, there was not much variation recorded among different micro nutrients availability in the soil.

Pantnagar: The availability of Zn (1.5 ppm) and Mn (13.6 ppm) was found higher in100% organic management followed by 75% organic+ innovative technology. However, the availability of Cu (4.6 ppm) and Fe (62.1ppm) was maximum with 75%organic+innovative technology under organic package. Among the cropping systems, the availability of Zn was higher(1.24ppm) in basmati rice-vegetable pea system. Cu (4.29 ppm) and Fe (50.73 ppm) was higher in basmati rice –chickpea system.

Influence of organic management package with reduced dose of organic manures, integrated and inorganic management packages on N, P and K uptake (Table 10-12)

Bajaura: Uptake of N, P and K by the different vegetable crops in cropping systems was estimated. Tomato and cauliflower recorded higher N uptake (2.99 and 2.22) with 50% each nutrient supplied through organic and inorganic sources under integrated management. Frenchbean and black gram recorded higher N uptake (2.40 and 2.42%) with 100% organic management under. Summer squash recorded higher N uptake under integrated management with 50% each organic and inorganic sources of nutrients.Tomato french bean, black gram, summer squash, lady finger and vegetable pea removed higher phosphorus (0.28, 0.20, 0.27, 0.28, 0.28 and 0.35 %) respectively compared to state recommendation. Tomato, cauliflower, french bean, black gram, lady finger and vegetable pea recorded higher K uptake (2.35, 2.56, 2.00, 2.12, 2.12 & 0.95% respectively) under integrated management practices with 50% each nutrient source through organic and inorganic. Black gram, lady finger and pea was at par with inorganic management and no variation was found. However summer squash recorded higher K uptake (2.16 %) under inorganic management with state recommendation and was at par with integrated management practices.

Raipur: Significant difference in N, P and K uptake during *kharif* due to various management packages was observed. The uptake was higher in soybean with state recommendation (159.9, 18.6 and 75.7 kg ha^{-1} respectively) and found to be higher (N 10.7 and 6.3%), (P 15.1 and 9.1%) and (K 15.3 and 11.4%) compared to organic and integrated management.

Ranchi: Among the rice based cropping systems, rice recorded higher N (92.38 kg/ha), P (22.73 kg/ha) and K (76.77 kg/ha) uptake with 75% organic+25% innovative practices under organic management followed by integrated and inorganic. During *rabi* N, P and K uptake in wheat was higher with 100% inorganic while in lentil crop the N (17.0 kg/ha) and K (10.58 kg/ha) recorded higher with integrated package (75% organic+ 25% inorganic). Uptake in potato and linseed was found to be higher (N 60.78 and 49.41 kg ha^{-1}), (P 40.76 and 5.82 kg/ha) and (K 131.95 and 23.52 kg/ha) under organic package.

Table 10. Influence of organic, inorganic and integrated package on N uptake of crops and cropping systems

Cropping systems/ management package	Organic						Inorganic						Integrated management (towrsd organic)					
	100% organic			75% organic + innovative organic practices			100% in organic			State recommendation			50% organic + 50% inorganic			75% organic + 25% inorganic		
	Kharif	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*
Bajaura																		
Tomato-cauliflower - french bean	2.02	2.80	2.40	1.98	2.75	2.37	2.11	2.90	2.22	2.20	2.95	2.26	2.19	2.91	2.30	2.00	2.89	2.34
Cauliflower-tomato		2.84	2.05		2.78	2.00		2.88	2.12		2.85	2.18		2.99	2.22		2.97	2.19
Black gram-cauliflower - summer squash	2.42	2.80	1.79	2.32	2.78	1.75	2.22	2.90	1.78	2.29	2.94	1.80	2.37	2.96	1.82	2.26	2.92	1.80
Lady's finger-pea	1.88	3.42		1.80	3.41		1.90	3.34		1.95	3.36		1.98	3.42		1.93	3.41	
Mean	2.11	2.97	2.08	2.03	2.93	2.04	2.08	3.01	2.04	2.15	3.03	2.08	2.18	3.07	2.11	2.06	3.05	2.11
Raipur																		
Soybean-maize	143.3			132.3			148.3			160.0			146.4			146.7		
Soybean-pea	143.4			124.8			149.4			160.5			148.9			144.4		
Soybean-chilli	140.9			127.3			151.0			159.4			150.4			146.8		
Soybean-onion	143.4			126.6			151.6			159.7			153.7			146.2		
Mean	142.8			127.8			150.1			159.9			149.9			146.0		
Ranchi																		
Rice- wheat	89.07	61.14		92.45	58.03		75.49	72.11		62.20	49.61		80.51	67.83		85.27	68.20	
Rice - lentil	84.85	11.33		89.82	8.99		70.24	13.08		61.31	6.59		77.39	15.65		81.26	17.00	
Rice- potato	92.97	60.78		97.98	54.43		78.59	38.18		64.46	31.13		86.13	43.53		90.56	49.66	
Rice - linseed	83.16	49.41		89.28	46.34		65.12	31.84		56.74	27.01		75.60	42.04		79.82	44.32	
Mean	87.51	45.67		92.38	41.95		72.36	38.80		61.18	28.59		79.91	42.26		84.23	44.80	

Table 11. Influence of inorganic, inorganic and integrated on P uptake of crops at different locations

Cropping systems/ management package	Organic						Inorganic						Integrated management (towrsd organic)					
	100% organic			75% organic + innovative organic practices			100% in organic			State recommendation			50% organic + 50% inorganic			75% organic + 25% inorganic		
	Kharif	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*
Bajaura																		
Tomato-cauliflower-french bean	0.20	0.36	0.18	0.22	0.38	0.19	0.24	0.32	0.18	0.28	0.35	0.20	0.25	0.39	0.19	0.22	0.38	0.18
Cauliflower-tomato		0.35	0.22		0.36	0.24		0.32	0.26		0.34	0.28		0.37	0.26		0.35	0.25
Black gram-cauliflower - summer squash	0.24	0.34	0.25	0.25	0.32	0.28	0.25	0.32	0.26	0.27	0. 34	0.28	0.25	0.36	0.26	0.26	0.34	0.24
Lady's finger-pea	0.16	0.30		0.15	0.32		0.25	0.34		0.28	0.35		0.25	0.35		0.22	0.33	
Raipur																		
Soybean-maize	16.06			14.68			17.12			19.06			16.56			16.73		
Soybean-pea	15.26			13.08			16.88			18.51			16.87			16.63		
Soybean-chilli	15.77			14.18			17.34			18.58			16.71			16.47		
Soybean-onion	16.19			14.23			16.69			18.29			17.62			15.92		
Mean	15.8			14.0			17.0			18.6			16.9			16.4		
Ranchi																		
Rice- wheat	21.86	10.93		21.76	10.20		17.99	13.85		14.51	8.04		19.02	12.53		20.14	12.37	
Rice - lentil	21.94	2.73		22.45	5.96		17.51	8.28		15.22	4.91		19.07	3.89		20.31	4.39	
Rice- potato	23.77	40.76		24.21	36.60		19.08	27.14		15.55	22.82		21.03	30.07		22.21	33.86	
Rice - linseed	21.59	5.82		22.48	5.49		16.49	3.53		14.53	3.00		19.22	4.97		20.30	5.09	
Mean	22.29	15.06		22.73	14.56		17.77	13.20		14.95	9.69		19.59	12.87		20.74	13.93	

Table 12. Influence of inorganic, inorganic and integrated on K uptake of crops at different locations

Cropping systems/ management package	Organic						Inorganic						Integrated management (towrsd organic)					
	100% organic			75% organic + innovative organic practices			100% in organic			State recommendation			50% organic + 50% inorganic			75% organic + 25% inorganic		
	Kharif	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*
Bajaura									(%)									
Tomato-cauliflower-french bean	2.20	2.53	1.95	2.19	2.50	1.96	2.28	2.52	1.95	2.31	2.54	1.98	2.35	2.56	2.00	2.29	2.55	1.99
Cauliflower-Tomato		2.51	2.25		2.53	2.28		2.52	2.25		2.54	2.28		2.56	2.32		2.52	2.28
Black gram-cauliflower - summer squash	2.05	2.52	2.12	2.08	2.54	2.14	2.10	2.55	2.14	2.12	2.58	2.16	2.12	2.55	2.15	2.10	2.52	2.10
Lady's finger-pea	2.10	0.82		2.12	0.85		2.08	0.92		2.12	0.95		2.12	0.95		2.07	0.92	
Raipur																		
Soybean-maize	64.4			59.5			71.0			75.6			62.9			63.4		
Soybean-pea	62.9			54.2			68.5			76.7			67.0			66.6		
Soybean-chilli	63.2			59.2			70.6			75.8			67.3			64.7		
Soybean-onion	65.7			59.7			64.5			74.8			71.1			64.0		
Mean	64.1			58.2			68.7			75.7			67.1			64.7		
Ranchi																		
Rice- wheat	77.06	36.20		77.44	34.57		65.63	41.26		57.95	29.38		70.28	38.62		74.29	38.91	
Rice - lentil	73.47	7.72		74.58	5.96		61.23	8.28		53.67	4.91		65.41	9.79		68.01	10.58	
Rice- potato	79.38	131.95		80.35	120.21		65.62	92.27		57.95	79.11		72.49	100.28		76.27	112.22	
Rice - linseed	72.17	23.52		74.70	22.41		58.40	15.29		50.38	13.02		64.75	19.72		67.48	20.35	
Mean	75.52	49.85		76.77	45.79		62.72	39.28		54.99	31.61		68.23	42.10		71.51	45.52	

Influence of organic, inorganic and integrated management on micronutrient (iron, manganese, zinc and copper) uptake at Bajaura (Table 13)

Tomato (*kharif*), cauliflower, lady finger and pea recorded higher iron uptake (0.55, 57.0, 0.42 and 0.42 mg/ha respectively) under 100% organic supply through organic sources while french bean, black gram and summer squash were recorded higher iron uptake (110.0, 116.0, and 54.0 mg/ha respectively) under integrated management either 50% each nutrient supply through organic and inorganic or with 75% organic + 25% nutrient. Cauliflower, black gram, summer squash, lady finger and pea recorded higher manganese uptake (28.0, 22.0, 24.0, 19.0 and 24.0 mg ha^{-1} respectively) with100% organic nutrient management. Whereas french bean and tomato (22.0 & 26.0 mg ha^{-1}) were recorded higher Mn uptake with 75% organic+innovative organic practices under organic management. Uptake of zinc in tomato, cauliflower, black gram, lady finger and peawas found higher (20.0, 23.0, 33.0, 16.0 and 11.0 mg ha^{-1}) respectively with organic management but at par with integrated nutrient management (75% organic+ 25% inorganic) whereas frenchbean and summer squash (22.0 & 26.0 mg ha^{-1}) recorded higher with 75% organic+25% innovative practices. Tomato, cauliflower, frenchbean, black gram, summer squash, lady finger and pea recorded higher copper uptake (9.6, 13.0, 12.2, 12.6, 8.3, 8.0, and 18.0 mg ha^{-1}) respectively under 100% organic management practice.

Influence of organic, inorganic and integrated nutrient management on nutrient uptake in turmeric at Calicut (Table 14)

The uptake of N, P and K, calcium, magnesium, iron, manganese, and zinc were significantly higher in integrated management (50% each organic and inorganic nutrient sources) followed by 100% organic package. Nutrients (N, P, K, Ca, Mg, Fe, Mn and Zn) uptake by the turmeric rhizome is found to be 42.1, 59.5, 39.9, 55.5, 56.7, 31.0, 27.8 and 58.1% higher over inorganic management respectively.

Microbial population in soil as influenced by the different management practices including cropping systems (Table 15-16)

Bajaura: Higher population of bacteria was recorded under 100% organic management of (16.2 $x10^6$ cfu/g) followed by 25% reduced dose of organic manure (13.3$x10^6$ cfu/g) but it was at par with each other and was found to be higher by 46.3% over inorganic package. Among the cropping systems, lady finger-pea recorded higher bacterial population (13.1$x10^6$ cfu/g). Fungi population also recorded higher under organic (13.5$x10^6$ cfu/g) and integrated (13.2$x10^6$ cfu/g) management package and was at par to each other. Soil actinomycetes and phosphate solubilizing bacteria was also recorded higher under 100% organic and 75% organic+25% inorganic nutrient management. Under organic management, actinomycetes was higher by 40.8% while PSB was higher by 38.8% compared to inorganic management. Among the cropping systems, actinomycetes and phosphate solubilizing bacteriawere not influenced by cropping system.

Bhopal: Higher bacteria, fungi and actinomyceteswere recorded under organic (100% nutrient supply through organic sources) and integrated (75% organic+ 25% inorganic). Under organic management, it was 41.2 and 31.2, 31.1 and 24.9, 52.2 and 37.9% higher compared to inorganic and integrated (50% each organic and inorganic nutrient) package.Among the cropping systems, higher bacterial population (16.8$x10^6$ cfu/g) was recorded insoybean-mustard but it was on par with soybean- linseed (16.3$x10^6$ cfu/g) while fungi recorded higher in soybean-chickpea (25.3$x10^6$ cfu/g). Soil actinomycetes was found to be significantly higher in soybean- wheat (71.4$x10^4$ cfu/g).

Table 13. Influence of organic, inorganic and integrated nutrient management on micronutrients (Fe, Mn, Zn and Cu) uptake by different crops at Bajura

Cropping systems/ management package	Organic						Inorganic						Integrated management (towrsd organic)					
	100% organic			75% organic + innovative organic practices			100% in organic			State recommendation			50% organic + 50% inorganic			75% organic + 25% inorganic		
	Kharif	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*	*Kharif*	*Rabi*	*Summer*
Iron (mg/kg)																		
Tomato-cauliflower-french bean	55	57	110	54	54	108	46	44	98	48	53	102	53	55	108	52	54	110
Cauliflower-tomato		56	55		52	53		43	44		49	48		54	57		52	54
Black gram-cauliflower-summer squash	110	55	50	112	52	46	96	44	40	102	50	44	116	53	54	112	52	50
Lady's finger-pea		42	42		39	39		33	31		37	34		40	40		39	38
Mean	82.5	52.5	64.3	83	49.2	61.5	71	41	53.3	75	47.2	57	84.5	50.5	64.8	82	49.2	63
Manganese (mg/kg)																		
Tomato-cauliflower-french bean	24	23	19	25	24	22	20	14	14	22	18	16	24	20	17	25	19	15
Cauliflower-tomato		22	25		20	26		15	19		19	23		20	23		18	22
Black gram-cauliflower-summer squash	22	28	24	20	24	22	14	14	15	16	18	17	22	23	22	19	20	20
Lady's finger-pea		19	24		17	21		13	16		14	18		19	21		17	19
Mean	23	23	23	22.5	21.25	22.75	17	14	16	19	17.25	18.5	23	20.5	20.8	22	18.5	19
Zinc (mg/kg)																		
Tomato-cauliflower-french bean	20	23	28	17	21	29	10	12	19	14	15	23	19	20	26	17	19	24
Cauliflower-tomato		19	19		16	17		12	12		14	14		17	17		15	15
Black gram-cauliflower-summer squash	33	20	18	30	17	19	20	11	11	24	14	14	29	17	17	26	14	15
Lady's finger-pea		16	11		14	9		8	6		11	8		14	9		12	7
Mean	26.5	19.5	19	23.5	17	18.5	15	10.8	12	19	13.5	14.75	24	17	17.3	21.5	15	15.25
Copper (mg/kg)																		
Tomato-cauliflower-french bean	9.6	13	12.2	8.1	12.3	10.7	4.8	6.8	6.8	6.1	8.1	7.9	8.7	11.3	10.7	8	9.6	7.8
Cauliflower-Tomato		12.6	9.3		11.3	7		7.5	6		9.3	7.2		11.4	8.5		9	8.6
Black gram-cauliflower-summer squash	12.6	12.1	8.3	12	11.8	7.8	7	8.3	4.6	8.3	9.2	5.5	11.1	12	7.6	11.5	12.4	7.7
Lady's finger-pea		8	18		6.8	17		4	11		5.9	12		7.2	16		7.3	18
Mean	11.1	11.4	12	10.1	10.5	10.6	5.9	6.7	7.1	7.2	8.1	8.1	9.9	10.5	10.7	9.8	9.5	10.5

Table 14. Effect of different management systems on nutrient uptake in turmeric rhizomes at Calicut

	Treatments	N	P	K	Ca	Mg	Fe	Mn	Zn	Cu
		kg/ha						g/ha		
Organic	100% Organic	76.61	18.53	54.07	6.44	8.00	1.54	0.81	0.23	0.05
	75% Organic + innovative organic practices	60.96	16.20	29.03	4.20	5.56	1.94	0.85	0.24	0.09
Inorganic	100% Inorganic	50.26	8.59	58.23	3.34	5.31	2.52	1.22	0.13	0.04
Integrated	50% Organic+50% inorganic	86.83	21.20	96.85	7.51	12.25	3.65	1.69	0.31	0.07
	75% Organic+25% Inorganic	51.71	14.17	48.10	5.12	4.89	2.79	0.66	0.13	0.08
	CD (*P=0.05*)	3.83	0.94	3.42	0.41	0.59	0.17	0.09	0.02	0.01

Coimbatore: Higher bacteria population was recorded under organic nutrient management of 16.3 and 15.0x10^6 cfu/g and it was 30.7 and 14.1% higher with 100% organic compared to inorganic and integrated. However fungi (11.3 and 9.0 x10^6 cfu/g) and actiniomycetes (9.3 and 8.7x10^4 cfu/g) recorded higher with organic (100% organic) and integrated (75% organic+25% inorganic) and it was found to be higher with organic by 38.0 and 38.7% compared to inorganic. Among the cropping systems, cotton-maize system recorded higher bacteria, fungi and actinomycetes population (15.0, 9.0x10^6 cfu/g) and (8.7x10^4 cfu/g) respectively.

Dharwad: Higher bacterial population (8.8x10^6 cfu/g) was recorded under integrated management with 50% each organic and inorganic nutrient and it was 12.5 and 25% higher over organic and inorganic management. Among the cropping system, maize-chickpea recorded higher bacteria (8.3x10^6 cfu/g) population. Higher fungal population (16.9 x10^6 cfu/g) recorded with75% organic+25% inorganic (integrated) management and it was at par with organic management practices, however organic package found to be higher by 26.8% over to inorganic. Among the cropping system, maize-chick pea performed well but at par with other three cropping systems. Higher actinomycetes (58.0x10^4 cfu/g) recorded under organic management through 100% organic package. It was found to be higher by 26.7 and 44.1% compared to inorganic and integrated. Among the cropping systems, maize-chick pea cropping system recorded higher actinomycetes (52.1 x10^4 cfu/g) followed by sorghum-green gram (45.4 x10^4 cfu/g).

Jabalpur: Higher bacteria (55.4 and 54.9x10^6 cfu/g), fungi (30.5 and 30.0x10^6 cfu/g), actinomycetes (14.6 and 14.3x10^4 cfu/g) and phosphate solubilizing bacteria (16.5 and 15.9x10^6 cfu/g) were recorded under organic management under 100% organic nutrients through manure and 75% organic+innovative practice. Among the cropping systems, basmati rice–wheat (durum)–green manure recorded higher fungi (40.7 x10^6 cfu/g), actinomycetes (12.0 x10^4 cfu/g) and phosphate solubilizing bacteria (15.2 x10^6 cfu/g) population in the soil as compare to other systems, while bacterial population was recorded higher in basmati rice–vegetable pea–sorghum (fodder) system (47.8x10^6 cfu/g).

Effect of different management systems on quality aspects of organic produce (Table 17)

Bajaura: Protein, TSS (^{0}brix) and vitamin C in vegetable crops french bean, black gram, tomato, pea and cauliflower were tested under different management. Organic management with 100% nutrient through manure performed well in terms of protein, TSS (^{0}brix) and vitamin C andit was found on par with integrated and inorganic management.Higher protein in french bean, black gram and pea (15, 15.2 and 21.4% respectively) recorded under organic management. TSS in tomato (5.2%) and pea (14.9%) was also

Table 15. Rhizosphre microbial (Bacteria and Fungi micro-organisms) population in soil as influenced by the different nutrient practices and cropping systems

Cropping systems / Management practice	Bacteria (x10^6 cfu/g)							Fungi (x10^6 cfu/g)						
	Organic		Inorganic (towards organic)		Integrated		Mean	Organic		Inorganic (towards organic)		Integrated		Mean
	100% organic	75% organic + innovative organic practices	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic + 25% inorganic	
Bajaura														
Tomato-cauliflower-french bean	16.8	13.8	8.7	11.8	12.6	14.0	12.9	13.6	12.2	8.8	12.5	11.7	12.8	11.9
Tomato-cauliflower	15.9	13.4	8.8	11.8	13.9	12.2	12.7	14.0	12.3	9.0	12.2	11.7	12.8	12.0
Black gram-cauliflower-summer squash	14.6	12.0	8.4	11.7	12.0	12.6	11.9	13.0	11.2	8.9	12.6	12.0	13.7	11.9
Lady finger-pea	17.5	14.0	9.0	12.0	12.4	13.6	13.1	13.4	11.5	8.9	11.0	12.6	13.5	11.8
Mean	16.2	13.3	8.7	11.8	12.7	13.1		13.5	11.8	8.9	12.1	12.0	13.2	
Bhopal														
Soybean- wheat	18.6	13.0	9.7	8.3	10.0	13.3	12.2	29.3	25.0	20.7	17.3	21.0	27.0	23.4
Soybean- mustard	22.3	17.6	14.0	12.2	16.6	18.3	16.8	28.3	24.7	20.3	22.0	23.0	25.7	24.0
Soybean- chickpea	19.3	14.3	10.0	10.7	12.3	14.7	13.6	33.7	25.0	21.0	22.7	24.3	25.3	25.3
Soybean- linseed	19.3	16.3	13.0	14.7	15.7	19.0	16.3	25.7	23.7	18.7	17.7	19.7	24.3	21.6
Mean	19.9	15.3	11.7	11.5	13.7	16.3		29.3	24.6	20.2	19.9	22.0	25.6	
Coimbatore														
Cotton - maize	18.0	16.0	12.0	13.0	16.0	15.0	15.0	12.0	10.0	8.0	7.0	7.0	10.0	9.0
Chillies - sunflower	15.0	15.0	11.0	10.0	13.0	13.0	12.8	10.0	8.0	6.0	6.0	7.0	8.0	7.5
Beetroot - maize	16.0	14.0	11.0	13.0	13.0	14.0	13.5	12.0	8.0	7.0	8.0	6.0	9.0	8.3
Mean	16.3	15.0	11.3	12.0	14.0	14.0		11.3	8.7	7.0	7.0	6.7	9.0	
Dharwad														
Cowpea-safflower	9.4	10.4	7.3	6.0	6.5	7.3	7.8	12.5	2.5	15.0	8.0	8.5	24.5	11.8
Pigeon pea (sole)	6.4	4.2	5.6	5.9	12.8	7.4	7.0	18.0	4.0	9.0	2.5	6.0	12.0	8.6
Sorghum-green gram	5.7	6.4	7.0	8.5	6.2	8.4	7.0	24.5	5.0	12.5	4.0	8.5	15.0	11.6
Groundnut +hybrid cotton (2:1)	10.2	3.9	5.1	6.5	9.4	7.3	7.1	12.0	8.0	18.0	5.0	4.0	19.0	11.0
Maize-chickpea	6.7	7.3	7.8	12.8	9.4	5.6	8.3	15.0	7..50	24.5	8.0	5.0	14.0	12.3
Mean	7.7	6.4	6.6	7.9	**8.8**	**7.2**		**16.4**	5.4	12.0	5.5	6.4	**16.9**	
Jabalpur														
Basmati rice – wheat (durum) – green manure	56.3	56.0	39.1	38.5	44.9	45.1	46.6	32.1	31.8	24.7	24.1	27.0	27.2	**27.8**
Basmati rice – chickpea – maize fodder	52.7	51.5	33.9	33.0	39.9	40.5	41.9	27.3	27.0	18.4	18.0	23.9	24.3	23.1
Basmati rice – berseem (fodder and seed)	52.5	52.2	36.1	35.8	42.8	43.2	43.7	28.9	28.1	18.9	17.6	21.7	22.1	22.9
Basmati rice – vegetable pea–sorghum (fodder)	60.0	60.0	39.4	39.1	43.9	44.5	**47.8**	33.4	33.0	18.9	18.3	24.8	25.5	25.6
Mean	**55.4**	**54.9**	37.1	36.6	42.9	43.3		**30.5**	**30.0**	20.2	19.5	24.3	24.7	

Table 16. Rhizosphre microbial (Actinomycetes and phosphate solubilizing micro-organisms) population in soil as influenced by the different nutrient practices and cropping systems

Cropping systems / Management practice	Soil Actinomycetes (x10⁴ cfu/g)							Phosphate solubilizing bacteria (x10⁴ cfu/g)						
	Organic		Inorganic (towards organic)		Integrated		Mean	Organic		Inorganic (towards organic)		Integrated		Mean
	100% organic	75% organic + innovative organic practices	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic + 25% inorganic	
Bajaura														
Tomato-cauliflower-french bean	12.6	10.2	7.5	10.2	10.2	11.8	10.4	14.2	11.9	8.5	11.2	11.7	12.5	11.7
Tomato-cauliflower	13.3	11.0	7.8	9.5	10.5	11.6	10.6	13.6	10.9	8.9	12	11.8	12.3	11.6
Black gram-cauliflower-summer squash	14.2	12.2	7.5	11.3	11.0	12.8	11.5	16	11.3	9.2	10.9	11.8	12.7	12.0
Lady finger-pea	12.0	9.2	8.0	10.9	11.5	12.6	10.7	15	11.8	9.6	11.2	11.5	12.6	11.9
Mean	13.0	10.7	7.7	10.5	10.8	12.2		14.7	11.5	9.0	11.3	11.7	12.5	
Bhopal														
Soybean- wheat	92.7	83.0	51.3	47.7	81.0	88.7	74.1							
Soybean- Mustard	88.3	49.7	30.0	33.7	46.7	68.3	52.8							
Soybean- Chickpea	99.0	71.7	48.7	68.7	49.7	74.0	68.6							
Soybean- Linseed	78.3	53.7	41.0	43.3	45.0	51.7	52.2							
Mean	89.6	64.5	42.8	48.4	55.6	70.7								
Coimbatore														
Cotton - maize	11.0	8.0	7.0	7.0	9.0	10.0	8.7							
Chillies - sunflower	8.0	6.0	4.0	4.0	5.0	7.0	5.7							
Beetroot - maize	9.0	7.0	6.0	6.0	7.0	9.0	7.3							
Mean	9.3	7.0	5.7	5.7	7.0	8.7								
Dharwad														
Cowpea-safflower	51.0	48.0	26.5	36.0	40.5	36.5	39.8	25.0	24.0	14.5	21.0	17.0	23.0	20.8
Pigeon pea (sole)	77.5	26.5	28.0	46.0	28.0	21.5	37.9	35.5	34.0	12.0	21.5	14.5	17.0	22.4
Sorghum-green gram	77.5	28.0	46.0	36.5	22.5	62.0	45.4	34.0	23.0	25.5	30.5	12.0	20.0	24.2
Groundnut +hybrid cotton (2:1)	48.0	46.0	53.5	21.5	27.5	41.5	39.7	21.0	20.0	21.0	22.5	25.5	11.5	20.3
Maize-Chickpea	36.0	53.5	58.5	62.0	43.5	59.0	52.1	14.0	18.0	21.5	23.0	21.0	34.0	21.9
Mean	58.0	40.4	42.5	40.4	32.4	44.1		25.9	23.8	18.9	23.7	18.0	21.1	
Jabalpur														
Basmati rice – wheat (durum) – green manure	17.4	17.1	6.4	6.1	12.2	13.0	**12.0**	16.9	16.5	13.4	12.5	15.5	16.1	**15.2**
Basmati rice – chickpea – maize fodder	14.2	14.0	5.8	5.2	10.7	11.1	10.2	16.7	16.0	11.2	11.0	11.9	12.6	13.2
Basmati rice – berseem (fodder and seed)	14.5	14.0	5.7	5.0	10.7	11.5	10.2	16.4	16.1	9.4	9.1	11.7	12.3	12.5
Basmati rice – vegetable pea–sorghum (fodder)	12.4	12.1	5.9	5.5	11.5	11.9	9.9	15.8	15.0	10.3	9.5	13.7	14.2	13.1
Mean	**14.6**	**14.3**	5.9	5.5	11.3	11.9		**16.5**	**15.9**	11.1	10.5	13.2	13.8	

Table 17. Influence of organic, inorganic and integrated package on quality of crops at different locations

Locations	Quality parameter	Crops	Organic		Inorganic		Integrated	
			100% organic innovative organic practices	75% organic +	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic+ 25% inorganic
Bajaura	Protein %	French bean	15.0	14.8	13.9	14.1	14.4	14.6
		Black gram	15.1	14.5	13.9	14.3	14.8	14.1
		Pea	21.4	21.3	20.9	21.0	21.4	21.3
	TSS (^{0} Brix)	Tomato (*Kharif*)	5.1	4.6	4.0	4.6	4.8	4.7
		Tomato (*Summer*)	5.2	4.8	4.2	4.9	4.7	4 .6
		Pea	14.9	14.4	12.6	13.0	13.8	13.5
	Vitamin C	Tomato	35.2	34.6	31.7	32.0	36.0	35.2
	(mg/100g)	Cauliflower	48.1	46.3	43.4	44.5	45.8	44.2
		Cauliflower	47.8	46.9	42.4	43.9	45.2	45.0
Bhopal	Protein %		36.33	35.99	35.21	35.19	35.47	36.04
	Oil (%)	Soybean	18.76	17.41	18.23	18.13	18.36	18.58
	Methionine (g/16gN)		1.75	1.73	1.63	1.64	1.69	1.70
Calicut	Oil (%)	Prathibha	2.15	2.00	2.30		1.90	2.45
		A.S	2.23	2.00	2.15		1.90	1.98
		Varna	2.15	2.23	2.38		1.98	2.38
		Sobha	2.48	2.23	2.00		1.73	2.23
		Sona	2.23	2.30	2.70		2.07	2.15
		Kanthi	1.98	2.45	2.38		2.23	2.23
		Suvarna	2.48	2.30	2.15		2.23	2.38
		Suguna	2.31	2.00	2.15		1.90	2.38
		Sudarsana	1.65	2.15	2.45		2.46	1.85
		Kedaram	1.65	2.23	2.15		1.90	2.00
		Prabha	1.65	2.68	2.00		2.31	2.15
		Mean	2.09	2.23	2.26		2.05	2.20
		CD(0.05) T	0.06					
		CD(0.05)V	0.08					
	Oleoresin (%)	Prathibha	9.8	8.5	7.4		10.0	8.2
		A.S	10.7	8.8	7.2		9.1	8.5
		Varna	7.4	8.0	5.3		8.3	5.3
		Sobha	5.6	4.9	5.1		6.0	5.6
		Sona	8.0	7.7	6.5		7.7	5.9
		Kanthi	7.5	7.0	4.2		7.1	5.5
		Suvarna	7.8	5.6	4.9		6.8	6.7
		Suguna	12.0	9.6	10.6		11.1	5.4
		Sudarsana	11.4	10.3	10.0		11.0	8.5
		Kedaram	11.3	10.4	10.6		9.9	9.7
		Prabha	11.8	12.5	8.8		10.9	9.0

Locations	Quality parameter	Crops	Organic		Inorganic		Integrated	
			100% organic innovative organic practices	75% organic +	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic+ 25% inorganic
		Mean	9.39	8.48	7.32		8.88	7.08
	Curcumin (%)	Prathibha	4.73	5.08	4.85		4.78	4.86
		A.S	4.94	5.33	4.50		4.78	4.50
		Varna	2.94	3.28	2.23		2.93	2.90
		Sobha	2.77	3.03	2.25		2.73	3.05
		Sona	2.81	2.80	2.53		2.73	3.43
		Kanthi	2.81	2.78	2.35		2.45	2.85
		Suvarna	2.92	2.85	2.35		2.45	2.70
		Suguna	3.88	4.53	3.53		3.93	3.95
		Sudarsana	3.13	3.00	3.78		3.90	4.13
		Kedaram	4.43	4.65	4.60		4.45	4.63
		Prabha	4.30	4.80	4.78		5.03	5.05
		Mean	3.60	3.83	3.42		3.65	3.82
Coimbatore	Ginning (%)	Cotton	32.5	35.6	34.3	35.7	32.9	36.9
	Fibre length (mm)		31.3	31.9	32.0	32.5	31.3	32.6
Umiam	Specific gravity	**Tomato**	1.22	1.16	1.11		1.17	
	Average fruit diameter (mm)		51.36	47.71	41.55		50.54	
	TSS (%)		4.72	4.55	4.08		4.34	
	Acidity (%)		0.70	0.67	0.61		0.66	
	Ascorbic acid		29.16	25.21	24.17		26.94	
	Reducing sugar (%)		2.72	2.57	2.31		2.48	
	Total sugar (%)		5.42	5.38	4.48		5.31	
	Lycopene		17.13	16.18	14.36		16.12	
	Root diameter (mm)	**Carrot**	28.88	25.12	23.64		31.09	
	Specific gravity		1.32	1.30	1.23		1.34	
	TSS		8.50	8.27	6.71		7.83	
	Ascorbic acid (mg/100g)		41.24	38.82	33.09		40.56	
	Acidity (%)		0.24	0.20	0.16		0.21	
	Beta carotene (mg/100g)		9.02	8.83	6.21		8.72	
	Total carotenoids (mg/g)		73.39	63.07	60.74		66.25	
	Total sugar (%)		6.11	5.92	4.51		5.67	
	Reducing sugar		4.53	4.31	3.58		4.22	

higher with organic package. Vitamin C in tomato and cauliflower recorded higher by 35.2 and 48.1% respectively.

Bhopal: Protein, oil (36.33, 18.76%) and Methionine 1.75 (g/16gN) recorded higher under organic management practice but it was on par with other management package.

Calicut: Oil, oleoresin and curcumin (%) for turmeric varieties were estimated. Significant difference in quality parameters was observed among treatments and between the varieties. Among turmeric varieties, oil content was significantly higher in inorganic management over other management practices followed by integrated (50% each organic and inorganic) whereas maximum oil content was noticed in Sona 2.70%. Under organic management among the varieties Suvarna and Shobha recorded maximum oil content. Oleoresin content was found to be significantly higher under organic management practices (9.39%). Prabha recorded maximum oleoresin content % irrespective of varieties influenced by management that was on par with Suguna under organic management practice. The varieties Keadaram and Prabha under organic management were also on par in respect to oleoresin content. Maximum curcumincontent was also recorded under organic management (3.83%) and it was on par within integrated (75% organic+25 % inorganic) of (3.82%). Aleppey supreme recorded maximum curcumin 5.33% which was on par with Prathibha 5.08% under organic management practice.

Coimbatore: Ginning and fibre length in cotton recorded higher under integrated management with 75% organic+25% inorganic supply through organic sources(36.9% and 32.6mm respectively).

Umiam: Specific gravity (1.22 g/ml), average fruit diameter (51.36 mm), TSS (4.72%), acidity (0.70%), ascorbic acid (29.16 mg/100g), reducing sugar (2.72%), lycopene (17.13 mg/100g) and total sugar (5.42%) of tomato recorded maximum under organic nutrient management followed by integrated. Quality parameters of carrot such as root diameter (mm), specific gravity (g/ml), TSS (%), ascorbic acid (mg/100g), acidity, beta carotene, total carotenoids, total sugar and reducing sugar reveals that the maximum root diameter (mm) was recorded under integrated (31.09 mm) management, whereas, TSS (%), acidity (%), beta carotene (mg/100g), total carotenoids, total sugar and reducing sugar were recorded under 100% organic (8.50%, 0.24%, 9.02 mg/100g, 73.39mg/g, 6.11% and 4.53% respectively) followed by integrated.

