

**A STUDY ON THE IMPACT ASSESSMENT OF
KRISHI VIGYAN KENDRAS
IN ANDHRA PRADESH**

**By
B. MALATHI**

M.Sc. (Ag.)

**THESIS SUBMITTED TO THE
ACHARYA N. G. RANGA AGRICULTURAL UNIVERSITY
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**DOCTOR OF PHILOSOPHY
(AGRICULTURAL ECONOMICS)**

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GUNTUR, ANDHRA PRADESH**

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2018

CERTIFICATE

Ms. B. MALATHI has satisfactorily prosecuted the course of research and that thesis entitled “**A STUDY ON THE IMPACT ASSESSMENT OF KRISHI VIGYAN KENDRAS IN ANDHRA PRADESH**” submitted is the result of original research work and is of sufficiently high standard to warrant its presentation to the examination. I also certify that neither the thesis nor its part thereof has been previously submitted by her for a degree of any University.

Date: 03-04-2018

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CERTIFICATE

This is to certify that the thesis entitled “**A STUDY ON THE IMPACT ASSESSMENT OF KRISHI VIGYAN KENDRAS IN ANDHRA PRADESH**” submitted in partial fulfilment of the requirements for the degree of **DOCTOR OF PHILOSOPHY IN AGRICULTURE (AGRICULTURAL ECONOMICS)** of the Acharya N. G. Ranga Agricultural University, Guntur is a record of the bonafide original research work carried out by **Ms. B. MALATHI** under our guidance and supervision.

No part of the thesis has been submitted by the student for any other degree or diploma. The published part and all assistance received during the course of the investigations have been duly acknowledged by the author of the thesis.

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DECLARATION

I, **B. MALATHI**, hereby declare that the thesis entitled “**A STUDY ON THE IMPACT ASSESSMENT OF KRISHI VIGYAN KENDRAS IN ANDHRA PRADESH**” submitted to **Acharya N.G. Ranga Agricultural University** for the degree of **DOCTOR OF PHILOSOPHY IN AGRICULTURE (AGRICULTURAL ECONOMICS)** is the result of original research work done by me. I also declare that no material contained in the thesis has been published earlier in any manner.

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ABSTRACT

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The present study attempts to evaluate the impact of Krishi Vigyan Kendras

With the following objectives:

1. To study the impact of Krishi Vigyan Kendras in productivity enhancement by bridging the yield gaps.
2. To evaluate the impact of vocational training programmes conducted by Krishi Vigyan Kendras in the study area.
3. To assess the economic benefits from the adoption of improved technologies.
4. To assess the factors contributing to the adoption of improved technologies by the farmers.

Andhra Pradesh state was purposively selected for the study. Three KVKs, one KVK from SAUs (KVK-Amadalavalasa, Srikakulam district), one from ICAR (KVK-Kalavacharla, East Godavari district) and one from NGOs (KVK-Yagantipalli, Kurnool district) were selected for the study which has completed minimum five years of functioning. A total of 360 farmers constituting 180 beneficiaries and 180 non-beneficiaries of the improved technology provided by the sampled KVKs, and 150 trainees were selected randomly making a total sample size of 510. Both primary and secondary data

were collected for the present investigation. The analytical models used for analyzing the data were technology adoption index, Cobb-Douglas type of production function, regression, decomposition analysis, Lorenz curves and Gini concentration ratio.

Impact of Krishi Vigyan Kendras on crop yields and returns revealed that, in KVK-Amadalavalasa increase in yield (12.80 q ha^{-1}) and per cent increase in net returns (42.94 %) over farmers practice were highest in case of mechanized system of rice intensification. Zero tillage maize technology resulted in increased net returns of Rs. 18,106 per hectare over farmers practice. In KVK-Yagantipalli, the results of frontline demonstrations in rice revealed that the increase in yield was highest in case of management of problematic soils i.e. reclamation of sodic soils with gypsum application as per soil test results (20.88 %) followed by foliar application of zinc (14.98 %) and integrated weed management (9.59 %) over farmers' practice. In redgram improved technology registered overall 25.34 per cent increase in yield over the farmers' practice with increase in net income of 44.56 per cent. Under KVK - Kalavacharla, in rice the yield of demonstration plots exceeded that of farmer's plots in all FLDs. In case of banana, it was found that increase in yield was highest (38.03 percent) in nutrient management with direct feeding of banana bunches, which resulted healthy fingers in banana.

Factors affecting productivity estimated by Cobb-Douglas production function for the improved technology/ variety revealed that seed in STCR paddy (0.162), HYV redgram (0.378) and planting material in direct feeding of nutrients and skirting of bunches in banana (0.944) were positively significant. Machine labour in MSRI rice (0.219) and human labour in STCR rice (1.945), HYV rice (0.26) and direct feeding and skirting of bunches in banana (0.104) were positively significant. Nitrogen was positively significant in zero tillage maize (0.138), HYV redgram (0.44) while it was negatively significant in STCR rice (-0.159). Phosphorous was positively significant in HYV rice (0.666) and MSRI rice (0.259). Potash was positively significant (0.162) in farmers' practice of rice in KVK-Amadalavalasa, STCR rice (0.204), HYV redgram (0.138) and farmers' practice (0.25) and direct feeding and skirting of banana bunches in banana (0.035). Irrigation was found to be positively significant in zero tillage maize (0.112), HYV rice (0.24) and direct feeding and skirting of bunches in banana (0.094).

The decomposition analysis of yield gap between the improved technology/ variety and the farmers' practice/ local variety indicated that the technology gap was the major contributing factor in the total difference in productivity in all the crops among all the three KVKs which was highest in case of soil test crop response (STCR) in paddy (392.98 %) in KVK-Yagantipalli of Kurnool district.

All the vocational trainings have given a boost to trainees by giving supplementary income and employment.

Lorenz curves and Gini concentration ratios depicted that there were comparatively lesser inequalities in distribution of income obtained from improved cultivation practices of crops when compared with the inequalities in distribution of income obtained from farmer's practices.

The technological adoption index (TAI) calculated for 180 technology adopting farmers indicated that all the farmers belonged to medium and high adoption category. Age of the farmer was a negative contributor in all the crops which revealed that with the increase in age of the farmer technology adoption level decreases. Educational level of the farmer had positive and significant contribution in the technology adoption of MSRI and STCR technology in rice. KVK training is the major contributor in the technology adoption whose impact was positive in all the three KVKs.

The important policy implications from the study are:

Forward linkages in terms of post-harvesting, transportation, packaging and marketing are necessary for new products or high yield products. KVK should focus on post harvest techniques to support farmers especially processing to encourage them to adopt new technologies. KVKs should be developed as resource centres which can provide/facilitate the access to inputs for farmers which are the crucial factor in the adoption of new technology. Krishi Vigyan Kendra in the district need to provide proper technical support to the farmers through different educational and extension methods to reduce the extension gap for better production in the district by creating awareness among the farmers about new technologies. Modernization of soil testing labs, keeping the farmers' needs in focus while providing training, focus upon new emerging areas like climate change, pre-harvest management and non-farm activities are need to be considered by the KVKs, host organizations and ICAR (Indian Council of Agricultural Research). Measures to be adopted to increase the outreach of KVKs by adopting innovative techniques viz. forming farmers groups, train farmers-trainer, redefining cluster approach, continuous interaction at village level, need based training, use of ICT (Information and Communication Technology), etc. To cope with the future challenges of technical advancement, the existing vocational and technical training system needs to be improved and marked with the needs of the economy. To support and to mobilize entrepreneurial skills of the farmers, KVKs should coordinate to start agri-business centres by the farmers in villages. Better feedback mechanism is needed and KVKs should follow up the trainee farmers, rural youth and women after the completion of training programmes to make sure that they will adopt the newly acquired skill in creation of employment which will eventually lead to increased income levels and livelihood security. The study leads to the observation that KVKs are playing a pro-active role in transferring new technology at field level and with beneficial impacts, but a lot is yet to be done to bridge the yield gaps in crops and entrepreneurial development of rural community.

Chapter I

INTRODUCTION

Agriculture with its allied sectors is unquestionably the largest livelihood provider in India, more so in the vast rural areas. The agriculture sector employs nearly half of the workforce in the country. However, it contributes to 17.5 % of the GDP (at current prices in 2015-16). Over the past few decades, the manufacturing and services sectors have increasingly contributed to the growth of the economy (Ministry of Agriculture, 2015), while the agriculture sector's contribution has decreased from more than 50 % of GDP in the 1950s to 15.4 % in 2015-16 (at constant prices).

India's production of food grains has been increasing every year, and India is among the top producers of several crops such as wheat, rice, pulses, sugarcane and cotton. It is the highest producer of milk and second highest producer of fruits and vegetables. However, the agricultural productivity is found to be lower in the case of most crops, as compared to other top producing countries such as China, Brazil and the United States. Total production of food grains increased from 51 million tons in 1950-51 to 252 million tons in 2015-16. According to the second advance estimate by the Ministry of Agriculture, food grains production is estimated to be 275.68 million tons in 2016-17. The country's requirement for food grains in order to provide for its population is projected to be 300 million tons by 2025. This implies that the crop output needs to grow at an annual average of 2 %, which is close to the current growth trend.

Key issues affecting agricultural productivity include the decreasing sizes of agricultural land holdings, continued dependence on the monsoon, inadequate access to irrigation, imbalanced use of soil nutrients resulting in loss of fertility of soil, uneven access to modern technology in different parts of the country, lack of access to formal agricultural credit, limited procurement of food grains by government agencies, and failure to provide remunerative prices to farmers. Given the importance of agriculture sector, Government of India initiated several

steps for its sustainable development in terms of food security, rural employment and environmentally sustainable technologies such as soil conservation, natural resource management and biodiversity protection which is essential for holistic rural development.