Influence of organic, inorganic and integrated management packages on economics of different crops and cropping systems. Table (18-19)

Bajaura: Higher gross return (Rs. 401922/ha) was recorded under organic nutrient management practice with 75% nutrient through manure followed by 100% organic (Rs. 380625/ha). It was 37.3 and 6.4% higher than inorganic and integrated management. Among the cropping systems, black gram-cauliflower-summer squash recorded higher gross return (Rs. 421781/ha) and it was 11.7, 27.9 and 37.6% higher than tomato-cauliflower-frenchbean, tomato-cauliflower and lady finger-pea respectively. In different production systems, lower cost of cultivation (Rs. 208647/ha) was recorded under inorganic management with 100% inorganic nutrient state recommendation recorded higher cost of cultivation (Rs. 257922/ha). Among the cropping systems, tomato-frenchbean-cauliflower recorded higher cost of cultivation (Rs. 292486/ha) and lady finger-pea recorded lower cost of cultivation (Rs. 180038/ha). Net return was recorded higher (Rs. 167759/ha) under organic management with 75% organic +innovative practices. It was 74.2 and 13.9% higher

Table 18. Influence of methods of organic, inorganic and integrated package on economics of different crops and cropping system

Cropping systems / Management practice	Gross returns (Rs./ha)							Cost of cultivation (Rs./ha)						
	Organic		Inorganic (towards organic)		Integrated		Mean	Organic		Inorganic (towards organic)		Integrated		Mean
	100% organic	75% organic + innovative organic practices	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic + 25% inorganic	
Bajaura														
Tomato-cauliflower-french bean	407875	441250	275500	335900	420550	384600	377613	302635	292135	260931	320931	283736	294549	292486
Tomato-cauliflower	345375	374625	210000	244950	334950	315900	304300	205340	196090	168815	218815	187844	195789	195449
Black gram-cauliflower-summer squash	475938	476250	325350	366750	451100	435300	421781	280260	272910	239788	299288	274203	282747	274866
Lady finger-pea	293313	315563	197200	203900	297850	272500	263388	179765	175515	165055	192655	181132	186107	180038
Mean	380625	401922	252013	287875	376113	352075		242000	234163	208647	257922	231729	239798	
Bhopal														
Soybean- wheat							67205							26071
Soybean- Mustard							56141							24519
Soybean- Chickpea							63849							25030
Soybean- Linseed							69273							24822
Mean	80818	75994	52412	54029	57292	61470		23614	28049	24771	25296	24514	24420	
Calicut														
Turmeric-Fallow	468596	416346	320209		406325	481075	418510	158996	148346	120401		149045	131635	141685
Coimbatore														
Cotton - maize	131,488	148,638	147,750	159,975	144,913	165,863	149,771	97,147	84,969	60,349	68,805	73,363	83,215	77,975
Chillies - sunflower	131,111	142,440	134,525	157,915	137,671	166,502	145,027	77,031	67,002	50,023	54,437	62,528	69,135	63,359
Beetroot - maize	263,125	276,125	273,250	289,875	275,875	308,350	281,100	110,903	94,675	72,374	92,405	89,278	98,143	92,963
Mean	175,241	189,068	185,175	202,588	186,153	213,572		95,027	82,215	60,915	71,882	75,056	83,498	
Dharwad														
Cowpea-safflower	41747	38579	67738	75669	63091	57020	57,307	31911	31599	35347	42457	35123	34747	35197
Pigeon pea (sole)	96575	70785	99483	102094	114085	105113	98,023	21994	21931	21088	24818	22981	22706	22586
Sorghum-green gram	64353	59829	85250	102718	86267	75352	78,962	27564	28577	28213	33613	29995	30740	29784
Groundnut +hybrid cotton (2:1)	162399	131321	210519	234313	174960	159334	178,808	47834	48627	44052	51599	47799	45624	47589
Maize-Chickpea	123130	116261	171369	170239	149238	117811	141,340	41577	43807	39970	46360	43161	41091	42661
Mean	97641	83355	126872	160074	118387	102379		34176	34908	33730	39769	35812	34982	
Jabalpur														
Basmati rice – wheat (durum) – green manure	167048	140381	146186	125619	136609	121845	139615	57000	57000	51000	51000	54000	54000	54000

Cropping systems / Management practice	Gross returns (Rs./ha)							Cost of cultivation (Rs./ha)						
	Organic		Inorganic (towards organic)		Integrated		Mean	Organic		Inorganic (towards organic)		Integrated		Mean
	100% organic	75% organic + innovative organic practices	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic + 25% inorganic	
Basmati rice – chickpea – maize fodder	129654	111634	102022	93372	94361	88315	103226	56000	56000	50000	50000	53000	53000	53000
Basmati rice – berseem (fodder and seed)	192440	187187	196852	186785	198270	180443	190330	58000	58000	51000	51000	55000	55000	54667
Basmati rice – vegetable pea–sorghum (fodder)	171331	149716	131367	120976	129611	117297	136716	56000	56000	50000	50000	52000	52000	52667
Mean	165118	147230	144107	131688	139713	126975		56750	56750	50500	50500	53500	53500	
Karjat														
Rice–groundnut							272490							
Rice – sweet corn							312859							
Rice – mustard							124312							
Rice – dolichos bean							255580							
Mean	282255	263152	227484	219734	227090	228148								
Modipuram														
Basmati rice– wheat - *Sesbania* green manure	158624	161141	106595	119566	106754	123156	129306	89740	84806	60671	69073	60685	66995	71995
Rice– barley (malt) – green gram	181203	182043	152322	158160	103559	128262	150925	101940	99706	81204	91684	60916	65816	83544
Maize(pop corn)- potato –okra + *Sesbania* green manure	538025	512600	396520	407480	311960	382520	424851	201333	193500	171249	186403	141613	150363	174077
Maize(sweet corn)- mustard- *Sesbania* green manure	203963	219025	166570	173790	127500	154350	174200	74295	70222	55163	64804	36330	41930	57124
Mean	270454	268702	205502	214749	162443	197072		116827	112059	92072	102991	74886	81276	
Pantnagar														
Rice-wheat -*sesbania*	229844	222827	171233	166597	185123	178371	192333	63965	52290	51472	52522	62117	66177	58091
Rice-chickpea + coriander-*sesbania*	337967	316867	247364	231785	258710	240998	272282	49425	41292	47195	48245	55748	55955	49643
Rice-vegetable pea + coriander-*sesbania*	229227	227268	189696	186643	198904	199118	205143	57975	50262	57845	58895	64718	64925	59103
Rice-potato-*sesbania*	220967	212679	152179	143470	167375	159618	176048	70969	64709	63921	64971	79356	84535	71410
Mean	254501	244910	190118	182124	202528	194526		60584	52138	55108	56158	65485	67898	
Raipur														
Soybean-Maize	353335	331584	277494	290525	262661	271285	297814	57457	56562	60103	63778	58804	58191	59149
Soybean-Pea	321076	301608	260029	271555	250231	263813	278052	44854	44345	47733	51416	46416	45717	46747

Cropping systems / Management practice	Gross returns (Rs./ha)							Cost of cultivation (Rs./ha)						
	Organic		Inorganic		Integrated (towards organic)		Mean	Organic		Inorganic		Integrated (towards organic)		Mean
	100% organic	75% organic + innovative organic practices	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic + 25% inorganic	
Soybean-Chilli	338272	313423	277289	280321	240959	239817	281680	48527	47728	51786	55487	50285	49492	50551
Soybean-Onion	343886	323485	280405	298181	274023	272077	298676	46888	46232	50979	54685	49049	48079	49319
Mean	339142	317525	273804	285146	256969	261748		49431	48717	52650	56342	51139	50370	
Ranchi														
Rice (Birsamati) –wheat (K 9107)	140037	139469	110327	85345	110930	114704	116802	70446	63095	49003	45451	65577	60770	59057
Rice (Birsamati) –lentil (PL 406)	90387	92982	65405	55514	70470	73955	74786	45708	41599	35403	32844	43619	41568	40124
Rice (Birsamati) –potato (Kufri Ashoka)	287966	274177	173395	145691	188460	205739	212571	95916	87846	74989	69162	91176	86505	84266
Rice (Birsamati) –linseed (Shekhar)	102205	106298	64465	57937	76101	79034	81007	48665	43831	34677	33329	45660	42697	41477
Mean	155149	153232	103398	86122	111490	118358		65184	59093	48518	45197	61508	57885	
Umiam														
Rice-Carrot	300420	275940	222300		280800		269865	117473	107250	85642		98927		102323
Rice-Potato	233700	210540	170100		210850		206298	159192	147038	120049		137196		140869
Rice-French bean	359040	315060	250250		298850		305800	105117	94894	70194		86732		89234
Rice-Tomato	333900	292140	239550		276000		285398	122627	111168	87704		101101		105650
Mean	306765	273420	220550		266625			126102	115088	90897		105989		

Table 19. Influence of methods of organic, inorganic and integrated package on economics of different crops and cropping system

Cropping systems / Management practice	Net returns (Rs./ha)							B:C ratio						
	Organic		Inorganic (towards organic)		Integrated		Mean	Organic		Inorganic (towards organic)		Integrated		Mean
	100% organic	75% organic + innovative organic practices	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic + 25% inorganic	
Bajaura														
Tomato-cauliflower-french bean	105240	149115	14569	14969	136814	90051	85126	0.35	0.51	0.06	0.05	0.48	0.31	0.29
Tomato-cauliflower	140035	178535	41185	26135	147106	120111	108851	0.68	0.91	0.24	0.12	0.78	0.61	0.56
Black gram-cauliflower-summer squash	195678	203340	85562	67462	176897	152553	146915	0.70	0.75	0.36	0.23	0.65	0.54	0.54
Lady finger-pea	113548	140048	32145	11245	116718	86393	83349	0.63	0.80	0.19	0.06	0.64	0.46	0.47
Mean	138625	167759	43365	29953	144384	112277		0.59	0.74	0.21	0.11	0.64	0.48	
Bhopal														
Soybean- wheat							41134							2.6
Soybean- Mustard							31622							2.3
Soybean- Chickpea							38818							2.6
Soybean- Linseed							44452							2.8
Mean	57204	47945	27640	28733	32778	37050		3.4	2.7	2.1	2.1	2.3	2.5	
Calicut														
Turmeric-Fallow	309600	268000	199808		257280	349440	276826	1.95	1.81	1.66		1.73	2.65	1.96
Coimbatore														
Cotton - maize	34341	63669	87401	91170	71550	82648	71796	2.83	1.33	0.69	0.75	1.03	1.01	1.09
Chillies - sunflower	54080	75438	84502	103478	75143	97367	81668	1.42	0.89	0.59	0.53	0.83	0.71	0.78
Beetroot - maize	152222	181450	200876	197470	186597	210207	188137	0.73	0.52	0.36	0.47	0.48	0.47	0.49
Mean	80214	106852	124260	130706	111097	130074		1.66	0.91	0.55	0.58	0.78	0.73	
Dharwad														
Cowpea-safflower	9836	6980	32391	33212	27698	22273	22110	1.31	1.22	1.92	1.78	1.80	1.64	1.61
Pigeon pea (sole)	74581	48854	78415	77276	91704	82407	75540	4.39	3.23	4.72	4.11	5.10	4.63	4.36
Sorghum-green gram	36789	31252	57037	69105	56272	44612	49178	2.33	2.09	3.02	3.06	2.88	2.45	2.64
Groundnut + hybrid cotton (2:1)	114565	82694	166467	182714	127161	113710	131219	3.40	2.70	3.78	4.54	3.60	3.49	3.59
Maize-Chickpea	45065	38835	44690	40882	44632	36153	41710	2.96	2.65	4.29	3.67	3.46	2.87	3.32
Mean	56167	41723	75800	80638	69547	59831		2.88	2.38	3.55	3.43	3.37	3.02	
Jabalpur														
Basmati rice – wheat (durum) – green manure	110048	83381	95186	74619	82609	67845	85615	1.93	1.46	1.87	1.46	1.53	1.26	1.59

Cropping systems / Management practice	Net returns (Rs./ha)							B:C ratio						
	Organic		Inorganic		Integrated (towards organic)		Mean	Organic		Inorganic		Integrated (towards organic)		Mean
	100% organic	75% organic + innovative organic practices	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic + 25% inorganic	
Basmati rice – chickpea – maize fodder	73654	55634	52022	43372	41361	35315	50226	1.32	0.99	1.04	0.87	0.78	0.67	0.95
Basmati rice – berseem (fodder and seed)	134440	129187	145852	135785	143270	125443	135663	2.32	2.23	2.86	2.66	2.6	2.28	2.49
Basmati rice – vegetable pea–sorghum (fodder)	115331	93716	81367	70976	77611	65297	84050	2.06	1.67	1.63	1.42	1.49	1.26	1.59
Mean	108368	90480	93607	81188	86213	73475		1.91	1.59	1.85	1.60	1.60	1.37	
Karjat														
Rice-groundnut							133127							1.95
Rice – sweet corn							143402							1.86
Rice – mustard							20213							1.22
Rice – *dolichos* bean							57794							1.29
Mean	108444	101427	94745	88694	73765	64728		1.61	1.61	1.71	1.69	1.47	1.40	
Modipuram														
Basmati rice– wheat (*durum*) – *sesbania* green manure	68884	76335	45924	50493	46069	56161	57311	1.53	1.80	1.50	1.48	1.45	1.74	1.58
Rice– barley (*malt*) – green gram	79263	82337	71118	66476	42643	62446	67381	2.48	2.59	2.76	2.33	2.12	3.00	2.55
Maize (*pop corn*) – potato– okra + *sesbania* green manure	336692	319100	225271	221077	170347	232157	250774	5.7	5.75	5.09	4.48	4.99	5.93	5.32
Maize (*sweet corn*) – mustard - *sesbania* green manure	129668	148803	111407	108986	91170	112420	117076	3.44	4.18	3.9	3.26	5.02	5.74	4.26
Mean	153627	156644	113430	111758	87557	115796		3.29	3.58	3.31	2.89	3.40	4.10	
Pantnagar														
Rice-Wheat -*sesbania*	165879	170537	119761	114075	123006	112194	134242	2.59	3.26	2.33	2.17	1.98	1.70	2.34
Rice-chickpea + coriander-*sesbania*	288542	275575	200169	183540	202962	185043	222638	5.84	6.67	4.24	3.80	3.64	3.31	4.58
Rice-vegetable pea + coriander-*sesbania*	171252	177006	131851	127748	134186	134193	146039	2.95	3.52	2.28	2.17	2.07	2.07	2.51
Rice-potato-*sesbania*	149998	147970	88258	78499	88019	75083	104638	2.11	2.29	1.38	1.21	1.11	0.89	1.50
Mean	193918	192772	135010	125966	137043	126628		3.37	3.94	2.56	2.34	2.20	1.99	
Raipur														
Soybean-maize	295872	275024	217395	226746	203857	213093	238665	5.15	4.86	3.62	3.56	3.47	3.66	4.05

Cropping systems / Management practice	Net returns (Rs./ha)							B:C ratio						
	Organic		Inorganic (towards organic)		Integrated		Mean	Organic		Inorganic (towards organic)		Integrated		Mean
	100% organic	75% organic + innovative organic practices	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic + 25% inorganic		100% organic	75% organic + innovative organic practices	100% inorganic	State recomm-endation	50% organic + 50% inorganic	75% organic + 25% inorganic	
Soybean-pea	276225	257266	212301	220136	203816	218096	231307	6.16	5.80	4.45	4.28	4.39	4.77	4.98
Soybean-chilli	289744	265702	225504	224837	190674	190324	231131	5.97	5.57	4.35	4.05	3.79	3.85	4.60
Soybean-onion	296995	277251	229431	243500	224974	223993	249357	6.33	6.00	4.50	4.45	4.59	4.66	5.09
Mean	289709	268811	221158	228805	205830	211377		5.90	5.56	4.23	4.09	4.06	4.24	
Ranchi														
Rice(Birsamati) –wheat (K 9107)	69591	76373	45353	53934	61324	39893	57745	2.13	2.61	2.62	1.86	1.47	1.87	2.09
Rice(Birsamati) –lentil (PL 406)	44679	51383	26851	32387	30001	22671	34662	1.26	1.63	1.27	0.88	0.78	1.08	1.15
Rice(Birsamati) –potato (Kufri Ashoka)	192050	186329	97284	119234	98405	76529	128305	3.87	4.28	2.93	2.43	2.22	2.82	3.09
Rice(Birsamati) –linseed (Shekhar)	53540	62467	30440	36337	29786	24607	39530	1.80	2.35	1.34	1.14	1.01	1.35	1.50
Mean	89965	94138	49982	60473	54879	40925		2.27	2.72	2.04	1.58	1.37	1.78	
Umiam														
Rice-Carrot	182947	168690	136658		181873		167542	1.56	1.57	1.60		1.84		1.64
Rice-Potato	74508	63502	50051		73654		65429	0.47	0.43	0.42		0.54		0.47
Rice-French bean	253923	220166	180056		212118		216566	2.42	2.32	2.57		2.45		2.44
Rice-Tomato	211273	180972	151846		174899		179748	1.72	1.63	1.73		1.73		1.70
Mean	180663	158333	129653		160636			1.54	1.49	1.58		1.64		

than inorganic and integrated management. Among the cropping systems, black gram- cauliflower-summer squash was found to be better (Rs. 146915/ha) as compared to other cropping systems.

Bhopal: Higher gross return (Rs. 80818/ha), net return (Rs. 57204/ha) and benefit cost ratio (3.4) was recorded under 100% organic management with organic nutrient input with supply through manure and it was 35.1 and 29.1% (gross return), 51.7 and 42.7% (net return), 38.2 and 32.3% (B:C ratio) higher than the inorganic and integrated management respectively. Among the cropping systems, soybean-linseed recorded higher gross return,net return and B:C ratio (Rs. 69273, Rs. 44452/ha and 2.8 respectively) as compared to other systems with cost of cultivation of Rs. 26071/ha compared to (Rs. 24519 /ha) in soybean-mustard.

Calicut: Turmeric-fallow system recorded higher gross return (Rs. 4,81,075/ha) with towards organic approach having 75% organic nutrient through manure+25% inorganic under integrated management and on par with 100% organic nutrient management (Rs. 4,68,596/ha). It was found to be 13.4 & 33.4% higher than 75% organic+innovative practices under organic management and inorganic nutrient management practices. Higher cost of cultivation was observed under (Rs. 1,58,996 /ha) organic management with 100% nutrient through manure.The cost was increased by 6.7 and 25.9% over integrated (50% organic+50% inorganic) and 100% inorganic nutrient management respectively. Net return and B:C ratio was also recorded maximum in towards organic approach with 75% organic nutrient through manure+25% inorganic under integrated management than organicand inorganic management.

Coimbatore: Higher gross return (Rs. 2,13,572/ha) was recorded under integrated management with 75% organic+25% inorganic and It is 21.9 & 15.3% higher than organic and inorganic management. Among the cropping systems, beetroot-maize recorded higher gross return (Rs. 2,81,100/ha) and it is higher 51.6 and 53.3% than chili-sunflower and cotton-maize respectively. High cost of cultivation (Rs. 95,027 /ha) was recorded under organic management and lower cost (Rs. 60,915 /ha) with inorganic management. Among the cropping systems, cotton-maize was found more profitable with lower cost of cultivation (Rs. 63,359/ha) whereas beetroot-maize was found higher cost (Rs. 92,996/ha). Higher net return (Rs. 1,30,706/ha) was recorded under inorganic management having state recommendation. It was at par with integrated management (Rs. 1,30,074/ha) with 75% organic+25% inorganic and 62.9% higher than organic management. In terms of cropping systems, beetroot-maize was found to give maximum net return (Rs. 1,88,137 /ha) and it was higher compared to other systems.

Dharwad: Higher gross return (Rs. 160074 /ha) was recorded under inorganic management with state recommendation. Integrated with 50% each organic and inorganicmanagementgave gross return of Rs. 1,18,387/ha and was found to be 17.5 and 29.6% higher than 100% and 75% organic management respectively. Among the cropping systems, groundnut-hybrid cotton recorded higher gross return Rs. 2,34,313/ha irrespective of management. Higher (Rs. 39769/ha) and lower (Rs. 33,730 /ha) cost of cultivation were found under inorganic with state recommendation and inorganic with 100% inorganic nutrients respectively. The cost of cultivation with 100% and 75% organic is more or less similar. In terms of cropping systems, groundnut-hybrid cotton (Rs. 51599/ha) was found higher cost whereas, pigeon pea recorded lowest cost (Rs. 21088/ha) with inorganic package. Higher net return of Rs. 58342/ha was recorded under inorganic management with state recommendation. Cropping system groundnut +hybrid cotton (2:1) registered higher net return (Rs. 1,31,219/ha) compared with other systems. Higher B:C ratio was

recorded (3.55) under inorganic condition whereas it was on par with integratedmanagement practices. In terms of cropping system, sorghum-greengram recorded higher B:C ratio (4.36) compared to other cropping systems.

Jabalpur: Result revealed that higher gross return and cost of cultivation under organic management with 100% organic through manure. Among the cropping systems, basmati rice-berseem (fodder and seed) recorded maximum gross return and production cost of Rs. 1,90,330 and 54,667/ha respectively compared to other systems. Net return (Rs. 1,08,368 /ha) and benefit cost ratio (1.91) was also higher in organic management with 100% organic supply through manures followed by inorganic management 100% nutrient supply through inorganic sources. Basmati rice-berseem (fodder and seed) gave significantly more benefit and return (Rs. 1,35,663/ha and 2.49). Rice-chickpea recorded significantly lower B:C ratio.

Karjat: Application of 100%organic management system recorded higher gross return (Rs. 282255/ha) and it was 24.1 & 24.3% higher than inorganic and integrated management respectively. Among the cropping systems, rice-sweet corn performed significantly higher gross return (Rs. 312859/ha) and it gave Rs. 40369 and 57279/ha more return than rice-groundnut and rice-dolichos bean. Rice-mustard recorded minimum gross return of Rs. 104099/ha. Higher net return of Rs. 108444/ha was recorded with organic management practice with 100% organic through manure. Though the gross and net return was higher with 100% organic management, the Benefit cost ratio was higher under 100% inorganic management (1.71). Among the cropping system, rice-sweet corn recorded higher net return (Rs. 143402 /ha) followed by rice-groundnut (Rs. 133127/ha) and found more beneficial than other cropping system. Rice-mustard resulted in lower net return and B:C ratio of Rs. 20213/ha and 1.22 respectively.

Modipuram: Organic management package with 100% organic through manure recorded higher gross return (Rs. 2,70,454/ha) and cost of cultivation (Rs. 1,16,827/ha) while integrated management with 50% each organic and inorganic recorded lower gross return and cost of cultivation. It was 24 & 39.3% higher than inorganic and integrated management respectively. Maize-potato–okra+green manure registered maximum gross return (Rs. 4,24,851/ha) and was found to be 328.6, 281.5 and 243.9% higher than basmati rice-wheat-*sesbania*, rice-barley-green gram and maize-mustard-*sesbania* respectively. Maize–potato–okra+*sesbania* recorded higher (Rs. 174077 /ha) cost of cultivation and lower (Rs. 57,124/ha) was under maize (sweet corn) -mustard-*sesbania*. Higher net return (Rs. 1,53,627 and 1,56,644/ha) were recorded with organic management with 100% nutrient through manure and 75% organic +innovative practices. Higher B:C ratio (4.1) was recorded under integrated management with 75% through organic manure +25% inorganic and found to be higher by23.8% than inorganic practices. In term of cropping system, maize-potato-okra+*sesbania* performed well with higher B:C ratio (5.32).

Pantnagar: Organic management with 100% nutrient through manure recorded higher gross return (Rs. 254501/ha). It was found to be 33.9 & 25.7% higher than inorganic and integrated management. Rice-chickpea+coriander +*sesbania* recorded significantly higher gross return (Rs. 2,72,282 /ha) and it was 32.7, 54.7 and 41.6% higher than rice-vegetable pea+coriander-*sesbania*, rice-potato-*sesbania* and rice-wheat-*sesbania* respectively. Cost of cultivation (Rs. 84535/ha) was higher under integrated management with 75% nutrient through manure in rice-potato-*sesbania.* Organic management package was found to be 43.6 and 41.5% higher than inorganic and integrated nutrient package. Benefit cost ratio was found to be 30.6 and 53.2% higher than inorganic and integrated management respectively. Lowest net returns &

B:C ratio (Rs.75083/ha & 0.89) were recorded in basmati rice-potato-s*esbania* system under 75% organic and 25% chemical mode of production.

Raipur: Higher gross return (Rs. 3,39,142/ha) was recorded under organic management with 100% organic through manure which was on par with 75% organic+ innovative practices (Rs. 3,17,525/ha) and found to be 23.9 & 32% higher with organic (100%) compared to inorganic (100%) and integrated (50% each) management respectively. Soybean-onion recorded higher (Rs. 2,98,676 /ha) gross return and it was on par with soybean-maize, but marginally higher over soybean-pea and soybean-chili. Higher cost of cultivation (Rs. 56342/ha) was recorded under inorganic management with state recommendation and minimum cost (Rs. 48717/ha) under organic management with 75% organic through manure. In terms of cropping systems, soybean-pea is found to be minimum cost of cultivation (Rs. 46747/ha) and soybean-maize recorded higher (Rs. 59149/ha) cost of cultivation. Organic management package with 100% nutrient through manure performed well with higher net return (Rs. 289709/ha) and BC ratio (5.90). It was found 31, 40.7 39.5 and 45.3% higher net return and B:C ratio than integrated and inorganic management practice respectively. Soybean-onion performed well with higher net return of Rs. 2,96,995/ha and B:C ratio of 6.33 compared with other cropping system under organic input package with 100% organic nutrient through manure.

Ranchi: Higher gross return (Rs. 287966/ha) was recorded under organic management with 100% nutrient through manure in rice-potato system. It was found to be 66.1 and 52.8% higher than inorganic and integrated respectively compared to other management practices. Lower cost of cultivation (Rs. 45197/ ha) was recorded under inorganic nutrient management with state recommendation and higher cost (Rs. 65184/ha) under organic management. Rice- lentil recorded lower (Rs. 40124/ha) cost of cultivation and rice (Birsamati)-potato (Kufri ashoka) recorded higher (Rs. 84266/ha) cost of cultivation. Organic management package recorded higher net return (Rs. 94138 /ha) with 75% nutrient through organic. It was found to be 88.3 & 71.5% higher than inorganic and integrated package respectively. Rice (Birsamati)-potato (Kufriashoka) performed well with higher gross return (Rs. 1,92,050/ha) compared to other cropping systems under organic management with 100% nutrient through organic sources while, rice (birsamati)-lentil gave minimum return (Rs. 34662/ha). Higher B:C ratio was recorded (2.72) under organic input package with 75% nutrient through organic sources +innovative practices.It was 19.8 and 98.5% higher than organic (100%) and integrated (50% each) management respectively. Among the systems, rice (Birsamati)-potato (Kufriashoka) recorded better B:C ratio (4.28) comparedto other cropping system under organic management.

Umiam: Higher gross return (Rs. 3,06,765 /ha) and cost of cultivation (Rs. 1,26,102/ha) was recorded under organic management with 100% through manure. It was 15 and 19% higher than 50% organic +50% inorganic package respectively. Rice-frenchbean recorded higher gross return (Rs. 3,05,800/ha) with lower cost of cultivation (Rs. 89,234/ha) comparedto other systems. Organic management with 100% through organic manure recorded higher net return (Rs. 1,80,663 s/ha) and It was 12.5 and 39.3% higher than integrated and inorganic packages. Higher B:C ratio was recorded under integrated management with 50% organic+50% inorganic nutrient (1.64) and it was found to be 6.5 and 3.8 % higher than organic & inorganic management respectively. Among the cropping system, rice-frenchbean also performed well with higher B:C ratio (2.44) comparedto other cropping systems. Rice-potato recorded lower B:C ratio (0.47).

7.3 Evaluation of response of different varieties of major crops for Organic Farming

Objectives

- To evaluate the response of varied duration and nutrient requiring varieties of major crops to organic production system
- To identify the suitable varieties of crops for organic management practices

Three to four groups of varieties based on crop duration, nutrient and water requirement and insect/disease tolerance was selected for evaluation. Two major varieties grown by the farmers in the region was also included. Minimum of 12 varieties were evaluated for potential cropping system of organic farming in 3 replications in RBD having the minimum plot size 20 m^2. All the centreshave taken up this experiment as it is very important to identify the varieties which form the core of organic farming package.

Year of start: 2013-14

Locations: All the 13 centres in different ecosystem as mentioned in section 7.1 have conducted the experiments.

Results

Bajaura (Table 20a-d)

Response of varieties/hybrids of important crops in tomato-pea-tomato and okra-cauliflower system under organic management at Bajaura

Tomato (Table 20a): Ten varieties in *kharif* and twelve varieties/hybrids of tomato in *summer* were evaluated in the system for their performance for suitability under organic conditions. Significant differences among

Table 20a. Yield attributes and yield of tomatoin tomato-pea-tomato system under organic management at Bajaura

Varieties/ Hybrids	Plant height (cm)		Numbers of fruits/plant		Fruit size (cm)		days to harvest		Yield (kg/ha)		TSS (^{0}Brix)	
	Kharif	*Summer*	*Kharif*	*Summer*	*Kharif*	*Summer*	*Kharif*	*Summer*	*Kharif*	*Summer*	*Kharif*	*Summer*
Yash	67.0	94.9	4	6	16.8	19.9	88.7	72	949	5926	3.93	4.13
Naveen 2000	69.9	98.7	5	8	13.7	16.9	89.3	72	970	6150	3.37	3.90
Manisha	70.6	99.4	4	7	18.5	22.0	88.7	73	967	11860	3.87	4.30
Red Gold	70.3	99.1	5	9	19.2	22.6	88.7	72	986	13914	3.73	4.50
Hybrid 7730	69.8	98.6	5	9	17.7	21.7	88.7	70	941	12547	3.13	3.90
Roma	64.5	93.3	3	7	18.7	22.2	89.3	72	633	7542	3.00	3.53
Sioux	57.2	86.0	2	5	17.5	20.9	89.3	75	503	5892	3.07	3.60
Best of All	71.7	99.0	3	6	18.2	21.3	88.7	70	764	3872	3.67	4.20
RK 123	72.3	101.0	4	7	22.1	22.0	88.7	70	990	10042	3.73	4.03
HeemSohna	70.4	99.1	5	8	15.5	17.4	88.7	70	1033	10365	3.87	4.23
Palam Pink		98.2		7		21.4		73		6863		3.23
Marglobe		94.5		4		20.4		72		4091		3.57
CD (P=0.05)	4.81	4.61			0.68	0.66	NS	NS	1.53	4.84	0.37	0.41

the varieties/hybrids for measured variables were observed except days taken to harvest. The variety PK 123 attained maximum plant height (72.3 and 101 cm) whereas Sioux recorded minimum plant height (57.2 and 86 cm) during *kharif* and *summer* season respectively.The maximum fruit yield was recorded with variety Heem Sohna (1033 kg/ha) in *kharif* and Red gold (13914 kg/ha) in *summer* with higher number of fruits/plant (5.0 and 9.0).

Pea (Table 20b): Eight varieties of pea were evaluated for their performance under organic conditions. Significant differences were observed among the varieties for different variables except TSS. Significantly higher pod yield (4687 kg/ha^{-1}) was recorded with variety Ten Plus, which was statistically at par with Nirali (4280 kg/ha) and Palam Priya (4133 kg/ha) but significantly higher than the all other varieties. Variety Ten Plus also attained significantly higher plant height (86.78cm), number of pods/plant (12.17), number of seeds/pod (7.10) and shelling (66.67%).

Table 20b. Yield attributes and yields of vegetable pea (*rabi*) in tomato-cauliflower-pea system under organic management at Bajaura

Entry	Plant height (cm)	Pod length (cm)	No. of pods / plant	No. of seeds / pod	Shelling (%)*	Pod yield (kg/ha)	TSS (^{0}Brix)
GC 477	68.54	6.57	10.60	5.17	59.20 (50.29)	3363	12.00
Pb 89	56.18	8.70	9.67	7.07	64.57 (53.45)	2910	12.67
Azad P-1	62.37	8.53	10.23	6.07	64.97 (53.69)	2843	13.33
PalamSumol	55.58	8.80	10.80	6.00	65.35 (53.92)	2730	12.00
PalamTriloki	59.17	8.63	10.57	5.97	62.20 (52.04)	3713	12.67
Nirali	69.38	8.63	12.13	6.17	63.47 (52.79)	4280	13.33
PalamPriya	79.31	8.87	12.03	6.67	64.27 (53.27)	4133	12.67
Ten Plus	86.78	8.77	12.17	7.10	66.67 (54.72)	4687	13.33
CD (P=0.05)	3.83	0.56	1.44	0.45	1.97	753	NS

* Figures within the parentheses are the arc sign transformed values

Okra (Table 20c): Six varieties of okra were evaluated in okra-cauliflower system for their suitability under organic conditions during *kharif*. Significant differences were observed for all the parameters such as plant height, days taken to harvest, no. of fruits/plant, fruit length and fruit yield. The results revealed that variety Chameli 015 and Indranil recorded significantly higher fruit yield (12607 & 12100 kg/ha respectively) compared to others, however both the varieties/hybrids were statistically at par with each other but superior to all the other varieties/hybrids.

Table 20c. Yield attributes and yields of okra in okra-cauliflower system under organic management at Bajaura

Varieties	Plant height (cm)	Days taken to harvest	No. of fruits/ plant	Fruit length (cm)	Fruit yield (kg/ha)
PalamKomal	205.3	55	21.3	8.5	9783
PusaMakhmali	219.6	60	20.5	8.6	10217
Perkins Long Green	213.0	62	16.2	8.1	10247
Indranil (F_1)	192.6	55	17.7	9.0	12100
Chameli 015 (F_1)	224.0	55	13.0	9.1	12607
P-8 (check)	209.7	55	17.2	8.2	10927
CD (P=0.05)	9.9	3	3.0	0.6	700

Cauliflower (Table 20d): Seven varieties/hybrids of cauliflower were evaluated during *rabi*. Though higher percentage of marketable curds was obtained in hybrid Chandramukhi (88.77%) and it was statistically at par with US 178 (88.37%), but the hybrid US 178 recorded significantly higher curd yield (10201 kg/ha) than other entries tested, followed by Chandramukhi (10000 kg/ha) and Maharani (9946 kg/ha). The Curd weight was significantly higher in Palam Uphar (458g). Maximum biomass yield ha^{-1} (14890 kg) with curd size (107.80 cm^2) were observed in Maharani, followed by US178 (14250 kg/ha) and Chandramukhi (14230 kg/ha) along with curd size US178 (102.37, 99.13 cm^2 respectively) and it was found to be statistically at par with Maharani. Due to occurrence of heavy snow fall in December followed by heavy rains till March end severely affected the crop growth resulting in very poor number of marketable curd, yield, curd size, curd weight in variety PSB -1.

Table 20d. Yield attributes and yields of cauliflower (*rabi*) in okra-cauliflower system under organic management at Bajaura

Variety/hybrid	Marketable curd (%)	Curd size (cm^2)	Curd weight (g)	Curd yield (kg/ha)	Biomass (kg/ha)
PSB-1	18.77 (4.43)	78.60	105.00	200	633
KT-25	71.70 (8.51)	98.93	325.33	8534	11917
PalamUphar	46.27 (6.87)	95.97	458.00	7801	11280
PSBK-1	69.20 (8.38)	92.30	356.33	9120	12980
Maharani F_1	87.53 (9.41)	107.80	307.00	9946	14890
US 178 F_1	88.37 (9.45)	102.37	311.67	10201	14250
Chandramukhi F_1	88.77 (9.47)	99.13	304.00	10000	14230
CD (P=0.05)	0.49	6.92	49.41	461	793

* Figures within the parentheses are the square root transformed values

Okra (Chameli-015) under organic management at Bajaura

Vegetable pea under organic management at Bajaura

Tomato fruits (Hybrid Red Gold) under organic management at Bajaura

Tomato crop (Hybrid Red Gold) under organic management at Bajaura

Bhopal (Table 21a-21e)

Response of different varieties/hybrids of crops in soybean-wheat and maize-chickpea system under organic management

Twelve varieties of each soybean, wheat, maize and chickpea including two major varieties grown by the farmers in the region were evaluated in soybean-wheat and maize-chickpea cropping systems.

Soybean (Table 21a): Among the varieties of soybean grown under similar nutrient source and doses, RVS-2002-4 resulted in significantly higher yield (1236 kg/ha) owing to higher pods/plant (38.1) and biomass (4152 kg/ha) than others while, JS 20-34 recorded lowest soybean yield (631 kg/ha). Variety JS 97-52 attained maximum plant height (39 cm) but statistically at par with JS 335, NRC 37 and RVS 2002-7. Significantly higher test weight was recorded in variety RVS 20-29 of 14.0g followed by RVS 2002-7. RVS 2002-6 recorded lower test weight of 8.0g.

Table 21a. Yield attributes and yields of soybean in soybean-wheat system under organic management at Bhopal

Varieties/ hybrids	Plant height (cm)	Pods/ plant	Seeds/ pod	Test weight (g)	Seed yield (kg/ha)	Total biomass (kg/ha)	Harvest index (%)
JS-335	37.7	29.7	3.5	12.0	820	3271	25.1
JS-93-05	28.7	27.5	2.8	10.7	784	2914	26.9
JS-95-60	33.7	27.7	3.4	12.0	788	3084	25.5
JS-20-41	29.3	36.4	3.1	10.0	1129	3805	29.7
NRC-7	29.5	32.0	3.2	12.0	1007	3752	26.8
NRC-37	38.5	27.3	2.9	9.3	846	3378	25.1
RVS-20-29	27.7	26.3	3.1	14.0	709	2332	30.4
RVS-2002-4	28.9	38.1	3.3	10.0	1236	4152	29.8
RVS-2002-6	27.3	27.5	3.0	8.0	768	2984	25.8
RVS-2002-7	37.1	28.2	2.7	12.7	977	3410	28.7
JS-97-52	39.0	37.3	3.3	10.7	1193	3786	31.5
JS-20-34	23.0	29.7	3.1	12.0	631	2419	26.1
CD(*P= 0.05*)	7.4	4.1	0.4	1.4	83	238	

Quality of soybean (Table 21e): A significant variation was observed for oil and protein content among the soybean varieties evaluated. The percentage of oil and protein content from different varieties of soybean seeds was found to be in the range of 18.2–20.3% and 35.8–37.6% respectively. The oil content (20.3%) was considerably higher for RVS 2002-7 variety and lower (18.2%) in the variety JS 20-34. Significantly higher protein (37.6%) was recorded with JS-93-05. Other soybean varieties protein value ranged from 35.8 to 37.5% was observed.

Wheat (Table 21b): Results revealed that there is significant higher grain yield, biomass yield, number of spikes m^{-1} row length and seeds $spike^{-1}$ recorded with variety HI 8498. It gave maximum grain yield (3317 kg/ha) whereas, variety HI 1500 recorded 60% lower yield (2078 kg/ha).

Maize (Table 21c): The range ofyield of different varieties recorded 837-2764 kg/ha having maximum grain yield with Kanchan (2764 kg/ha) straw yield (5989 kg/ha) and minimum in variety sweet corn (837 kg/ha) biomass yield (1942 kg/ha) followed by Proagro 4412 which also exhibited good yield due to the

Table 21b. Response of wheat varieties for yield attributes and yield in soybean-wheat system under organic management at Bhopal

Varieties/hybrids	Spike/M row length	Seeds/spikes	Grain yield (kg/ha)	Total Biomass (kg/ha)	Harvest index (%)
C-306	71.7	62.9	2048	4656	44.0
HI-8663	79.0	68.7	2583	5688	45.4
HI-1544	71.0	61.8	2550	5545	46.0
MALWASHAKTI	84.7	72.5	2885	6456	44.7
GW-322	69.3	69.9	2583	5670	45.6
GW-366	87.0	72.3	3119	6341	49.2
HI-1531	74.7	64.0	2372	5672	41.8
HI-8498	88.7	74.5	3317	6874	48.2
HI-1500	70.0	61.3	2078	4404	47.2
JW-1202	84.3	70.7	3086	6404	48.2
HD-932	73.3	60.8	2422	5292	45.8
LOK-1	72.0	66.0	2357	5144	45.8
CD (*P= 0.05*)	7.8	4.7	398	577	

Table 24c. Yield attributes and yield of different maize varieties/hybrids in maize-chickpea system under organic management at Bhopal

Varieties/ hybrids	Plant height (cm)	Cobs/ plant	Rows/ cob	Seeds/ row	Seed yield (kg/ha)	Total biomass (kg/ha)	Harvest index (%)
Kanchan	151	1.0	12.5	17.3	2764	5989	46.2
Pratap 5	126	1.0	10.6	15.4	1928	4185	46.1
Arawali	142	1.2	12.8	21.3	1773	3985	44.5
Sona 222	163	1.1	12.1	18.2	1727	3966	43.5
Pratap 6	161	1.2	10.0	15.2	1997	4751	42.0
JM 216	132	1.1	12.8	20.2	1593	3564	44.7
Popcorn 1	127	1.2	10.5	18.8	911	1955	44.6
JM 8	144	1.1	11.9	17.0	2193	4740	46.3
JM 12	143	1.1	10.5	16.3	1856	4054	45.8
Proagro 4412	134	1.2	12.2	21.8	2537	5803	43.7
Sweet Corn	106	1.2	12.2	19.8	837	1942	43.1
CPBG 4202	140	1.0	11.7	19.8	1365	3001	45.5
CD(*P= 0.05*)	NS	NS	1.1	4.3	712	1094	

higher seeds/row (21.8). Sona 222 recorded significantly higher plant height of 163 cm while, sweet corn attained minimum height 106 cm.

Quality of maize (Table 21e): Among all the quality parameters assessed, Pro agro-4412 was outstanding and superior over all the varieties/hybrids evaluated. It recorded more protein (9.90%), ash% (1.49) and tryptophan (0.89g/16gN), but in term of oil content it was reverse, rcording lesser oil (3.27%). Other maize varieties resulted in protein value ranging from 8.80 (sweet corn) to 9.60% (Kanchan). Non-significant effect was found in ash and tryptophan among all the varieties.

Chick pea (Table 21d): The chickpea varieties exhibited differences among themselves in yield attributes and yield. In all the yield components assessed, JG 130 was outstanding and superior over all the hybrids/

Table 21d. Yield attributes and yield of different chickpea varieties/hybrids in maize-chickpea system under organic management at Bhopal

Varieties/hybrids	Pods/plant	Seeds/pod	Grain yield (kg/ha)	Total Biomass (kg/ha)	Harvest index (%)
RVG-202	96.0	1.5	1652	4278	38.6
JG-16	88.7	1.7	1486	3974	37.4
JGK-3	98.9	1.5	1070	3141	34.1
RVG-203	92.0	1.2	1600	4241	37.7
JG-11	78.2	1.5	1270	3548	35.8
JG-6	70.1	1.1	1096	2906	37.7
JG-130	94.0	1.8	1707	4541	37.6
JG-315	80.3	1.7	1439	3722	38.7
JG-63	71.2	1.3	1233	3789	32.6
JG-74	71.9	1.5	1015	3405	29.8
VIRAT	97.3	1.6	1147	3226	35.6
UJJWALA	92.9	1.1	807	2514	32.1
CD (P=0.05)	13.0	0.2	296	534	

Table 21e. Quality of soybean and maize as influenced by different varieties under organic management

Soybean			Maize				
Varieties/ hybrids	Oil (%)	Protein (%)	Varieties/ hybrids	Protein (%)	Oil (%)	Ash (%)	Tryptophan (g/16 g N)
JS-335	19.4	36.4	Kanchan	9.6	3.53	1.48	0.83
JS-93-05	19.2	37.6	Pratap 5	9.4	3.36	1.39	0.82
JS-95-60	18.9	36.3	Arawali	9.6	3.93	1.40	0.75
JS-20-41	19.3	36.2	Sona 222	9.5	3.39	1.41	0.80
NRC-7	18.6	36.1	Pratap 6	9.4	3.74	1.42	0.75
NRC-37	18.6	36.9	JM 216	9.6	3.71	1.28	0.72
RVS-20-29	19.7	37.5	Popcorn 1	9.0	3.98	1.29	0.66
RVS-2002-4	19.6	35.9	JM 8	9.5	3.66	1.42	0.85
RVS-2002-6	19.9	35.8	JM 12	9.1	3.47	1.43	0.79
RVS-2002-7	20.3	36.1	Pro agro 4412	9.9	3.27	1.49	0.89
JS-97-52	18.7	36.0	Sweet Corn	8.8	3.98	1.26	0.68
JS-20-34	18.2	35.9	CPBG 4202	9.6	3.48	1.38	0.82
CD(*P= 0.05*)	0.1	0.4	CD(*P= 0.05*)	0.1	0.15	NS	NS

varieties evaluated. It produced more seeds/pod (1.8), with higher seed yield (1707kg) ha^{-1} and correspondingly higher biomass yield ha^{-1} of 4541 kg followed by RVG 202 and RVG 203 which is at statistically at par. Rest of varieties were varied from 2514 to 3974 kg/ha on grain yield basis..

Calicut (Table 22a-c)

Eleven varieties of turmeric were evaluated in turmeric–fallow systems to study the response to organic farming at Calicut

Turmeric (Table 22a): Among management systems, integrated system with 50% manure application through organic sources + 50% through inorganic sources recorded maximum mean yield (27000 kg/ha).

Variety, Sudarshana recorded highest yield (32500 kg/ha) followed by Suguna (31400 kg/ha) under integrated management practice. Varieties, Kedaram and Prabha recorded maximum yield under organic management practices (100%) of 23300 and 23400 kg/ha. The yield of turmeric varied from 15700 to 23400 kg/ha with 100% organic management. There was a significant difference between the varieties of the turmeric cultivars ($p \leq 0.05$).

Table 22a. Effect of different management systems on yield (t/ha) of turmeric varieties

Varieties	Organic		Integrated		Inorganic 100%	mean
	100%	75%	75% organic + 25% inorganic	50% organic + 50% inorganic		
Prathibha	16700	19600	26000	28100	16000	22100
A.S	21500	21300	26300	27000	15400	22300
Varna	15700	16200	18000	23600	16200	17900
Sobha	19100	16900	17700	24900	17000	19100
Sona	16900	13300	15400	23600	12700	16400
Kanthi	17300	15000	16800	29200	17700	19200
Suvarna	16000	13000	16300	22900	19400	17500
Suguna	21200	20300	23000	31400	12100	21600
Sudarsana	22000	18900	25700	32500	12600	22300
Kedaram	23300	15100	18000	28700	13200	19600
Prabha	23400	14800	18000	26500	14900	19500
Mean	19400	16700	20100	27000	15600	
(CD=0.05) T	900					
(CD =0.05)V	1300					

Quality of Turmeric (Table 22b-c): Significant difference in oleroresin and curcumin content in turmeric varieties observed. Among turmeric varieties, oleoresin content was found to be significantly higher with 100% organic management practices (12% in Sugna followed by 11.8% in Prabha). The oleoresin content

Table 22b. Effect of different management systems and varieties on oleoresin content (%) in turmeric

Varieties	Organic		Integrated		Inorganic 100%	mean
	100%	75%	75% organic + 25% inorganic	50% organic + 50% inorganic		
Prathibha	9.8	8.5	10.0	8.2	7.4	8.75
A.S	10.7	8.8	9.1	8.5	7.2	8.85
Varna	7.4	8.0	8.3	5.3	5.3	6.84
Soba	5.6	4.9	6.0	5.6	5.1	5.43
Sona	8.0	7.7	7.7	5.9	6.5	7.16
Kanthi	7.5	7.0	7.1	5.5	4.2	6.25
Suvarna	7.8	5.6	6.8	6.7	4.9	6.35
Suguna	12.0	9.6	11.1	5.4	10.6	9.71
Sudarsana	11.4	10.3	11.0	8.5	10.0	10.25
Kedaram	11.3	10.4	9.9	9.7	10.6	10.36
Prabha	11.8	12.5	10.9	9.0	8.8	8.75
Mean	9.39	8.48	8.88	7.08	7.32	
CD(P=0.05) T	0.27					
CD(P=0.05) V	0.40					

Table 22c. Effect of different management systems and varieties on curcuminin turmeric

Varieties	Organic		Integrated		Inorganic 100%	mean
	100%	75%	75% organic + 25% inorganic	50% organic + 50% inorganic		
Prathibha	4.73	5.08	4.78	4.86	4.85	4.82
Alleppey Supreme	4.94	5.33	4.78	4.50	4.50	4.81
Varna	2.94	3.28	2.93	2.90	2.23	2.85
Soba	2.77	3.03	2.73	3.05	2.25	2.76
Sona	2.81	2.80	2.73	3.43	2.53	2.86
Kanthi	2.81	2.78	2.45	2.85	2.35	2.65
Suvarna	2.92	2.85	2.45	2.70	2.35	2.65
Suguna	3.88	4.53	3.93	3.95	3.53	3.96
Sudarsana	3.13	3.00	3.90	4.13	3.78	3.59
Kedaram	4.43	4.65	4.45	4.63	4.60	4.55
Prabha	4.30	4.80	5.03	5.05	4.78	4.79
Mean	3.60	3.83	3.65	3.82	3.42	
CD(0.05) T	0.10					
CD(0.05) V	0.15					

varied from 5.6 to 12.0%. Maximum curcumin content was recorded under organic management with 75% organic manure through organic sources + innovative practices (3.83%) which was statistically on par with integrated management (50% organic+50% inorganic). Aleppey supreme recorded maximum curcumin (5.33%) followed by Prathibha (5.08%) under organic management practice.The range of curcumin varied from 2.23% in Varna with inorganic management to 5.33% in Alleppey Supreme under 75% organic + innovative package.

Coimbatore (Table 23a-e): Productive tillers count of the rice varieties differed significantly with CO(R)-51 having the highest count (13.3 hill^{-1}) followed by Mappillai samba (12.9 hill^{-1}), Kitchili samba and CB 05022 (each 11.9 hill^{-1}) and the least productive tillers recorded in Bhavani (7.8hill^{-1}). Among the cultivars,

Table 23a. Response of rice varieties/hybrids under organic management at Coimbatore

Treatments	Productive tillers hill^{-1}	Panicle length (cm)	No. of filled grains panicle^{-1}	No. of grains/ panicle	1000 grains weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest index
Bhavani	7.8	20.4	69.8	94.9	20.6	2260	6600	0.26
White Ponni	11.4	18.4	78.9	102.3	15.1	2870	3500	0.45
Mappillai samba	12.5	22.2	74.4	96.0	24.0	3380	7300	0.32
Kitchili samba	11.9	20.4	32.3	68.2	15.2	2100	4800	0.30
IR 20	9.0	19.3	70.5	89.1	17.1	3080	2900	0.52
CO 43	10.5	18.8	53.8	88.7	14.5	2860	3100	0.48
CO(R) 48	10.5	21.0	61.7	84.7	16.5	3260	4100	0.44
CO(R) 51	13.5	15.3	48.7	62.7	13.1	2080	2500	0.45
CB 05022	11.9	21.1	95.9	126.5	16.9	4100	4200	0.49
KDML 105	8.1	22.7	76.9	99.1	14.2	2010	5100	0.28
Red kavuni	9.3	22.3	67.8	84.5	19.5	2170	4400	0.33
Jeeraga samba	11.1	19.8	71.4	108.1	11.6	2520	4700	0.35
CD (P=0.05)	0.7	0.7	5.2	6.8	1.1	210	1100	

the length of panicle varied from 15.3 cm (COR 51) to 22.7cm (KDML-105). The number of filled grains/ panicle were significantly higher in CB 05022 (95.9) followed by white ponni (78.9) while, Kitchili samba recorded least number of filled grains/panicle (32.3). Number of filled grain and grains/panicle was rather higher in the CB 05022 variety than the other variety. Mappillai samba showed significantly higher seed weight (24g) followed by the bhavani (20.6g) and Red kavuni (19.5g) then the others cultivars while, Jeeraga samba recorded least test weight (11.6 g). In all the varieties assessed, CB 05022 outperformed and superior over all the cultivars evaluated. It produced more grains/panicle with more filled grains and correspondingly recorded higher rice yield (4100 kg/ha). The grain yield was obtained in the range of 2010 to 4100 kg/ha, whereas straw yield recorded 2500 kg to 7300 kg/ha (Table 23a).

Physical quality parameter such as kernel length, kernel breadth, length breadth ratio, hulling and milling percentage were estimated at post-harvest stageand given in Table 23b.

Table 23b. Physical parameters of rice varieties under organic management at Coimbatore

Treatments	Kernel length (mm)	Grain Size	Kernel breadth (mm)	Scale	L/B Ratio	Grain Shape	Hulling (%)	Milling (%)
Bhavani	5.6	Medium	1.9	4	2.95	Medium	78.0	72.8
White Ponni	5.6	Medium	1.9	4	2.95	Medium	84.0	74.0
Mappillai samba	5.6	Medium	1.8	4	3.11	Slender	81.6	73.6
Kitchili samba	5.9	Medium	1.8	4	3.28	Slender	74.8	68.0
IR 20	5.7	Medium	1.9	4	3.00	Medium	80.4	71.2
CO 43	5.6	Medium	2.1	3	2.67	Medium	88.4	79.2
CO(R) 48	5.8	Medium	1.8	4	3.22	Slender	76.0	68.4
CO(R) 51	5.8	Medium	1.8	4	3.22	Slender	71.6	65.6
CB 05022	5.9	Medium	1.9	4	3.11	Slender	70.0	60.0
KDML 105	7.0	Long	1.8	4	3.89	Slender	85.2	78.0
Red kavuni	5.6	Medium	2.0	4	2.80	Medium	76.0	66.8
Jeeraga samba	4.0	Short	1.8	4	2.22	Medium	82.8	77.2

KDML 105 recorded remarkably higher kernel length of 7.0 mm under long size category while, variety Jeeraga samba recorded 4.00 mm kernel length of under short category. The other varieties, Bhavani, White ponni ,Mappillai samba, Kitchili samba, IR-20, CO-43, CO(R) 48, CO(R) 51, CB 05022 and Red kavuni recorded kernel length ranged from 5.6-5.9 mm and they were classified as medium size category. The variety CO-43 recorded numerically higher kernel breadth of 2.1 mm.

Cooking parameter such as kernel length after cooking(KLAC) , kernel breadth after cooking(KBAC), linear elongation ratio(LER), breadth wise elongation ratio (BER) and water absorption and expansion ratio were also estimated at post-harvest stage (Table 23c).

KDML 105 recorded highest kernel length after cooking (10.3mm) while Kitchili samba and Jeeraga samba recorded 7.2 and 6.0 mm respectively of the lowest value. Other varieties CB 05022, Mappillai samba, White Ponni, CO(R) 48, IR 20, CO(R) 51, Red kavuni, Bhavani and CO 43 ranged from 8.3 to 8.9 mm of kernel length after cooking. The maximum Kernel breadth after cooking registered in Mappillai samba and Red kavuni (2.8), while lowest value of 2.0 recorded in the Kitchili samba. Maximum linear elongation ratio and breadth wise elongation ratio were recorded in the variety Mappillai samba 1.57 and 1.56 respectively followed by White ponni and CO(R) 48. Water absorption had a positive influence on

Table 23c. Cooking parameters of rice varieties under organic management at Coimbatore

Treatments	KLAC (mm)	Scale	KBAC (mm)	Scale	LER	BER	Water absorption ratio	Water expansion ratio
Bhavani	8.3	1	2.7	2	1.48	1.42	3.02	2.6
White Ponni	8.5	1	2.6	2	1.52	1.37	3.05	2.6
Mappillai samba	8.8	1	2.8	2	1.57	1.56	3.18	2.7
Kitchili samba	7.2	1	2.0	2	1.22	1.11	3.38	2.5
IR 20	8.4	1	2.6	2	1.47	1.37	3.00	2.7
CO 43	8.3	1	2.8	2	1.48	1.33	3.13	2.8
CO(R) 48	8.5	1	2.6	2	1.47	1.44	3.52	3.0
CO(R) 51	8.4	1	2.5	2	1.45	1.39	3.10	2.8
CB 05022	8.9	1	2.6	2	1.51	1.37	3.23	3.0
KDML 105	10.3	3	2.5	2	1.47	1.39	3.81	3.4
Red kavuni	8.4	1	2.8	2	1.50	1.40	3.25	2.6
Jeeraga samba	6.0	1	2.3	2	1.50	1.28	3.36	2.9

KLAC=Kernel length after cooking; KBAC= Kernel breadth after cooking; LER= Linear elongation ratio; BER= Breadth wise elongation ratio

grain elongation and volume expansion ratio. KDML 105 recorded higher water absorption and volume expansion ratio of 3.81 and 3.40 respectively followed by CO(R) 48 3.52 and 3.00 respectively. The variety IR 20 recorded lowest water absorption ratio of 3.00 whereas, the lesser volume expansion was noticed in Kitchili samba 2.50.

Bio-chemical characters (Table 23d): Amylose content play a significant role in determining the overall cooking, eating and pasting properties of a rice variety. The variety Mappillai samba, Kitchili samba and IR 20 registered higher amylose content of 26.6, 26.5 and 24.3 per cent respectively and grouped under high amylose content category. The varieties Bhavani, White ponni, CO 43, CO(R) 51, KDML105, Red kavuni and Jeeraga samba comes under intermediate amylose content category ranged from 17.3-20.4%. Varieties CO(R) 48 and CB 05022 recorded amylose content of lower category ranged from 15.8-16.2%. Aroma is important character in rice and variety KDML 105 recorded higher aroma content of 4 and classified as

Table 23d. Bio chemical parameters of rice varieties under organic management at Coimbatore

Treatment	Amylose content (%)	Amylose character	Aroma	Alkali digestion	Rating	Length of gel (mm)	Category
Bhavani	17.5	I	2	I	3	58	Flaky
White Ponni	18	I	2	I	3	60	Flaky
Mappillai samba	26.6	H	2	I	4	65	Soft
Kitchili samba	26.5	H	2	H	6	70	Soft
IR 20	24.3	H	2	L	2	67	Soft
CO 43	18.8	I	2	I	3	60	Flaky
CO(R) 48	16.2	L	2	I	5	60	Flaky
CO(R) 51	17.2	I	2	L	2	75	Soft
CB 05022	15.8	L	2	I	5	70	Soft
KDML 105	17.3	I	4	H	7	65	Soft
Red kavuni	20.4	I	2	I	4	50	Flaky
Jeeraga samba	17.3	I	3	I	5	56	Flaky

L-Low; I-Intermediate; H-High

good quality. Aroma content in Jeeraga samba is 3 and classified as moderate and rest of the varieties CO(R) 51, CB 05022, Red kavuni, Bhavani, White ponni, CO(R) 48, CO 43, IR 20, Kitchili samba and Mappillai samba having lower aroma of 2 and classified as poor aroma quality. The gelatinization temperature of the endosperm starch, a useful test of cooking quality, refers to the cooking temperature at which water is absorbed and the starch granules well irreversibly in hot water with a simultaneous loss of crystallinity and birefringence. The time required for cooking is determined by the gelatinization temperature. Varieties IR 20 and CO(R) 51 recorded lower alkali digestion described as kernel not affected/swollen and comes under rating 2. The varieties Bhavani, White ponni and CO 43, Mappillai samba, CO(R) 48 and CB 05022 grouped in the rating of 3 based on the alkali digestion value. The variety KDML 105 and Kitchili samba has high alkali digestion value and grouped under 6th and 7th category describes kernel completely dispersed. Varieties Mappillai samba, Kitchili samba, IR 20, CO(R) 51, CB 05022, KDML 105 have higher length of gel consistency (>60 mm) and they were classified as soft rice. Bhavani, White ponni, CO 43, CO(R) 48, Red kavuni andJeeraga samba have lesser gel consistency less than 60 mm and were classified as flaky rice.

Insect pests and natural enemies (Table 23e): The major insect pests observed in the experimental field were the green leaf hopper, brown plant hopper, yellow stem borer and leaf folder under organic management conditions. The rice variety Red Kavuni recorded lowest green leaf hopper population (2.40 hill^{-1}) which was on par with Bhavani, Mappillai samba, Kitchili samba, CO-43 and CB-05022. The higher green leaf hopper population 5.10 hill^{-1} was found in CO(R) 51. The variety Bhavani recorded the lowest brown plant hopper population (2.07 hill^{-1}) which was statistically on par with IR 20. The highest brown plant hopper incidence of 6.67 per hill was observed in KDML 105. The leaf folder damage was lower (2.54%) in Kitchili samba followed by KDML 105, IR 20 and Red kavuni 2.92, 2.97 and 3.18%, respectively. The higher leaf folder damage of 5.72% was observed in Mappillai samba. The symptoms at vegetative

Table 23e. Incidence of major insect pests and their natural enemies of rice varieties under organic farming at Coimbatore

Treatment	Pest incidence					Natural enemies (Nos. hill^{-1})		
	Green leaf hopper (No./ hill)	Brown plant hopper (No./hill)	Leaf folder (%)	Stem borer (%)		Spider	Rove Beetle	Lady Bird beetle
				Dead heart	White ear			
Bhavani	1.75 (2.57)	1.60 (2.07)	3.37	4.77	1.18	1.27 (1.10)	1.76 (2.60)	1.05 (0.60)
White Ponni	1.97 (3.40)	1.99 (3.47)	3.72	4.5	1.88	1.39 (1.43)	1.37 (1.37)	1.00 (0.50)
Mappillai samba	1.84 (2.90)	2.24 (4.53)	5.72	7.11	3.33	1.28 (1.13)	1.21 (0.97)	1.06 (0.63)
Kitchili samba	1.82 (2.80)	2.10 (3.90)	2.54	5.57	2.25	1.38 (1.40)	1.25 (1.07)	1.05 (0.60)
IR 20	1.98 (3.43)	1.68 (2.33)	2.97	3.61	1.04	1.15 (0.83)	1.41 (1.50)	1.11 (0.73)
CO 43	1.80 (2.73)	2.06 (3.73)	4.36	8.23	3.06	1.33 (1.27)	1.61 (2.10)	1.26 (1.10)
CO(R) 48	1.89 (3.07)	1.90 (3.10)	3.13	4.27	1.87	1.33 (1.27)	1.44 (1.57)	1.06 (0.63)
CO(R) 51	2.37 (5.10)	2.10 (3.90)	4.36	8.15	3.75	1.42 (1.53)	1.70 (2.40)	1.08 (0.67)
CB 05022	1.84 (2.90)	2.59 (6.23)	3.46	6.22	2.32	1.30 (1.20)	1.60 (2.07)	1.29 (1.17)
KDML 105	1.91 (3.13)	2.68 (6.67)	2.92	5.66	2.36	1.21 (0.97)	1.61 (2.10)	1.31 (1.23)
Red kavuni	1.69 (2.40)	2.22 (4.43)	3.18	3.3	1.25	1.34 (1.30)	1.39 (1.43)	1.18 (0.90)
Jeeraga samba	1.90 (3.10)	1.88 (3.03)	4.33	5.49	2.41	1.37 (1.37)	1.49 (1.73)	1.26 (1.10)
CD (P=0.05)	0.17	0.22	-	-	-	0.03	0.04	0.03

Figures in parenthesis are original values

stages caused by stem borers were lowest (3.30%) in Red Kavuni followed by IR 20 (3.61%) and White ponni (4.50%). The highest incidence was noticed in CO 43 (8.23%). The white ear symptoms observed during milking stage of the crops was lowest (1.25%) in Red kavuni, and higher in CO(R) 51 (3.75%).

The natural enemies commonly observed are spiders, rove beetles, and lady bird beetles. The rove beetles population per hill was more irrespective of varieties evaluated followed by spiders and mirid bugs. The number of spider population over the varieties ranges from 0.83 in IR-20 to 1.53 in CO(R) 51. The rove beetle population was highest (2.40) in CO(R) 51 and the lowest rove beetle numbers 0.97 was observed in Mappillai samba and was on par with Kitchilisamba. The lady bird numbers were more (1.23) in KDML-105 and less in White ponni (0.50).

Dharwad (Table 24a-f)

Five varieties of sorghum, chickpea and wheat were evaluated under organic and inorganic conditions during *kharif* and *rabi* season

Sorghum

Five varieties of sorghum, namely DSV 6, CSH 14, SVD 1101, SPV 2172 and SPV 2250 were evaluated. The effect of cultivars and organic and inorganic management were significant on plant height, 1000 grains weight and yield. The inorganic system produced significantly taller plants (158.3 cm), 1000 grain weight (19.4 g) grain yield (3429 kg/ha), stover yield (17500 kg/ha) and harvest index compared to organic management in main crop of sorghum during *kharif*. Though, the yield in ratoon crop was also higher but not differed significantly whereas main crop + ratoon crop of sorghum recorded significantly higher grain and stover yield 6402 and 25872 kg/ha respectively also under inorganic conditions.

Among the varieties, variety SPV 2250 attained the maximum plant height of 164 and 181 cm under both the conditions of organic and inorganic management respectively followed by SPV 2172 and DSV 6. Variety CSH 14 recorded significantly higher 1000 grains weight with organic management of 22.6 g while SVD 1101 recorded 209 g with inorganic. CSH 14 also produced higher grain yield during *kharif* (As a main crop) and during *rabi* as a ratoon crop (1627 kg/ha and 2806 kg/ha, respectively) while SVD 1101 produced lower grain and stover yield as a main crop or ratoon crop with organic management system. Under inorganic condition, variety SPV 2172 recoded maximum grain yield (4222 kg/ha) as main crop followed by DSV 6 (4065 kg/ha) while as ratoon crop CSH 14 also produced higher grain (4269 kg/ha).

Chickpea

The results revealed that inorganically grown chickpea varieties had higher plant height (54.3 cm), number of branches/plant (5.7), numbers of pod/plant (77.9), pod weight/plant (33.7), seed weight/plant (26.6 g), seed yield (5133 kg/ha) and straw yield (9895 kg/ha) except 1,000-grain weight and harvest index as compared with organically grown, and a non-significant difference was observed in management practices. Reduction in number of branches/plant, numbers of pod/plant, pod weight/plant, seed weight/plant, seed yield and straw yield were found to be 14, 9.7, 15.8, 11.3, 8.3 and 21.5% respectively under organic production.

Table 24a: Yield attributes of sorghum cultivars (main crop) during *kharif* as influenced by different production systems under rainfed farming situation at Dharwad

Sorghum cultivars	Plant height (cm)			1000 Grain weight (g)			Grain yield (kg/ha)			Stover yield (kg/ha)			Harvest Index		
	Organic	Inorganic	Mean	Organic	Inorganic	Mean	Organic	Inorganic	Mean	Organic	Inorganic	Mean	Organic	Inorganic	Mean
DSV 6	146.5	172.2	159.4	21.3	19.8	20.5	1043	4065	2554	15394	21500	18447	0.10	0.20	0.10
CSH 14	121.1	126.0	123.6	22.6	17.3	20.0	1627	3592	2610	14028	12492	13260	0.10	0.30	0.20
SVD 1101	87.6	110.4	99.0	20.5	20.9	20.7	290	2300	1295	6403	12707	9405	0.00	0.20	0.10
SPV 2172	146.8	201.7	174.2	14.7	19.3	17.0	790	4222	2506	14951	20802	17877	0.00	0.20	0.10
SPV 2250	164.0	181.0	172.5	14.8	19.6	17.2	478	2966	1722	13104	20213	16658	0.00	0.10	0.10
Mean	133.2	158.3	145.7	18.8	19.4	19.0	846	3429	2137	12700	17500	15100	0.10	0.20	0.10
CD (P=0.05)		CD			CD)			CD			CD			CD	
Production System (PS)		20.70			0.49			498			4.03			0.01	
Sorghum Cultivars (cv.)		19.80			1.37			708			3.78			0.04	
Cv at same PS		NS			1.94			NS			NS			NS	

* Organic farming, *Inorganic:Conventional farming with the use of farm yard manure and inorganic fertilizers

Table 24b: Grain yield, stover yield and harvest index of sorghum cultivars (main crop + ratoon crop) during kharif and rabi as influenced by different production systems under rainfed farming situation at Dharwad

Sorghum cultivars	Grain yield (kg/ha) (Ratoon crop during rabi)			Stover yield (kg/ha) (Ratoon crop during rabi)			Grain yield (kg/ha) (Main crop+ Ratoon crop)			Stover yield (kg/ha). (Main crop+ Ratoon crop)			Harvest Index (Main crop+ Ratoon crop)		
	Organic	Inorganic	Mean	Organic	Inorganic	Mean	Organic	Inorganic	Mean	Organic	Inorganic	Mean	Organic	Inorganic	Mean
DSV 6	2275	2302	2289	6420	5786	6103	3318	6367	4843	21814	27282	24548	0.15	0.23	0.19
CSH 14	2806	4269	3537	9188	11505	10346	4432	7861	6147	23217	23996	23607	0.19	0.33	0.26
SVD 1101	2018	2728	2373	7086	7516	7301	2309	5028	3668	9855	20223	15039	0.18	0.25	0.21
SPV 2172	2344	2627	2486	7673	8211	7942	3134	6849	4992	22623	29014	25819	0.14	0.24	0.19
SPV 2250	2747	2940	2843	8372	8630	8501	3225	5906	4566	21457	28843	25159	0.15	0.20	0.18
Mean	2438	2973	2706	7748	8329	8039	3284	6402	4843	19797	25872	22834	0.16	0.25	0.21
CD (P=0.05)		CD			CD			CD			CD			CD	
Production System (PS)		NS			NS			740			NS			0.075	
Sorghum Cultivars (cv.)		509			1.6			826			4404			0.044	
Cv at same PS		NS			NS			NS			NS			NS	

Table 24c. Growth and yield components of chickpea cultivars as influenced by different production systems under rainfed farming situation at Dharwad

Chickpea Cultivars	Plant height (cm)			Number of branches/ plant			Number of pods/ plant			Pod weight (g/plant)			Seed weight (g/plant)			1000 Seed weight (g)		
	Organic	Inorganic	Mean	Organic	Inorganic	Mean	Organic	Inorganic	Mean	Organic	Inorganic	Mean	Organic	Inorganic	Mean	Organic	Inorganic	Mean
A1	51.4	55.9	53.6	4.5	3.5	4.0	55.9	92.5	74.2	25.5	35.6	30.6	22.3	27.4	24.9	252	236	244
MABC 27	56.4	52.8	54.6	5.7	6.3	6.0	68.7	64.9	66.8	25.9	29.2	27.5	22.5	21.9	22.2	379	359	369
MABC 37	54.7	51.8	53.2	5.5	7.1	6.3	77.0	81.1	79.0	28.5	33.3	30.9	21.8	28.4	25.1	386	342	364
BGD 103	47.7	54.0	50.9	4.9	5.5	5.2	77.5	85.7	81.6	31.7	34.2	32.9	26.9	26.9	26.9	333	330	332
JAKI 9218	59.5	56.9	58.2	4.4	5.9	5.1	75.9	65.3	70.6	33.9	36.4	35.1	26.0	28.5	27.3	260	260	260
Mean	53.9	54.3	54.1	5.0	5.7	5.3	71.0	77.9	74.4	29.1	33.7	31.4	23.9	26.6	25.3	322	305	314
CD (P=0.05)		CD			CD			CD			CD			CD			CD	
Production system		NS			NS			NS			NS			2.878			NS	
Cultivars (cv.)		NS			1.24			NS			NS			2.434			NS	
Cv at same PS		NS			NS			16.92			5.009			3.441			NS	

Table 24d. Yield of chickpea varieties as influenced by different production systems under rainfed farming situation at Dharwad

Chickpea Cultivars	Seed yield (kg/ha)			Straw yield (kg/ha)			Harvest index		
	Organic	Inorganic	Mean	Organic	Inorganic	Mean	Organic	Inorganic	Mean
A1	4575	4585	4580	7224	9816	8520	0.39	0.32	0.35
MABC 27	4281	4756	4519	7618	7882	7750	0.36	0.38	0.37
MABC 37	4724	5582	5153	7993	10669	9331	0.37	0.35	0.36
BGD 103	4673	5289	4981	9160	10126	9643	0.34	0.38	0.36
JAKI 9218	5438	5454	5446	8730	10981	9856	0.39	0.33	0.36
Mean	4738	5133	4936	8145	9895	9020	0.37	0.35	0.36
Comparing the means of		(P=0.05)			(P=0.05)			(P=0.05)	
Production system (PS)		NS			NS			NS	
Cultivars (cv.)		531			NS			NS	
Cv at same PS		NS			NS			NS	

Table 24e. Growth and yield components of wheat cultivars as influenced by different production systems under rainfed farming situation at Dharwad

Wheat (Durum) Cultivars	Plant height (cm)			Number of ears/m row length			Length of ear			Grain weight/m row length (g)			1000- Grain weight (g)		
	Organic	Inorganic	Mean	Organic	Inorganic	Mean	Organic	Inorganic	Mean	Organic	Inorganic	Mean	Organic	Inorganic	Mean
BIJAGA YELLOW	87.7	90.0	88.7	82.5	64.2	73.3	5.5	6.2	5.8	87.8	85.5	86.6	45.9	43.6	44.7
UAS 446	59.5	58.0	58.7	83.3	90.5	86.9	4.4	4.0	4.2	89.6	97.0	93.3	38.7	43.0	40.8
DWR 2006	86.4	84.4	85.4	65.5	81.5	73.4	4.2	4.1	4.2	80.8	97.6	89.2	45.7	46.6	46.1
UAS 347	70.3	71.6	70.9	70.0	105.8	87.9	7.3	8.3	7.8	110.1	113.2	111.7	40.2	42.4	41.3
NIAW 1415	52.4	50.8	51.6	81.5	89.8	85.7	7.1	7.0	7.0	86.0	93.7	89.9	35.4	34.0	34.7
Mean	71.4	70.9	71.1	76.6	86.3	81.5	5.7	5.9	5.8	90.9	97.4	94.1	41.2	41.9	41.5
CD (P=0.05)		CD			CD			CD			CD)			CD	
Production system		NS			8.59			NS			NS			NS	
Cultivars (cv.)		3.9			8.08			0.61			NS			1.0	
Cv at same PS		NS			11.43			NS			NS			NS	

Table 24f. Yield of wheat cultivars as influenced by different production systems under rainfed farming situation at Dharwad

Wheat (Durum)	Grain yield (kg/ha)			Straw yield (kg/ha)			Harvest Index		
Cultivars	Organic	Conventional	Mean	Organic	Conventional	Mean	Organic	Conventional	Mean
BIJAGA YELLOW	3088	3356	3222	5811	5854	5833	0.35	0.37	0.36
UAS 446	3432	3148	3290	3843	4911	4377	0.61	0.46	0.53
DWR 2006	3395	3157	3276	5957	6531	6244	0.37	0.33	0.35
UAS 347	4378	4597	4488	5725	6312	6019	0.43	0.42	0.13
NIAW 1415	3532	3676	3604	3545	3357	3451	0.50	0.52	0.51
Mean	3565	3587	3576	4976	5393	5185	0.45	0.42	0.44
Comparing the means of		CD (P=0.05)			CD (P=0.05)			CD (P=0.05)	
Production system (PS)		NS			NS			NS	
Cultivars (cv.)		255			1316			0.113	
Cv at same PS		NS			NS			NS	

Among the cultivars, the plant height of chickpea varied from 47.7 cm (BGD 103) to 59.5 cm (JAKI 9218), Number of branches/plant ranged from 4.4-5.7, Number of pods/plant ranged from 55.9-77.5, 1000 Seed weight varied from 252 (g) in MABC 27 to 386 (g) in MABC 37. Similarly, the variation in grain yield is from 4281 kg in MABC 27 -5438 kg in JAKi 9218 ha^{-1}. Significantly higher seed yield (5438 kg) ha^{-1} was recorded in variety Jaki 9218, rest of varieties recorded statistically on par to each other under organic production systems.