The National Agricultural Research System (NARS) in India has made efforts for propelling agricultural growth and achieving sustainable production in agriculture and its allied sectors through its research and various extension education programmes. This led to ushering in green, yellow, white and blue revolutions in agriculture in the country and significantly increased the production of food grains, oilseeds, milk and fish. However, ever increasing population and changes in food habits, climate change, natural resource base degradation necessitates new strategies and innovations for accelerating agricultural growth. Given the limited scope for increasing agricultural production through expansion in cultivated area, the only alternative to meet the requirements of the increasing population is through increasing productivity.

In spite of the various initiatives by the Government, agriculture universities, research institutions and other stakeholders, the productivity of Indian agriculture still remains low compared to many developing and developed countries, which is a cause of concern. Agricultural innovations and diffusion of new technologies are key drivers to attain food and nutritional security in the country besides providing farmers a competitive edge over traditional farming, thus facilitating better standards of living. Farming in different resource endowments must be sustainable, economical and intensive in order to provide dependable, long-term support for rural households. To realize their true potential, farmers must have access to the state-of-the-art technologies, necessary inputs and related information in all the segments, be it crop, livestock or fisheries. In this context, the Government of India through Indian Council of Agricultural Research (ICAR) has established a wide network of Krishi Vigyan Kendras (KVKs) in all the rural districts of the country for the cause of farming community. These KVKs under the aegis of the National Agricultural Research and Education System (NARS) are the real carriers of frontline technologies and impart knowledge and critical input support to the farmers.

KVK (Agricultural Science Centre) is a grass root level organization meant for application of technology through assessment, refinement and demonstration of proven technologies under different 'micro farming' situations in a district (Das, 2007). The ICAR has over the years evolved an effective and well-tested frontline extension system, which is exemplary and admired all over the world. It started with establishment of first Krishi Vigyan Kendra (KVK) in Pondicherry in 1974 based on Dr. Mohan Singh Mehta Committee Report and subsequently spread across different parts of the country. The number of KVKs has risen to 680 by the year 2017 and new KVKs are to be established in the newly created districts and some larger districts of the country.

The KVK scheme is 100 per cent financed by Government of India and functioning under different host organizations viz. State Agricultural Universities (SAUs), Central Agricultural University (CAU), ICAR Institutes, Deemed Universities (DUs), State Governments, Public Sector Undertaking (PSU) and related Government Departments, Non Government Organizations (NGOs) and Other Educational Institutions (OEI) working in agriculture aiming at assessment, refinement and large scale adoption of technology/products.

Enhancing the socio-economic standards of rural farmers by upgrading their knowledge and skills is the main objective of transfer of technology. Acquisition and application of technology does not stand alone, but is conditioned by political, social, economic and cultural factors that can impede the diffusion or transfer of technology. KVK as an integral part of the National Agricultural Research System (NARS) aims at assessment of location specific technology modules in agriculture and allied enterprises, through technology assessment, refinement and demonstrations and are linking the NARS with extension system and farmers. Accordingly, the KVKs have been recognized as effective institutional links between agricultural research and extension system in the country.

The mandate of KVK is technology assessment and demonstration for its application and capacity development. To implement the mandate effectively, the following activities are envisaged for each KVK:

- On-farm testing to assess the location specificity of agricultural technologies under various farming systems.
- Organize Frontline demonstrations to establish production potential of technologies on the farmers' fields.
- Capacity development of farmers and extension personnel to update their knowledge and skills in frontier agricultural technologies and enterprises.
- To work as knowledge and resource centre of agricultural technologies for supporting initiatives of public, private and voluntary sector in improving the agricultural economy of the district.
- Provide farm advisories using ICT and other media means on varied subjects of interest to farmers.

In addition, KVKs produce quality technological products (seed, planting material, bio-agents and livestock) and make it available to farmers, organize frontline extension activities, identify and document selected farm innovations and converge with ongoing schemes and programs within the mandate of KVK.

KVK functions as a knowledge and resource centre of agricultural technologies for supporting farmers in improving their agricultural production and livelihood. At present, KVK appears to be the only institutional system at the district level for technological backstopping in agriculture and allied sectors.

PROBLEM STATEMENT

The Indian Council of Agricultural Research (ICAR) has a well established frontline extension system in the form of Krishi Vigyan Kendras for effective dissemination of new technologies for the benefit of farmers in the country. This important movement has travelled almost 44 years of successful journey to build a strong network in almost all districts of the country. A number of organizations are involved in the implementation of Krishi Vigyan Kendras in truly a public-private partnership mode, which is rather unique in the world.

KVK is an institutional innovation inspiring the World of the 21st Century for the farmers and played a very important and crucial role in technology refinement and dissemination. Beginning from 1974 when the first KVK was established, these institutions have proven and reached stakeholders' expectations. The KVKs have witnessed several changes in their functions over the years. Accordingly their functional definition also has radically got refined so as to meet the new challenges in agriculture.

In view of the changing scenario of agriculture, the activities of KVKs need to keep pace to address newer challenges in the areas of climate change, market led extension, mechanization, agri-business and so on. It is to be ascertained if the new technologies are percolating to the ground level. Are farmers inclined to accept new inventions? Are these changes becoming accessible to farmers and helping them in any way and how effective is the role of KVKs in meeting these goals, are some of the questions needs to be addressed. The present study attempts to evaluate the impact of Krishi Vigyan Kendras on the productivity enhancement and increase in income levels of farmers by technology dissemination on improved cultivation practices and vocational training programmes in Andhra Pradesh.

The objectives of the study are:

1. To study the impact of Krishi Vigyan Kendras in productivity enhancement by bridging the yield gaps.
2. To evaluate the impact of vocational training programmes conducted by Krishi Vigyan Kendras in the study area.
3. To assess the economic benefits from the adoption of improved technologies.
4. To assess the factors contributing to the adoption of improved technologies by the farmers.

HYPOTHESES

For any research problem it is important to set relevant hypotheses that can be tested and which would facilitate significant economic analysis and interpretation of the results. The following hypotheses were formulated in the present investigation.

- 1) Improved technologies have yield advantage over farmers' practice.
- 2) The income generated from improved cultivation practices is comparatively more than that of farmers' practice.
- 3) The vocational training programmes conducted by the Krishi Vigyan Kendras will improve the income levels of trainee adopters.
- 4) Socio-economic characteristics of the farmers impacted their decision of technology adoption.
- 5) Adoption of improved technology reduces the inequalities in income distribution.

LIMITATIONS OF THE STUDY

The study has been conducted over a limited period of time, in a limited area of particular agro-climatic and socio-economic conditions and hence suffers from drawbacks for generalisation of results. The conclusions drawn were applicable to those areas with similar conditions. The study is based on both primary and secondary data. The secondary data was collected from Krishi

Vigyan Kendras, Government offices and other publications. The necessary primary data was collected from the farmers based on their recall memory by survey method and hence has inherent limitations as they do not keep any written document of the data. This may lead to some variations in the result.

ORGANISATION OF THE THESIS

The thesis has been organized under the following chapters.

- Chapter- I : Introduction, problem statement, objectives, hypotheses and limitations of the study.
- Chapter- II : Review of literature pertaining to present study.
- Chapter- III : Material and methods used for the study.
- Chapter- IV : A critical analysis of the results and presentation of discussions.
- Chapter-V : Summary, conclusions and suggested policy implications from the study.

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LIST OF SYMBOLS AND ABBREVIATIONS

%	:	Per cent
&	:	and
/	:	Per
<i>et al.</i> ,	:	Co-workers
Fig.	:	Figure
ha	:	Hectare
HYV	:	High yielding Variety
i.e.	:	That is
etc.	:	And so on
Kg	:	Kilogram
Mt	:	Million tonnes
M ha	:	Million hectare
No.	:	Number
q.	:	Quintal
Rs.	:	Indian currency Rupees
t	:	Tonne
viz.	:	Namely
kg ha ⁻¹	:	Kilogram per hectare
kg	:	Kilogram
R ²	:	Co-efficient of Multiple Determination
FLD	:	Frontline Demonstration
FP	:	Farmers' Practice

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LITERATURE CITED

- Ahmad, A., Prem, G and Kumar, R. 2013. Impact of Frontline Demonstrations on Indian Mustard through Improved Technologies. *Indian Research Journal of Extension Education*. 13 (1): 117-119.
- Agricultural Statistics at a Glance. 2015. Directorate of Economics and Statistics, Ministry of Agriculture, Government of India.
- Ajrawat, B., Parmar, A. M and Jamwal, M. 2013. Impact of front line demonstration of oilseed crops in improved technology transfer. *Journal of Oilseed Brassica*. 4 (2): 96-97.
- Anupama, J., Singh, R. P and Kumar, R. 2005. Technical Efficiency in Maize Production in Madhya Pradesh: Estimation and Implications. *Agricultural Economics Research Review*. 18: 305-315.
- Arora, R. K. 2015. Impact of Vocational Training Programmes on “Mushroom Cultivation for Self Employment” In District Ambala, Haryana, India. *International journal of Recent Advances in Multidisciplinary Research*. 2 (1): 171-173.
- Arthi, K., Saravanakumar, V and Balasubramanian, R. 2016. Is Sustainable Sugarcane Initiative (SSI) Technology More Profitable than Conventional Method for Sugarcane Production? — An Economic Analysis. *Agricultural Economics Research Review*. 29 (1): 117-126.
- Atibudhi, H. N and Sahoo, S. 2000. Effects of education on productivity of high yielding varieties of rice in Sambalpur district, Orissa. *Indian Journal of Agricultural Economics*. 55 (3): 540.
- Balai, C. M., Jalwania, R., Verma, L. N., Bairwa, R. K and Regar, P. C. 2013. Economic Impact of Front Line Demonstrations on Vegetables in Tribal Belt of Rajasthan. *Current Agricultural Research Journal*. 1 (2): 69-77.
- Balasaheb, D. T. 2013. Quantification of yield gaps in different planting types of sugarcane in Maharashtra. Indira Gandhi Institute of Development Research, Mumbai WP-2013-011. July 2013, <http://www.igidr.ac.in/pdf/publication/WP-2013-011.pdf>.
- Bar, N., Dash, S. R., Mishra, P and Prusty, S. 2014. Impact of KVK Training on Development of Tribal Farmers- A study in Odisha. *Journal of Environment and Ecology*. 5 (2): 249-257.