Evaluation of response of different varieties of wheat for organic farming during *rabi* season

UAS 347 (Bread wheat) produced 25.53%, 36.41%, 37.00% and 39.29% higher seed yield over cultivars NIAW 1415 (Bread wheat) (3604 kg/ha), UAS 446 (Durum wheat) (3290 kg/ha), DWR 2006 (Durum wheat) (3276 kg/ha) and BIJAGA YELLOW (Durum wheat) (3222 kg/ha), respectively. Variety UAS 347 also gave significantly higher grain yield when it was grown under organic condition followed by NIAW 1415, UAS 446, DWR 2006 BIJAGA YELLOW and produced 24, 27.6, 29 and 41.8% higher grains.

Jabalpur (Table 25a-f)

Twelve varieties of rice and wheat were tested for their suitability under organic nutrient management

Rice: Significant difference among the varieties for tillers/m^{-2}, panicle length, grains/panicle, grain yield and straw yield were recorded with PS 3 (301.8, 23 cm, 139, 3090 and 4718 kg/ha respectively), recording better. Among the cultivars, number of effective tillers m^{-2} of rice varied from 180.8 (BVD-109) to 301.8 mm (PS-3), whereas the variation in length of panicle ranged from 14.3 (BVD-109) to 23 cm (PS-3). Similarly, the variation in grain yield was observed from 2063 kg/ha in BVD-109 to 3090 kg/ha in PS-3 being followed by JR-201, (2878 kg), Pusa basmati-1 (2874 kg) IR-36 (2592 kg) and PS 4 (2551 kg) ha^{-1}. The other verities MTU-1010 (2397 kg), Shehdri (2391 kg), Madhuri (2337 kg), IR-64 (2320 kg) and PS-5 (2310 kg) ha^{-1} were at par to each other.

Wheat: Spike length, grains/spike and test weight recorded significantly higher in HI-1500 (11.1 cm, 48 and 42.4 g respectively). Spike length in different varieties of wheat was found to be in the range of 8.1–11.1cm as shown in Table and test weight of wheat grains were in the range of 41.3–42.4. Significantly

Performance of Basmati rice (PS-5) under organic management at Jabalpur

Performance of Wheat (HI-1500) under organic management at Jabalpur

Table25a. Yield attributes and yield of rice varieties under organic management at Jabalpur

Rice varieties	Plant height (cm)	Effective tillers / m²	Panicle length (cm)	Grains/ panicle	Test weight (g)	Sterility (%)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest index
PS 5	72.2	224.0	17.6	114.0	25.5	17.1	2310	3489	39.8
Shehdri	73.1	212.5	15.9	114.6	25.3	18.1	2391	3913	37.8
PS 4	64.8	286.5	21.5	129.8	25.6	16.6	2551	4086	35.5
BVD 109	75.3	180.8	14.3	103.6	25.6	19.6	2063	3177	39.4
JR-201	75.3	281.2	21.9	138.2	25.7	15.5	2878	4506	39.0
Dhanteshwari	73.6	285.3	21.2	134.5	25.7	14.5	2852	4170	40.5
Madhuri	69.6	244.5	17.4	118.9	25.6	17.5	2337	3882	39.5
IR 36	63.3	222.3	15.9	132.8	25.4	18.5	2592	4190	38.4
MTU 1010	65.6	222.8	15.1	123.7	25.8	18.8	2397	3816	38.3
IR 64	74.3	204.0	15.9	119.9	25.9	18.5	2320	3531	39.3
Pusa 1	76.3	280.0	21.2	136.8	25.4	15.7	2874	4438	39.1
PS 3	78.0	301.8	23.0	139.0	25.8	12.3	3090	4718	39.6
CD (P=0.5 %)	2.0	32.0	1.2	7.5	NS	0.4	96	244	1.5

Table 25b. Yield attributes and yield of wheat varieties under organic farming at Jabalpur

Rice varieties	Plant height (cm)	Effective tillers / m²	Spike length (cm)	Grains/ spike	Test weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest index
JW 17	73.7	556.5	9.4	41.5	41.7	3922	6427	37.7
JW 3020	73.2	552.4	8.1	38.3	41.3	3493	5699	38.3
JW 3173	73.3	613.9	10.5	46.3	42.3	4473	6434	41.6
JW 3269	74.3	533.3	10.1	42.3	42.1	4167	6924	37.4
JW 3288	74.1	556.2	10.0	42.3	42.0	4105	6556	39.4
HI 1531	72.7	552.7	9.8	37.6	41.7	4105	6189	38.5
HI 1500	73.9	494.5	11.1	48.0	42.4	63.3	6434	42.7
C 306	72.3	555.6	9.2	40.6	41.6	3873	6089	39.7
HW 2004	73.1	558.8	10.2	42.7	42.1	4228	6311	40.2
HI 2987	73.5	413.9	10.4	45.3	42.3	4256	6434	40.0
HD 4672	74.1	580.3	9.6	42.1	41.7	4002	6821	36.9
HI 1418	73.0	456.0	11.0	47.3	42.4	4526	6403	41.9
CD (P=0.5 %)	2.1		1.9	2.6	0.4	148	213	12.2

highest wheat yield was recorded with the HI 1500 (4796 kg/ha) and found to be on par to HI 1418 (4733kg) and JW-3173 (4629 kg). These varieties are significantly superior over HW 2004 (4267 kg/ha), JW 3269 (4231 kg), JW 3288 (4200 kg) HD-4672 (4214 kg/ha), JW 17 (4152kg) C-306 (4056 kg), and JW 3020 (3830 kg/ha). Wheat variety HI 1531 recoded lowest yield.

Total productivity: The total productivity of rice-wheat cropping systems under organic management in term of rice equivalent yield (REY) is given in Table 28c. Rice-wheat cropping system with PS-3 and HI 1418 recorded significantly higher rice equivalent yield of 7668 kg/ha followed by cropping system Madhuri (rice) and HI-1500 (wheat) 7173 kg/ha; JR 201 and JW-3288 with the REY of 7129 kg/ha, respectively.

Production efficiency: Production efficiency in term of productivity per hectare per day with a particular varieties in the system was lowest (25.03 kg/ha/day) with the variety PS 5 and JW 17 of rice and wheat respectively followed by MTU 1010 and HW 2004 (25.63 kg/ha/day). Other varieties of rice and wheat in the systems were recorded in between 26.14 to 29.86 kg/ha/day and being at par to each other. The variety PS-3 (rice)-HI 1418 (wheat) recorded highest production efficiency of 32.35 and significant superior to all the varieties in the system of rice wheat.

Consumptive use of water: The varieties PS-5 and JW-17 of rice and wheat in system recorded highest consumptive use of water (258.2 cm/ha) and found significantly superior over to all other varieties in rice-wheat cropping system except, Madhumati-HI-1500, PS-4-JW-3173 with the production efficiency of 248.3 and 248.01 cm/ha, respectively.

Water productivity: Water productivity in term of water-use-efficiency (WUE) for the different varieties of rice-wheat cropping system was calculated. Significantly higher water productivity (32.33 kg/ha/cm) was recorded with the varieties Dhanteswari and HI 1531 closely followed by PS 3 and HI 1418 (31.94 kg/ha/cm) and JR 201 and JW 3288 (31.91 kg/ha/cm). Other varieties of rice and wheat in system mode recorded water productivity from 27.13 to 29.55 kg/ha/cm. The lowest water productivity recorded by the variety PS 5 and JW 17 (24.63 kg/ha/cm) in the system.

Table 25c. Rice equivalent yield, production efficiency, consumptive use of water and water productivity under different varieties of rice and wheat under organic management at Jabalpur

Rice (*Kharif*)	Wheat (*Rabi*)	Rice equivalent yield (kg/ha)	Production efficiency (kg/ha/day)	Consumptive use of water (cm/ha)	Water productivity (kg/ha/cm)
PS 5	JW 17	6358	25.03	258.2	24.63
Shehdri	JW 3020	6026	27.90	220.4	27.34
PS 4	JW 3173	7065	27.71	248.01	28.49
BVD 109	JW 3269	6355	28.62	223.62	28.41
JR – 201	JW 3288	7129	31.83	223.43	31.91
Dhanteshwari	HI 1531	7045	29.86	217.96	32.33
Madhuri	HI 1500	7173	27.17	248.3	28.89
IR 36	C 306	6589	26.25	242.87	27.13
MTU 1010	HW 2004	6689	25.63	235.74	28.37
IR 64	HI 2987	6638	26.14	224.64	29.55
Pusa 1	HD 4672	7072	28.75	241.04	29.34
PS 3	HI 1418	7668	32.35	240.08	31.94
CD (P=0.5 %)		122.5	5.03	-	3.79

Economic analysis: The maximum gross return of Rs. 191697/ha/year, net return of Rs. 136697/ha/year and B:C ratio of 2.49 were recorded with the variety PS-3 and HI-1418 followed by Madhuri and HI 1500 (GR 179329, NR 124329 and B:C ratio 2.26) in the system. The lowest gross return, net return and B:C ratio was recorded by the variety Shehdri and JW 3020 with Rs.150645, Rs. 95645 and 1.74 respectively.

Soil physical and chemical properties: The difference among the varieties in respect of physical and chemical properties found to be significant. Maximum organic carbon content (7.20%) in the soil was

Table 25d. Economics of various different varieties of rice and wheat in cropping systems under organic management at Jabalpur

Rice (*Kharif*)	Wheat (*Rabi*)	Gross return (Rs/ha/annum)	Cost of cultivation (Rs/ha)	Net return (Rs/ha/annum)	B:Cratio
PS 5	JW 17	158960	55000	103960	1.89
Shehdri	JW 3020	150645	55000	95645	1.74
PS 4	JW 3173	176623	55000	121623	2.21
BVD 109	JW 3269	158864	55000	103864	1.89
JR – 201	JW 3288	178224	55000	123224	2.24
Dhanteshwari	HI 1531	176137	55000	121137	2.20
Madhuri	HI 1500	179329	55000	124329	2.26
IR 36	C 306	164717	55000	109717	1.99
MTU 1010	HW 2004	167234	55000	112234	2.04
IR 64	HI 2987	165953	55000	110953	2.02
Pusa 1	HD 4672	176791	55000	121791	2.21
PS 3	HI 1418	191697	55000	136697	2.49

Table 25e. Effect of different varieties of rice and wheat on soil properties at the end of cropping cycle in Jabalpur

Rice (*Kharif*)	Wheat (*Rabi*)	pH	EC (dS/m)	OC (g/kg)	Available nutrients (kg/ha)		
					N	P	K
PS 5	JW 17	7.25	0.32	7.08	277	14.76	296
Shehdri	JW 3020	7.43	0.31	6.70	268	13.03	288
PS 4	JW 3173	7.31	0.32	7.08	274	14.19	295
BVD 109	JW 3269	7.33	0.35	6.94	273	13.70	293
JR – 201	JW 3288	7.17	0.34	7.20	279	14.34	301
Dhanteshwari	HI 1531	7.13	0.35	6.77	271	13.46	297
Madhuri	HI 1500	7.31	0.37	7.09	272	12.99	293
IR 36	C 306	7.29	0.35	7.01	271	13.44	295
MTU 1010	HW 2004	7.23	0.34	6.76	269	13.30	292
IR 64	HI 2987	7.24	0.33	6.99	278	14.00	299
Pusa 1	HD 4672	7.22	0.34	6.93	273	13.77	297
PS 3	HI 1418	7.17	0.36	6.73	269	13.70	291
CD (P=0.5 %)		0.06	0.04	0.24	5.60	0.58	5.76

found to be with rice (JR-201)-wheat (JW-3288) system and it was closely followed by varieties of rice and wheat of Madhuri-HI1500, PS5-JW-17and PS4-JW 3173 in the system. Maximum available N (279 kg/ha) was also found with rice (JR-201)-wheat (JW-3288) system and minimum was with rice (Shehdri)-wheat (JW-3020) system 268 kg/ha. Variety PS-5 of rice in *kharif* and JW-17 of wheat in *rabi* recorded higher available P (14.76 kg/ha) while minimum (12.99 kg/ha) was with Madhuri in *kharif* and HI-1500 in *rabi*. Maximum available K recorded with IR 64-HI 2987 (299 kg/ha) while minimum was in shehdri-JW-3020 of 288 kg/ha.

Microbial changes in soil: Among the varieties grown in *kharif* and *rabi* in system mode, significantly higher fungi (36.08x10^4/gcfu) and azatobacter (26.74x10^6/gcfu) was recorded in rice (JR-201)-wheat (JW-3288). Bacteria and PSB was found to be higher in rice (PS-5)-wheat (JW 17) (48.3 and 16.09x10^6/gcfu). System rice (MTU-1010)-wheat (HW-2004) retained significantly higher Actinomycets 20.45 10^6/g while lower was with rice (Shehdri)-wheat (JW 3020) system (14.15x10^6/gcfu).

Table 25f. Effect of microbial changes in soil under different varieties of rice and wheat at Jabalpur

Rice (*Kharif*)	Wheat (*Rabi*)	Fungi (10^4/gcfu)	Bacteria (10^6/gcfu)	AZB (10^6/gcfu)	PSB (10^6/gcfu)	ACT (10^4/gcfu)
PS 5	JW 17	35.19	48.30	26.34	16.09	15.12
Shehdri	JW 3020	34.54	45.59	24.68	15.37	14.15
PS 4	JW 3173	34.68	46.88	25.82	15.98	14.83
BVD 109	JW 3269	34.91	47.76	25.55	15.37	15.87
JR – 201	JW 3288	36.08	46.08	26.74	15.96	15.18
Dhanteshwari	HI 1531	35.17	45.52	25.56	15.59	14.65
Madhuri	HI 1500	35.65	47.10	25.53	14.86	14.65
IR 36	C 306	35.61	45.59	26.03	15.44	14.87
MTU 1010	HW 2004	34.55	45.61	25.33	14.54	20.45
IR 64	HI 2987	35.95	45.87	26.51	15.57	15.08
Pusa 1	HD 4672	35.48	45.60	26.05	15.50	14.81
PS 3	HI 1418	34.66	45.07	25.48	14.97	14.55
CD (P=0.5 %)		1.31	0.71	0.94	0.91	0.91

Karjat (Table 26a-c)

During *kharif* season 15 varieties of rice including 4 early, 4 mid late, 4 late and 3 varieties popularly grown by the farmers were evaluated and 15 varieties of groundnut during *rabi* season in the system mode under organic management.

Rice: Significantly higher plant height, number of tillers hill^{-1}, effective tillers hill^{-1}, panicle length, grain and straw yield was recorded by Sahyadri-4 (106.6 cm, 20.5, 19.1, 28.6, 4110 and 5650 kg/ha respectively) under early sown conditions. Sahyadri-4 outperformed better under mid-late sown condition with the yield of 3858 kg/ha. Variety sahyadri-5 (4857 and 5731 kg/ha) recorded maximum grain and straw yield among rice varieties. Lowest grain yield was recorded by Karjat-4 (2933 kg/ha).

Ground nut: Groundnut variety, RHRG-6083 attained maximum plant height (48 cm) followed by JL 220 (47.2 cm) and JL 776 (46.3 cm) whereas Phule Pragati was recorded the shortest variety (28.4 cm). Significantly higher dry pods yield (2414 kg/ha) recorded in Konkan Gaurav followed by TG 26 and RHRD 6083 which is statistically at par to each other. Variety JL 501 produced lower yield (1711 kg/ha). Haulm weight (3968 kg/ha) was recorded higher in RHRG 6083 over rest of the varieties.

System equivalent yield and economics: Cropping systemvariety Jaya (rice) grown during *kharif* and groundnut variety Konkan Gaurav grown in *rabi* recorded significantly higher system equivalent yield (REY 24449 kg/ha), net return (Rs. 1,79,841/ha) and net return per rupees invested (2.18) compared to other varieties evaluated in the system. Lowest system equivalent yield and net return was recorded in rice (Karjat-7)-groundnut (SBXI) of 18630 kg/ha and Rs. 1,00,698/ha respectively. The variation of systems

Table 26a. Evaluation of response of different varieties of rice on yield attributes and yields in rice-groundnut system under organic management at Karjat

Duration	Rice varieties / hybrids	Plant Height (cm)	No. of tillers hill^{-1}	Effective tillers hill^{-1}	Panicle Length (cm)	Grain Yield (kg ha^{-1})	Straw Yield (kg ha^{-1})
Early	Karjat – 4	78.5	16.6	14.9	20.8	2933	3461
	Karjat-7	99.3	19.3	17.4	21.7	3620	4154
	Ratnagiri-1	105.8	15.7	14.2	22.4	3925	4495
	Sahyadri-4	106.6	20.5	19.1	28.6	4110	5650
Mid-late	Karjat-5	115.2	15.8	14.6	26.6	3628	4281
	Karjat-6	100.0	16.2	14.8	19.9	3686	4350
	Palghar-1	89.9	14.5	12.8	26.8	3827	4398
	Sahyadri-3	120.2	22.5	21.1	28.1	3858	4489
Late	Ratnagiri-2	109.5	14.8	13.5	25.6	3675	4336
	Ratnagiri-3	105.0	16.0	14.8	23.4	4719	5568
	Karjat-8	115.5	18.8	17.1	22.9	4785	5647
	Sahyadri-5	104.5	23.07	21.9	27.6	4857	5731
Grown by	Karjat-3	100.0	18.9	17.1	23.8	4013	4481
farmers	Jaya	108.5	14.9	13.8	20.8	4081	4816
	Karjat-2	103.8	16.2	14.8	21.2	3684	4347
	CD(p=0.05)	3.7	1.47	1.39	1.28	270	319

Table 26b. Evaluation of response of different varieties of groundnut on yield attributes and yields in rice-groundnut system under organic management at Karjat

Groundnut varieties/hybrids	Plant Height(cm)	Yield dry pods (kg/ ha)	Haulm weight (kg/ ha)
Phule-6021	39.8	1932	3232
SB XI	37.1	1727	2757
Western-44	38.8	1733	2779
Western-66	43.2	1780	3038
TAG-24	31.4	1934	3224
TKG-Bold	41.8	2279	3780
Kopergaon-1	37.2	1923	3222
PhulePragati (JL-24)	28.4	2235	3290
JL-220	47.2	1962	3739
JL-776	46.3	2291	3813
JL-501	35.8	1711	2873
TG-37 A	44.5	2015	3345
TG-26	35.9	2352	3926
KonkanGaurav	35.8	2414	3888
RHRG-6083	48.0	2330	3968
CD(*p=0.05*)	2.17	81	110

equivalent yield in other varieties of rice and groundnut in systems ranged from 18637-24233 kg/ha similarly, the variation in net return (Rs./ha) was observed from Rs. 1,00,806 to 1,76,908/ha.

Table 26c. Response of different varieties of rice and groundnut in rice-groundnut system on system equivalent yield and economics under organic management at Karjat

Rice	Groundnut	System equivalent yield (kg ha^{-1})	Gross returns (Rs. ha^{-1})	Net returns (Rs. ha^{-1})	B:C ratio
Karjat - 4	Phule-6021	19208	261224	108563	1.71
Karjat-7	SB XI	18630	253359	100698	1.66
Ratnagiri-1	Western-44	18986	258210	105549	1.69
Sahyadri-4	Western-66	20743	282109	129448	1.85
Karjat-5	TAG-24	20986	285414	132753	1.87
Karjat-6	TKG-Bold	22906	311336	158675	2.04
Palghar-1	Kopergaon-1	20274	275726	123065	1.81
Sahyadri-3	PhulePragati (JL-24)	24233	329569	176908	2.16
Ratnagiri-2	JL-220	20702	281547	128886	1.84
Ratnagiri-3	JL-776	23193	315420	162759	2.07
Karjat-8	JL-501	18637	253468	100806	1.66
Sahyadri-5	TG-37 A	22736	309201	156540	2.03
Karjat-3	TG-26	23853	324392	171731	2.12
Jaya	KonkanGaurav	24449	332502	179841	2.18
Karjat-2	RHRG-6083	23398	318213	165552	2.08
CD (p=0.05)		782	10607	10607	0.07

Ludhiana (Table 27a-b)

Ten varieties of rice and twelve of wheat were studied for rice-wheat system for suitability under organic management. All the varieties of rice and wheat were grown under similar nutrient source and doses.

Basmati rice: Basmati rice variety BR-9 attained higher plant height (142.9 cm) and it was statistically at par with Panjab basmati-2 but significantly higher than the other varieties. Pusa basmati-1121 recorded plant height of 128.7 cm and it was on par with Pusa-1612, CR-2007, Ent-6001, Ent-6002 and Pusa basmati -3. Lowest plant height was recorded by Pusa-1592 (106.9 cm).Significantly higher number of effective tillers (321) was observed in Ent-6001 and the lowest number of effective tillers recorded in Pusa basmati-1509. The variation in panicle length is ranging from 23.4 cm to 27.5cm and found to be non-significant among the rice varieties. The highest number of grains/panicle (85.7) recorded with variety Pusa basmati-1592 and it was significantly higher than all other varieties except UPR-3560 (85.5). The lowest number of grains/panicle was in Ent-6001 (65.8) and it was statistically on par with Pusa basmati-2, Pusa basmati-1509, Pusa basmati-1121, Ent-6002 and Puanjab basmati-3. The thousand grains weight was observed in the range from 25.9g (Pusa basmati-2) to 31.5g (Pusa basmati-1509) for rice.Grain yield of basmati rice varied from 3587-5586 kg/ha with a maximum variation of 55.7%. Basmati rice variety Pusa 1592 outperformed significantly higher grain yield of 5586 kg/ha followed by Pusa basmati-1121 (4886 kg/ha) while, Pusa Basmati-2 recorded lowest grain yield (3587 kg/ha). Straw yield did not differ significantly among all the varieties.

Wheat: Among the varieties, maximum height was found to be for C-306 and minimum in PBW-658. The highest number of effective tillers (360) was observed in PBW 175 than the other varieties except PBW-621, BWL-0134 and BWL-720 which were statistically at par. The lowest number of effective tillers was in

Table 27a. Performance of basmati rice varieties/hybrids under organic management in rice-wheat system at Ludhiana

Rice varieties/ hybrids	Plant height (cm)	Effective tillers / m²	Panicle length (cm)	Grains/ panicle	1000 grain weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest index
Punjab Basmati 2	141.3	282	27.5	66.5	25.9	3587	6084	37.1
Pusa Basmati 1509	110.7	255	24.4	67.7	31.5	3759	5808	39.3
Pusa Basmati 1121	128.7	301	26.6	64.3	28.1	4886	6828	41.7
Pusa 1592	106.9	286	25.6	85.7	28.8	5586	7542	42.6
Pusa 1612	123.6	262	25.2	71.4	30.8	4492	6901	39.4
CR 2007	127.7	273	25.8	71.3	30.1	4595	5680	44.7
Ent 6001	127.0	321	25.6	60.4	26.7	4258	6200	40.7
Ent 6002	124.6	297	23.4	65.8	26.8	4262	4851	46.8
UPR 3560	142.9	273	28.7	85.5	26.0	4796	5722	45.6
Punjab Basmati 3	125.9	284	24.2	68.9	26.6	3878	6032	39.1
CD (P=0.05)	6.3	21	NS	9.3	2.3	730	NS	

Table 27b. Performance of wheat varieties/hybrids under organic management in rice-wheat system at Ludhiana

Wheat varieties/ hybrids	Plant height (cm)	Effective tillers / m²	Spike length (cm)	Grains/ spike	1000 grain weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest index
PBW 702	89.5	307	8.4	28.4	43.2	3211	4317	42.7
PBW 706	91.4	280	8.5	32.6	45.1	3611	4510	44.5
PBW 621	88.3	236	8.2	35.1	41.7	4028	4173	49.1
PBW 644	94.9	298	8.4	35.6	45.7	4167	4573	47.7
PBW 175	99.7	360	8.2	22.3	45.4	3222	4543	41.5
BWL-4440	88.8	301	7.5	30.9	40.7	3556	4073	46.6
BWL -0134	96.2	343	8.5	31.1	45.2	4278	4517	48.6
BWL-1940	84.1	278	8.9	35.7	43.1	3833	4310	47.1
PBW658	80.4	264	9.4	35.3	43.8	3861	4383	46.8
BWL- 720	99.8	246	7.7	37.3	38.2	4222	3820	52.5
C-306	117.8	299	6.9	28.4	36.0	2722	3603	43.0
PBW 660	90.7	298	7.2	33.3	38.6	3528	3857	47.8
CD (P=0.05)	7.5	37.0	1.0	4.3	NS	740	470	

PBW-658. Spike length recorded significantly higher (9.4 cm) in PBW 658 than other varieties followed by BWL 1940 (809 cm), PBW 706 (8.5 cm) BWL-0134 (8.5 cm) PBW-702 (8.4 cm) and PBW-644 (8.4 cm) these were statistically on par. Variation in thousand-grain weight per spike was recorded in range from 36.0 (g) in C-306 to 45.7 g in PBW-644 and did not differ significantly. Significant higher grain yield of wheat (4278 kg/ha) was observed in BWL -0134 and it was significantly higher than the other varieties of wheat except BWL-720, PBW-644, BWL-1940, PBW-621, PBW-658, BWL-1940, PBW-706 and BWL-4440 which were statistically at par among themselves. The lowest grain yield was recorded with C-306 (2722 kg/ha). Highest straw yield recorded in PBW 644 (4573 kg/ha) whereas harvest index was found to be higher in BWL-72, while lower straw yield was produced by C-306 (3603 kg/ha) however, PBW-175 recoded 41.5 harvest index as lowest.

Modipuram (Table 28a-d)

Twelve promising varieties of maize and mustard in maize-mustard system were evaluated under similar nutrient source and doses.

Maize: Significant variation among the varieties for all the traits was observed, except cobs girth and grains row/cob. The variety seed tech-2324 recorded the highest plant height (222 cm) and it was statistically at par with HQPM-1 (218 cm). Shorter plant wereobserved HQPM-5 (153 cm) however, dry matter plant^{-1} was recorded maximum in PMH-4 (180g) followed by PMH-1 and HQPM-1(160g). Number of cobs per plants was recorded significantly higher with PMH-3 (1.67) followed by PMH-1, PMH-5, HQPM-1and Bio-9637 but these were on par to each other. Maximum cob length was observed in Seed tech-2324 (23.8 cm) followed by PMH-1 and Bio-9681. Among the varieties, maximum 1000-grains weight was recorded in Seed tech-2324 followed by PMH-4. Higher grain and stover yield was found to be in PMH-3 (6330 and 9340 kg/ha respectively) followed by seed tech-2324 (5830 kg/ha). Gross return, net returns

Table 28a. Growth parameter, yield attributes, yield and harvest index of maize cultivars in maize –mustard systems under organic management at Modipuram

Maize varieties/ hybrids	Plant height (cm)	Dry matter/ plant (g)	Cobs/ plant	Cob length (cm)	Cob girth (cm)	Grain rows/ cob	Grains/ row	1000 grain wt. (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest Index
Prakash	197	110	1.20	19.6	14.0	12.8	39.4	236	5500	8370	0.40
Seed tech- 2324	222	144	1.40	23.8	15.6	12.8	36.8	339	5830	8630	0.40
PMH-1	203	160	1.60	19.8	15.2	13.7	36.0	267	5330	8270	0.40
PMH-3	199	100	1.67	20.6	14.6	14.8	40.8	250	6330	9340	0.42
PMH-4	188	180	1.40	19.6	14.8	13.2	38.2	301	5670	8690	0.42
PMH-5	190	152	1.60	16.8	13.6	14.4	31.4	261	5510	8090	0.39
HQPM-5	153	128	1.40	19.8	14.4	13.2	32.4	272	5170	7950	0.39
HQPM-1	218	160	1.60	20.6	16.0	14.4	38.8	246	4510	6550	0.39
Bio- 9681	192	120	1.60	19.8	15.0	14.8	35.2	266	4670	6550	0.41
Bio- 9637	210	140	1.20	20.0	15.8	13.6	35.0	296	5500	8440	0.42
Vivek hybrid- 9	166	94	1.20	20.4	15.4	14.8	37.4	239	4170	6040	0.39
Vivek QPM- 9	171	80	1.27	17.0	14.9	13.6	31.6	242	3830	5350	0.40
CD (p=0.05)	13.6	13.8	0.19	3.4	NS	NS	3.8	6.1	451	739	

Table 28b. Economics of different of maize cultivars under organic management at Modipuram

Maize varieties/ hybrids	Gross return (Rs/ha/annum)	Cost of cultivation (Rs/ha/annum)	Net returns (Rs/ha/annum)	B:C ratio
Prakash	90090	41425	48665	1.17
Seed tech- 2324	95495	41425	54070	1.31
PMH -1	87305	41425	45880	1.11
PMH -3	103685	41425	62260	1.50
PMH -4	92875	41425	51450	1.24
PMH -5	90254	41425	48829	1.18
HQPM-5	84685	41425	43260	1.04
HQPM-1	73874	41425	32449	0.78
Bio- 9681	76495	41425	35070	0.85
Bio- 9637	90090	41425	48665	1.17
Vivek hybrid- 9	68305	41425	26880	0.65
Vivek QPM- 9	62735	41425	21310	0.51

and net return per rupee invested was recorded higher with PMH-3 followed by (Rs. 1,03,685, Rs.62,260 ha^{-1} and 1.50 gross, net returns and B:C ratio respectively) seed tech-2324 and PMH-4.

Mustard: The differences for all measured variable among the varieties was observed to be significant for mustard crop except primary branches $plant^{-1}$. Among the varieties maximum plant height was recorded with RGN-48 (171 cm) but statistically at par with RH- 0406, RGN- 229 and Urvashi and minimum was with Pusa Mustard-25 (NPJ-112). The numberof secondary branches was higher with Pusa Mustard-25. Number of siliqua/plant was found to be significantly higher with Pusa bold (299) while, grains/siliqua was found to be higher in DRMRIJ- 31 (17.4) followed by pusa bold, RH-0406 which was statistically at par. Among the mustard varieties, significantly higher grain yield was recorded with RGN-229 (1970 kg/ha) and it was statistically at par with RH- 0406, urvashi, NRCHB-506, Pusa Bold and RGN-48 (1950, 1910, 1910, 1870 and 1830 kg/ha respectively). Variety DRMRIJ 31 gave minimum yield of 1530 kg/ha. The yield

Table28c. Growth parameter, yield attributes, yield and harvest index of mustard cultivars in maize –mustard systems under organic management at Modipuram

Mustard varieties/ hybrids	Plant height (cm)	Dry matter/ plant (g)	Primary Branches/ plant	Secondary Branches/ plant	No. of siliqua/ plant	Grains/ siliqua	1000 grain wt. (g)	Seed yield (kg/ha)	Stover yield (kg/ha)	Harvest Index
DRMRIJ- 31	146	57.2	3.8	10.5	181	17.4	6.9	1530	6550	18.9
NRCDR- 02	143	54.9	3.4	15.0	245	13.6	5.9	1750	6000	22.6
NRCHB- 101	144	51.5	4.1	14.0	283	13.0	5.3	1650	5540	22.9
NRCHB- 506	153	62.9	4.8	18.4	270	14.0	5.1	1910	7170	21.0
Pusa Mustard-25 (NPJ-112)	133	51.1	5.8	21.4	227	15.4	4.2	1650	5460	23.2
Pusa Mustard-26 (NPJ-113)	143	51.5	5.8	16.8	236	15.2	4.8	1670	5520	23.2
PusaTarak	144	52.9	4.2	20.8	228	12.4	5.8	1570	5850	21.2
RH- 0406	167	60.9	4.8	14.8	212	17.0	5.6	1950	6800	22.3
RGN- 229	164	64.4	4.8	20.6	273	15.2	5.2	1970	7370	21.1
RGN- 48	171	60.4	5.0	18.2	232	14.8	6.0	1830	6840	21.1
Urvashi	162	63.9	4.6	17.2	253	14.8	5.5	1910	7340	20.6
Pusa Bold	157	66.4	5.6	18.2	299	17.2	6.4	1870	7800	19.3
CD (p=0.05)	9.24	4.19	NS	2.92	31.5	2.27	0.35	203	540	

Table 28d. Economics of different of mustard cultivars under organic management at Modipuram

Mustard varieties/hybrids	Gross return (Rs/ha)	Cost of cultivation(Rs/ha)	Net returns (Rs/ha)	B:C ratio
DRMRIJ- 31	59288	34870	24418	0.41
NRCDR- 02	67813	34870	32943	0.49
NRCHB- 101	63938	34870	29068	0.45
NRCHB- 506	74013	34870	39143	0.53
Pusa Mustard-25 (NPJ-112)	63938	34870	29068	0.45
Pusa Mustard-26 (NPJ-113)	64713	34870	29843	0.46
PusaTarak	60838	34870	25968	0.43
RH- 0406	75563	34870	40693	0.54
RGN- 229	76338	34870	41468	0.54
RGN- 48	70913	34870	36043	0.51
Urvashi	74013	34870	39143	0.53
Pusa Bold	72463	34870	37593	0.52

of RGN-229 was found to be 29% higher than variety DRMRIJ 31. Maximum gross, net return and net return per rupee invested was recorded with RGN-229 (Rs. 76,338, 41,468/ha and 0.54) followed by RH-0406. Varieties Urvashi, NRCHB-506, Pusa Bold and RGN- 48 also gave good returns and net return per rupee invested than the rest of other varieties.

Pantnagar (Tables 29a-b)

Seven coarse grain varieties of rice and seven fine grain basmati rice varieties during *kharif* and fourteen varieties of wheat in *rabi* were evaluated with similar organic nutrient inputs and doses.

Growth, yield attribute and yield of rice: Plant height at harvest and grain weight per panicle (g) of rice showed significant variation among different rice varieties. Plant height of different coarse grain rice varieties ranged from 93 to 118 cm and that of fine grain rice varieties ranged from 93 to 127 cm. Tallest varieties reported among coarse grain & fine grain rice varieties were PD-18 &Taraori, respectively. Effective tillers of rice did not differ significantly. Among coarse grain varieties, highest number of effective tillers/m^2 was 289 in Pusa-44 whereas among fine grain rice varieties, highest number of effective tillers/m^2 was 262 in Pant Basmati-1. Significantly higher grain weight/panicle among coarse grain rice varieties were observed in UPR-3425-11-1-1 (3.29g) being at par with NDR-359 (2.61).

1000-grain weight, grain yield, straw yield & harvest index showed significant variation among different rice varieties. 1000-grain weight of different coarse grain rice varieties ranged from 25.4 to 30.9g and that of fine grain rice varieties ranged from 21.2 to 22.5 g. Significantly higher test weight of coarse grain rice varieties was found in PD-4 (30.9g) which was at par with NDR-359 (28.5 g). However, 1000-grain weight of fine grain weight of fine grain rice varieties were at par with each other, maximum being observed in UPR-3506-7-1 (22.5g). Grain yield of coarse grain rice varieties ranged from 5149 to 6098 kg/ha and that of fine grain rice varieties ranged from 2556 to 4425 kg/ha. Among coarse grain rice varieties, significantly higher grain yield was observed in NDR-359 (6098 kg/ha) which was found to be at par with all other varieties except PD-4. Significantly higher grain yield among fine grain rice varieties was observed in Pant Basmati-1 (4425kg/ha) which was at par with all other fine grain rice varieties except Taraori & Type-3. Straw yield of coarse grain rice ranged from 5484 to 6257 kg/ha, significantly higher being recorded in

Performance of rice (var. NDR-359) at Pantnagar under organic management

Performance of wheat (var. HD-2967) at Pantnagar under organic management

Table 29a. Response for yield attributes, yield, harvest index and N, P, K & S uptake of rice varieties/hybrids in rice-wheat system under organic management at Pantnagar

Rice varieties/ hybrids	Plant height (cm)	Effective tillers/ m^2	Grain weight / panicle (g)	1000 grain weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest Index	Total N uptake (kg/ha)	Total P uptake (kg/ha)	Total K uptake (kg/ha)	Total S uptake (kg/ha)
Coarse grain											
Pant dhan-4	95	262	2.22	30.9	5148	5484	0.48	87.1	15.6	184.8	15.2
IR-64/36	108	275	2.14	25.6	5300	5889	0.47	87.5	13.4	209.6	15.7
Pusa-44	93	289	2.24	27.4	5986	5890	0.50	100.2	17.1	220.3	19.1
Pant dhan-18	118	272	2.31	25.4	5811	5700	0.50	97.4	22.0	236.3	31.5
Pant dhan-19	102	264	2.42	27.2	5706	5481	0.51	100.8	23.2	219.4	27.4
NDR-359	95	254	2.61	28.5	6098	6257	0.49	101.4	24.9	212.3	26.0
UPR-3425-11-1-	98	255	3.29	28.0	5433	5706	0.49	94.8	22.6	212.9	20.6
Basmati type											
Taraori	127	242	1.34	21.2	2556	5193	0.33	45.1	13.0	170.1	11.7
Pusa-1509	93	248	1.58	21.7	3361	4697	0.42	59.6	17.4	160.4	10.3
Pusa Basmati-1	105	256	1.52	22.1	3692	4886	0.43	69.7	17.0	155.9	10.5
Pusa-1121	108	252	1.75	22.3	4328	5007	0.46	74.7	22.1	192.1	11.4
Pant DRR Basmati-1	110	262	1.86	22.4	4425	4851	0.48	79.4	19.2	177.3	11.6
UPR-3488621	95	247	1.83	22.2	3925	4885	0.45	60.2	17.4	162.7	10.2
UPR-3506-7-1-1	120	245	1.91	22.5	3868	4813	0.44	62.9	17.6	174.9	11.2
CD (*P=0.05*)	9.4	NS	0.77	2.75	821	437	0.01	25.1	8.72	26.7	14.3

Table 29b. Response for yield attributes, yield, harvest index and N, P, K & S uptake of wheat varieties/hybrids in rice-wheat system under organic management at Pantnagar

Wheat varieties/ hybrids	Plant height (cm)	Spikes m^2	No. of grains/ spike (g)	Grain wt./ spike (g)	1000-grain wt. (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest Index	N uptake (kg/ha)	P uptake (kg/ha)	K uptake (kg/ha)	S uptake (kg/ha)
WH-1105	98	285	59.4	2.39	42.8	3994	5474	42.2	88.6	23.8	90.6	14.2
PBW-550	95	279	52.6	2.21	45.7	4026	5546	42.1	84.1	19.0	85.6	11.9
UP-2628	93	274	51.1	1.97	42.8	3755	5518	40.4	82.9	23.5	98.1	12.6
UP-1109	106	315	54.7	2.02	43.6	4427	5370	45.2	83.0	24.8	103.3	15.3
UP-2425	96	336	58.9	2.07	51.6	3623	5530	39.6	80.7	24.0	79.6	15.4
UP-2843	100	361	57.3	2.05	47.3	4053	4749	46.0	76.4	22.3	76.3	10.8
UP-2841	105	288	51.6	2.08	40.5	4050	5705	41.6	89.6	23.1	87.8	16.6
UP-2572	98	309	54.6	2.21	48.0	4072	5328	43.3	90.0	23.1	86.7	12.4
DPW-62150	99	259	49.5	2.11	46.5	3820	5810	39.7	88.8	22.3	100.9	11.7
UP-2565	104	268	47.1	2.27	46.5	4108	5691	41.9	85.6	25.2	77.9	13.1
HD-2967	112	285	55.2	2.20	43.8	3802	5396	41.4	71.6	23.5	80.1	12.8
UP-2684	105	350	55.9	2.05	42.8	4037	5624	41.8	90.5	27.2	94.6	12.4
DBW-17	109	316	51.4	2.18	40.7	3737	5495	40.5	80.5	24.0	83.0	12.4
UP-2784	106	316	54.4	2.15	42.6	3964	5431	42.3	88.9	25.8	96.0	12.8
CD (*P=0.05*)	4.5	43.5	6.5	NS	2.01	356.0	NS	3.59	NS	NS	NS	NS

NDR-359 being at par with IR-64 & Pusa-44 while that of fine grain rice varieties ranged from 4697 to 5193 kg/ha and significantly higher being recorded in Taraori & at par with all other varieties except Type-3. Among fine grain rice varieties, harvest index was significantly higher in Pant Basmati-1 (47.7) and was at par with all other varieties except Taraori, Type-3 and Pusa basmati-1.

Nutrient Uptake in Paddy: Significant differences in N, P, K and S uptake were observed among different rice varieties. Nitrogen uptake in coarse grain rice varieties was found to be higher in NDR-359 (101.4 kg/ha) but at par with all other coarse grain rice varieties while, N uptake by fine grain rice varieties was significantly higher in Pant Basmati-1 (79.4 kg/ha) and at par with all other rice varieties except Taraori. P uptake by coarse grain rice varieties was found significantly higher in NDR-359 (24.9 kg/ha) and at par with all other variety expected IR-64 on the other hand, phosphores uptake by fine grain rice variety was significantly higher in PUSA 1121 (22.1 kg/ha) and at par with all other rice variety except Taraori. Potassium uptake by coarse grain rice varieties was found significantly higher in Pusa-44 (134 kg/ha) and *at par* with all other rice varieties, while K uptake by fine grain rice varieties was found to be significantly higher in Pusa-1121 (117 kg/ha) but *at par* with Pant Basmati-1 and Taraori. Sulphur uptake by coarse grain rice varieties was found to be significantly higher in PD-18 (31.5 kg/ha) which was *at par* with all other varieties except PD-4 and IR-64, while S-uptake by fine grain rice varieties was found higher in Taraori and *at par* with all other fine grain rice varieties.

Yield attributes and yield of wheat: Plant height at harvest, spikes/m^2, number or grains/spike showed significant variation among different wheat varieties, however, grain weight./spike of wheat varieties was fond non-significant. Plant height at harvest of different wheat varieties ranged from 93 to 112 cm, tallest variety reported was HD-2967, (112cm), followed by DPW-17 (109 cm).

Significant differences in spikes/m^2 of wheat varieties were observed and it ranged from 259 to 361. Significantly higher spikes/m^2 of wheat was found in UP- 2843 (361) which was found to be *at par* with UP-2684 (350), DPW-17 in UP – 2843 (316) varieties. Likewise spikes/m^2, no of grains/spike ranged between 47.1 to 59.4 among different wheat varieties and significantly higher no of grains/spike were observed in WH-1105 (59.4) being at par with UP-2425(58.9),UP- 2843(57.3), UP-2572 (54.6), HD-2967 (55.2), UP-2684 (55.9) and UP- 2784 (54.4). Grain weight per spike of wheat was found non-significant among different wheat varieties and ranged from 1.97 to 2.39 (g), maximum grain wt./spike (2.39 g) being observed under WH-1109 wheat variety. Grain yield of different wheat varieties ranged from 3623 to 4427 Kg/ha. Significantly higher grain yield being recorded in UP-1109 (4427 kg/ha) and was at par with UP- 2565 (4108 kg/ha) compared to other wheat varieties. Non- significant differences in straw yield among different wheat varieties were observed and straw yield ranged from 4749 to 5810 kg/ha, higher straw yield being observed in DPW-62150 (5810 kg/ha). Harvest index was significantly higher in UP-2843 and was at par with UP-1109 and UP-2572.

Total nutrient uptake: Non-significant differences in N,P,K and S uptake were observed among different wheat varieties. Higher uptake, of Nitrogen and Phosphorus was observed in UP-2684 (90.5 and 27.2 kg/ha, respectively). Potassium uptake was found to be higher in UP- 1109 (103.3 kg/ha), however higher sulphur uptake was observed in UP-2841 (16.6 kg/ha).

Raipur (Table 30a -b)

Fifteen traditional/improved scented rice varieties and 15 popular chilli varieties in the region were assessed for their response under organic management in rice-chilli cropping system

Highest plant height and no. of tillers hill^{-1} were observed in traditional short grain scented rice variety Jeeraphool (185.45 cm and 21.89 respectively), whereas the maximum no. of filled grain penicle^{-1} was obtained in variety Jayagundi (259) which was significantly superior over rest of the rice varieties, however variety, Jeraphool was next in order and produced 211 filled grain panicle^{-1}.

Other yield attributing characters like panicle length was higher in Shamjeera (31.5 cm) which was comparable with Badsahbhog and Jayagundi (31.0 and 30.85 cm respectively) whereas, the lowest length of panicle was recorded in Dubraj (22.45 cm). As regards to test weight of the scented rice varieties, the highest test weight was achieved by Kubarimohar (20.28 g) while the lowest test weight in Shyamjeera (12.98 g). Grain characters like grain length and grain width, significantly higher grain length was recorded in Sugandhmati (9.80 mm), while grain width was higher in Dujai (2.60 mm). The highest grain yield of scented rice was recorded in Jayagundi (4256 kg/ha) which was significantly superior over rest of the varieties except Gopalbhog, Jeeraphool, Tulsimanjari and CR Sugandha Dhan-907 which produced 3678, 3972, 3683, and 3661 kg/ha respectively. The lowest grain yield of scented rice was observed in Lalu 14 (1522 kg/ha). However, the harvest index was higher in CR Sugandha Dhan-907 (0.38) while the lowest harvest index was obtained in Dubraj (0.19).

Table 30a. Response of different traditional and improved scented varieties of rice under organic production system at Raipur

Variety	Plant height at harvest (cm)	Tillers hill^{-1} at harvest (g)	No. of filled grains/ panicle	Panicle length (cm)	Test weight	Grain length (mm)	Grain width (mm)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest Index
Badshahbhog	167.8	12.8	190.0	31.0	14.5	7.1	2.2	3517	10067	0.25
Gopalbhog	145.2	16.0	161.0	29.2	18.2	8.2	2.4	3678	13911	0.21
Vishnubhog	119.2	21.9	185.0	27.0	14.5	6.4	2.4	3561	13994	0.20
Bisni	160.3	12.6	158.0	24.6	14.2	6.3	2.4	3111	8778	0.26
Shyamajeera	171.2	19.2	140.0	31.5	13.0	5.7	2.2	3289	11156	0.23
Jeeraphool	185.5	21.9	211.0	28.1	16.5	6.1	2.1	3972	13761	0.23
KubriMohar	146.8	14.3	168.0	28.8	20.3	7.3	2.3	2472	9861	0.20
TulsiManjari	143.7	14.9	148.0	28.6	13.1	7.8	2.2	3683	9428	0.28
Jaygundi	179.1	16.0	259.0	30.9	16.1	6.2	2.4	4256	7300	0.37
Gagabaru	184.1	20.0	151.0	28.5	14.9	5.4	2.3	2628	10150	0.21
Sugandhmati	143.2	20.2	165.0	26.9	19.5	9.8	2.2	3183	7261	0.31
Lalu 14	128.1	17.0	158.0	24.1	20.0	7.6	2.3	1522	5356	0.22
Dujai	152.3	12.0	154.0	23.9	18.2	8.5	2.6	3511	12489	0.22
Dubraj	144.4	15.0	129.0	22.5	19.7	8.4	2.3	2539	10683	0.19
CR Sugandha Dhan 907	110.2	14.0	159.0	26.1	19.8	8.5	2.3	3661	6061	0.38
CD (*P=0.05*)	16.2	1.8	14.6	1.1	0.7	0.2	0.1	639	2773	0.05

Chilli: Since majority of traditional scented rice cultivars are long duration up to 145 days, the transplanting of chilli was done during second fortnight of December and due to late transplanting in winter the growth and yield of chilli was not up to the mark hence the yield of chilli is not reported.

Soil nutrient status: After harvest of the rice crop highest soil organic carbon was observed in variety Gopalbhog (0.81 %) and lowest was observed in the variety CR Sugandha Dhan-907 (0.66 %). Available Nitrogen, phosphorus and potassium also exhibited significant variation. Higher available soil nitrogen was observed in the variety Gagabaru 298.23 kg/ha and lowest was in Gopalbhog (249.88 kg/ha). However, available phosphorus was recorded in the variety Tulsi Manjari 15.90 kg/ha and lowest was with variety Gagabaru 13.21 kg/ha. In case of available soil potassium the highest value was observed in the variety Lalu 14 (465.60 kg/ha).

Table 30b: Nutrient status after end of cropping cycle of rice-chilli system under organic production system at Raipur

Variety	Organic Carbon (%)	Available N (Kg/ha)	Available P (Kg/ha)	Available K (Kg/ha)
Badshahbhog	0.72	256.12	15.30	309.34
Gopalbhog	0.81	249.88	15.50	364.67
Vishnubhog	0.77	290.12	15.39	368.90
Bisni	0.74	278.14	14.56	393.12
Shyamajeera	0.74	280.45	15.49	427.00
Jeeraphool	0.76	295.26	14.25	388.19
KubriMohar	0.78	253.41	15.41	460.11
TulsiManjari	0.71	274.21	15.91	373.18
Jaygundi	0.77	261.98	15.40	411.48
Gagabaru	0.71	298.23	13.21	331.07
Sugandhmati	0.74	267.32	14.11	411.48
Lalu 14	0.78	283.11	14.68	465.60
Dujai	0.72	289.14	14.24	318.41
Dubraj	0.75	257.24	14.38	429.07
CR SugandhaDhan 907	0.66	269.10	14.29	380.56
CD (P=0.05)	0.12	24.77	1.01	34.21

Ranchi (Table31a-d)

Twelve varieties of rice and wheat were assessed for their performance under organic management conditions in the system mode with same level and sources of nutrients.

Yields attributes and yield of rice: Maximum tillers (327 m^{-2}) was noticed in variety Birsamati, followed by Naveen, Lalat, Birsavikasdhan 203 and MTU 10 (318, 315, 315 and 313 tillers m^{-2}, respectively). The lowest number of tillers (235 m^{-2}) was noted in variety BVD-110. Among rice varieties, plant height was maximum (113.2 cm) in variety BVD-110 followed by 110.8 cm and 110.4 cm in Anjali and Birsa vikas sugandha 1, respectively. The panicle length and grains/panicle was higher (24.8 cm and 113.6) in variety Birsa sugandha dhan 1 and statistically at par with Akhchhai, Naveen, MTU 10, Birsamati and Lalat. The

Table 31a. Yield and yield attributing characters of rice varieties under organic management practices at Ranchi

Cropping System	Effective tillers/m²	Plant height (cm)	Panicle length (cm)	Grain/panicle	1000 grain weight (g)	Grain yield (q/ha)	Straw yield (q/ha)
BirsaVikasDhan 203	315	85.4	22.5	95.5	21.7	3733	6480
BirsaDhan 201	292	86.9	21.4	90.5	24.1	3578	6178
BirsaVikasSugandha 1	265	110.4	24.8	113.6	20.8	3556	5976
B.V.D110	235	113.2	20.9	89.5	22.1	2667	5012
Sahbhagi	280	96.8	21.8	91.9	22.4	3289	5821
Birsamati	327	107.8	23.9	104.2	20.7	3989	6335
Anjli	247	110.8	22.1	93.7	22.4	2867	5263
Lalat	315	87.6	24.1	104.4	22.6	4067	6159
MTU 10	313	86.9	23.7	102.4	24.1	4200	6333
Akhchhai	260	100.7	23.1	98.9	22.9	3178	5684
PusaSugandha	282	97.4	24.3	108.3	21.9	3778	6140
Naveen	318	94.8	23.5	101.7	21.7	3889	6377
CD (P=0.05)	31	10.0	2.2	12.7	1.3	504	726

Table 31b. Yields and yield attributing characters of wheat varieties under organic management practices at Ranchi

Varieties	Number of spikes/m²	Plant height (cm)	Spike length (cm)	No. of grains/ spike	1000 grain weight (g)	Grain yield (kg/ha)	Straw Yield (kg/ha)
Raj 4250	293	88.9	7.3	27.3	41.48	2244	3567
GW 366	353	87.5	8.9	32.5	39.27	2967	4396
NW 2036	327	87.1	8.0	29.5	40.88	2667	4062
K0307	368	91.6	9.9	32.9	40.10	3233	4662
K9107	342	96.0	8.2	30.1	39.73	2747	4160
HI 1563	298	91.2	7.5	27.3	43.03	2333	3687
Raj 4229	347	81.5	9.5	31.6	42.20	3104	4538
DBW 14	322	78.0	7.8	29.2	40.35	2604	3982
WR 544	298	92.0	7.7	25.9	48.08	2500	3864
BG 3	320	84.6	8.4	28.5	46.33	2844	4258
HD 2733	290	79.6	6.8	26.7	42.61	2222	3538
DBW 39)	333	83.0	8.7	30.5	43.37	2960	4371
CD (P=0.05)	35.98	4.8	0.67	2.18	7.15	357	538

maximum grain yield of rice (4200 kg/ha) was obtained with rice variety MTU-10 which was significantly superior over all the rice varieties except Lalat (4067 kg/ha), Birsamati (3989 kg/ha), Pusa Sugandha (3771 kg/ha), Naveen (3889 kg/ha) and Birsa Vikash Dhan-203 (3733 kg/ha).

Yields attributes and yield of wheat: The varietal effect on the number of spike m^2, spike length and number of grains $spike^{-1}$ was significant and the results indicated that the maximum number of spike (368 m^2), spike length (9.9 cm) and number of grains $spike^{-1}$ (32.9) was recorded in variety K0307, followed by GW 366 and Raj 4229 with (spike m^2 353 and 347, spike length 8.9 and 9.5 cm) and grains $spike^{-1}$ 32.5

Table 31c. Systems productivity and economics of different varieties of rice and wheat crop under organic management at Ranchi

Treatment	REY of *rabi* crop (kg/ha)	System productivity (kg/ha)	Gross return (Rs/ha)			Cost of cultivation (Rs/ha)			Net Returns (Rs/ha)			Benefit : cost ratio		
			Rice	Wheat	System	Rice	Wheat	System	Rice	Wheat	System	Rice	Wheat	System
Rice (Birsavikasdhan 203) - wheat (Raj 4250)	2619	6352	77334	42783	120117	30926	39460	70386	46408	3323	49731	1.50	0.08	1.58
Rice (Birsadhan 201) – wheat (GW 366)	3461	7039	74030	55434	129464	30926	39460	70386	43104	15974	59078	1.39	0.40	1.79
Rice (Birsavikassugandha 1) – wheat (NW 2036)	3111	6667	77161	50218	127379	30926	39460	70386	46235	10758	56993	1.50	0.27	1.77
Rice (B.V.D110) – wheat (K0307)	3772	6439	56196	59968	116164	30926	39460	70386	25270	20508	45778	0.82	0.52	1.34
Rice (Sahbhagi) – wheat (K9107)	3204	6493	68409	51640	120049	30926	39460	70386	37483	12180	49663	1.21	0.31	1.52
Rice (Birsamati) – wheat (HI 1563)	2722	6711	85642	44403	130045	30926	39460	70386	54716	4943	59659	1.77	0.13	1.90
Rice (Anjli) – wheat (Raj 4229)	3622	6489	60098	57792	117890	30926	39460	70386	29172	18332	47504	0.94	0.46	1.40
Rice (Lalat) – wheat (DBW 14)	3039	7105	81990	49098	131088	30926	39460	70386	51064	9638	60702	1.65	0.24	1.89
Rice (MTU 10) – wheat (WR 544)	2917	7117	84607	47276	131883	30926	39460	70386	53681	7816	61497	1.74	0.20	1.94
Rice (Akhchhai) – wheat (BG 3)	3319	6496	66247	53302	119549	30926	39460	70386	35321	13842	49163	1.14	0.35	1.49
Rice (Pusasugandha) – wheat (HD 2733)	2593	6370	81460	42382	123842	30926	39460	70386	50534	2922	53456	1.63	0.07	1.70
Rice (Navin) – wheat (DBW 39)	3453	7342	79623	55259	134882	30926	39460	70386	48697	15799	64496	1.57	0.40	1.97
CD (p=0.05)	417	651												

Table 31d. Soil nutrient status of different varieties of rice and wheat under organic management practices at Ranchi

Cropping system	pH	OC%	Available nutrient (kg/ha)			Uptake (kg/ha)		
			N	P	K	N	P	K
Rice (Birsa Vikas Dhan 203) - wheat (Raj 4250)	6.01	0.65	253.8	37.7	204.2	145.5	34.6	113.0
Rice (Birsa Dhan201) – wheat (GW 366)	6.11	0.65	252.9	38.1	203.7	152.6	36.4	113.9
Rice (Birsa Vikas Sugandha 1) –wheat (NW 2036)	6.05	0.68	266.8	43.2	223.9	144.2	34.0	105.4
Rice (B.V.D110) – wheat (K0307)	6.19	0.67	264.3	41.0	219.2	143.6	33.1	104.0
Rice (Sahbhagi) – wheat (K9107)	6.08	0.66	257.9	39.5	206.5	143.2	33.0	106.0
Rice (Birsamati) – wheat (HI 1563)	6.04	0.66	259.7	42.7	215.9	148.6	35.3	111.8
Rice (Anjli) – wheat (Raj 4229)	6.16	0.67	263.8	40.8	218.3	142.8	33.4	105.0
Rice (Lalat) – wheat (DBW 14)	6.05	0.65	252.1	37.2	202.5	152.8	35.9	108.8
Rice (M.T.U 10) – wheat (WR 544)	6.04	0.66	259.3	39.8	207.1	153.3	35.6	111.5
Rice (Akhchhai) – wheat (BG 3)	6.12	0.67	262.9	40.5	216.5	142.1	32.7	106.9
Rice (Pusa sugandha) –wheat (HD 2733)	5.90	0.66	260.0	40.5	214.9	144.7	33.7	104.2
Rice (Naveen) – wheat (DBW 39)	6.10	0.66	255.0	39.0	205.7	160.4	37.9	119.1
Initial	5.5	0.42	230.0	32.3	162.0	4.8	4.0	4.9

Performance of rice (var. MTU-10) at Ranchi under organic management

Performance of wheat (var. K-0307) at Ranchi under organic management

and 31.6) respectively). Among the cultivars, the length of wheat varied from 96 cm (K-9107) to 78 cm (DBW 14), whereas the variation in 1000-grains weight of the wheat ranged from 48.1g (WR-544) to 39.2 g (GD-366). K-0307 recorded the higher wheat yield (3233 kg/ha) and rice equivalent yield of wheat crop (3772 kg/ha) which was statistically at parwih Raj 4229 (3104 kg/ha), GW 366 (2967 kg/ha), DBW 39 (2960 kg/ha) and BG-3 (2844 kg/ha).

Systems productivity and economics of system: In terms of system productivity of rice-wheat, Navin (rice) - DBW 39 (wheat) sequence gave significantly higher system productivity (7342 kg/ha) followed by MTU10-WR544, Lalat-DBW-14 and BirsaDhan 201-GW366. Rice (Navin) – wheat (DBW 39) gave the highest gross, net return and B:C ratio of Rs. 1,34,882, 64,496 ha^{-1} and 1.97 respectively.

Soil nutrient status at the end of cropping cycle: There was significant improvement in soil pH, organic carbon, available N, P & K in different varieties under rice-wheat cropping system from their initial values. After completion of cropping cycle, higher organic carbon (0.68%) was found in system rice (Birsa Vikas Sugandha 1) -wheat (NW 2036). Birsa Vikas Sugandha 1- NW 2036 recorded the highest available N, P & K kg/ha in the soil at the end of cropping cycle.

Umiam (Table 32a-h)

Eleven varieties of maize among which eight were composites, one hybrid and two local varieties, 10 varieties of french bean in which 8 were improved and 2 were local and 24 varieties/lines of tomato were screened under organic management.

Maize: Plant height at harvest was significant. Among the tested varieties of maize, plant height was highest in RCM 75 (251.8 cm) followed by RCM 1-3 (248.3 cm) and Hemant (246.3 cm) whereas, Hybrid (210.0 cm) recorded the shortest plant followed by DA 61-A (222.9. cm) and Local yellow (224.1cm). Considerable variation in chlorophyll content across the growth stages were also noticed among the maize line/varieties. Significantly higher chlorophyll index (CI) at 60 DAS was recorded in DA 61 A (48.2) followed by RCM 1-3 (47.1) and minimum CI in variety RCM 1-1 (43.1).

Table 32a. Plant height and chlorophyll index of different varieties of maize under organic management at Umiam

Varieties	Plant height (cm)	Chlorophyll index (CI)	
		30 DAS	60 DAS
RCM-1-1	246.0	35.9	43.1
RCM-1-2	233.2	36.9	45.3
RCM-1-3	248.3	41.6	47.1
RCM-75	251.8	38.9	45.8
RCM-76	242.9	38.5	44.3
Vijay composite	234.4	36.8	45.0
Hemant	246.3	36.4	43.6
DA 61 A	222.9	41.7	48.2
Hybrid (JKMH)	210.0	35.4	45.2
Local Yellow	224.1	37.6	44.5
Local White	234.4	39.0	44.9
CD(P=0.05)	15.50	3.05	2.63

The longest cob length was recorded with variety DA 61-A (14.3 cm) followed by local yellow (13.9cm). However, shortest cob length was recorded in the variety local white (11.4 cm). Cob weight was maximum in variety DA 61-A (223.8 g) followed by RCM-75 (219.4 g). Green cob yield was recorded maximum in DA 61-A (5590kg/ha) followed by RCM-75 (5500kg/ha). DA 61-A recoded maximum grain yield (3390 kg/ha) followed by RCM-76 (3290 kg/ha). Lower grains yield was recorded in the local white (2670 kg/ha) followed by RCM-1-2 (2940 kg/ha). Highest harvest index was observed in DA 61-A (0.30) followed by RCM-1-1 (0.30).

Soil chemical and physical properties: Among the tested varieties/lines of maize maximum SOC value was recoded with DA 61 A followed by RCM-75 and RCM-1-3. Highest bulk density was recorded under Hemant variety and lowest with Local white and RCM-1-3. The available NPK status in soil after cultivation of different maize varieties/line, maximum soil available N (213.7 kg/ha) and P (19.61kg/ha) recorded under Local yellow whereas maximum K was recorded under RCM 1-3.

Table 32b. Yield attributes and yields of different varieties of maize under organic management at Umiam

Varieties	Cob Length (cm)	Cob weight (g)	Green cob yield (Kg/ha)	Seed yield (kg/ha)	Stover yield (kgha)	Harvest index (%)
RCM-1-1	13.3	210.8	5100	3070	7130	0.30
RCM-1-2	12.8	201.6	4680	2940	6860	0.30
RCM-1-3	13.3	212.8	5280	3270	8010	0.29
RCM-75	13.8	219.4	5500	3290	7980	0.29
RCM-76	13.7	211.8	5360	3260	7980	0.29
Vijay composite	13.1	197.0	4690	3140	7810	0.29
Hemant	12.6	190.9	4610	3010	7190	0.30
DA 61 A	14.3	223.8	5590	3390	7750	0.30
Hybrid (JKMH)	12.9	196.2	4530	3000	7300	0.29
Local Yellow	13.9	179.5	3900	2780	6930	0.29
Local White	11.4	164.7	3840	2670	6830	0.28
CD(P=0.05)	1.00	14.5	660	350	640	NS

Table 32c. Soil physical and chemical properties at harvest of maize under organic management at 0-15 cm soil depth.

Varieties	Soil pH	SOC (%)	Bulk density (g/cc)	Available N (kg/ha)	Available P (kg/ha)	Available K (kg/ha)
RCM-1-1	5.00	2.08	1.19	209.6	17.8	200.6
RCM-1-2	5.08	2.08	1.18	213.1	16.8	196.8
RCM-1-3	4.92	2.10	1.17	211.3	19.3	203.2
RCM-75	4.93	2.10	1.19	196.6	18.4	202.5
RCM-76	5.08	2.09	1.20	199.3	17.5	196.7
Vijay composite	5.05	2.09	1.21	202.5	18.1	194.6
Hemant	4.91	2.07	1.23	198.4	17.4	188.8
DA 61 A	4.97	2.11	1.19	197.8	18.2	200.6
Hybrid (JKMH-501)	5.05	2.07	1.22	196.2	14.9	193.9
Local Yellow	5.09	2.09	1.16	213.5	19.6	202.2
Local White	4.93	2.07	1.17	210.3	19.5	198.0
CD(P=0.05)	NS	0.07	0.08	7.98	2.48	NS

Table 35d. Fodder quality of different varieties of maize under organic management (90 DAS)

Varieties	Crude protein (%)	Crude fibre (%)	E.E (%)	Ash (%)	NFE (%)
RCM-1-1	10.7	24.7	1.28	12.3	50.7
RCM-1-2	12.2	24.5	1.39	11.2	50.6
RCM-1-3	12.0	29.0	1.62	11.0	46.5
RCM-75	11.3	26.4	1.23	13.9	47.1
RCM-76	11.2	26.2	1.27	9.9	51.3
Vijay composite	10.7	25.0	1.64	11.4	51.4
Hemant	11.9	25.2	1.53	10.8	50.6
DA 61 A	10.2	25.9	1.49	11.0	51.4
Hybrid (JKMH-501)	11.1	24.6	1.58	10.0	52.3
Local Yellow	10.7	28.1	1.24	9.7	50.1
Local White	11.0	24.5	1.42	10.1	52.9
CD (=0.05)	1.15	2.91	0.27	1.94	3.25

E.E- Ether extract, NFE-Nitrogen free extract

Table 32e. Screening of maize varieties against stem borer, (*Chilopartellus* Swinhoe)

Varieties	Stem borer infestation (%)		Leaf Injury rating (LIR)	Resistance reaction
	Plant Infestation (%)	Dead heart (%)		
RCM-1-1	75.0	7.5	8.0	HS
RCM-1-2	10.1	0.8	3.0	R
RCM-1-3	36.2	5.6	5.9	MS
RCM-76	55.6	6.7	6.3	HS
DA-61-A	39.6	4.8	6.0	MS
RCM-75	51.4	6.6	6.1	HS
Hybrid	39.0	4.4	6.0	MS
Sweet corn	30.1	4.0	4.0	MS
Local White	56.1	5.3	6.3	HS
Hemant	39.2	4.4	6.0	MS
Vijay Composite	62.1	5.8	6.9	HS
Local Yellow	65.3	8.4	7.7	HS
CD (p=0.05)	2.52	0.87		

LIR>3 or <6 = moderately susceptible (MS); LIR > 6 = Highly susceptible (HS); LIR ≤ 3 Resistance (R)(Kumar *et al.,* 2012)

Fodder quality: RCM-1-2 and RCM-1-3 were recorded the higher crude protein content among the 11 varieties. But crude fibre was found to be higher under RCM-1-3 and Local yellow. In respect to ether extract, RCM-1-3 and Vijay composite were recorded higher values.

Stem borer infestation in Maize: Among the 11 varieties tested, RCM-1-1 and Local Yellow exhibited more stem borer infestation and leaf injury. It was recorded that RCM-1-2 found to be resistant to stem borer infestation.

Tomato: Plant was higher in the MCTR 5 (43.27 cm) and lowest was found in the cultivar VL 4 (15.40 cm). In case of chlorophyll index data highest index were found in cultivar MT 2 (46.10). The tomato cultivars namely MCTR 5 (6.3 nos.), MT 2 (6.3 nos.) and RCM T8 (6.3 nos.) produce higher as well as same number of primary branches which were statistically at par with fifteen cultivars specifically Sel 1 (6 nos.), MCTR 7B (6 nos.), MT 9 (5.7 nos.), Avinash 3 (5.3 nos.), Sel 2 (5.3 nos.), DVRT 2 (5.3 nos.), MCTR 4B (5.3 nos.), H 86 (5.3 nos.), DMT 5 (5 nos.), Sel 9A (5 nos.), VAR 801 (5 nos.), RCT 3 (4.7 nos.), MT 3 (4.7 nos.), and Pant T 10 (4.7 nos.).

Less fruit borer infection (8.8%) was observed in MT-2 compared to the other cultivars. Other less infested cultivars were Pant T-10 (9.9%), MT 11 (10.5%) and MT 9 (10.6%). Among the cultivars most infested cultivars are H 86 (19.0%) which are statistically at par with VAR 801 (16.2%), SET 9A (15.6%) and Rocky (15.5%). In case of pest disease index (PDI), among the all twenty four tomato cultivars, PDI were less in cultivar MT 2 (20%); the most susceptible on late blight disease was found to be H-86 (85%) and which was at par with MCTR 4B (74.52%).