- Barua, U and Tripathi, A. K. 2015. Impact of frontline demonstration on yield enhancement of Turmeric. *International Journal of Farm Sciences*. 4 (4): 235-239.
- Basavaraja, H. 2000. Crop yield potentials and constraints in the production of Major Crops in North Dry Zone of Karnataka. *Agricultural Situation in India*. 56 (12): 743-753.
- Bisaliah, S. (1977). Decomposition analysis of output change under new production technology in wheat farming – some implications to returns on investment. *Indian Journal of Agricultural Economics*. 32 (3): 193-201.
- Chakravorty, S., Chandrasekhar, S and Naraparaju, K. 2016. Income Generation and Inequality in India's Agricultural Sector: The Consequences of Land Fragmentation. Working Paper-2016-028. Indira Gandhi Institute of Development Research (IGIDR), Mumbai. <http://www.igidr.ac.in/pdf/publication/WP-2016-028.pdf>.
- Chauhan, A. K and Kundu, T. R. 2005. Impact of new dairy farming technology on employment and income of rural households in Haryana. *Indian Journal of Dairy Science*. 58 (4): 293-297.
- Chen, Y and Xu, L. 2016. Study on influencing factors of farmer's adoption behaviour for new maize variety in Huaxian, Henan province. *Asian Agricultural Research*. 8 (10): 21-25, 29.
- Chengappa, P. G., Janaiah, A and Srinivasa, G. M. V. 2003. Profitability of hybrid rice cultivation evidence from Karnataka. *Economic and Political Weekly*. 38 (25): 2531- 2534.
- Chi, T. T. N and Yamada, R. 2002. Factors affecting farmers' adoption of technologies in farming system: a case study in Omon district, Can Tho province, Mekong Delta. Proceedings of the annual workshop on "Development of New Technologies and their Practice for Sustainable Farming Systems in the Mekong Delta, 26-28, November 2002. JIRCAS Mekong delta project, Can Tho. 392-398.
- Choudhary, A. K., Yadav, D. S and Singh, A. 2009. Technological and extension yield gaps in oilseeds in Mandi district of Himachal Pradesh. *Indian Journal of Soil Conservation*. 37 (3): 224-229.
- Clarke, N., Bizimana, J. C., Dile, Y., Worqlul, A., Osorio, J., Herbst, B., Richardson, J. W., Srinivasan, R., Gerik, T. J., Williams, J., Jones, C. A and Jeong, J. 2017. Evaluation of new farming technologies in Ethiopia using the Integrated Decision Support System (IDSS). *Agricultural Water Management*. 180: 267–279.

- Daniel, H. M and Maseko, S. 2015. Factors Influencing Adoption of Conservation Agriculture: A Case for Increasing Resilience to Climate Change and Variability in Swaziland. *Journal of Environment and Earth Science*. 5 (22): 16-25.
- Das, P. 2007. Proceedings of the meeting of DDG (AE), ICAR, with officials of state Departments, ICAR institutes and Agricultural Universities, NRC Mithun, Jharmapani, Zonal Coordinating Unit, Zone-III, Barapani, Meghalaya, India. Pp 6.
- Dat, V. T. 2001. Closing the rice yield gap for food security. Centre International de Hautes Etudes Agronomiques Mediterraneennes, Paris (France). Pp 126.
- De Dutta, S. K., Gomez, R. W., Herdt and Baker, R. 1978. Methodology for an integrated experiment survey on rice yield constraints. An interim report on constraints to high yields on Asian rice farms. International Rice Research Institute, Manila.
- Deharia, A. 2009. Impact of Krishi Vigyan Kendra in changing the knowledge and socio-economic status of the tribal women in Chhindwara district of Madhya Pradesh. M.Sc. (Ag.) Thesis Submitted to Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur.
- Devi, K. S and Pannarasi, T. 2009. An economic analysis of modern rice production technologies and its adoption behavior in Tamil Nadu. *Agricultural Economics Research Review*. 22 (9): 241-247.
- Dutta, R. 2014. Yield Gap Analysis of Rapeseed-Mustard in North Bank Plain Zone of Assam. *Indian Research Journal of Extension Education*. 14 (3): 122-124.
- Duwayri, M., Tran, D. V and Nguyen, V. N. 1999. Reflections on yield gaps in rice production. *International Rice Commission Newsletter*. 48: 13-26.
- Elum, Z. A and Sekar, C. 2015. An empirical study of yield gap in seed cotton production in Tamil Nadu state, India. *Indian Journal of Agricultural Research*. 49 (6): 549-553.
- Gaddi, G. M., Mundinamani, S. M and Basavaraj, H. 2002. Yield gaps and constraints in the production of rabi sorghum in Karnataka - A path coefficient analysis. *Agricultural Economics Research Review*. 15 (1): 13-25.
- Gavali, A.V., Deokate, T. B., Choudhari, R. B and Kamble, B. H. 2011. Yield gap analysis of jowar in Maharashtra. *Agricultural Economics Research Review*. 24 (2): 339-343.

- Gavaria, K. M., Gajja, B. L and Pathak, R. 2010. Decomposition analysis of output change under new wheat technology in arid region of Rajasthan: An econometric study. *Annals of Arid Zone*. 49 (2): 131-136.
- Gomez, K. A. 1977. On farm assessment of yield constraints methodological problems: An interim report on constraints to high rice yields on Asian rice farms. IRRI, Philippines.
- Gomez, K. A., Herdt, R. W., Barker and De Dutta, S. K. 1979. A methodology for identifying constraints to high rice yields on farmers fields. Farm level constraints to high rice yields in Asia: 1974-1977. IRRI, Los Banos, Philippines.
- Goswami, K and Chatterjee, B. 2006. Impact of infrastructure and technology on agricultural productivity in Uttar Pradesh. *Agricultural Economics Research Review*. 22 (10): 110-116.
- Govardhanrao, V and Ramana, P. V. 2017. Economic Performance of Zero Tillage Technology in Maize under Agency Tracts of Andhra Pradesh. *Asian Journal of Agricultural Extension, Economics & Sociology*. 16 (4): 1-4.
- Hasan, M. K and Islam, M. F. 2010. Technical inefficiency of wheat production in some selected areas of Bangladesh. *Bangladesh Journal of Agricultural Research*. 35 (1): 101-112.
- Herdt, R. W and Wickham, T. 1975. Exploring the gap between potential and actual rice yields in Philippines. Food research institute studies. 16 (2): 163-181.
- Hossain, S. K. M. 2007. Economic analysis of rice production in Bardhman district of West Bengal. M.Sc. thesis of Department of Agricultural Economics, G. B. Pant University of Agriculture and Technology, Pantnagar.
- Hussain, A., Bashir, A., Anwar, M. Z and Mehmood, I. 2011. Agricultural productivity and rural poverty in the rice-wheat and mixed-cropping zones of the Punjab. *Pakistan Journal Life Social Sciences*. 9 (2): 172-178.
- Islam, M., Mohanty, A. K and Kumar, S. 2011. Correlatiing Growth, Yield and Adoption of Urdbean Technologies. *Indian Research Journal of Extension Education*. 11 (2): 20-24.

- Jain, L. K. 2014. Economics and gap analysis in Isabgol cultivation through frontline demonstrations in Western Rajasthan. *International Journal of Agricultural Extension*. 2 (2): 109-114.
- Jain, R., Arora, A and Raju, S. S. 2009. A novel adoption index of selected agricultural technologies: linkages with infrastructure and productivity. *Agricultural Economics Research Review*. 22 (1): 109-120.
- Jha, G. K., Burman, R. R., Dubey, S. K and Singh, G. 2011. Yield gap analysis of major oilseeds in India. *Journal of Community Mobilization and Sustainable Development*. 6 (2): 209-216.
- Joshi, N. S., Bariya, M. K and Kunjadia, B. B. 2014. Yield gap analysis through Front Line Demonstration in Wheat crop. *International Journal of Scientific and Research Publications*. 4 (9): 1-3.
- Kamruzzaman, M., Islam S. M. F., Begum M. A. A., Shiblee S. M. A., Kibria M. G and Ray, S. K. 2001. Adoption level of wheat technology & the grower's knowledge gap in Bangladesh. *Pakistan Journal of Biological Sciences*. 4 (1): 1-6.
- Kaul, S. 2002. Economic study of yield gap and constraints in production of gram in Haryana. *Indian Journal of Agricultural Economics*. 57 (3): 413.
- Khedkar, N. S., Bhargav, K. S., Nayak, M. P., Ambawatia, G. R and Umat, R. 2016. Analysis of yield gap through front line demonstration of mustard. *Research in Environment and Life Sciences*. 9 (4) 461-463.
- Khondoker, A. M., Mohanty, S and Nelson, A. 2015. Factors influencing hybrid rice adoption: a Bangladesh case. *Australian Journal of Agricultural and Resource Economics*. 59 (2): 258-274.
- Koshta, A. K and Chandrakar, M. R. 2006. A study on economic efficiency of resources in production of rice under irrigated and rainfed situations of Chhattisgarh. *Journal of Agricultural Issues*. 11 (1): 57-64.
- Kotu, B. H., Verkuijil, H., Mwangi, W and Tanner, D. 2000. Adoption of improved wheat technologies in Adaba and Dodola Woredas of the Bole highlands, Ethiopia, Mexico, D. F. International Maize and Wheat Improvement Center (CIMMYT) and Ethiopian Agricultural Research Organization (EARO), pp 3.
- Kumar, R and Agarwal, S. K. 2002. Economics of bread wheat as affected by planting system, seed rate and nitrogen fertilization in sandy loam soil of Haryana. *Haryana Agricultural University Journal of Research*. 32 (1): 23-25.