Table 32f: Growth parameters of different tomato cultivars at Umiam

Cultivars	Plant height (cm)		Chlorophyll Index		Primary branches (Nos.)		Secondary branches (No.s)	
	30 DAT	60 DAT	30 DAT	60 DAT	30 DAT	60 DAT	30 DAT	60 DAT
TMC 2	25.20	43.20	41.8	38.98	4.3	5.7	0.0	5.0
MCTR 4	30.53	49.10	43.1	38.42	6.0	6.3	0.7	5.0
DMT5	27.97	43.03	41.4	37.71	5.0	6.0	1.0	5.0
MCTR 413	28.30	60.37	38.0	41.43	5.3	4.7	0.0	4.3
Avinash 3	24.00	46.40	33.2	38.93	5.3	4.0	0.0	4.3
Sel 2	29.13	47.57	40.4	29.86	5.3	5.7	0.3	5.0
RCT 3	28.77	44.17	40.5	31.70	4.7	6.0	2.7	5.3
MT 3	31.07	55.43	41.2	42.81	4.7	5.3	2.0	4.7
RCM T8	29.80	49.77	39.9	34.79	6.3	4.7	0.0	4.0
SET 9A	29.07	36.93	38.6	31.07	5.0	5.3	0.3	3.7
MCTR 7B	21.37	41.97	39.6	36.22	4.3	6.3	0.0	4.7
Sel 3	27.83	48.67	42.9	36.50	2.7	3.3	1.3	1.3
DVRT 2	26.00	47.20	37.3	33.72	5.3	5.0	0.3	4.0
MT 9	32.27	42.30	43.1	35.48	5.7	5.3	0.7	4.0
MT 11	33.50	49.67	42.9	35.23	4.0	6.0	0.0	5.0
MT 2	34.57	66.20	46.1	43.57	6.3	7.3	1.3	6.0
ArkaVikash	21.37	34.63	41.4	38.09	4.3	6.3	0.0	4.7
H 86	24.17	38.07	42.1	46.41	5.3	6.0	0.0	3.3
Sel 1	30.23	38.63	42.0	35.71	6.0	6.0	1.0	4.3
MCTR 5	43.27	112.00	40.9	39.49	6.3	6.7	0.3	5.7
VAR 801	31.87	63.37	46.1	43.13	5.0	5.7	0.3	3.3
VL 4	15.40	61.20	40.9	43.47	4.3	2.7	0.3	3.0
Pant T 10	28.37	47.40	43.8	36.74	4.7	6.0	0.3	4.7
Rocky	29.97	58.97	43.5	42.61	3.0	4.3	0.7	3.7
CD (P=0.05)	6.23	20.36	4.28	5.03	1.72	1.79	0.99	1.81

Table 32g. Yield of different tomato cultivars and incidence of insect-pests (pod borer) and disease (late blight)

Cultivars	Pod borer incidence	Pest and disease index (late blight)	Reaction (late blight)	Yield(kg/ha)
TMC 2	12.0	36.67	T	9510
MCTR 4	12.2	30.36	T	14020
DMT5	11.2	29.63	T	14200
MCTR 413	11.0	74.52	HS	6850
Avinash 3	12.4	56.67	S	7760
Sel 2	11.7	50.00	S	8820
RCT 3	12.3	30.37	T	14640
MT 3	11.6	23.33	R	17270
RCM T8	13.6	27.14	T	12210
SET 9A	15.6	29.52	T	12940
MCTR 7B	11.4	26.30	T	14880
Sel 3	11.4	26.67	T	14800
DVRT 2	12.9	33.33	T	10460
MT 9	10.6	22.96	R	18780
MT 11	10.5	22.96	R	18600
MT 2	8.8	20.00	R	22450
ArkaVikash	13.7	32.86	T	11120
H 86	19.0	85.93	HS	5920
Sel 1	13.3	29.52	T	12930
MCTR 5	11.6	29.52	T	12980
VAR 801	16.2	32.86	T	11750
VL 4	12.9	56.67	S	7700
Pant T 10	9.9	22.96	R	18990
Rocky	15.5	52.33	S	8670
CD (P=0.05)	3.9	11.48		8920

MT-2 (22450 kg/ha) recorded higher yield due to less pod borer incidence and less late blight incidence and which was statistically at par Pant T-10 (18990 kg/ha), MT-9 (18780 kg/ha), MT-11 (18600 kg/ha) and MT-3 (17270 kg/ha). The lowest yield was found in the cultivar H 86 (5920 kg/ha).

French bean: Taller plant recorded in Naga Local (238.37cm) followed by RCM-FB-18 (223.4 cm) and RCM-FB-80 (223.17 cm) and shortest plant recorded in Maram (47.4 cm). Naga local (16.05 cm) recorded the highest pod length followed by RCM-FB-18-2 (15.82 cm) and RCM-FB-61 (15.03 cm). Average pod weight was highest in Naga local (11.23 g) followed by RCM-FB-18 (10.10 g) and RCM-FB-19 (7.30 g) while lowest average pod weight was recorded in Maram (3.77 g) followed by Nagaland Local-1 (4.27 g)

Table 32h: Evaluation of different varieties of frenchbean under organic management at Umiam

Variety	Plant height (cm)	Pod length (cm)	Average pod weight (g/pod)	Green pod yield (kgha)	Seed yield (kg/ha)	Stover yield (kg/ha)
RCM FB 18	223.40	15.82	10.10	7810	3630	6180
RCM FB-19	188.43	15.03	7.30	5500	3060	5360
RCM FB-37	219.83	14.62	7.07	5310	2290	5060
RCM FB 61	157.11	13.93	6.30	3500	2280	4780
RCM FB-62	216.24	13.40	6.40	5470	2370	5140
RCM FB-80	223.17	14.97	6.93	5640	2810	4790
Nagaland local 1	197.81	13.16	4.27	2090	1440	3200
Nagaland local 3	147.90	14.54	5.80	4930	2870	6220
Maram	47.40	12.84	3.77	980	630	1270
Naga local	238.37	16.05	11.23	8700	4170	7450
CD (P=0.05)	13.16	1.53	0.55	1040	710	760

Performance of different maize varieties at Umiam under organic management

Performance of different frenchbean varieties at Umiam under organic management

and Nagaland Local-3 (5.80 cm). The highest green pod yield was recorded in Naga local (8700 kg/ha) followed by RCM-FB-18 (7810 kg/ha) and RCM-FB-19 (5500 kg/ha). Lowest green pod yield was recorded in Maram (980 kg/ha) followed by Nagaland local 1 (209 0 kg/ha) and RCM-FB-61 (3500 kg/ha). Seed yield also shown the similar trend.Stover yield was highest in Naga local (7450 kg/ha) followed by Nagaland local 3 (6220 kg/ha) and RCM-FB-18 (6180 kg/ha). Lowest stover yield was recorded in Maram (1270 kg/ha) followed by Nagaland local 1 (3200 kg/ha) and RCM-FB-61 (4780 kg/ha) which was closely followed by RCM-FB-18 (4790 kg/ha).

7.4 Evaluation of bio-intensive complimentary cropping systems under organic production systems

Objectives

- To evaluate the various land configuration and intercropping options for managing the soil nutrient and pests under organic production system
- To assess the infestation level of insect, disease and weeds under bio-intensive complimentary systems

Treatments: Four land configuration methodsin main plot and cropping system in sub plot were taken up.

Land Configuration: Conventional, Furrow Irrigated Raised Bed, Broad bed & Furrow and Raised & Sunken Bed

Cropping system: Four location specific complimentary bio-intensive cropping systems were taken in Sub Plots**.** Experiment was conducted at Dharwad, Pantnagar and Umiamcentres with 3 replications in split plot design.

Year of start: 2013-14

Results:

Evaluation of performance of different cropping systems influenced by different conservation agriculture practices and different land configuration with or without crop residues under organic management

Dharwad (Table 33a-f)

Yield and economics of various crops and cropping systems as influenced by land configuration and crop residue management

Four systems namely soybean-wheat, groundnut +cotton (2:1), green gram-sorghum and soybean + pigeon pea (2:1) were evaluated with four land geometry namely, broad bed furrow method with crop residue, broad bed furrow without residue, conventional flatbed with residue and conventional flatbed without residue. Soybean and ground nut recorded higher seed yield (2186 and 2565 kg/ha respectively) on conventional flatbed with crop residue technique. Among the land configuration techniques, conventional flatbed without residue recorded higher yield across the cropping system. Yield of cotton (669 kg/ha), sorghum (2775 kg/ha) and pigeon pea (1232 kg/ha) was recorded higher under broad bed furrow with crop residue. Significantly higher system equivalent yield was recorded in soybean-wheat system (3650 kg/ha) and it was on par with soybean +pigeon pea system (3629 kg/ha).

Conventional flatbed method of planting with crop residue produced higher net monetary returns and B:C ratio (Rs. 76,665/ha and 3.16 respectively) followed by broad-bed and furrow (BBF) method of planting with crop residues (Rs. 73,342/ha and 3.02, respectively). Among the cropping systems, ground nut-cotton (2:1) recorded higher net return (Rs. 94938/ha) while, soybean-wheat system was more beneficial

Table 33a. Yield and equivalent yield of various crops in cropping system as influenced by land configuration and crop residues management at Dharwad

Cropping systems	Yield (kg/ha) *Kharif*					Yield (kg/ha) *rabi*/intercrop					Systems equivalent yield (kg/ha)				
	Broad bed and furrow		Conventional flatbed		Mean	Broad bed and furrow		Conventional flatbed		Mean	Broad bed and furrow		Conventional flatbed		Mean
	with crop residues	without crop residues	with crop residues	without crop residues		with crop residues	without crop residues	with crop residues	without crop residues		with crop residues	without crop residues	with crop residues	without crop residues	
Soybean-wheat	2125	1990	2186	2110	2103	2209	2021	2388	2125	2186	3689	3421	3876	3614	3650
Groundnut +cotton (2:1)	2315	1940	2565	1846	2166	669	508	583	481	560	2394	1954	2495	1857	2175
Green gram -sorghum	63	25	25	30	36	2775	2575	2867	2207	2606	2975	2654	2946	2302	2719
Soybean +pigeon pea (2:1)	1587	1468	1605	1623	1571	1232	1177	1181	1180	1193	3713	3499	3643	3660	3629
Mean	1523	1356	1595	1402		1721	1570	1755	1498		3193	2882	3240	2858	

Table 33b. Economics of different cropping systems as influenced by land configuration and crop residues management

Cropping systems	Gross return (Rs./ha)					Cost of cultivation (Rs./ha)					Net return (Rs./ha)					B:C ratio				
	Broad bed and furrow		Conventional flatbed		Mean	Broad bed and furrow		Conventional flatbed		Mean	Broad bed and furrow		Conventional flatbed		Mean	Broad bed and furrow		Conventional flatbed		Mean
	with crop residues	without crop residues	with crop residues	without crop residues		with crop residues	without crop residues	with crop residues	without crop residues		with crop residues	without crop residues	with crop residues	without crop residues		with crop residues	without crop residues	with crop residues	without crop residues	
Soybean-Wheat	105837	98148	111202	103686	104718	32044	31824	31412	29956	31309	73793	66324	79790	73730	73409	3.30	3.08	3.54	3.46	3.34
Groundnut+ Cotton (2:1)	158028	128984	164695	122581	**143572**	47823	46582	46366	53764	48634	110205	82402	118329	68817	**94938**	3.30	2.77	3.55	2.80	2.98
Green gram - Sorghum	67146	59901	66491	51956	61374	33926	32528	33067	33458	33245	33220	27373	33424	18498	28129	1.98	1.84	2.01	1.55	1.85
Soybean + pigeon pea (2:1)	106526	100386	104518	105005	104109	30376	30303	29403	28525	29652	76150	70083	75115	76480	74457	3.51	3.31	3.55	3.68	**3.51**
Mean	**109384**	96855	**111727**	95807		36042	35309	35062	36426		**73342**	61546	**76665**	59381		**3.02**	2.75	**3.16**	2.87	

Table 33c. Soil physical and chemical properties as influenced by land configuration and crop residues management

Cropping systems	Bulk density (g/cc)					pH					Electrical conductivity (dS/m)					Organic carbon (g/kg)				
	Broad bed and furrow		Conventional flatbed		Mean	Broad bed and furrow		Conventional flatbed		Mean	Broad bed and furrow		Conventional flatbed		Mean	Broad bed and furrow		Conventional flatbed		Mean
	with crop residues	without crop residues	with crop residues	without crop residues		with crop residues	without crop residues	with crop residues	without crop residues		with crop residues	without crop residues	with crop residues	without crop residues		with crop residues	without crop residues	with crop residues	without crop residues	
Soybean-Wheat	1.22	1.25	1.2	1.24	1.23	7.19	7.27	7.17	7.34	7.24	0.19	0.21	0.17	0.19	0.19	5.43	5.13	5.27	5.07	5.23
Groundnut+ Cotton (2:1)	1.19	1.25	1.19	1.23	1.21	7.19	7.25	7.21	7.19	7.21	0.20	0.21	0.19	0.22	0.20	5.53	5.47	5.17	5.33	5.38
Green gram - Sorghum	1.21	1.26	1.22	1.24	1.23	7.18	7.19	7.2	7.27	7.21	0.21	0.20	0.21	0.22	0.21	5.43	5.23	5.27	5.17	5.28
Soybean + pigeon pea (2:1)	1.22	1.23	1.21	1.24	1.23	7.2	7.15	7.23	7.22	7.2	0.21	0.19	0.24	0.20	0.21	5.73	5.37	5.30	5.00	5.35
Mean	1.21	1.25	1.21	1.24		7.19	7.21	7.2	7.26		0.20	0.20	0.20	0.21		5.53	5.30	5.25	5.14	

Table 33d. Available N, P and K at the end of cropping cycle as influenced by land configuration and crop residues management

Cropping systems	Available N (kg/ha)					Available P (kg/ha)					Available K (kg/ha)				
	Broad bed and furrow		Conventional flatbed		Mean	Broad bed and furrow		Conventional flatbed		Mean	Broad bed and furrow		Conventional flatbed		Mean
	with crop residues	without crop residues	with crop residues	without crop residues		with crop residues	without crop residues	with crop residues	without crop residues		with crop residues	without crop residues	with crop residues	without crop residues	
Soybean-wheat	296.2	269.4	273.6	282.9	280.5	30.7	28.6	32.2	30.4	30.5	392.6	382.0	384.4	380.6	384.9
Groundnut +cotton (2:1)	290.8	271.2	294.0	280.4	284.1	31.2	29.3	31.1	29.3	30.2	391.0	383.7	384.7	377.7	384.2
Green gram -sorghum	292.4	284.4	271.9	281.5	287.3	31.9	31.0	30.8	30.2	30.9	393.3	382.2	386.3	383.0	386.2
Soybean +pigeon pea (2:1)	314.0	276.3	392.2	275.4	289.5	32.6	31.0	31.0	29.7	31.1	395.0	381.8	385.7	380.9	385.8
Mean	298.3	275.3	282.9	280.0		31.6	30.0	31.3	29.9		393.0	382.4	385.3	380.5	

Table 33e. Microbial activity in soil at grand growth periods of crop/s as influenced by land configuration and residues management

Cropping systems	Bacterial population (x10^6 cfu)					Fungal population (x10^6 cfu)					Population of actinomycetes (x10^4 cfu)					Phosphate solubilizing bacteria (x10^6 cfu)				
	Broad bed and furrow		Conventional flatbed		Mean	Broad bed and furrow		Conventional flatbed		Mean	Broad bed and furrow		Conventional flatbed		Mean	Broad bed and furrow		Conventional flatbed		Mean
	with crop residues	without crop residues	with crop residues	without crop residues		with crop residues	without crop residues	with crop residues	without crop residues		with crop residues	without crop residues	with crop residues	without crop residues		with crop residues	without crop residues	with crop residues	without crop residues	
Soybean-Wheat	7.42	8.78	10.42	4.47	7.77	10.33	6.33	4.50	12.17	8.33	54.33	54.50	45.00	34.67	47.13	34.67	23.17	20.00	21.00	24.71
Groundnut+ Cotton (2:1)	6.27	7.68	4.53	7.77	6.56	6.67	7.50	5.67	11.33	7.79	39.79	51.67	56.50	51.00	49.74	15.00	22.17	21.67	22.33	20.29
Green gram - Sorghum	9.85	6.85	6.92	9.12	8.18	13.17	9.00	9.67	12.00	10.96	40.67	25.83	39.17	35.67	35.33	31.67	22.00	22.67	17.33	23.42
Soybean + pigeon pea (2:1)	5.53	9.63	7.08	7.77	7.50	7.33	9.00	7.67	4.83	7.21	32.17	36.83	48.67	26.33	36.00	19.67	31.83	18.83	23.33	23.42
Mean	7.27	8.24	7.24	7.28		9.38	7.96	6.88	10.08		41.74	42.21	47.33	36.92		25.25	24.79	20.79	21.00	

Table 33f :Available micronutrients in the soil at the end of cropping cycle as influenced by land configuration and crop residues management

Cropping systems	Available copper (mg/ka)					Manganese (mg/ka)					Iron (mg/ka)					Zinc (mg/ka)				
	Broad bed and furrow		Conventional flatbed		Mean	Broad bed and furrow		Conventional flatbed		Mean	Broad bed and furrow		Conventional flatbed		Mean	Broad bed and furrow		Conventional flatbed		Mean
	with crop residues	without crop residues	with crop residues	without crop residues		with crop residues	without crop residues	with crop residues	without crop residues		with crop residues	without crop residues	with crop residues	without crop residues		with crop residues	without crop residues	with crop residues	without crop residues	
Soybean-Wheat	1.60	1.52	1.57	1.46	1.54	11.26	11.04	11.14	11.13	11.14	9.84	9.75	9.65	9.76	9.75	0.95	0.91	0.94	0.87	0.92
Groundnut+ Cotton (2:1)	1.58	1.57	1.49	1.48	1.53	11.33	11.21	11.1	11.09	11.18	10.03	9.87	9.88	9.67	9.86	0.91	0.92	87.00	0.91	0.90
Green gram -Sorghum	1.58	1.56	1.46	1.45	1.51	11.32	11.16	11.3	11.12	11.23	10.07	9.73	10.02	10.07	9.97	0.97	0.81	0.92	0.84	0.88
Soybean + pigeon pea (2:1)	1.58	1.52	1.59	1.52	1.55	11.18	11.15	11.14	11.13	11.15	10.33	9.89	9.77	9.78	9.94	0.99	0.91	0.99	0.89	0.94
Mean	1.59	1.54	1.53	1.48		11.27	11.14	11.17	11.12		10.07	9.81	9.83	9.82		0.95	0.89	0.93	0.88	

in term of per rupees invested. The use of crop residues as a mulch for existing crop in different cropping systems and incorporation for succeeding crop was found more beneficial under both conventional flatbed and broad bed and furrow (BBF) method of planting.

Physical and chemical properties of soil

Soil physical and chemical properties were not significantly influenced by different cropping systems under various land configuration and residues management. The reduction in bulk density (1.21 mg/m^3) was found in broad bed furrow and conventional method of planting with crop residues. Among the cropping system groundnut+ cotton (2:1) system recorded lower bulk density. Organic carbon content in the soil was found higher in broad bed furrow method of planting with crop residues (5.53 g/kg).

Microbial population

Higher microbial activity such as bacterial population and phosphate solubilizing bacteria were seen in broad bed and furrow with crop residues while fungi and actinomycetes was higher in conventional flatbed method of planting. Bacterial population (8.24 x10^6 cfu/g) recorded under broad bed and furrow without crop residues, while phosphate solubilizing bacteria (41.74 x10^6 cfu/g) was higher with crop residue. However, fungi population in the soil was higher under conventional flatbed without crop residue.

Pantnagar (Table 34a-f)

Yield, yield attributes and harvest index of paddy

Yield attributing characters of basmati rice *viz*, plant height, weight of grains/panicle and test weight were significantly influenced by different resource conservation practice. Significantly higher plant height (112 cm) was obtained in basmati rice-wheat –*sesbania* cropping system, though, plant height was found at par with SRI-wheat- *sesbania* and DSR-wheat-moong on broad-bed and furrow system.

Table 34a. Yield attributes of rice as influenced by different resource conservation practice

Treatments	Plant height (cm)	Effective tillers/ m^2	1000-grain wt. (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest Index
Basmati rice-wheat-*sesbania*	112	273	28.7	3656	5562	39.7
SRI-wheat- *sesbania*	111	291	29.3	3944	5625	41.2
DSR-wheat(Zerotillage) –*Sesbania*	103	284	27.2	3178	5197	37.9
DSR-wheat-moong on broad bed and furrow	105	312	28.6	3078	5233	37.0
DSR-vegetable pea -cowpea on broad bed and furrow	100	313	247.0	3022	5259	36.5
DSR-chickpea–moong on broad bed and furrow	96	321	28.6	2944	4967	37.2
FIRB: DSR+soyabean -vegetable pea+mustard	103	264	27.5	3142	4802	39.5
FIRB:rice +pigeon pea-cowpea +okra	102	283	26.4	2518	4685	35.0
CD(P=0.05)	7.7	58.4	1.90	254.0	253.8	2.04

DSR-Direct seeded rice, FIRB- Furrow irrigated raised bed

DSR + vegetable pea on BBF at Pantnagar

DSR + soybean + vegetable pea + mustard at Pantnagar

DSR+pigeonpea + cow pea on FIRB at Pantnagar

No-significant difference in effective tillers/m^2 of basmati rice was found among different resource conservation techniques, maximum effective tillers (321/m^2) recorded under DSR-chickpea-moong on broad bed and furrow system. Likewise panicle weight, 1000 grain wt. of basmati rice was also significantly higher in SRI-wheat-*sesbania* system and at par with all other resource conservation techniques except DSR-wheat-*sesbania* , DSR-vegetable pea-cowpea on broad- bed and furrow system and rice +pigeon pea –cowpea +okra in furrow and raised bed resource conservation techniques. There was significant influence of resource conservation practices on grain yield, straw yield and harvest index of basmati rice. SRI-wheat-*sesbania* system recorded significantly higher grain yield (3944 kg/ha) and straw yield (5625 kg/ha) over all other resource conservation practices, though, straw yield under SRI –wheat – *sesbania* was at parwith basmati-rice- wheat – *sesbania*. Significantly higher harvest index (41.2) was also obtained with SRI- wheat – *sesbania*, and it was found at par with basmati rice-wheat-*sesbania* and DSR+ soybean –vegetable pea + mustard in furrow irrigated raised bed system.

Nutrient uptake in rice

Significantly higher nitrogen (95.23 kg/ha), phosphorus (33.72 kg/ha) and potassium uptake 118.1 kg/ha) by basmati rice was recorded with SRI-wheat – *sesbania*. However, S uptake (20.17 kg/ha) was significantly higher in DSR- wheat (ZT) –*sesbania* . Nitrogen and phosphorus uptake in SRI-wheat- *sesbania* was found on par with basmati rice- wheat- *sesbania*, *w*hile K uptake by basmati rice under SRI- wheat –

Table 34b. Nutrient uptake (kg/ha) by basmati rice as influenced by resource conservation practice

Treatments	N uptake (kg/ha)	P uptake (kg/ha)	K uptake (kg/ha)	S uptake (kg/ha)
Basmati rice-wheat-*sesbania*	88.82	30.68	111.9	19.55
SRI-wheat- *sesbania*	95.23	33.72	118.1	20.05
DSR-wheat (Zero tillage) –*sesbania*	80.99	27.15	108.1	20.17
DSR-wheat-moong on broad bed and furrow	70.53	24.63	109.2	14.82
DSR-veg. pea -cowpea on broad bed and furrow	75.21	27.44	105.4	14.33
DSR-chickpea–moong on broad bed and furrow	71.72	25.61	101.0	14.44
FIRB: DSR+ soybean -vegetable pea+ mustard	77.32	29.41	100.1	15.20
FIRB: rice +pigeon pea-cowpea +okra	79.44	26.66	94.2	18.13
CD(P=0.05)	8.7	3.3	11.1	3.87

sesbania was found on par with basmati rice- wheat- *sesbania*, DSR-wheat (ZT)-*sesbania* and DSR-wheat-moong on broad bed and furrow system. Significantly higher sulphur uptake by DSR-wheat (ZT)-*sesbania* was found on par with basmati rice-wheat- *sesbania*, SRI-wheat-*sesbania* and basmati rice +pigeon pea –cowpea+okra grown under furrow irrigated raised bed system .

Yield and Yield attributes of *rabi* crops

Maximum plant height (106 cm) and spikes/m^2 (312) of wheat was observed in DSR-wheat-moong on broad bed and furrow system followed by basmati rice-wheat-sesbania resource conservation practices. Plant height and pods/plant of chickpea under DSR- chickpea- moong on broad bed and furrow system was 89 cm and 46 cm, respectively. In case of vegetable pea, maximum plant height (81 cm) and pods/plant (20) were observed in DSR-vegetable pea –cowpea on broad bed and furrow system as compared to DSR+ soybean-vegetable pea +mustard on furrow in raised bed system. Plant height and pods/plant of cowpea were 191 and 178 cm respectively.

Perfomance of Chickpea-coriander +moong at Pantnagar

Table 34c. Yield attributes and yields of *rabi* crops as influenced by different resource conservation practice

Treatments	Plant height (cm)	Spikes/m^2 of wheat pods/ plant of veg. pea and cowpea	No. of grains/ spike of wheat pods/plant of veg. pea and cowpea	1000 grain weight of wheat and 100 seed weight of veg. pea and cowpea (g)
Basmati rice-wheat-*sesbania*	103	308	46.8	46.57
SRI-wheat- *sesbania*	102	286	45.2	46.67
DSR-wheat (Zero tillage) –*sesbania*	100	312	46.4	48.69
DSR-wheat-moong on broad bed and furrow	106	312	45.2	46.75
DSR-veg. pea -cowpea on broad bed and furrow	81	20	6.9	39.27
DSR-chickpea–moong on broad bed and furrow	89	46	2.1	28.46
FIRB:DSR+ soybean-vegetable pea+mustard	67	15	6.0	38.74
FIRB:rice +pigeon pea-cowpea +okra	191	178	3..3	7.51
CD(P=0.05)	10.5	41.8	2.82	2.48

Maximum no of grains/spike of wheat (46.8) was observed in basmati rice –wheat-*sesbania* whereas, maximum 1000 grain wt. (46.6 g) of wheat was observed in DSR-wheat(ZT)-*sesbania*. Seeds/pods and 100 seed of chickpea under DSR-chickpea-moong on broad bed and furrow system was 2.1 and 28.5 g, respectively. In case of vegetable pea, maximum seeds/pods (6.9) and 100 seed wt. (39.3g) were recorded in DSR-vegetable pea-cowpea on broad bed and furrow system as compared to DSR +soybean-vegetable pea + mustard on furrow irrigated raised bed system. However, seeds/pods and 100 seed weight of cowpea were 3.3 and 7.51 g, respectively under basmati rice+ pigeon pea-cowpea +okra resource conservation techniques.

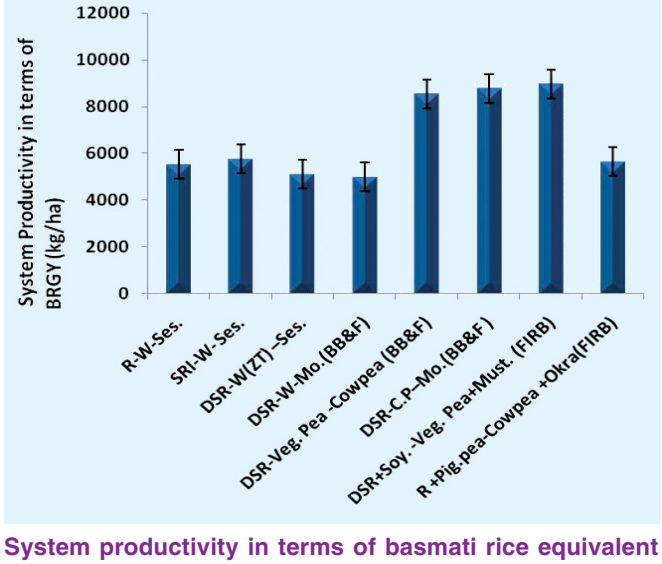
Wheat-mustard + moong on broad bed furrow system at Pantnagar

SRI-wheat technique at Pantnagar

Table 34d. Yield of *rabi* crops and wheat equivalent yield as influenced by different practice

Treatments	Yield of *rabi* crops (kg/ha)					
	Wheat	Veg. pea	Chickpea	Coriander	Mustard	Wheat equivalent yield (kg/ha)
Basmati rice-wheat-*sesbania*	3219	-	-	-	-	3219
SRI-wheat-*sesbania*	3048	-	-	-	-	3148
DSR-wheat (Zero tillage) –*sesbania*	3190	-	-	-	-	3324
DSR-wheat-moong on broad bed and furrow	3322	-	-	-	-	3322
DSR-veg. pea -cowpea on broad bed and furrow	-	9249	-	417	-	9520
DSR-chickpea–moong on broad bed and furrow	-	-	1524	600	-	10042
FIRB:DSR+ soybean-vegetable pea+ mustard	-	7462	-	-	-	6124
FIRB: rice +pigeon pea-cowpea +okra	-	-	-	-	-	-
CD(P=0.05)	-	-	-	-	-	738.0

Maximum grain yield of wheat (3322 kg/ha) was observed in DSR-wheat-moong on broad bed and furrow system while lowest grain yield (3048 kg/ha) was observed in SRI-wheat –*sesbania*. Green pod yield of vegetable pea recorded higher (9249 kg/ha) in DSR-vegetable pea-cowpea on broad bed and furrow system as compared to 7462 kg/ha in DSR+ soybean-vegetable pea+ mustard. Chickpea yield recorded under DSR-chickpea-moong on broad-bed and furrow system (1524 kg/ha). Wheat equivalent yield was significantly influenced by different resource conservation techniques. Significantly higher wheat equivalent yield (10042 kg/ha) was observed in DSR-chickpea-moong on broad bed and furrow system which was at par with DSR-vegetable pea –cowpea on broad bed and furrow system.



System productivity in terms of basmati rice equivalent yield as influenced by different resource conservation practice

Economics

Economic analysis of different cropping system managed through different resource conservation practices calculated and maximum net returns (Rs.2,10,485 /ha) and B:C ratio (4.35) was recorded in DSR + soybean –vegetable pea + mustard in broad bed and furrow system followed by DSR-chickpea – moong on broad bed and furrow system. Minimum net returns (Rs. 52345 /ha) and B: C ratio (1.53), was observed in rice-pigeon pea–cowpea + okra under furrow raised bed system. System productivity in terms of basmati grain equivalent yield was significantly influenced by resource conservation practices and significantly higher system productivity (8968 kg/ha) was observed in DSR+ soybean –vegetable pea + mustard in furrow irrigated raised-bed system which was at par with DSR-chickpea–moong on broad bed and furrow and DSR-veg. pea -cowpea on broad bed and furrow.

Table 34e. Relative economics of different resource conservation technologies

Treatments	System productivity (kg/ha)	Cost of cultivation (Rs./ha)	Net Return (Rs./ha)	B:C Ratio
Basmati rice-wheat-*sesbania*	5524	63965	99754	1.56
SRI-wheat- *sesbania*	5770	63545	104060	1.64
DSR-wheat (Zero tillage) –*sesbania*	5106	60655	94951	1.57
DSR-wheat-moong on broad bed and furrow	5005	62705	90682	1.45
DSR-veg. pea -cowpea on broad bed and furrow	8546	59865	202882	3.39
DSR-chickpea–moong on broad bed and furrow	8770	48165	204582	4.25
FIRB:DSR+ soybean-vegetable pea+ mustard	8968	48392	210485	4.35
FIRB: rice +pigeon pea-cowpea +okra	5639	34164	52345	1.53
CD(P=0.05)	655	-	-	-

Soil nutrient status

Nutritional status of soil after completion of crop cycle in terms of organic carbon, available N,P,K and S were not significantly influenced by resource conservation practices. Higher organic carbon was recorded in rice + pigeon pea- cowpea + okra in furrow irrigated raised bed system 1.22. Available N ranged from 324 to 393 kg/ha, maximum availability recorded in DSR-chickpea-moong on broad bed and furrow system. Available phosphorus ranged from 34.7 to 44.0 kg/ha and maximum availability of phosphorus recorded in DSR-wheat- *sesbania*. Availability of K (265 kg/ha) and S (37 kg/ha), was higher under DSR+ soybean-vegetable pea+ mustard resource conservation techniques.

Table 34f. Nutrient status of soil after completion of crop cycle

Treatments	Organic carbon (%)	Available N (kg/ha)	Available P (kg/ha)	Available K (kg/ha)	Available S (kg/ha)
Basmati rice-wheat-*sesbania*	1.14	341	36.3	259	37.0
SRI-wheat- *sesbania*	1.18	365	35.0	261	34.3
DSR-wheat (Zero tillage) –*sesbania*	1.21	356	44.0	262	30.3
DSR-wheat-moong on broad bed and furrow	1.18	348	36.3	236	34.7
DSR-veg. pea -cowpea on broad bed and furrow	1.15	371	36.0	250	34.0
DSR-chickpea–moong on broad bed and furrow	1.18	393	36.0	248	33.7
FIRB:DSR+ soybean-vegetable pea+ mustard	1.04	324	38.7	265	37.0
FIRB: rice +pigeon pea-cowpea +okra	1.22	336	34.7	260	34.3
CD(P=0.05)	NS	NS	NS	NS	NS

Umiam: (Table 35a-f)

The Raised and sunken bed were made in sequence for efficient drainage and inter-plot water harvesting with a fixed width i.e. 1 m for raised and 1.25 m for sunken bed. The lengths of all the plots were same (8 m). The surface soil layer of each sunken bed was removed and deposited on the adjacent raised beds making about 30 cm bed height. All the crop residues and weed biomass were placed below the raised beds and covered properly. Transplanted rice was grown in sunken beds during *kharif* season with four rice varieties namely Shahsarang-1, Lampnah, IR 64 and Vivek Dhan-82. Potato (*cv.* Kufri Jyoti), French bean (Naga local) and Carrot (New Kuroda) were grown during pre-*kharif* season (January to May) followed by okra in *kharif* season (June to August/Sept). *Kharif* rice was harvested by leaving at least 20 cm standing stubble during last week of November and thereafter in sunken beds lentil was grown under zero tillage. For growing lentil in sunken beds, the rice fields were drained at physiological maturity.

Growth parameters and yield of rice on sunken bed

Among the rice varieties, the highest plant height was recorded in Vivek-Dhan-82 (91.6 cm) which was followed by Shahsarang-1 (79.8 cm) and IR 64 (73.1 cm). Lampnah (70.0 cm) recorded the shortest plants. Tillers per square meter was recorded highest in Shahsarang-1 (308.3) followed by Lampnah (250.3) and IR 64 (245.7). The lowest numbers of tillers were recorded in Vivek Dhan-82 (196.7). Panicle per square meter also followed the same trend as tillers per square meter.In rice based cropping systems on sunken beds, the rice productivity in sunken beds ranged from 3290 to 4470 kg/ha under among sequences with mean productivity of 3850 kg/ha and 3910 kg/ha under rice-lentil and rice-pea cropping system, respectively. Among the rice varieties, Shahsarang-1 recorded the highest yield (4470 kg/ha) followed by Lampnah (4210 kg/ha) under rice-pea cropping sequence. During *rabi* season, lentil yield ranged from 1010 to 1130 kg/ha. The highest lentil yield was recorded in the system rice (Vivek dhan-82) -lentil (1110 kg/ha). Pea yield ranged from 3900 to 4700 kg/ha. The highest pea yield was recorded in the system rice (Vivek dhan-82) - pea (4700 kg/ha) followed by pea after lampnah (4400 kg/ha). The highest rice equivalent yield was recorded under rice (Lampnah)–pea (13070 kg/ha) followed by rice (VD-82) – pea 12660 kg/ha.

Table 35a. Growth parameters and yield *Kharif* and *rabi*crops on sunken beds.

Cropping sequence	Plant height (cm)	Tiller/m²nos.	Panicle/m²nos.	Yield (kg/ha)		REY (kg/ha)
				Rice	Lentil and Pea	
Rice (IR-64) - lentil	73.1	245.7	222.7	3560	1010	6930
Rice (VD-82) -lentil	91.6	196.7	184.3	3290	1110	6990
Rice (Shahsarang-1) -lentil	79.8	308.3	276.3	4370	1040	7840
Rice (Lampnah)-lentil	70.0	250.3	233.3	4170	1130	7940
Mean	78.6	250.3	229.2	3850	1070	7420
Rice (IR-64) - Pea	73.7	269.3	241.3	3630	4200	12050
Rice (VD-82) -Pea	95.4	224.0	207.3	3330	4700	12660
Rice (Shahsarang-1) -pea	81.3	316.7	304.3	4470	3900	12300
Rice (Lampnah) -pea	71.2	258.6	241.7	4210	4400	13070
Mean	80.4	267.1	248.6	3910	4300	12520

Yield of vegetables on raised-bed

Potato, French bean and carrot recorded yield on raised bed of 15000, 7200 and 14200 kg/ha respectively. The yield of okra during *kharif* season ranged from 7900 to 8300 kg/ha and was highest under french bean- okra cropping system (8300 kg/ha) whereas rice equivalent yield was recorded higher under carrot–okra cropping system (34400 kg/ha).

Table 35b. Yield and rice equivalent yield of vegetable crops on raised-bed

Cropping sequences	Yield of raised bed crops (kgha)		REY(kg/ha)
	Pre-*kharif*	*Kharif*	
Potato-okra	15500	8000	18300
French bean- okra	7200	8300	20300
Carrot- okra	19900	7900	34400
Mean	14200	8067	24333

Physico-chemical properties of soil

French bean-okra cropping sequence recorded higher soil pH (5.18), soil oorganic carbon (2.33%), available nitrogen (267.55 kg/ha), phosphorus (24.86 kg/ha) and potassium (263.79 kg/ha) under raised beds condition followed by carrot-okra cropping sequence except soil pH where it is higher in potato-okra cropping sequence. In case of sunken beds, rice (Shahsarang-1)-lentil cropping sequence recorded maximum soil pH (5.22), OC (2.74%), available nitrogen (278.82 kg/ha), phosphorus (27.6 kg/ha) and (271.16 kg/ha) followed by rice (Shahsarang-1)-pea cropping sequence.