- Kumar, A., Avasthe, R. K., Lepcha, B., Mohanty, A. K and Shukla, G. 2012. Impact of Front Line Demonstrations on Yield Enhancement of Ginger (var. *Majauley*) in Tribal Reserve Biosphere of Sikkim Himalaya. *Journal of Agricultural Science*. 3 (2): 121-123.
- Kumar, S., Singh, R and Singh, A. 2014. Assessment of Gaps in Pulse Production in Hamirpur District of Himachal Pradesh. *Indian Research Journal of Extension Education*. 14 (2): 20-24.
- Kumawat, R. N., Singh, Y. V., Dohare, R. S., Satapathy, P. K and Das, S. 2013. Yield and economics of mustard varieties on soils of Rajasthan and Gujarat under different components of production. *Scholarly Journal of Agricultural Science*. 3 (6): 226-232.
- Kumbhare, N. V and Singh K. 2011. Adoption behaviour and constraints in wheat and paddy production technologies. *Indian Research Journal of Extension Education*. 11 (3): 41-44.
- Lal, B and Tandon, V. 2011. Impact of Vocational Training Programmes on Knowledge Gain by the Rural Youths. *Journal of Community Mobilization and Sustainable Development*. 6 (2): 174-176.
- Malik, S. K. 2000. Extent and magnitude of the adoption of new sugarcane production technology in western U. P.. *Indian Sugar*. 50 (9): 621-624.
- Manjarekar, R. G., Mandavkar, P. M., Hanmante, A. A and Talathi, M. S. 2015. Impact of Front Line Demonstration on Okra in Raigad District of Maharashtra. *Journal of Krishi Vigyan*. 4 (1): 37-40.
- Mankar, D. M, Kamble, P. B and Nirban. 2004. Factors influencing adoption of recommended rice cultivation technology by scheduled caste farmers. *Karnataka Journal of Agricultural Sciences*. 17 (3): 502-507.
- Manonmani, S., Thiyagarajan, K and Mohanasundaram, K. 2010. Corh 3-hybrid rice seed production - a way for empowering women in agriculture. *Green Farming*. 1 (1): 100-101.
- Marciano, E. B., Gascon, F. B., Cabrera, E and Hossain, M. 2001. Rice research for food security and poverty alleviation. Proceedings of the International Rice Research Conference. 31 March – 3 April, 2001. Los Banos, Philippines. 603-615.
- Matuschke and Quaim, M. 2006. Adoption and impact of hybrid wheat in India. International Association of Agricultural Economist Conference. Gold Coast, Australia. August 12-18.

- Meena, V. K., Subramannian, S., Anjlo, P and Dipti, N. V. 2015. Populerization of Maize among the small farmers of Ernakulam district of Kerala through front line demonstration. *Indian Journal of Agricultural Research*. 49 (6): 558-561.
- Mishra, D. K., Tailor, R. S., Pathak, G and Deshwal, A. 2007. Yield Gap Analysis of Blight Disease Management in Potato through Front Line Demonstration. *Indian Research Journal of Extension Education*. 7 (2&3): 82-84.
- Mittal, S and Kumar, P. 2000. Literacy, technology adoption, factor demand and productivity: An econometric analysis. *Indian Journal of Agricultural Economics*. 55 (3): 490-499.
- Mohanty, A. K., Islam, M., Kumar, G. A. K and Kumar, A. 2014. Enhancing Rice (*Oryza sativa*) Productivity through Demonstrations of SRI Method of Cultivation in Mid-Altitude Region of Indo-Himalayan Belt of Sikkim. *Indian Research Journal of Extension Education*. 14 (3): 88-92.
- Mondal, M. H. 2011. Causes of yield gaps and strategies for minimizing the gaps in different crops of Bangladesh. *Bangladesh Journal of Agricultural Research*. 36 (3): 469-476.
- Moser, C and Barrett, C. 2006. The complex dynamics of smallholder technology adoption: the case of SRI in Madagascar. International Association of Agricultural Economists, Annual Meeting.
- Murty, B. S. R., Sridhar, G and Patil, D. V. 2013. Success of vocational skill trainings leading to empowering rural community – Role of NGOs. *International Journal of Humanities and Social Science Invention*. 2 (11): 16-23.
- Naeem, U. R and Khattak, A. H. 2008. An assessment of the inequality in income and land holdings among rural rice farmers of district Swat. *Sarhad Journal of Agriculture*. 24 (1): 187-189.
- Naik, D and Pradhan, D. C. 2005. Resource use efficiency in irrigated rice farms in Orissa. *Indian Journal of Agricultural Economics*. 60 (3): 515-516.
- Narayanmoorthy, A. 2000. Farmer's education and productivity of crops: A new approach. *Indian Journal of Agricultural Economics*. 55 (3): 511-520.
- Narayanmoorthy, A and Kalamkar, S. S. 2004. Agricultural policy in Maharashtra: A policy Matrix. *Artha Vijana*. 45 (3-4): 330-334.

- Nasurudeen, P. 2004. Impact of technology on paddy farms in Karaikal region of union territory of Pondicherry. *Agricultural Economics Research Review*. 17 (1): 43-50.
- Nazir, T., Vaida, N and Dar, M. A. 2012. The Impact of Vocational Training Courses on Knowledge and Adoption of Rural Women in Kashmir. *Journal of Sustainable Society*. 1 (4): 84- 87.
- Nyaudoh, N. U. 2010. Yields, Cost of Production and Economic Return to Management of Maize/Cassava Intercrop as Influenced by Different Tillage Practices. *Researcher*. 2 (10): 68-74.
- Panwar, A., Choudhary, S., Wankhede, A and Swarnakar, V. K. 2017. Study on Impact of Vocational Training Programme Conducted by KVK for Rural Women in Khandwa Block of Khandwa District of M.P. *SSRG International Journal of Agriculture & Environmental Science*. 4 (4): 39-41.
- Patole, S. D., Shinde, H. R and Yadav, D. B. 2008. Chickpea production in Ahmednagar district of Maharashtra: a technological gap analysis. *Journal of Food Legumes*. 21: 270-273.
- Peiris, T. D. G. J., Abeynayake N. R and Perera, M. S. 2009. Socio-economic factors affecting the technology adoption level of sugarcane in rain fed sector in Sevenagala. *Journal of Food and Agriculture*. 2 (2): 22-27.
- Poonia, T.C and Pithia, M. S. 2011. Impact of Front Line Demonstrations of Chickpea in Gujarat. *Legume Research*. 34 (4): 304- 307.
- Pouchepparadjou, A., Kumaravelu, P. and Achoth, L. 2005. An econometric analysis of green technology adoption in irrigated rice in Pondicherry union territory. *Indian Journal of Agricultural Economics*. 60: 660-676.
- Prasad, H. N and Kushwaha, R. K. 2015. Impact of KVK's training programmes on socio-economic status of farm women. *Plant Archives*. 15 (1): 421-428.
- Rahman, M. S and Haque, Z. 2013. Adoption of selected wheat production technologies in two northern districts of Bangladesh. *International Journal of Agriculture Research Innovation and Technology*. 3 (1): 5-11.
- Raj, A. D., Yadav, V and Rathod, J. H. 2013. Impact of Front Line Demonstrations (FLD) on the Yield of Pulses. *International Journal of Scientific and Research Publications*. 3 (9): 1-4.

- Ram, S and Nayak, P. K. 2002. Rice yield socio-economic constraints in coastal agro ecological region of Orissa. *Agricultural Economics Research Review*. Conference proceedings: 141-142.
- Rama Rao, I.V.Y. 2011. Estimation of efficiency, sustainability and constraints in SRI (system of rice intensification) vis-a-vis traditional methods of paddy cultivation in north coastal zone of Andhra Pradesh. *Agricultural Economics Research Review*. 24 (2): 325-331.
- Rama Rao, I.V.Y. 2012. Efficiency, Yield Gap and Constraints Analysis in Irrigated vis-a-vis Rainfed Sugarcane in North Coastal Zone of Andhra Pradesh. *Agricultural Economics Research Review*. 25 (1): 167-171.
- Ramasamy, C., Shanmugan, T. R and Pray, C. 1997. Priority setting for rice research in Southern India - An ex-ante approach. *Indian Journal of Agricultural Economics*. 52 (1): 101-113.
- Ramegowda, P. V., Munireddy, R and Chinnappareddy, B. V. 2008. Impact of government programmes on reduction of inequalities of income of the coastal fisher folk of Karnataka. *Mysore Journal of Agricultural Sciences*. 42 (3): 498-501.
- Rane, A. A., Bagade, S. R., Khobarkar, V. K and Patil, H. K. 2004. Impact of IVLP on crop production in Hodawade village of Vengurle Tehsil. *Agricultural Economics Research Review*. 17 (Conference No.): 202.
- Rao, P. P and Rao, V. G. K. 1993. Adoption of rice production technology by the tribal farmers. *Journal of Research ANGRAU*. Pp 108.
- Rath, N. C., Das, L., Mishra, S. K and Lenka, S. Adoption of upland rice technologies by and its correlates. International rice congress. 9-13 October 2006, New Delhi.
- Raveendran, N., Ajjain, N., Angles, S and Selvakumar, K. 2004. Impact study on intervention in Cotton – based cropping systems in Tamil Nadu. *Agricultural Economics Research Review*. 17(Conference No.): 205.
- Razzaque, M. A and Rafiquzzaman, S. 2006. Comparative analysis of T. Aman rice cultivation under different management practice in coastal area. *Journal of Agriculture and Rural Development*. 5 (1&2): 64-69.
- Reddy, G. R., Raju, V. T and Janaiah, A. 1996. An economic analysis of yield gaps and constraints in rice production in Guntur district of Andhra Pradesh. *Journal of Research- ANGRAU*. 24 (2): 106-111.