Table 35c. Physico-chemical properties of soil

Cropping sequences	pH	Soil organic carbon (%)	Available N (kg/ha)	Available P (kg/ha)	Available K (kg/ha)
Raised bed					
Potato-Okra	5.16	2.19	251.24	21.65	261.94
French bean- Okra	5.18	2.33	267.55	24.86	263.79
Carrot- Okra	5.11	2.22	265.11	21.73	261.05
Mean	5.15	2.25	261.30	22.75	262.26
Sunken bed					
Rice (IR-64) - Lentil	5.19	2.62	266.02	24.22	265.94
Rice (VD-82) -Lentil	5.20	2.68	266.93	25.37	266.12
Rice (Shahsarang-1) -Lentil	5.22	2.74	278.82	27.36	271.16
Rice (Lampnah) -Lentil	5.20	2.71	273.14	27.04	270.71
Mean	5.21	2.69	271.23	26.00	268.48
Rice (IR-64) - Pea	5.11	2.61	264.92	23.68	265.09
Rice (VD-82) -Pea	5.12	2.65	265.81	24.47	265.77
Rice (Shahsarang-1) -Pea	5.22	2.72	276.20	26.50	270.65
Rice (Lampnah) -Pea	5.21	2.70	271.51	26.31	269.42
Mean	5.17	2.67	269.61	25.24	267.73

7.5 Development of Integrated Organic Farming System Models

Objective

- To evaluate the modules of organic production system to develop integrated organic farming system

Farming system modules

Module	Components
Crop	Identified high value crops of organic farming + required quantity of fodder for livestock
Livestock	Cow/Buffalo/Goat/Poultry depending upon the location and size of the model
Complimentary enterprises	Biogas, Vermicompost unit, Live fencing, seed/planting material production unit

Locations: Calicut, Coimbatore and Umiam

Year of start: 2013-14

Results:

Calicut

Spices based Integrated organic farming system (Area: 0.4 ha)

The plot with spices, fodder and vegetables combination was established at Chelavoor farm. Crop component comprises of turmeric (2000 m^2), fruit crop banana (100 m^2), pineapple (200 m^2), vegetable cow pea (100 m^2) and fodder grasses viz., CO-3 (500 m^2), Hybrid Napier (200 m^2), CO4 (500 m^2) and Congo signal (200 m^2). Turmeric, ginger, fodder grasses (congo signal grass, CO-3, CO-4), yams, tapioca, banana and pineapple were planted and established. Fodder grasses (686 kg) Tapioca (80 kg) and vegetable cowpea (8 kg) was harvested. A profit of Rs. 79, 631/- was obtained from integrated organic farming system/acre.

Coimbatore (Table 36a-d)

Composition of organic farming system (0.40 ha)

Components	Treatments/ Remarks
Crop component	Cropping Systems: 1. Okra + leaf coriander - maize + cowpea (fodder) - (0.12 ha) 2. Green manure - cotton - sorghum (0.12 ha) 3. Fodder grass CO CN (4) and desmanthus (0.10 ha)
Agro forestry	*Azardhiracta indica, Melia dubia, Sesbania sesban, Pongamia pinnata*
Dairy	2 cows with calves
Vermicompost	The residue of the crops and manure from the dairy unit are converted into vermicompost and used as enriched manure for crops
Area under supporting activities	Manure pit, threshing floor etc.
Border plants	Desmanthus, Banana, *Glyricidia* sp.

Performance of okra + leaf coriander - maize + cowpea (fodder) system

In okra, plant height of 73.8 cm was recorded with 1585 kg/ha of dry matter production. Available N, P and Kin soil was recorded 248, 8.4 and 475 kg/ ha at the end of cropping cycle. Fruit yield of 10560 kg/ha was recorded in okra (variety Anarva). Net return of Rs. 63,250/ha was recorded in organic farming system model.

Maize: Maize var. COH (M) 6 was sown in the system and it gave 4807 kg/ha of grain yield with 5131 kg/ ha of straw yield. Maize recorded the net income of Rs. 31,038/ ha under organic farming system model.

Table 36a. Plant height, dry matter, soil fertility status and yield of okra under organic farming system mode

Particulars (at harvest)	Okra
Plant height (cm)	73.8
DMP (kg/ha)	1585
N (kg/ha)	248
P (kg/ha)	8.4
K (kg/ha)	475
Fruit length (cm)	9.1
Fruit girth (cm)	4.98
No. of fruits/plant	16.7
Fruit weight (g/ fruit)	14.3
Fruit yield (kg/ha)	10560
Cost of cultivation (Rs/ha)	95150
Gross return (Rs/ha)	158400
Net return (Rs/ha)	63,250

Table 36b. Plant height, dry matter, soil fertility, yield and economics of maize under organic farming system mode

Particulars	Maize (at harvest)
Plant height (cm)	216.3
DMP (kg/ha)	8173
N (kg/ha)	259
P (kg/ha)	11.6
K (kg/ha)	461
No. of rows/cob	13.9
No. of grains/row	35.3
100 Seed wt. (g)	31.7
Grain yield (kg/ha)	4807
Straw yield (kg/ha)	5131
Cost of cultivation	29,050
Gross return	60,088
Net return	31,038

Table 36c. Plant height, dry matter, soil fertility, yield and economics of cotton under organic farming system mode

Particulars	Cotton (at harvest)
Plant height (cm)	109.1
DMP (kg/ha)	4301
N (kg/ha)	250
P (kg/ha)	9.3
K (kg/ha)	479
No of sympodial branches	15.6
No of bolls per plant	21.9
Seed cotton yield (kg/ ha)	993
Cost of cultivation (Rs/ha)	35,600
Gross return (Rs/ha)	49,650
Net return (Rs/ha)	14,050

Table 36d. Economic of different cropping systems under integrated organic farming systems mode

Cropping system	Area (ha)	Crop	Yield (kg/ ha)	Total cost (Rs. /ha)	Gross return (Rs. /ha)	Net return (Rs. /ha)
Bhendi + leaf coriander - maize + cowpea (fodder)	0.12	Bhendi	10560	95150	1,58,400	63,250
		Coriander (Leaf)	1321	5,000	9,247	4,247
		Maize	4807	29,050	60,088	31,038
		Cowpea fodder	Used as feed for dairy			
			Total	1,29,200	2,27,735	98,535
Green manure - cotton - sorghum	0.12	Cotton	993	35,600	49,650	14,050
		Sorghum	-	-	-	-
Fodder	0.10	Fodder sorghum (single cut)		Used as feed for dairy unit		

Performance of green manure - cotton – sorghum system

Cotton recorded 4301 kg/ha of dry matter production at the stage of harvest. Seed cotton yield of 993 kg/ha was recorded. Net return of Rs. 14050/ha was recorded.

Umiam: Organic food production through IOFS (0.04 ha)

The IOFS model comprising different enterprises such as cereals (rice and maize), pulses (lentil, pea), oilseeds (soybean, rapeseed), vegetable crops (frenchbean, tomato, carrot, okra, brinjal, cabbage, potato, broccoli, cauliflower, chili, coriander, etc.), fruits (Assam lemon, papaya, peach), dairy unit (a milch cow + calf), fodder crops, central farm pond, farmyard manure pits and vermicomposting unit. A farm pond of 460 m^2 area with average depth of 1.5 m was part of the IOFS model for life saving irrigation and aquaculture. Climbing vegetables such as bottle gourd, chow-chow, cucumber, ridge gourd etc., were grown on a structure created above water bodies in one side of the pond dyke for vertical intensification. Pumpkin was raised in another side of the pond and allowed to crawl on the ground. The washings from the dairy unit were diverted to fish pond for promoting growth of zooplankton and phytoplankton for fish growth. The solid waste from cow shed was used for FYM making and vermicomposting. The total cost of cultivation was recorded at Rs. 55,839/- per year under the IOFS model with an area of 0.43 ha. Maximum expenditure was incurred in crop component of the model with 48% of the total cost of cultivation. Dairy unit with one adult cow and one calf registered 36 % of the total cost of cultivation, while fishery component recorded 9% of the total cost of cultivation. For maintaining vermicomposting unit of 72 m^2 area and other important operations like hedgerow planting, residue recycling, rock phosphate application and liming, the expenditure incurred was Rs. 3700/- which account to 7% of the total cost. A total net return of Rs. 62,531/- per year was obtained under the IOFS model which is much higher than the region's farmer common practices of rice mono cropping or improved practice of rice-vegetables cropping system (Table 37a). The highest contribution towards the total net return was contributed by crop component of the model (61%) followed by dairy (25%) and fishery component (20%). The fish production was 136 kg. The net return from dairy component was calculated only in terms of milk production since the cow-dung produced was recycled back into the model which was used as manure for crop production. The production of vermin-compost from model was 1500 kg annually and it was used in the farm itself for nutrient supplement to crops.

Table 37a. Economics of the IOFS model (area=0.43 ha)

Sl. No.	Components		Area (ha)	Cost of cultivation/ year (Rs)	Gross return / year (Rs)	Net return / year (Rs)
1	Crops	Cereals, pulses, oilseeds, vegetables, fruits and fodder crops	0.373	27129 (48%)	65370 (55%)	38241 (61%)
2	Dairy	1 milch cow + 1 calf	0.004	20250 (36%)	36000 (30%)	15750 (25%)
3	Fishery	Composite	0.05	4760 (9 %)	17000 (14%)	12240 (20%)
4	Nutrient cycling	Vermi-compost /FYM/ Hedgerow planting/ Residue recycling/Rock phosphate application/Liming	0.01	3700 (7%)	0	-3700 (-6%)
		Total	0.43	55839	118370	62531
Farmers' practice-I (Rice-Fallow)				10100	25800	15,700
Farmers' practice-II (Rice-vegetables in small scale)				18975	43493	24,518
REY of 18 t/ha was recorded under the IOFS model compared to 4.0 t and 6.75 t/ha under farmers' practice-I & II, respectively						

For 0.43 ha area, the total nutrient requirement for organic crop production has been estimated to be Nitrogen (64.7 kg), phosphorus (P_2O_5) (23.1 kg) and potassium (K_2O) (53.8 kg) (Table 37b). On farm nutrient recycling in IFOS model was found to be 59.7 kg N, 18.9 kg P_2O_5 and 51.9 K_2O. Hence, 92% of the total N requirement, 82% of the total P_2O_5 requirement and 96% of the total K_2O requirement could be met within the model itself and only 8% of the total N requirement, 18 % of the total P_2O_5 requirement and 4 % of the total K_2O requirement is required to be obtained from the external source to sustain the model.

Table 37b. On-farm nutrient supply balance sheet under IOFS model (area=0.43 ha)

Components	Nutrient requirement (kg)			On-farm nutrient recycled (kg)			Nutrient Balance (kg)		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
Cereals (Rice, Maize)	21.1	7.5	17.5	6.6	2.3	12.2	-14.5	-5.3	-5.3
Horticultural crops (Vegetables, Fruits)	31.4	11.2	26.2	11.8	2.6	9	-19.6	-8.6	-17.2
Dairy	0	0	0	13.1	4.9	6.6	13.1	4.9	6.6
Others (Oilseeds, Pulses, Green manuring crop, fodder, etc.)	12.2	4.4	10.1	28.2	9.1	24.1	16	4.8	14
Total	64.7	23.1	53.8	59.7	18.9	51.9	-4.9 92%	-4.2 82%	-1.9 96%

Fish culture in Integrated organic farming system

Chili under Integrated organic farming system

Cabbage production under organic farming system

7.6 Tribal Sub Plan (TSP)

Tribal sub plan activities were undertaken at selected locations in which cluster based demonstrations, trainings, human resources development activities were undertaken.

Locations: Coimbatore, Dharwad, Raipur and Umiam

Year: 2013-14

Coimbatore: 50 farmers from five villages (Kethakadu, Veerakkal, Korapathy, Baralikkadu and Poochamarathur) in Karamadai block of Coimbatore district in Tamil Nadu) were selected. Silpaulin Vermi-beds (10 nos.) were given in Karamadai block in Tamil Nadu. Earthworms @ 2kg / bed for 10 beds, vegetables & millets seeds, Jasmine seedlings @ 100 per trainee, Saplings of Mandarin orange, lemon and fruit crops, Bio-fertilizers viz., *Azospirillum*(1kg) +*Phosphobacteria* (1kg) per trainee and Bio-control agents viz., *Pseudomonas* (1kg) and *Trichoderma* (1kg) were provided to 50 tribal families in Karamadai block of Tamil Nadu. Fifty tribal farmers including 20 women tribal farmers were trained on Organic Farming methods and techniques in 5 villages of Karamadai block in Coimbatore district. Special lectures on mushroom cultivation, apiculture, bio-fertilizer production were given. Inputs such as 10000 number of Jasmine seedlings, 16.4 kg vegetable seeds, 200 kg of Azospirillum, Phosphobacteria, VAM and 100 kg of bio-control agents such as Pseudomonas fluroscens and trichodermaviridie were also given for practicing the organic farming in the form of Participatory Guarantee System (PGS).

Karjat

Capacity Building of tribal families on organic crop production was organized at Pathraj village in Raigad district of Maharashtra in which 100 tribals attended. Inputs such as Vijay variety of chickpea and Konkansadabahar variety of cowpea were distributed to 30 households @ 1kg each /household to make use of training.

Raipur: 15 families in 1 village (Telghara) in Kanker district of Chhatisgarh were adopted. Two low cost compost pit created in Kanker district of Chhatisgarh.

Umiam

Cluster based demonstration of organic farming package in tribal clusters was undertaken for organic food production through integrated farming system using cluster approach. A village in Meghalaya namely Mynsain have been adopted for disseminating organic production technology developed in the Institute in participatory mode. The village is having 132 households with an approximate area of 60 ha. As per the interaction with the farmers and elderly peoples of the village, it is learnt that the village is totally organic and so far no inorganic input has been applied.

Soil Fertility status: For understanding IFS, soil samples from 0-15 and 15-30 cm were collected from various land type. A total of 160 samples were collected.

Table 38a.Soil Fertility status of IOFS model

Particulars		Available N (kg/ha)	Available P (kg/ha)	Organic carbon (%)	pH
Lowland	0-15	210.1 ± 27.8	9.1 ± 6.4	1.00 ± 0.59	4.97± 0.62
	15-30	163.1 ± 22.9	10.0 ± 1.7	0.89 ± 0.60	
Upland	0-15	207.9 ± 55.7	21.2± 12.5	1.11 ± 0.39	5.01 ± 0.67
	15-30	166.1± 62.1	23.5 ± 18.1	1.07 ± 0.42	

Development of farm pond

The pond was constructed on farmer's land of Mynsain village for multiple uses, such as, pisciculture and for rearing of animals, for irrigation purposes during lean period and for cultivation of crops. Liming (2 t/ha) and application of FYM (10 t/ha) was performed after digging new pond for developing soil fertility, an amount of Rs.50, 000 was incurred for construction of this pond. Apart from the new pond, three existing ponds were also renovated in farmer's field for multiple uses. The construction and renovation of these ponds were actively participated by the farmer's themselves which in turn added some amount of employment to the villagers. In addition to this 3000 nos. of fingerlings were distributed to the farmers' for IFS models Names of farmers, village and geographical coordinates of the demonstration sites have been provided in Table 38b.

Table 38b. List of beneficiary for pond and their geographical location of the demonstration site

Name of beneficiary	Area of pond (m^2)	Latitude (N)	Longitude (E)	Elevation above sea level (m)
Mrs.Pretywon Rynghang	300	25°44.340'	092°01.082'	863m
Mr. Rongdondor Rympei	240	25°44.150'	092°00.920'	876m
Mr. Lamphrang Rympei	360	25°44.613'	092°01.214'	856m
Mr. Presion Mawlong	400	25°44.742'	092°01.157'	862m

Table 38c: Growth analysis of fish species in Mynsain village (6 Months stocking)

Species	Weight (g)	Total Length (cm)	Girth (cm)
Catla	123.40 ± 31.35	13.60 ± 2.30	12.60 ± 2.97
Grass Carp	104.40 ± 40.98	11.90 ± 3.44	5.40 ± 1.14
Golden Carp	112.20 ± 23.11	13.50 ± 1.94	8.18 ± 0.83
Common Carp	121.00 ± 6.52	12.60 ± 2.07	7.00 ± 1.58

The different fish species including of surface feeder (Catla), Column feeder (Grass Carp) and bottom feeder (Common carp) were adapted in farmer's pond. After six months it was found that Catla attained maximum weight (123.40 ± 31.35) and length (13.60 ± 2.30) whereas minimum weight and length was found in grass carp (104.40 ± 40.98) and length of (11.90 ± 3.44).

***Jalkund*:** A small rain water harvesting structure called *Jalkunds* suitable for hilltops was introduced in Mynsain village. The dimension was 5m x 4m x 1.5m which can store about 30,000 liters water were constructed in farmer's fields, as harvesting water is the main problems in these areas. Most of the farmers depend on rainfall as sources of irrigation but cultivation during winter season make them difficult to manage water, all they are depended is the amount of moisture retained in the soil as water source. *Jalkund* were constructed at higher elevations, so as water flowing down the slopes is collected in a *jalkund* that will roughly store an adequate amount of water for the farmers' to utilize for irrigation.

Construction of *Jalkund* was done by the following ways:

- Excavation of the *Jalkund* on selected site was done before onset of monsoon. The bed and sides of the kund were leveled by removing rocks, stones or other projections, which otherwise might damage the lining material.
- The inner walls including bottom of the kund are to be properly smoothened by plastering with mixture of clay and mudy soil.
- After clay plastering, about 3-5 cm thick cushioning was done with locally and easily available (long tall grasses) on the walls and bottom to avoid any kind of damage to the lining material from any sharp or conical gravel etc.
- It is followed by lying down of 250 GSM silpaulin sheets. The sheet was laid down in the kund in such a way that it touches the bottom and walls loosely and uniformly and stretched out to a width of about 50 cm all around the length and width of the kund. About 30 x 30 cm trench was dug all around the kund and 25 cm outer edge of the sheet was buried in the soil so that the sheet is tightly bound from all around.

Farmers in mynsain village are using stored water for growing vegetables such as frenchbean, cabbage, brocolli, tomato, lettuce, cucurbits and for rearing of animals such as pig and poultry. Using stored water economically in various farm activities is the most acceptable and profitable one particularly to those in hills top where drought is the major problem. Therefore, the stored water helps the farmers of this village to raised crops for the whole year.

The names of farmers, village and their geographical location of the demonstration sites have been provided in Table given below.

Table 38d. List of beneficiary for Jalkund and their geographical locations

Name of beneficiary	Latitude (N)	Longitude (E)	Elevation above mean sea level (m)	Multiple use
Mrs Pynsan Rynghang	25^{0}44.704'	092^{0}01.276	872m	For cultivation of vegetables (Broccoli, cabbage, lettuce, French bean)
Mrs Skola Kurbah	25^{0}44.542'	092^{0}01.236'	859m	For cultivation of vegetables (Broccoli, cabbage, lettuce, French bean)
Mrs Ladei Nongsiej	25^{0}44.573'	092^{0}01.318'	861m	For cultivation of vegetables (Broccoli, cabbage, lettuce, French bean)
Mr Ambor Makhroh	25^{0}44.313'	092^{0}00.056'	875m	For cultivation of vegetables (Broccoli, cabbage, lettuce, French bean) and for rearing of pigs
Mr Synsharsuk Rynghang	25^{0}44.539'	092^{0}01.447'	866m	For cultivation of vegetables (French bean) and vermicomposting unit
Mrs Guardian Shadap	25^{0}44.301'	092^{0}00.847'	884m	For cultivation of vegetables (French bean)
Mrs Hynniew Rynghang	25^{0}44.602'	092^{0}01.261'	874m	For cultivation of vegetables (lettuce, French bean) and for piggery and dairy.
Mrs Trias Makhroh	25^{0}44.222'	092^{0}00.835'	882m	For cultivation of vegetables (Broccoli, cabbage, lettuce, French bean) and for rearing of pigs and poultry.

Name of beneficiary	Latitude (N)	Longitude (E)	Elevation above mean sea level (m)	Multiple use
Mr Aphilous Makhroh	25°44.317'	092°00.068'	869m	For cultivation of vegetables (Broccoli, cabbage, lettuce, French bean) and for rearing of pigs.
Mrs Entinora Rynghang	25°44.557'	092°01.296'	860m	For cultivation of vegetables (Brocolli, cabbage, lettuce, french bean) for rearing pig and dairy.
Mr Pynskhem Kharsohnoh	25°44.522'	092°01.072'	868m	For cultivation of vegetables (Chilli, French bean).
Mr Phang Rympei	25°44.623'	092°01.287'	876m	For cultivation of vegetables (Broccoli, cabbage, lettuce, French bean) and for rearing of pigs.
Mr Rongdondor Lapang	25°44.313'	092°00.037'	874m	For cultivation of vegetables (Tomato, Broccoli, cabbage, lettuce, French bean).
Mrs Shandriana Rympei	25°44.745'	092°01.338'	876m	For cultivation of vegetables (Broccoli, cabbage, French bean) and for rearing of Poultry.
Mr Bolbahadur Sarki	25°44.571'	092°00.872'	882m	For cultivation of vegetables (French bean) and for rearing Cows.
Mrs Blianda Lapang	25°44.493'	092°01.057'	874m	For cultivation of vegetables (French bean).

Vermicomposting unit: Community vermicomposting unit (size 6m x 8m x 2.6m) consisting of eight composting tanks (size 2m x 1.5m x 0.75m) has been constructed in Mynsain village with an objective to recycle on farm biomass to increase the fertility of the soil. Vermicomposting unit were constructed with a rectangular bricks columns, cement tanks which are filled with organic wastes and composting is taken up. The biomasses from farmer's field are collected by the community and were used for vermicomposting. After one year of harvesting it was found that the farmers can harvest 5-8 tonnes of vermicompostanually.

Vermi-beds: Five numbers of such beds of the size 12' x '4' x 2' were introduced to the farmers for vermicomposting, and can produce about 1200 kgs to 1500 kgs vermicompost. Vermi-beds can be done on a small scale by farmers with household organic wastes. Crop residue and agricultural waste was collected and filled in this bed by the farmers and decomposition processes are under progress.

Table 38e. List of beneficiary for Vermi-beds and their geographical location of the demonstration site

Name of beneficiary	Latitude (N)	Longitude (E)	Elevation above sea level (m)
Mr. Noviroy Rympei	092'01.318	25'44.729	882
Mr. Skhemlang Lyngdoh	092'01.107	25'44.535	880
Mr. Jril Makhroh	092'01.041	25'44.516	871
Mr. Lanshon Wahlang	092'00.159	25'44.368	484
Mrs. Airisha Kyrsian	092'00.981	25'44.378	887

Improved Farm Yard Manure storage tank

Five numbers of Improved FYM storage tank (Pit and shed) has been constructed in five farmer's field. Pit size of 4m x 3m x 1m was dug and was covered on top with grass and plastics to protect the pits from rainfall. Residues from field were collected inside the pits along with cow dung for decomposing. This will help the farmers to get on farm manure for crop cultivation.

Table 38f. List of beneficiary for improved FYM storage tank and their geographical location of the demonstration site

Name of beneficiary	Latitude (N)	Longitude (E)	Elevation above sea level (m)
Mr. Brola Kyrsian	092'00.884	25'44.339	866
Mrs. Mercy Rynghang	092'01.279	25'44.561	869
Mrs. Batriti Rynghang	092'01.041	25'44.516	880
Mrs. Rilin Makhroh	092'00.857	25'44.144	888
Mrs. Wanroi Kyrsian	092'00.859	25'44.363	884

Land Development and modification

Terracing: Bench terraces were developed in different farmer's field to bring additional area under cultivation. Bench terraces are usually found on medium to steep slope, they consist of beds which are more or less level and risers (walls or bunds). It is easy to grow crops on the beds because it is fairly level. To be effective, bench terraces must be well maintained. The risers planted with grass, and repair them if necessary. Use conservation agriculture on the beds to conserve the soil, encourage water to sink in, and maintain fertility. The newly prepared terraces were applied with lime (2t/ha), FYM (15t/ha) and other biomass to develop soil fertility. The vegetables like groundnut, rice bean, green gram, soybean etc. are planned to cultivate in first year to develop soil fertility. At present, five bench terraces were constructed in different farmer's field of Mynsain village under TSP-NPOF.

Table 38g. List of beneficiary for Terracing and their geographical locations

Name of beneficiary	Area (m^2)	Latitude (N)	Longitude(E)	Elevation above sea level (m)
Mrs Guardian Shadap	2700	25°44.305'	092°00.836'	884m
Mrs Tiewlang Lapang	1332.93	25°44.313'	092°00.036'	874m
Mr Ambor Makhroh	1800	25°44.301'	092°00.048'	873m
Mrs Dapbiang Makhroh	1856.28	25°44.377'	092°01.053'	874m
Mrs Shandriana Rympei	2386.23	25°44.736'	092°00.335'	872m
Mr Synsharsuk Rynghang	2703	25°44.537'	092°01.419'	861m
Mr KJ War	2640	25°44.682'	092°01.273'	884m

Raised and Sunken bed: Raised and Sunken beds were developed for cultivation of vegetables. The dimensions of the raised bed were 0.75-1m Breadth, 10m length, 0.3-0.5m height and the drainage channel (Sunken bed) varies from 0.2-0.5m. A total of 10509.02m^2 area has been brought under vegetablecultivation in lowland through raised and sunken beds. Vegetables such as tomato (Var; Avinash, Rocky) french bean (var. Naga local) potato (var. Kufrimegha), carrot (var. New Kuroda), lettuce etc are grown by the farmers on raised beds.

Table 38h: Location of demonstration sites and beneficiary details

Name of beneficiary	Area (m^2)	Latitude (N)	Longitude (E)	Elevation above sea level (m)	Crops Grown
Mr Aphilous Makhroh	1031.2	25°44.116'	092°00.869'	864m	French bean, Tomato, Potato
Mr Ambor Makhroh	1209.3	25°44.253'	092°00.010'	857m	Frenchbean, tomato, Potato
Mrs Hostina Makhroh	220.70	25°44.218'	092°00.903'	858m	Lettuce
Mrs Dapbiang Makhroh	1466	25°44.402'	092°01.016'	870m	Tomato, frenchbean
Mrs Hunlang Makhroh	582.30	25°44.212'	092°00.882'	860m	Tomato
Mr Debinus Nongsiej	1466	25°44.614'	092°01.100'	840m	Carrot, Tomato, Potato, Frenchbean

Name of beneficiary	Area (m^2)	Latitude (N)	Longitude (E)	Elevation above sea level (m)	Crops Grown
Mr Rongdondor Makhroh	621.28	25°44.083'	092°00.942'	873m	Tomato
Mr Shaibor Makhroh	1085.88	25°44.090'	092°00.879'	866m	Tomato
Mr Bankhrawbok Rynghang	469.82	25°44.590'	092°01.092'	844m	Frenchbean
Mrs Rina Lapang	1520.40	25°44.151'	092°00.900'	862m	Tomato, Potato, Frenchbean
Mrs Paleiti Makhroh	836.14	25°44.094'	092°00.916'	869m	Tomato
Total Area = 10509.02m^2					

Fruit trees plantation

Four hundred numbers each of Peach and Guava seedlings were planted in different farmer's field in the month of July covering an area of about 1 Acre. Pits (size 1 x 1x 1 m) were dug at 5 x 5 m apart and were incorporated with upper 30 cm soil along with 3 to 5 kg FYM. In the initial stages, trees were allowed to grow as a single upright stem up to a height of 70 to 80 cm. The shoots emerging from ground level or below the graft/bud union and dried twigs were removed periodically. Four varieties were planted in the field namely Allahabad Safeda, RCGH-1 and RCGH-7, RCGH-4. The survival percentage is about 85%, the remained intercultural practices are being followed by the farmers.

Table 38i. Location of Fruit plantation sites and beneficiary details

Name of beneficiary	Latitude (N)	Longitude (E)	Elevation above sea level (m)
Mrs. Ladeishisha Nongsiej	25°44.618'	092°01.360'	867m
Mrs. Kynshew Rynghang	25°44.657'	092°01.303'	872m
Mr. Alexander Rynghang	25°44.432'	092°01.012'	855m

Pineapple plantation

Five thousand numbers of pineapple suckers (Var. kew) were planted during monsoon in four farmers field covering an area of 2500 m^2, plantation was done across the slope to ensure higher yield by reducing soil loss. Planting was done at a spacing of 30 x 60 x 90 cm in double row method of planting, i.e. suckers were planted at a distance of 30 cm from plant to plant in the line and 60 cm in between two lines and 90 cm between two double rows. Well rotten FYM @ 1kg/pit were applied at the time of planting.

Improved maize varieties

Improved maize variety viz. DA-61A @150kg, RCM-1-3@20kg were distributed to the farmers for comparison with the available local variety.

Table 38j: Area and production of different Maize variety in farmer's field

Name of beneficiary	Area (m^2)	Production (kg)	Yield (kg/ m^2)	Yield (t/ha)
		DA-61-A		
Mrs. Shalita Lyngdoh	266	78	0.293	2.932
Mrs. Entermi Lyngdoh	150	46	0.307	3.067
Mrs. Bahunlang Muktieh	200	59	0.295	2.950
Mr. Comfortable Muktieh	233	84	0.361	3.605
Mrs. Lilda Lyngdoh	240	72	0.300	3.000
Mrs. Tina Kyrsian	160	56	0.350	3.500
Mrs. Banriing Rynghang	250	61	0.244	2.440

Name of beneficiary	Area (m^2)	Production (kg)	Yield (kg/ m^2)	Yield (t/ha)
Mrs. Sophimon Rynghang	144	42	0.292	2.917
Mrs. Entinora Rynghang	100	58	0.580	5.800
Mrs. Ladeishisha Nongsiej	156	60	0.385	3.846
Mrs. Skola Kurbah	240	89	0.371	3.708
Mrs. Balensar Makhroh	70	10	0.143	1.429
Mrs. Dapbiang Makhroh	110	60	0.545	5.455
Mrs. Wanroi Kyrsian	160	77	0.481	4.813
Mrs. Junior Lyngdoh	127	65	0.512	5.118
Mrs. Buromshai Lyngdoh	120	54	0.450	4.500
Mr. Jril Makhroh	120	71	0.592	5.917
Mr. Debinus Nongsiej	84	60	0.714	7.143
Mrs. Balahun Makhroh	60	35	0.583	5.833
Mrs. Bianglu tRympei	115	49	0.426	4.261
Mrs. Shalala Rympei	137	60	0.438	4.380
Mrs. Bedeona Rympei	55	25	0.455	4.545
Mrs. Shaldiana Rympei	120	55	0.458	4.583
Mrs. Elis Lapang	98	47	0.480	4.796
Mrs. Sorida Rynghang	60	32	0.533	5.333
Mrs.Bibirilang Rympei	55	25	0.455	4.545
Mrs. Mercy Rynghang	178	68	0.382	3.820
Mrs. B. Lyngdoh	160	50	0.313	3.125
Mr. Bensimai Nongsiej	77	32	0.416	4.156
Mrs. Perila Rynghang	72	46	0.639	6.389
Mean	**137.23 ± 62.5**	**54.20 ± 18.3**	**0.43 ± 0.1**	**4.26 ± 1.3**
		RCM-1-3		
Mrs. Rina Lapang	150	30	0.200	2.000
Mrs. Brola Kyrsian	105	44	0.419	4.190
Mrs. Tiewlang Lapang	60	18	0.300	3.000
Mrs. Merinda	127	51	0.402	4.016
Mean	**122.38 ± 64.4**	**41.75 ± 21.1**	**0.35 ± 0.1**	**3.49 ± 1.1**
		Local		
Mean	**53.17 ± 29.64**	**10.82 ± 8048**	**0.18 ± 0.04**	**1.85 ± 0.4**

It was found that a total number of 34 farmers were provided with maize seeds of different variety i.e. DA 61 A and RCM 1-3 for comparison with the available local variety. According to the farmer's practices, it was found that the average production is higher in DA-61- A (54.20 ± 18.30) compared to RCM 1-3 (41.75 ± 21.14) and the local variety with the least production (10.82 ± 8048).

Fodder cultivation

Cultivation of fodder crops in degraded land was done with an objective to supply green fodder to the dairy unit. Besides cultivation of fodders in hill slopes would rehabilitate degraded land by reducing soil loss. Fodder cultivation was done in one farmer's field (Mr. Aikylluid Rympei) covering an area of 0.5 acre. Two varieties of fodder viz; Setaria and Co-4 (250 nos. each) were planted at a spacing of 50 x 50 cm along with multipurpose trees at 5 meter distance. FYM @ 500g/pit were applied at the time of planting.

Poultry

230 numbers of poultry chicks (Layer) were distributed to 15 farmers in order to increase the socio-economic condition of the villages. The average eggs layed by each poultry birds were 18-20 numbers per month.

Table 38k. List of beneficiary for poultry rearing

Sl. no	Name of Beneficiary	Nos./Units of Poultry	Eggs Production/ month	Income/month (Rs.)
1.	Mrs. Fianca Masharing	15	-	-
2.	Latiplang Makhroh	15	-	-
3.	Mrs. Aitimon Kyrsian	15	-	-
4.	Mrs. Treil Makhroh	15	-	-
5.	Mrs. Rina Lapang	15	56	448
6.	Aphilous Makhroh	15	94	772
7.	Mrs. Lilda Lyngdoh	15	35	280
8.	Mrs. Barisha Makhroh	15	62	496
9.	Mrs. Perila Rynghang	15	-	-
10.	Mrs. Hynniew Rynghang	15	-	-
11.	Mrs. Kynshew Rynghang	15	-	-
12.	Mrs. Sker Kyrsian	15	-	-
13.	SynsharKurbah	15	-	-
14.	Mrs. Jorda Kyrsian	15	-	-
15.	Jopthiaw Makhroh	15	27	216

Introduction of improved pig variety

Farmers were provided with improved breeds (75% Hampshire and 25% mixed local) of livestock for higher productivity and income. Seven units (one male and one female) improved cross breed piglets was provided to each beneficiary farmers in Mynsain village. Two units of local piglets were also included in farming system for comparisons. After one year, 19 pigs with an average weight 60 kg has been sold by the farmers at an average price of Rs. 200/- per kg.

Hedge row Intercropping

Leguminous hedge row species such as *Tephrosia* sp. was grown at regular interval across the slope (10 to 20 m depending upon the slope). The hedge row species was also grown around the farm to serve as fencing, conserve soils and water and supply nutrient rich green leaf manure. The interspaces would be used for crop production.

Improved rice production: Improved rice production technology has been introduced to the farmers.

Variety: Shahsarang 1, IURON 514.

Cultivation method: Integrated crop management
Spacing: 20 x 20 cm
Seedlings age: 20 days
No. of seedlings/hill:2

Organic Vegetables and Crop Production

Leguminous crops: Crops like groundnut, soybean etc. were cultivated in newly constructed terraces to develop fertility of the soil. Groundnut (Var. ICGS 76 @ 30 kg) and Soybean (Var. JS 81) were demonstrated in different farmer's field and was found that 750 kg of groundnut were produce from an area of 3000 square meter.

Table 38k. Area and production of groundnut in farmers' field

Sl no.	Farmer's Name	Area (m^2)	Production (kg)	Production (kg/m^2)	Production (t/ha)
1	Mrs. Shaldiana Rympei	120	15	0.125	1.250
2	Mrs. Shalita Lyngdoh	66	6.25	0.095	0.947
3	Mrs. Guardian Shadap	90	10.5	0.117	1.167
4	Mr. Ambor Makhroh	56	7	0.125	1.250
5	Mrs. Dapbiang Makhroh	112.5	10	0.089	0.889
6	Mr. Rongdondor Makhroh	84	9	0.107	1.071
7	Mrs. Barisha Makhroh	49	4.125	0.084	0.842
8	Mr. Aphilous Makhroh	72	5.5	0.076	0.764
9	Mr. Phlan Kyrsian	75	8.5	0.113	1.133
10	Mrs. Rias Makhroh	105	10.2	0.097	0.971
	Mean	**82.95 ± 23.88**	**8.61 ± 3.11**	**0.10 ± 0.02**	**1.03 ± 0.17**

Turmeric Plantation: Turmeric is one of the major spices in northeastern region, though turmeric has not occupied a significant area in the region due to non-existence of processing industry but now some farmers of the adopted village have started growing turmeric. About 900 kg of turmeric rhizome (Var. Megha Turmeric-1) were distributed to different farmers. Most of the farmers were planted in raised bed (Bun System) at a spacing of 30 x 30cm and FYM applied @ 2kg/m^2.

Table 38l. List of beneficiary for Turmeric plantation and their Production

Name of beneficiary	Area (m^2)	Production (kg)	Yield (kg/ m^2)	Yield (t/ha)
Mrs. Krias Makhroh	330	603.2	2.08	20.80
Mrs. Burom Lyngdoh	275	661.92	2.76	27.58
Mrs. Rias Makhroh	260	364	1.40	14.00
Mrs. Ladei Nongsiej	300	735	2.45	24.50
Mrs. Trias Makhroh	286	612.04	2.14	21.40
Mrs. Briap Kyrsian	180	241.2	1.34	13.40
Mrs. Shalita Lyngdoh	156	117	0.75	7.50
Jopthiaw Makhroh	169	231.53	1.37	13.70
Mrs. Hynniew Rynghang	195	272.22	1.40	13.96
Mrs. Sharai Rynghang	130	326.82	2.51	25.14
Mrs. Sophimon Rynghang	192	192.77	1.00	10.04
Mrs. Elis Lapang	144	171.94	1.19	11.94
Mrs. Melis Rympei	120	224.4	1.87	18.70
Mr. Ambor Makhroh	182	318.5	1.75	17.50
Mrs. Rachel Lapang	145.2	297.66	2.05	20.50
Mr. Lanshon Wahlang	172.2	200.10	1.16	11.62
Mean	**197.59 ± 59.17**	**348.14 ± 193.84**	**1.70 ± 0.59**	**17.02 ± 5.88**

French bean: A total of 43 kg French bean seeds (Var. Naga local) were provided to twenty one numbers of beneficiaries in Mynsain village for crop diversification, the seed were planted at a spacing of 30 x 15 cm and FYM @ 10 t/ha was incorporated. The average production was found to be (1.67 ± 0.69 t/ha).

Broccoli: 40 g of Broccoli seeds (Var. Fiesta) were introduced to three farmers in Mynsain village, nursery preparation and other inter cultural practices was done by the farmers, the seedling was transplanted at a recommended spacing of 45 x 30 cm and FYM @10-15 t/ha was incorporated before transplanting of the seedlings. The average yield was found to be (3.90 ± 0.61 t/ha).

Table 38m. List of beneficiaries, Area and Production of French beans in Mynsain Village

		French bean (Var. Naga Local)			
Sl. No.	**Name of Famers**	**Area (m^2)**	**Production (kg)**	**Yield (kg/ m^2)**	**Yield (t/ha)**
1	Mrs. Melis Rympei	100	26	0.26	2.60
2	Mrs. Shandriana Rympei	80	10	0.125	1.25
3	Mrs. Entinora Rynghang	230	60	0.26	2.61
4	Mrs. Ladei Nongsiej	130	29	0.22	2.23
5	Mrs. Mercy Rynghang	150	30	0.2	2
6	Mrs. Pretiwon Rynghang	100	20	0.20	2.00
7	Mr. Synsharsuk Rynghang	110	30	0.27	2.73
8	Mrs. Guardian Shadap	140	40	0.29	2.86
9	Mrs. Skola Kurbah	150	10	0.07	0.67
10	Mrs. Pynsan Rynghang	350	58	0.17	1.66
11	Mrs. Paleiti Makhroh	120	20	0.17	1.67
12	Mrs. Hostina Makhroh	100	10	0.1	1
13	Mr. Consider makri	260	48	0.18	1.85
14	Mr. Ambor Makhroh	140	15	0.11	1.07
15	Mrs. Rachel Lapang	130	20	0.15	1.54
16	Mr. Rongdondor Makhroh	120	10	0.08	0.83
17	Mr. Aphilous Makhroh	300	27	0.09	0.90
18	Mr. Morning Lapang	100	10	0.1	1
19	Mr. Debinus Nongsiej	180	15	0.08	0.83
20	Mr. Bankhrawbok Rynghang	115	25	0.22	2.17
21	Mrs. Dapbiang Makhroh	225	35	0.16	1.56
	Mean	**158.57 ± 7**	**26.10 ± 15.2**	**0.17 ± 0.07**	**1.67 ± 0.69**

Table 38n. List of beneficiaries, Area and Production of Broccoli in Mynsain Village

		Broccoli (Var. Hybrid Broccoli Fiesta)			
Sl. No.	**Name of Famers**	**Area (m^2)**	**Production (kg)**	**Yield (kg/ m^2)**	**Yield (t/ha)**
1	Mrs. Ladei Nongsiej	200	75	0.37	3.75
2	Mrs. Pynsan Rynghang	115	53	0.46	4.60
3	Mrs. Phairi Rynghang	90	30	0.33	3.3
	Mean	**135 ± 60.1**	**52.67 ± 15.6**	**0.39 ± 0.06**	**3.90 ± 0.61**

Cabbage: 50g of cabbage seeds (Var. Fiesta) were introduced to five farmers in Mynsain village, nursery preparation and other inter cultural practices was done by the farmers, the seedling was transplanted at a recommended spacing of 45 x 45 cm and FYM @10-15 t/ha was incorporated before transplanting of the seedlings. The average yield was found to be (4.38 ± 1.62 t/ha).

Potato: 30 kg of potato tubers (Var. Kufri megha) were provided to eleven farmers in Mynsain village, the sprouted seeds tubers were planted in temporary raised beds made by the farmers in paddy field after

		Cabbage (Var. Hybrid Cabbage US 2125)			
Sl. No.	Name of Famers	Area (m^2)	Production (kg)	Yield (kg/ m^2)	Yield (t/ha)
1	Mr. Aphilous Makhroh	100	40	0.40	4.00
2	Mrs. Entinora Rynghang	180	63	0.35	3.50
3	Mrs. Melis Rympei	40	21	0.52	5.25
4	Mrs. Phairi Rynghang	60	15	0.25	2.50
5	Mrs. Pynsan Rynghang	6	4	0.66	6.66
	Mean	**77.20 ± 66.78**	**28.60 ± 23.24**	**0.44 ± 0.16**	**4.38 ± 1.62**

		Potato (Var. Kufri megha)			
Sl. No.	Name of Famers	Area (m^2)	Production (kg)	Yield (kg/ m^2)	Yield (t/ha)
1	Mrs. Perila Rynghang	8	11.85	1.48	14.81
2	Mr. Debinus Nongsiej	22.19	17	0.77	7.66
3	Mr. Aphilous Makhroh	13.51	9	0.67	6.66
4	Mr. Ompher Nongsiej	8.72	4	0.46	4.59
5	Mr. Bankhrawbok Rynghang	5.53	5	0.90	9.04
6	Mr. Ambor Makhroh	16.35	14	0.86	8.56
7	Mr. Bensimai Nongsiej	9.81	7.75	0.79	7.90
8	Mrs. Skola Kurbah	18.26	7.5	0.41	4.11
9	Mrs. Syrpai Rympei	10.9	6.42	0.59	5.89
10	Mrs. Tiewlang Lapang	6.66	3.45	0.52	5.18
11	Mrs. Merinda Lapang	8	2.25	0.28	2.81
	Mean	**11.63 ± 5.31**	**8.02 ± 4.63**	**0.70 ± 0.32**	**7.02 ± 3.24**

rice harvesting. The tubers were planted in furrows at the spacing of 50 x 30 cm and FYM @ 10-15 t/ha were applied in opened furrows before planting. The Average yield was (7.02 ± 3.24 t/ha).

Bitter gourd: 80g of Bitter gourd seeds (Var. Malay 101) were provided to three farmers in Mynsain village, before planting the soil were ploughed thoroughly 3-4 times through digging with spades and well rotten FYM @ 15 t/ha is mixed at the time of ploughing. The seeds are planted at the spacing of 1.5 to 2.5m (row to row) x 60 to120cm (plant to plant). The average yield was found to be (7.11 ± 1.86 t/ha).

		Bitter Gourd (Var. Malay 101)			
Sl. No.	Name of Famers	Area (m^2)	Production (kg)	Yield (kg/ m^2)	Yield (t/ha)
1	Mr. Pynskhem Kharsohnoh	120	70	0.58	5.83
2	Mr. Debinus Nongsiej	40	37	0.93	9.25
3	Mr. Bankhrawbok Rynghang	40	25	0.63	6.25
	Mean	**66.67 ± 46.19**	**44 ± 23.30**	**0.71 ± 0.19**	**7.11 ± 1.86**

Cucumber: 90g of Cucumber seeds (Var. Malini) were provided to farmers in Mynsain village, before planting the soil were ploughed thoroughly 3-4 times through digging with spades and well rotten FYM @ 15 t/ha is mixed at the time of ploughing. The seeds are planted at the spacing of 1.5 to 2.5m (row to row) x 60 to 90cm (plant to plant). The average yield was found to be (8.72 ± 0.81t/ha).

		Cucumber (Var. Malini)			
Sl. No.	Name of Famers	Area (m^2)	Production (kg)	Yield (kg/ m^2)	Yield (t/ha)
1	Mrs. Hynniew Rynghang	90	73	0.81	8.11
2	Mrs. Skola Kurbah	100	96	0.96	9.60
3	Mrs. Guardian Shadap	78	60	0.77	7.69
4	Mrs. Rachel Lapang	105	88	0.84	8.38
5	Mrs. Sophimon Rynghang	60	52	0.87	8.67
6	J. Nongsiej	80	74	0.93	9.25
7	Mrs. Iarihun Lapang	84	85	1.01	10.12
8	Mr. Bolbahadur Syrki	120	105	0.88	8.75
9	Mr. Rophin Kurbah	75	59	0.79	7.87
	Mean	**88 ± 18.01**	**76.89 ± 18**	**0.87 ± 0.08**	**8.72 ± 0.81**

Lettuce: 60g of lettuce seeds (Var. Iceberg Cabbage TYP) were provided to six numbers of farmers in Mynsain village, seedlings were planted on temporary raised beds in low land area after rice harvesting. The seedlings are transplanted at the spacing of 45 x 30 cm and FYM @ 10t/ha were applied at the time of planting. The average yield was found to be (4.11 ± 0.70 t/ha).

		Lettuce (Iceberg Cabbage TYP)			
Sl. No.	Name of Famers	Area (m^2)	Production (kg)	Yield (kg/ m^2)	Yield (t/ha)
1	Mrs. Hostina Makhroh	50	20	0.40	4.00
2	Mr. Shemphang Rympei	130	42	0.32	3.23
3	Mrs. Pynsan Rynghang	80	34	0.43	4.25
4	Mrs. Entinora Rynghang	60	32	0.53	5.33
5	Mrs. Ladei Nongsiej	115	47	0.41	4.09
6	Mrs. Phairi Rynghang	40	15	0.38	3.75
	Mean	**79.17 ± 36.39**	**31.67 ± 12.34**	**0.41 ± 0.07**	**4.11 ± 0.70**

Tomato: 200g of tomato seeds (Var. Avinash and Rocky) were introduced to the farmers of Mynsain village, seedlings were planted on temporary raised beds in low land area after rice harvesting. The seedlings are transplanted at the spacing of 60 x 45 cm and FYM @ 20t/ha were applied at the time of planting. The average yield was found to be higher in Rocky (18.79 ± 4.19 t/ha) than in Avinash (17.15 ± 6.31).

		Tomato (Var. Avinash)			
Sl. No.	Name of Famers	Area (m^2)	Production (kg)	Yield (kg/ m^2)	Yield (t/ha)
1	Mrs. Sophimon Rynghang	27	60	2.22	22.22
2	Mrs. Jiaryngkhat Nongsiej	100.45	150	1.49	14.93
3	Mr. Lanshon Wahlang	40.39	100	2.48	24.76
4	Mrs. Ladei Nongsiej	145.75	250	1.72	17.15
5	Rophin Kurbah	54.05	50	0.93	9.25
6	Mrs. Hunlang Makhroh	96.82	140	1.45	14.46
7	Mr. Borkin Rynjah	76.86	60	0.78	7.81
8	Mr. Shlur Makhroh	496.7	900	1.81	18.12
9	Mrs. Skola Kurbah	132.6	340	2.56	25.64
	Mean	**130.07 ± 143.15**	**227.78 ± 269.94**	**1.71 ± 0.63**	**17.15 ± 6.31**

		(Var. Rocky)			
10	Mrs. Paleiti Makhroh	297.8	600	2.01	20.15
11	Mrs. Hostina Makhroh	100.34	180	1.79	17.94
13	Mr. Ambor Makhroh	330.07	800	2.42	24.24
14	Mr. Rongdondor Makhroh	329.3	780	2.37	23.69
15	Mr. Aphilous Makhroh	255.24	425	1.67	16.65
16	Mr. Morning Lapang	79.56	90	1.13	11.31
17	Mr. Debinus Nongsiej	136.2	270	1.98	19.82
18	Mrs. Dapbiang Makhroh	212	350	1.65	16.51
	Mean	**217.56 ± 101.73**	**436.88 ± 266.74**	**1.88 ± 0.42**	**18.79 ± 4.19**

Soybean

		Soybean			
Sl. No.	**Name of Famers**	**Area (m^2)**	**Production (kg)**	**Yield (kg/ m^2)**	**Yield (t/ha)**
1	Mrs. Shaldiana Rympei	35	3	0.086	0.857
2	Mr. Shemphang Rympei	22.5	1.35	0.060	0.600
	Mean	**28.75 ± 8.84**	**2.18 ±1.17**	**0.07 ± 0.02**	**0.73 ± 0.18**

Sweet potato: 500 numbers of sweet potato cuttings (Var. Kokrajhar) were planted in two farmers at a spacing of 50 x 50 cm on raised beds, inter cultural operation (weeding and earthing up) followed after 30 days of planting by the farmers and FYM @ 10-15 t/ha were incorporated. The average yield was found to be (19 ± 1.41 t/ha).

		Sweet potato cuttings (Var. kokrajhar)			
Sl. No.	**Name of Famers**	**Area (m^2)**	**Production (kg)**	**Yield (kg/ m^2)**	**Yield (t/ha)**
1	Mr. Lamphrang Rympei	16	28.8	1.800	18
2	Mrs. Skola Kurbah	18	36	2.000	20
	Mean	**17 ± 1.41**	**32.4 ± 5.09**	**1.90 ± 0.14**	**19 ± 1.41**

Organic ginger cultivation was adopted by the farmers (Mrs Hynniew Rynghang) covering an area of 2858.4 square meter. Quantity of planting was eight quintal with a production of Twenty four quintal. Mostly the farmers were doing mixed cropping of ginger-colocasia – chlli for higher productivity.

Integrated Farming System (IFS) practiced by the Farmers in Mynsain Village

Seven farmers in Mynsain village have already started practicing organic farming in integrated farming system (IFS) mode. They integrated crops (Rice, Maize), Vegetables (Tomato, French bean, Potato, Lettuce, Carrot), Livestock (Dairy/ Piggery), Water harvesting (Jalkund) etc in IFS mode.

ITKs documented from Mynsain village

For Management of pest and diseases in Crops

a. Maize seed mixed with turmeric (Shynrai) before sowing helps to protect the seeds from disease attack during seedling stage, the method is prevalent in some places of RiBhoi district included the





Integrated Organic Farming System in Mynsain village

List of farmers for IFS model

Sl. No.	Farmers	Farming Components	NRM
1	Rias Makhroh	Pineapple + Turmeric + Vegetables+ Dairy + Poultry	Jalkund
2	Ladeishisha Nongsiej	Fruit Trees (Guava, Carambola, Pomelo, Banana) + Vegetables + Dairy	Jalkund
3	Entinora Rynghang	Fruit Trees (Guava, Carambola, Banana) + Vegetables + Piggery + Dairy	Jalkund
4	Pynsanlang Rynghang	Vegetables + Piggery + Poultry + Apiculture	Jalkund
5	Lamphrang Rympei	Rice + Vegetables + Piggery + Poultry + Pisciculture	Ponds
6	Skola Kurbah	Vegetables + Piggery + Dairy	Jalkund
7	Hynniew Rynghang	Vegetables + Piggery + Poultry	Jalkund

Mynsain village where maize cultivation is usually done; this method is generally practiced by khasi people of Meghalaya.

Materials required: Turmeric (powdered)

Process involved: Selection of maize seed was done by soaking the seed in water in which the infected seed will float on the surface of water, the selected seeds was taken in a plate/ vessel where turmeric powdered were added and mixed.

Quantity required: 200g of grounded turmeric in 1kg of maize seeds.

Uses: the mixture of turmeric and maize seeds was directly applied in soil.

Advantage: The application of this method helps to protect the seeds from damages which may cause through pest and diseases attack and also protect the seed from dormancy and late germinations.

b. Leaves of *Cannabis sativa*to protect crops from pests:

Community/Area: Khasi/RiBhoi District of Meghalaya

Materials required: *Cannabis sativa,* Soil.

Process involved: Cannabis leaves and soil is mixed in the ratio of 1:1 and is kept for 12- 24 hours for proper intermingling. Then the mixture is applied on paddy and ginger cultivations, the mixture protect paddy and ginger from all kind of pest and disease attack and acts as repellant of stored grain pests.

c. Twigs and leaves of Sla Latdoh and pine trees : Sla Latdoh and pine trees needle was placed in rice field to prevent the plants from pest and diseases, this method was mainly practiced by the khasi community and is also prevalent in RiBhoi district of Meghalaya.

Materials required: Sla Latdoh/pine trees needle

Process involved: The whole plant (Sla Latdoh) was placed at water entrance and sometimes the leaves of pine trees is dipped into the sources of water, the field is kept flooded with this water, after few days the water is drained away, this process is repeated for 3-4 times in each season. Sometimes

the twig and leaves tied together are also placed within the paddy field. This was used for all pests but the main pest targeted is gundhi bug.

d. Mixture of silkworm excrete and Ginger to control pest of paddy:

Community/Area: Khasi/RiBhoi District of Meghalaya

Materials required: Silkworm and Ginger extracts.

Process involved: Silkworm and Ginger extracts were prepared @ 1:1 and was kept overnight for decomposition and then 1 litre of water was added to it, the mixture is applied at the time of fruiting of paddy to protect it from pest and diseases.

Quantity required: Silkworm excrete and Ginger is mixed @1:1 to make a paste.

Uses: The mixture is applied i-when the paddy field is in fruiting stage, it kills soil borne pest and act as disease repellant.

Training cum awareness programme: One training on organic farming system in cluster approach and one field day on conservation agriculture and organic farming were organized during the year.

Infrastructure created and inputs distributed to the beneficiaries under the programme at Umiam

Sl. no.	Particulars	Quantity	Dimension/ Specification	Purpose	No. of beneficiaries
1	**Infrastructure**				
	Ponds construction and Renovation	4 nos.	20m X 20m	Water harvesting and fish culture	4
	Jalkund	17 nos.	5m x 4m x 1 m	Water harvesting	17
	Terracing	7 nos.	-	Bench terraces	7
	Community Vermi-composting Units	1 no.	6m x 8m x 2.6m	Vermicomposting	-
	Improved Farm Yard manure storage tank	5 nos.	4m x 3m x 1m	On farm manure production	5
	Vermi- beds	5 nos.	12' x 4' x 2'	On farm vermicompost	5
2	**Seeds and Planting materials**				
	French bean	43kg	-	Crop diversification	21
	Broccoli	40g	-	Crop diversification	3
	Cabbage	50g	-	Crop diversification	4
	Tomato	720g	-	Crop diversification	40
	Lettuce	180g	-	Crop diversification	14
	Bitter Gourd	80g	-	Crop diversification	3
	Cucumber	200g	-	Crop diversification	9
	Turmeric	900 kg	-	Crop diversification	16
	Potato	530kg	-	Crop diversification	20
	Pea	65kg	-	Zero tillage	38
	Toria	12kg	-	Zero tillage	17
	Groundnut	50kg	-	Crop diversification	20
	Guava	400 nos	-	Integrated farming	3
	Peach	200 nos	-	Integrated farming	2
	Assam lemon	500nos.	-	Integrated farming	50
	Rice	150kg	-	Introduction of improved varieties	10
	Maize	170	-	Introduction of improved varieties	100

Sl. no.	Particulars	Quantity	Dimension/ Specification	Purpose	No. of beneficiaries
	Fodder	500 nos.	-	Supply fodder to dairy units	1
3	**Livestock and Fish**				
	Piglets	10nos.		Integration with farm ponds	5
	Poultry	230nos.	-	Meat and egg	15
	Fingerlings	3000nos.	-	Composite fish culture	10
4	**Inputs for Livestock**				
	Pig feed	300kg	-	Pig nutrition	10
	Poultry feed	550kg	-	Poultry nutrition	15
5	**Tools and Implements**				
	Silpaulin	17 nos.	36 x30 ft. (250gsm)	Lining Jalkund	17
	Paddy Thresher	1 no	-	Paddy threshing	Community
	Maize Sheller	5 nos.	-	Shelling maize	Community
	HP electrical pump	1 no	-	Irrigation	Community
	Rake	5 nos.	-	Collecton on farm residue	Community
	Furrow opener	2nos.	-	Zero tillage crop cultivaton	Community
6	**Training and Awareness programme**				
	Training cum awareness programme on organic farming in cluster approach Field day	3	-		95

8. PUBLICATIONS/HUMAN RESOURCE DEVELOPMENT AND WORKSHOPS/MEETINGS

8.1 Publications

Research Papers

Aher, S.B., Lakaria, B.L., Swami Kaleshananda, Singh, A.B., Ramana, S., Ramesh, K. and Thakur, J.K. (2015). Effect of organic farming practices on soil and perfarmence of soybean (Glycine max) under semi arid tropical conditions in Central India.*Journal of Applied and Natural Science* **7**(1): 67-71.

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Singh, D.K., Akhtar, Z., Gupta, S., Srivastava, A., Singh, V.V. and Sharma, Y. (2016). Sustainable production of organic basmati rice in mollisols of Uttarakhand (India).*Ecology Environment & Conservation* **22**: 335-343.

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Shukla, V.K. and Vishwakarma, S.K. attended National Seminar on "Technologies fir Sustainable Production through Climate Resilient Agriculture" and participated in the poster session on " Development of innovative farming practices to mitigate the effect of climate change at Kymore plateau and Satapura holls zone of Madhya Pradesh is to be held from August 8-9, 2014 at JNKVV, Jabalpur

Shukla, V.K. attended National symposium on " Organic Agriculture" and participated in the poster session on " Studies on Comparative efficiency of organic chemical and integrated nutrient management practices on crop productivity and Soil health under various cropping system" to be held on 26-27 Feb 2015 at Agriculture College and Research Institute Madurai.

Shukla, V.K., Sahu, R.P. and Vishwakarma, S.K. attended National Seminar on "Weather and Climate risks in Agriculture under Changing Climate : Management and Mitigation" and participated in the poster session on "Productivity and economics of scented rice (*Oryza sativa*) – potato (*Solanum tuberosum*) high value cropping system as affected by different nutrient management practices" held at College of Agriculture, Tikamgarh during 12-13 March 2015.

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Radio/TV talk

Aulakh, C.S. had given a radio and TV talk on 14th August and 1th October at Ludhiana.

Singh, A.B. had given a TV talk on "organic farming and vermicomposting" on dated 05/11/2014 at Doordarshan Kendra, Bhopal.

अलसी की उन्नत कृषि कार्यमाला। कार्यक्रम कृषि विश्वविद्यालय से खेतों तक। 20.10.2014 **M, 'kjn fo'odekA**

ग्रीष्म कालीन मूंग व उडद की उन्नत कृषि कार्यमाला। कार्यक्रम कृषि विश्वविद्यालय से खेतों तक। 12.03.2015 **M, 'kjn fo'odekA**

8.2 Human Resource Development

8.2.1 Sponsored training organised for farmers

Name of the institute/ organisation	Name of the trainees	Coordinators	Duration of the training	Nature of training imparted
SIAET, Bhopal	Different organic source of nutrients	Dr A B Singh	6-10 July and 3-7 August, 2015	Farmers training
SIAET, Bhopal	Sources & production of organic inputs	Dr A B Singh	13-17 July, 2015	Farmers training
Project Director, ATMA	Organic Farming	Dr A B Singh	June 06, 2014	Farmers training
1CAR- IISS, Bhopal	Jaivik Khad va Kenchwa Khad Banane ki Bidhi	Dr A B Singh	15 Oct and 08 December, 2014	Farmers training
Mahakaushal Sugar & Power Industry Limited Bachai Narsinghpur, Madhya Pradesh	Vermicompost and Organic manure production	Dr A B Singh	31 August and 01 September, 2014	Farmers training
ICAR-IISS, Bhopal	Jaivik Khad va Kenchwa Khad Banane ki Bidhi	Dr A B Singh	1 october, 2014	Farmers training
State Institute of Agriculture Extension & Training, Bhopal	Organic farming and composting technique	Dr A B Singh	21 Nov., 2014	Extension officers / worker
ICAR- CIAE, Bhopal	Jaivik Khad ka utpadhan evam krishi utpadhan mein yogdan	Dr A B Singh	12 Dec. 2014	Workshop
Deputy Director Agriculture, bhopal	Organic farming and Soil health	Dr A B Singh	6 Feb. 1015	Farmers training
State Institute of Agriculture Extension & Training, Bhopal	Organic farming and Soil health	Dr A B Singh	17 March, 2015	Extension officers / worker

8.2.2 Training organized

- Dr M C Manna, Dr A B Singh and Dr A K Tripathi Organized 21 days Winter School on “Waste Recycling and Resource management through Rapid Composting Techniques” held during December 3-23, 2014. 25 participants from ICAR Institutes and SAU’s were participated in the training.
- Organised Field day programme on farmers field on 19th January, 2015 at Perwalia Sadak, Bhopal.
- Three training cum awareness programme on “Organic farming system in cluster approach” was organized for the farmers of Mynsain village at ICAR Research complex for NEH Region, Umiam, Meghalaya under the project ‘ Network Project on Organic Farming’ (NPOF-TSP) to improved their package and practices skills on organic farming. The objectives of the training were to help the participants to understand the role of organic agriculture, to sustain and enhance the health of

ecosystems and organisms from the smallest in the soil to human beings. In view of this it also help the trainees to avoid the use of fertilizers, pesticides, food additives that may have adverse health effects.

- A Field Day on "Conservation Agriculture and Organic Farming" was organized by Division of Natural Resource Management, ICAR Research Complex for NEH Region, Umiam, Meghalaya on 12th March 2014. About 65 farmers, 25 researchers and stakeholders was participated in the programme.

8.2.3 M.Sc./Ph.D. thesis generated from the project at Jabalpur

S. No.	Name	Thesis title	Degree
1.	Ms. Vibha Daheriya	Evaluation of rice varieties under organic Farming	M. Sc.
2.	Ms. Deepa Sharma	Evaluation of rice varieties under organic farming	M. Sc.
3.	Ms. Gayatri Kori	Productivity of Rice (*Oryza sativa L.*) as affected by Integrated Nutrient Management under Rice-Wheat cropping system in Kymore Plateau and Satpura Hills Zone of Madhya Pradesh	M. Sc.
4.	Ms. Shweta Masram	Production potential of scented rice under different organic nutrient management	M. Sc.
5.	Ms. Princy Jain	Effect of tillage, mulch and fertility levels on productivity and economics of the different cropping systems in Kymore Plateau and Satpura hills	M. Sc.
6.	Mr. Manish Kumar Meshram	Integrated Plant Nutrients Management in rice crop through organic & inorganic sources in vertisol	M. Sc.
7.	Ms. Suchi Gangwar	Agronomic evaluation of biodynamic product and panchgavya for organic calculation of important cropping system	Ph. D.
8.	Ms. Megha Dubey	Studies on comparative efficiency of organic, chemical and integrated nutrient management practices on soil health and crop productivity under various cropping system	Ph. D.

8.3 Workshops/Group Meetings

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. He highlighted the importance of organic farming in niche areas and crops along with important issues such as insect, disease and weed infestation under organic farming. He also urged to develop insect, disease resistant varieties for organic farming and promote the organic farming using farming systems approach with inclusion of the livestock. Dr. S. Bhaskar, Assistant Director General (AAF & CC) & Guest of Honour highlighted the importance of the organic farming and told 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 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. Dr. K.K. Singh, Director, ICAR-CIAE, Dr V.P. Singh, Director, ICAR-NIHSAD, Bhopal and Dr HimanshuPathak, Director, ICAR-NRRI, Cuttak also graced the inaugural session.

Inaugural session

Release of Publications of NPOF scheme

In 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.

Dr Balraj Singh, Vice Chancellor, Rajasthan Agriculture University, Jodhpur, Chief Guest in the plenary session of the Group Meeting informed that organic farming is gaining momentum in India mainly due to soil, livestock and human health concerns and he appreciated the presentation of recommendations of the group meeting in 4 categories such as technologies for upscaling, policy, research and general issues. Dr S. Bhaskar, ADG (AAFCC) while giving his remarks on recommendations stated that outcome of the group meeting will be highly useful for researchers, policy makers and organic growers. Dr AS Panwar, Director, ICAR-IIFSR emphasized on time bound implementation of approved research programmes by all the co-operating 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. The group meeting ended with vote of thanks proposed by Dr N. Ravisankar, National PI, ICAR-IIFSR.

Address by Dr S. Bhaskar, ADG (AAFCC) in Inaugural session

Presentation of best centre certificate to TNAU, Coimbatore by Dr Balraj Singh, Vice Chancellor, RAU, Jodhpur

The consolidated recommendations of the group meeting is given below

A. Research

1. All the old NPOF centres (13 numbers) and 7 AICRP on IFS centres (Jorhat, Jammu, Parbhani, Rahuri, Faizabad, Bichpuri and Kalyani) will undertake the new experiment on **"Evaluation of weed management practices under organic production system"**. Each centre, will submit the specific technical programme for their respective cropping systems based on the overall treatment structure to ICAR-IIFSR within a month for its approval.

2. Yield gap analysis between scientific and farmers organic management should be made by 13 centres (old) by using the geo-referenced characterization and experimental data.

3. Nutrient budgeting under different production systems should be worked out using applied nutrients, removal by crops and balance available at the end of crop cycle.

4. Pest repellent plants in the regions should be identified and included in the IOFS models as pest repellent cafeteria.

5. All the new centres should collect production system wise soil samples up to 1.50 m depth at an interval of 15 cm and depth wise bulk density and SOC should be estimated. This is required for estimation of C sequestration rate.

6. Modifications in cropping systems approved for Karjat (rice-chickpea; rice-field bean; rice-brinjal; rice-onion), Pantnagar (GM-basmati rice-chickpea), SK Nagar (Groundnut-wheat-pearlmillet), Coimbatore (Cotton + redgram-cowpea in IOFS model), Udaipur (Guava in place of papaya in IOFS model) and Umiam (Brocoli).

7. Climate resilient production systems should be identified by using long term meteorological data and experimental yield data. Format for submitting the long term meteorological and yield data will be given by ICAR-IIFSR by October 2016 and data should be submitted by centres to ICAR-IIFSR by 31 December 2016.

8. Bankable project of IOFS model should be prepared by Coimbatore and Umiam centres.

B. Others

1. Training for stability analysis of crop varieties should be imparted to all centres by ICAR-IIFSR by involving plant breeding experts.

2. All the centres should submit data sheets and annual reports by 30th September of every year otherwise subsequent funds will not be released. The annual report should contain all the information including experimental results, publications, collaborative studies, ATR on observations of monitoring visits, publications, trainings, human resource development etc. Both soft and hard copy should be submitted in time.

9. APPENDIX

Details of crops and varieties used in Evaluation of organic, inorganic and integrated production systems for crops and cropping systems at various locations

Crop	Variety
Bajaura	
Black gram (*Kharif*)	Palampur- 93
Lady's Finger (*Kharif*)	P-8
Tomato (*Kharif*)	Roma
Cauliflower (*Rabi*)	PSBK-1
Pea (*Rabi*)	Azad P-1
French bean (*Summer*)	Falguni
Tomato (*Summer*)	HeemSohna
Summer Squash (*Summer*)	Australian Green
Bhopal	
Soybean	JS-335
Durum wheat	HI-(Malwa Shakti) 8498
Mustard	Pusa Bold
Chickpea	JG-130
Linseed	JL-9
Calicut	
Ginger	Varada, Rejatha and Mahima
Turmeric	Prathibha , Alleppey Supreme, Varna, Sobha, Sona, Kanthi, Suvarna, Sudarsana, Kedaram, Prabha
Black Pepper	Sreekara, Panniyur -1
Coimbatore	
G M (Sunnhemp)	CO 1
Cotton	Suraj
Maize	COH(M) 6
Chillies	PKM 1
Sunflower	COSFV5
Beetroot	Ruby queen
Maize	COH(M) 6
Dharwad	
Cowpea	C 152
Safflower	A 1
Pigeonpea	TS-3R
Greengram	DGGV 2
Sorghum	M 35-1
Groundnut	GPBD 4
Hy. cotton	DHB 1062
Maize	ARJUN
Chickpea	A1

Crop	Variety
Karjat	
Rice	Karjat – 4
Groundnut	SB – XI
Maize (Sweet corn)	Sugar – 75
Mustard	Varuna
Dolichos bean (Green pod vegetable)	Konkan Bhushan
Jabalpur	
Basmati rice	Pusa Basmati -1
Wheat	HD 4672
Chickpea	JG-322
Berseem	J B - 1
Vegetable pea	Arkel
Maize	TGK 54
Sorghum fodder	MP Chari
Ludhiana	
Basmati rice	Panjab basmati 3
Pigeonpea	PAU 881
Moong	PAU 911
Wheat	HD 2967
Chickpea	GPF 2
Modipuram	
Basmati rice	PB-6
Rice	Saket-4
Maize Grain	Bajaura pop corn
Green cob	Madhuri
Wheat	HI - 8498
Okra	Arka Anamika
Potato	Chipsona-3
Barley	DWRB-91
Green gram	Pusa vishal
Mustard	Pusa bold
Pantnagar	
Sesbania	Ses pant-1
Basmati rice	Pusa basmati-1
Wheat	UP-2572
Chickpea	Pant kabuli chana-1
Vegetable Pea	Arkel
Potato	Kufri bahar 3797
Coriander	Harit RS-5
Sesbania	Pant Ses-1
Rice	Pusa-1121

Crop	Variety
Soybean	PS 1347
Maize	PSM-3
Pigeon pea	UPAS 120
Moong	PM-5
Cowpea	PL-2
Mustard	PR-15
Okra	ArkaAnamika
Raipur	
Soybean	JS – 335
Maize	Sugar-75
Vegetable pea	Pant sabjimatar" (PSM 3)
Chilli	Agnirekha
Onion	Nasik red

Crop	Variety
Ranchi	
Rice	Birsamati
Wheat	K- 9107
Lentil	PL 406
Potato	KufriAshoka
Linseed	Shekhar
Umiam	
Rice (sunken bed) *kharif*	Shahsarang-1, Lampnah, IR 64 and Vivek Dhan-82
Rice (raised bed)	Bhalum-1
Carrot	New Koroda
Potato	Kufrijyoti
French bean	Naga local
Tomato	Rocky

10. ANNEXURE

ICAR-Network Project on Organic Farming
Contact Address of NPOF Centres (as on 31 March 2016)

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ACRONYMS

ALE : Aquous leaf extract

ASE : Aquous seed extract

BBF : Broad bed and furrow

B:C : Benefit:Cost

BD : Biodynamic

CC : Cost of cultivation

CDM : Cowdung manure

Cu : Copper

DSR : Direct seeded rice

DTPA : Diethylene triamine penta acetic acid

EC : Enriched compost

ECe : Electrical conductivity

Fe : Iron

FB : Flat bed

FYM : Farm yard manure

GLM : Green leaf manure

GM : Green manure

GR : Gross returns

IOFS : Integrated organic farming system

ITK : Indigenous technical knowledge

K : Potassium

KC : Karanj cake

Mn : Manganese

MOP : Muriate of potash

N : Nitrogen

NC : Neem coated

NEOC : Non edible oil cakes

NPV : Nuclear Polyhedrosis virus

NR : Net returns

NRPRI : Net return per rupee invested

OC : Organic carbon

P : Phosphorus

PG : Panchagavya

pH : Negative logarithum of hydrogen ion concentration

PPM : Parts per million

RBD : Randomized block design

RP : Rock phosphate

RSB : Raised and sunken bed

SRI : System of rice intensification

SSP : Single super phosphate

TSP : Tribal sub plan

VC : Vermicompost

Zn : Zinc

NOTES

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