- Report of the Committee on Streamlining the Functioning of Krishi Vigyan Kendras in the Country. 2002. Division of Agricultural Extension, Indian Council of Agricultural Research, Krishi Anusandhan Bhawan, Pusa, New Delhi, India.
- Report of the High Power Committee on Management of Krishi Vigyan Kendra (KVK). 2014. Agricultural Extension Division, Indian Council of Agricultural Research, Krishi Anusandhan Bhawan, Pusa, New Delhi, India.
- Roy, B. C and Datta, K. K. 2000. Rice-wheat system in Haryana: Prioritizing production constraints and implication for future research. *Indian Journal of Agricultural Economics*. 55 (4): 671-682.
- Roy, S. D. 2013. Impact of Fish Farming on Land Relations: Evidence from a Village Study in West Bengal. *Indian Journal of Agricultural Economics*. 68 (2): 221-239.
- Rudrapur, S., Patil, B. L and Sharma, M. T. 2015. Decomposition Analysis of Income Difference between Flood and Border Strip Method of Irrigation in Cultivation of Wheat in the Malaprabha Command Area of Karnataka. *International Journal of Commerce and Business Management*. 8 (1): 7-11.
- Sahu, S. K and Das, S. 2015. Impact of Agricultural Related Technology Adoption on Poverty: A Study of Select Households in Rural India. Working Paper-131/2015 November. Madras School of Economics.
- Samson, P., Katengeza, Stein, T., Holden, Rodney, W and Lunduka. 2016. Adoption of Drought Tolerant Maize Varieties under Rainfall Stress in Malawi. Fifth Conference of the African Association of Agricultural Economists (5th CAAAE), 23-26 September, Addis Ababa, Ethiopia.
- Sananse, S. L., Vichare, S. R., Ingole, B. V and Patil, H. K. 2005. Yield gap analysis of rice based cropping systems in North Konkan Coastal Agro-Ecosystem of Maharashtra. *Agricultural Situation in India*. 64 (1): 7-15.
- Sarma, H., Sarma, R., Sarmah, A. K., Upamanya, G. K and Kalita, N. 2014. Yield Gap Analysis of Toria (*Brassica campestris*) in Barpeta District of Assam. *Indian Research Journal of Extension Education*. 14 (2): 127-129.
- Sarungbam, D and Prasad, Y. E. 2011. Factors Affecting Adoption of Monocropping of Rice in Manipur: A Logistic Approach. *Agricultural Economics Research Review*. 22: 333-337.

- Shah, V. D. 2001. Evaluation of management of seed supply in oilseeds and pulses in Rajasthan. Research Study Agro-Economic Research Center, Sardar Patel University. 12 (14): 145.
- Sharma, A. K., Kumar, V., Jha, S. K and Sachan, R. C. 2011. Frontline demonstrations on Indian mustard: an impact assessment. *Indian Research Journal of Extension Education*. 11 (3): 25-31.
- Sharma, M., Singh, G and Keshava. 2014. Impact Evaluation of Training Programmes on Dairy Farming in Punjab State. *Indian Research Journal of Extension Education*. 14 (1): 105-108.
- Sharma, M. L., Husian, N., Kabdwal, B. C and Dev, C. 2002. Study of Yield Gap and Constraints in Small Millets in Uttaranchal. *Indian Journal of Agricultural Economics*. 57 (3): 407.
- Singh, D., Meena, M. L., Choudhary, M. K and Tomar, P. K. 2013. Improved package of practices for Cumin farmers: Impact of Training and FLDs. *International Journal of Seed Spices*. 3 (1): 52-57.
- Singh, D., Patel, A. K., Baghel, M. S., Singh, S. K., Singh, A and Singh, A. K. 2014. Impact of Front Line Demonstration on the Yield and Economics of Chickpea (*Cicer arietinum L.*) in Sidhi District of Madhya Pradesh. *Journal of Agrisearch*. 1 (1): 22-25.
- Singh, D., Patel, K., Singh, A., Singh, S. K and Baghel, M. S. 2014. Impact of Front Line Demonstration of Mustard in Improved Technology Transfer. *International Journal of Advanced Research in Management and Social Sciences*. 3 (6): 42-45.
- Singh, D. V., Mukhi, S. K and Mishra, S. N. 2016. Impact of Vocational Training Programme on Income and Employment Generation towards the farmers. *International Journal of Humanities and Social Science Invention*. 5 (2): 71-77.
- Singh, K., Peshin, R and Saini, S. K. 2010. Evaluation of the agricultural vocational training programmes conducted by the Krishi Vigyan Kendras (Farm Science Centres) in Indian Punjab. *Journal of Agriculture and Rural Development in the Tropics and Subtropics*. 111 (2): 65-77.
- Singh, K. M and Singh, R. K. P. 2000. Rice in Bihar- An economic analysis with special reference to boro rice. *Agricultural Situation in India*. 54 (11): 677-681.

- Singh, M and Chahal, S. S. 2009. A study on the extent of various recommended technologies in wheat cultivation in Punjab. *Agricultural Economics Research Review*. 22 (9): 349-354.
- Singh, M. P., Sharma, B. K., Singh, S. P and Kumar, S. 2009. Technological gap in sugarcane-wheat cropping system in upper gangetic plain zone. *Project Agriculture*. 9 (1): 92-97.
- Singh, N. P. 2005. Performance analysis of pulse in frontline demonstrations. *Indian Journal of Pulse Research*. 18 (2): 202-205.
- Singh, R. K. P., Sinha, D. K and Singh, L. N. 2004. Impact of modern technology on rice production in Bihar. *Agricultural Economics Research Review*. 17 (1): 59-67.
- Singh, S., Singh, R. K and Singh, R. 2013. Enhancing rice and wheat production by bridging yield gap in western Uttar Pradesh of India. *Journal of Wheat Research*. 5 (2): 43-47.
- Singh, S. R. K., Mishra, A., Gautam, U. S., Dwivedi, A. P and Prem Chand. 2014. Scouting Technological Vis-a Vis Extension Gaps in Soybean Production in Madhya Pradesh. *Indian Research Journal of Extension Education*. 14 (2): 41-45.
- Singh, S. N., Singh, V. K., Singh, R. K and Singh, R. K. 2007. Evaluation of On-Farm Front Line Demonstrations on the Yield of Mustard in Central Plains Zone of Uttar Pradesh. *Indian Research Journal of Extension Education*. 7 (2&3): 79-81.
- Singh, V., Chaurasia, S. P. R and Sharma, J. S. 2002. An economic analysis of farm income distribution on potato specialized farms in Agra district of Uttar Pradesh, *Indian Journal of Agricultural Economics*. 57 (4): 741-750.
- Sinha, R. P and Gupta, S. P. 2004. Impact of Krishi Vigyan Kendra (KVK) on crop productivity and input use pattern – A case study. *Agricultural Economics Research Review*. 17 (Conference No.): 199.
- Sinha, R. P and Singh, V. K. 1997. Constraints of rice production in Bihar a case study. *Journal of Applied Biology*. 7 (1-2): 101-104.
- Srinivas, A., Mounica, D and Pavani, U. 2015. Impact of Front Line Demonstrations (FLD) on the Yield of Cotton. *International Journal of Engineering Science and Innovative Technology*. 4 (2): 114-118.

- Srinivas, R. N., Shareef, S. M and Raju, V. T. 2002. Resource productivity and resource use efficiency in bela lands in Srikakulam district of Andhra Pradesh. *Economic Affairs*. 47 (1): 48-51.
- Statistical Abstract of Andhra Pradesh. www.apsdps.ap.gov.in/dp/downloads/SA_2015.PDF.
- Sudha, M., Gajanana, T. M and Murthy, D. S. 2006. Economic impact of commercial hybrid seed production in vegetables on farm income, employment and farm welfare – a case of tomato and okra in Karnataka. *Agricultural Economics Research Review*. 19 (2): 251-268.
- Suthar, J. V., Chawda, S. K., Patel, A. T., Pastagia, J. J and Patel, B. B. 2016. Impact of Front Line Demonstration on the Yield of Poha Rice (*Oryza sativa*) in Surat District. *Journal of Bio-Innovation*. 5 (4): 588-593.
- Teggelli, R. G., Patil, D. H., Naik, A., Ahamed, B. Z and Patil, M. C. 2015. Impact of Frontline Demonstration on the Yield and Economics of Pigeonpea in Kalaburgi District of Karnataka State. *International Journal of Science and Nature*. 6 (2): 224-227.
- Tanvi Deshpande. 2017. State of agriculture in India. PRS legislative research. Ministry of Agriculture. [file:///G:/State%20of%20Agriculture%20in%20India.pdf](http://www.prsindia.org/). <http://www.prsindia.org/>
- Tekwa, I. J., Bunu, G. M and Makama, M. 2010. Impacts of modern farm machinery and implements adoption on sugarcane (*Saccharrum officinarum*) farmers' income in Mubi, North Eastern Nigeria. *Journal of Agricultural Social Sciences*. 6: 101-104.
- Thakare, A. B and Nagpure, S. C. 2004. Impact Assessment of Agricultural Technology on Cotton Production. *Agricultural Economics Research Review*. 17(Conference No.): 201.
- Thakur, J and Hossain, M. 2002. Estimation of yield gaps, losses and constraints to rice production in Bihar. *Agricultural Economics Research Review*. Conference proceedings. Pp: 133-134.
- Thakur, N. S and Khadka, R. 2004. Socio-economic study on current farmer's practices on wheat and mustard production systems in Surkhet, Salyan and Doti districts, Nepal. *Agriculture Research Journal*. 5: 49-56.
- Truong, T. N. C. 2008. Factors affecting technology adoption among rice farmers in the Mekong delta through the lens of the local authorial managers: an analysis of qualitative data, Oman Rice. *Agriculture update*. 3 (11): 293-296.

- Tsinigo, E., Yankyera, K. O., Fialor, S. C and Asante, I. T. 2016. Decomposition analysis of technological change in rice production in Ghana. *British Journal of Applied Science and Technology*. 18 (1): 1-11.
- Veeranjaneyulu, K., Krishnaveni, G., Lakpathi, G and Rajanikanth, P. 2014. Skill Development and Enhanced Livelihood Opportunities through Apparel Making & Embroidery Trainings KVK, Kampasagar, Nalgonda District. *International Journal of Scientific & Technology Research*. 3 (1): 6-10.
- Venkatasubramanian, V., Sajeew M. V and Singha, A. K. Concepts, Approaches and Methodologies for Technology Application and Transfer - A Resource Book for KVKs. Zonal Project Directorate, Zone – III, Indian Council of Agricultural Research, Umiam, Meghalaya.
- Verma, A. R. 2006. Growth of production and productivity of principal crops and constraints of food security in Madhya Pradesh. *Indian Journal of Agricultural Economics*. 61 (3): 442-443.
- Vir, K and Joshi, C. P. 2003. Technological gap in adoption of sugarcane production technology. International Conference on Communication for Development in the Information Age: Extending the Benefits of Technology for All. January, pp 9-38.
- Visalakshi, M and Sireesha, A. 2015. Study on influence of tillage methods on productivity of maize. *Indian Journal of Agricultural Research*. 49 (5): 452-455.
- Yadav, R. N and Gangwar, A. C. 1986. Production constraints in Bihar state. *Agricultural Situation in India*. 41 (1): 9-13.
- Yadav, V. P. S., Kumar, R., Deshwal, A. K., Raman, R. S., Sharma, B. K and Bhela, S. L. 2007. Boosting Pulse Production through Frontline Demonstration. *Indian Research Journal of Extension Education*. 7 (2&3): 12-14.
- Yadav, Y. P., Singh, B and Kumar, A. 1999. Evaluation of front line demonstration trials on mustard in south - western region of Haryana. *Haryana Agricultural Journal of Research*. 29 (1): 9-13.
- Wani, M. H., Baba, S. H., Rama Sundaram, P., Yousuf, S and Yousuf, S. 2013. Has Adoption of Improved Rice Technology Enhanced Economic and Livelihood Security in Kashmir Valley? *Agricultural Economics Research Review*. 26 (Conference Number): 165-171.

Zachary, M., Gitonga and Groote, H. D. 2016. Role of hybrid maize adoption on food security in Kenya: An application of two-step generalized method of moments (gmm2s). 5th Conference of African Association Agricultural Economists (5th CAAAE). United Nations Conference Centre - Addis Ababa, Ethiopia, 23-26 September.

Note: The pattern of literature cited above is in accordance with the guidelines for thesis presentation Acharya N.G. Ranga Agricultural University, Guntur, Andhra Pradesh.

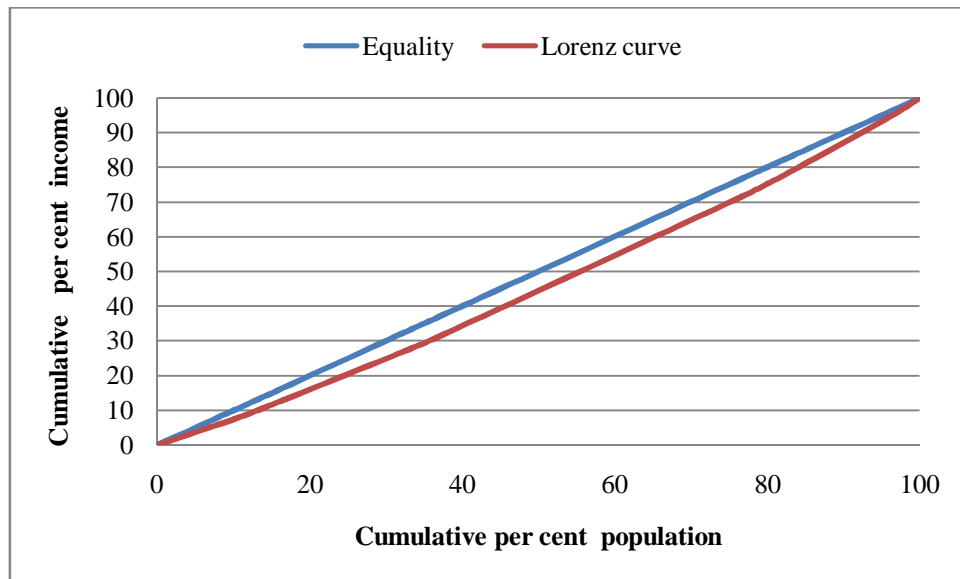


Fig. 1. Pattern of distribution of income generated from farmers' practice in Rice: KVK- Amadalavalasa

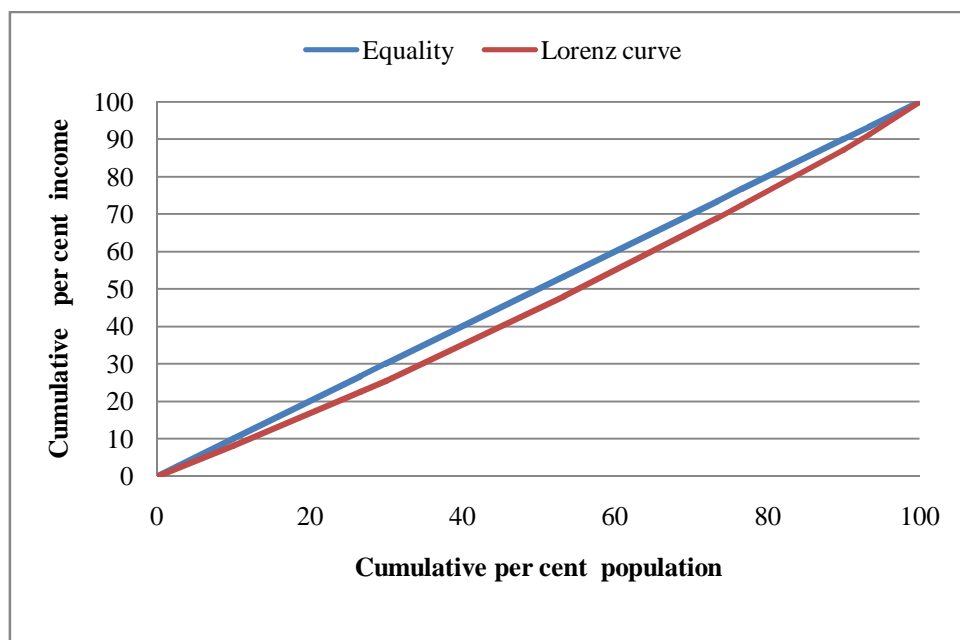


Fig. 2. Pattern of distribution of income generated from MSRI technology in Rice: KVK- Amadalavalasa

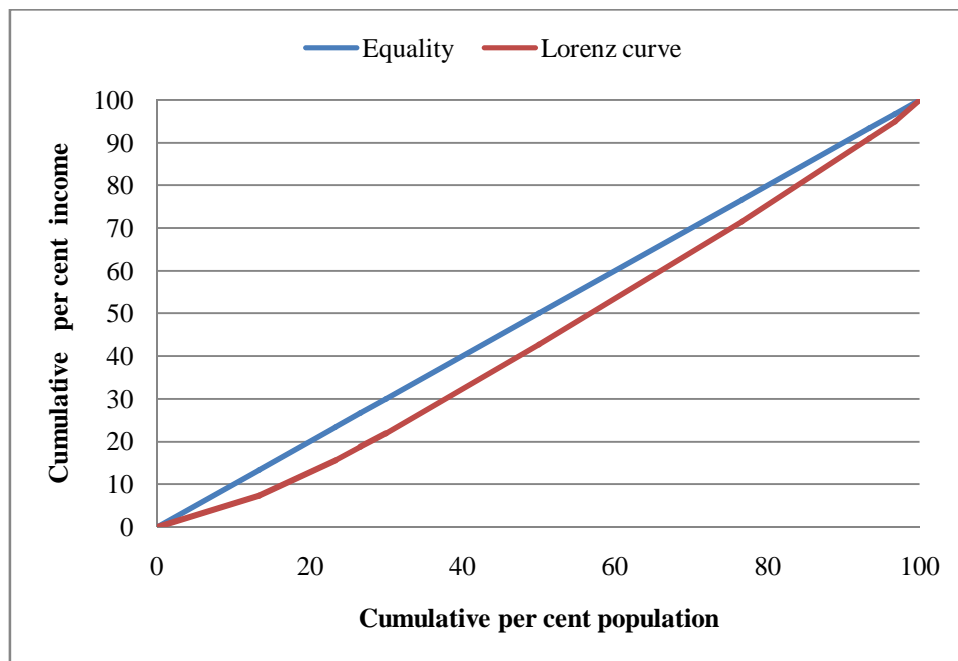


Fig. 3. Pattern of distribution of income generated from farmers' practice in Maize: KVK-Amadalavalasa

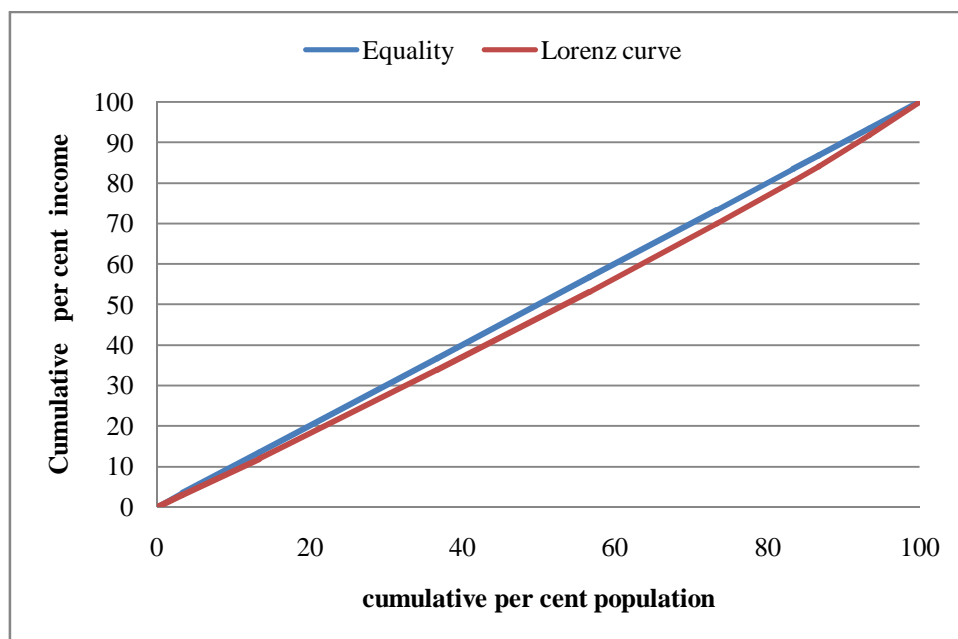


Fig.4. Pattern of distribution of income generated from Zero tillage maize: KVK-Amadalavalasa

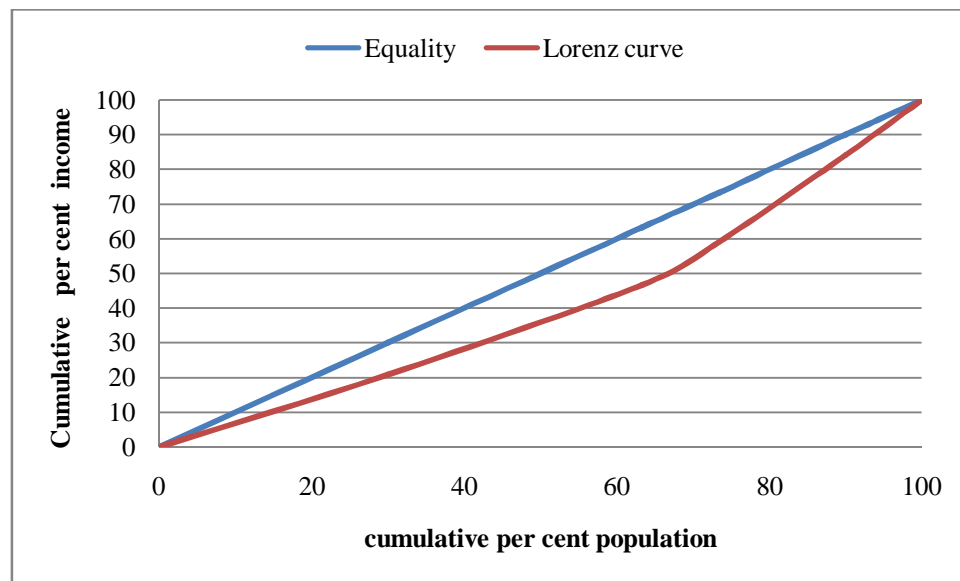


Fig. 5. Pattern of distribution of income generated from farmers' practice in Rice: KVK-Yagantipalli

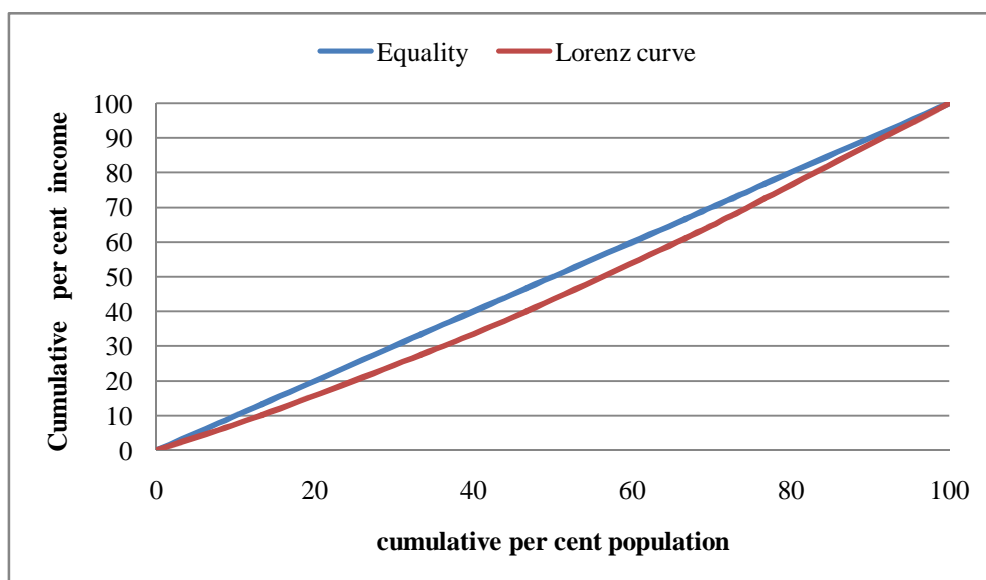


Fig. 6. Pattern of distribution of income generated from STCR (Soil test crop response) in Rice: KVK-Yagantipalli

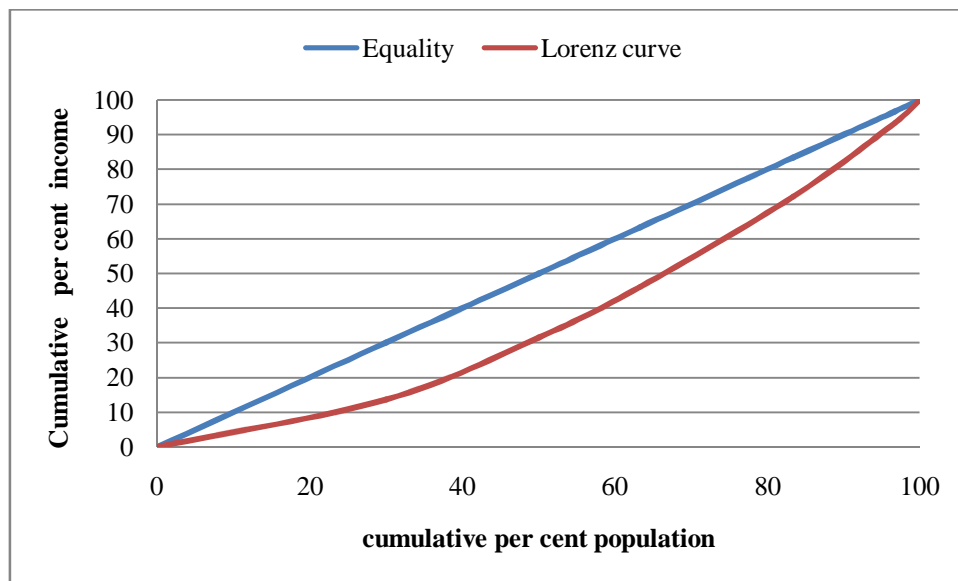


Fig. 7. Pattern of distribution of income generated from farmers' practice in Redgram (Traditional varieties): KVK-Yagantipalli

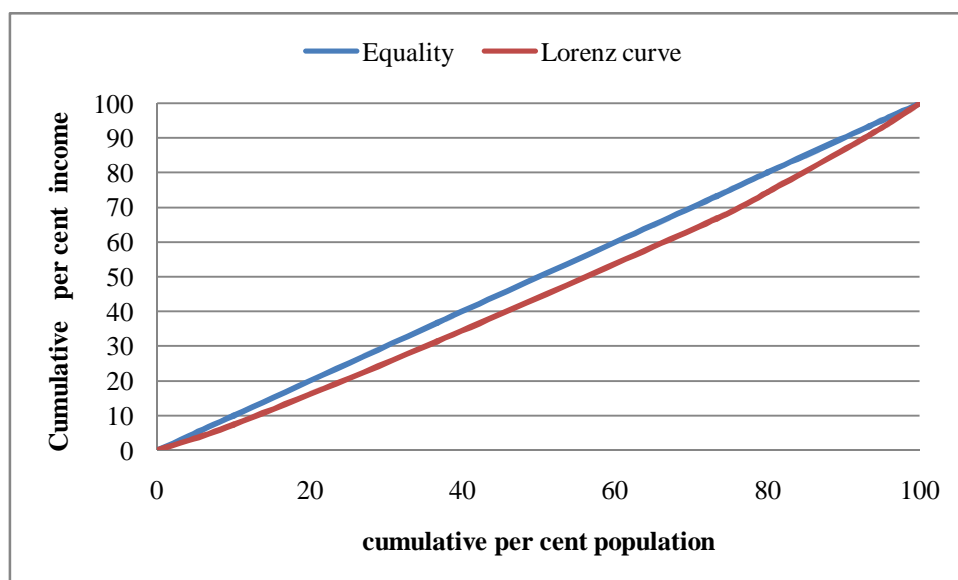


Fig. 8. Pattern of distribution of income generated from high yielding varieties of Redgram: KVK-Yagantipalli

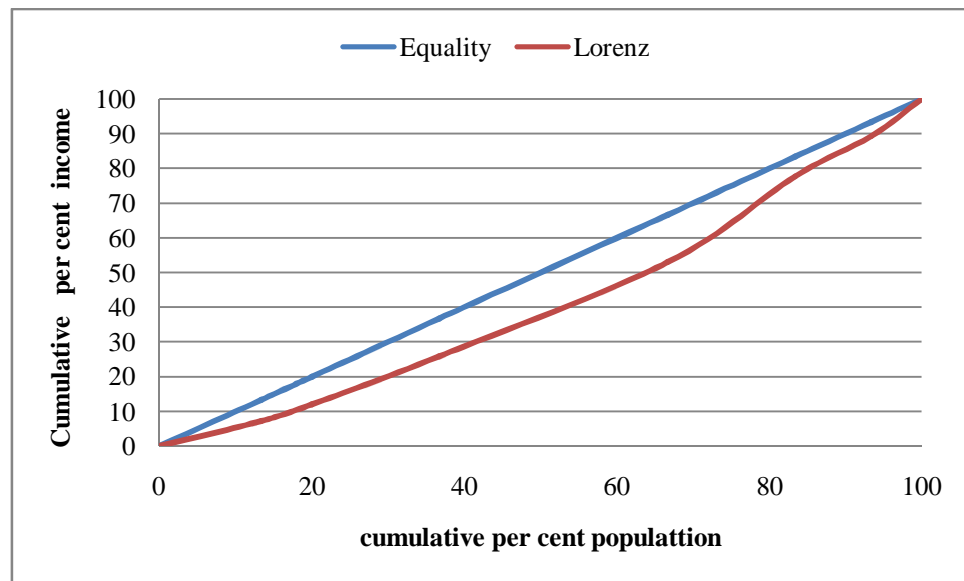


Fig. 9. Pattern of distribution of income generated from farmers' practice in Rice: KVK-Kalavacharla

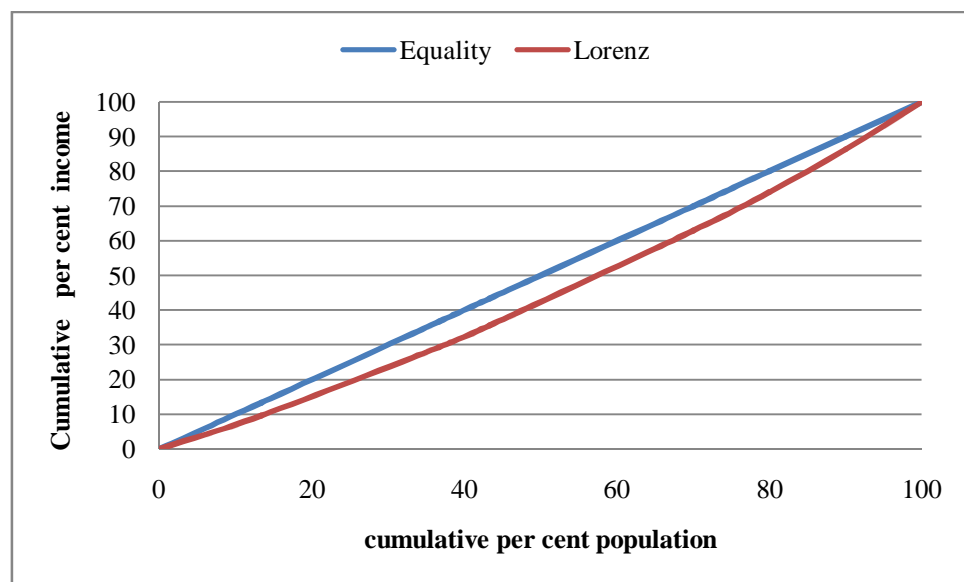


Fig. 10. Pattern of distribution of income generated from high yielding varieties of Rice: KVK-Kalavacharla

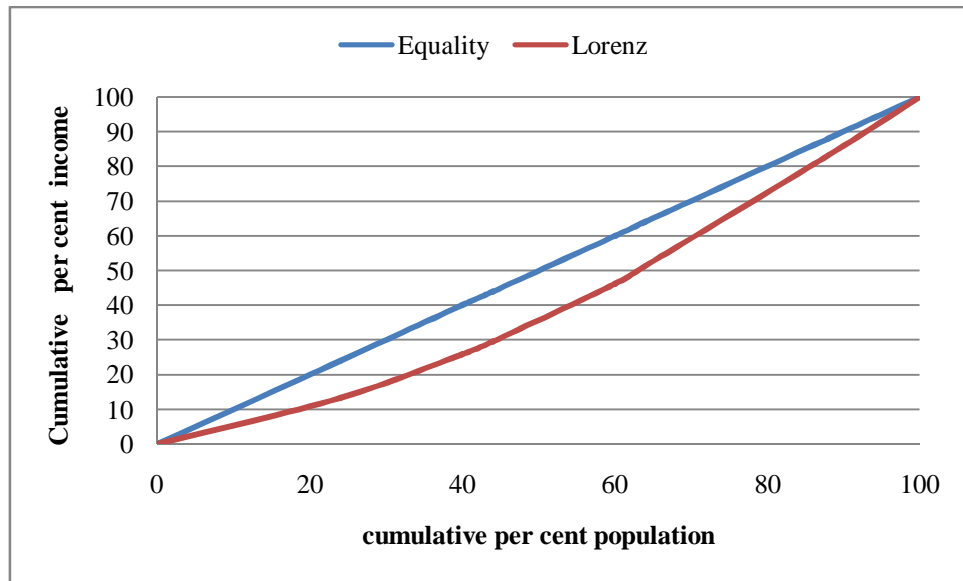


Fig. 11. Pattern of distribution of income generated from farmers' practice in Banana: KVK-Kalavacharla

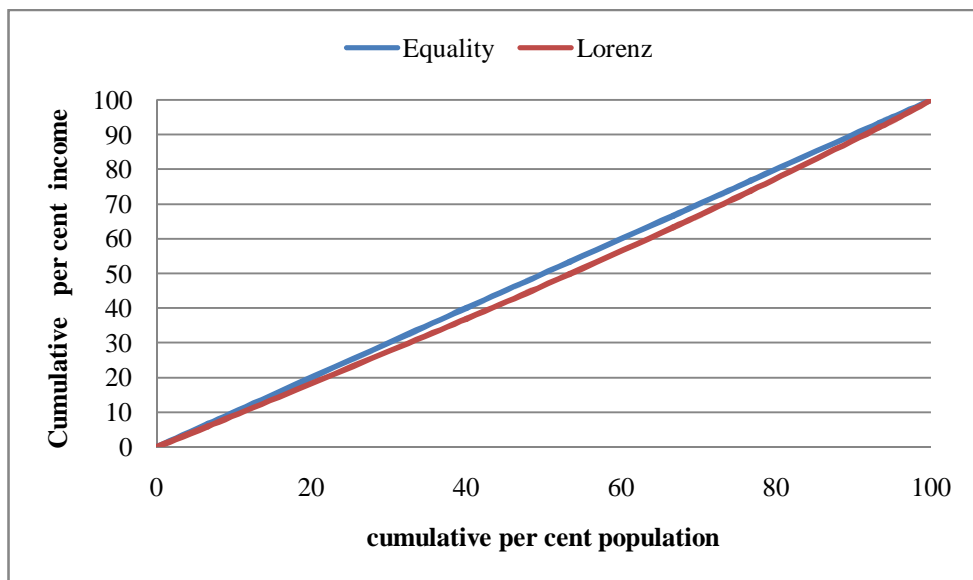


Fig. 12. Pattern of distribution of income generated from direct feeding & skirting of bunches in Banana: KVK-Kalavacharla

Table 4.56. Comparison of Gini coefficient for Farmers' practice and improved technology in KVK-Amadalavalasa

Crop	Farmers Practice	Improved Technology
Rice	0.15	0.07
Maize	0.11	0.05

Table 4.57. Comparison of Gini coefficient for Farmers' practice and improved technology in KVK-Yagantipalli

Crop	Farmers Practice	Improved Technology
Rice	0.14	0.08
Redgram	0.24	0.09

Table 4.58. Comparison of Gini coefficient for Farmers' practice and improved technology in KVK-Kalavacharla

Crop	Farmers Practice	Improved Technology
Rice	0.17	0.11
Banana	0.18	0.11

Chapter III

MATERIAL AND METHODS

This chapter deals with the methodology adopted in the present study with respect to sampling design, data collection from the sample, statistical tools and techniques employed in data analysis in order to meet the objectives of the study. An attempt has also been made to brief the procedural details adopted in the selection of KVKs and farmers besides the method of data collection from respondents and the analytical tools used to arrive at valid conclusions from the data.

The chapter is presented under the following heads:

3.1 Sampling procedure

3.2 Sources and collection of data

3.3 Statistical tools and techniques

3.1 SAMPLING PROCEDURE

Multistage sampling technique was used for the study as detailed below.

3.1.1 Selection of KVKs

The state of Andhra Pradesh was purposively selected for the study. At present 24 Krishi Vigyan Kendras are functional in 13 districts of Andhra Pradesh. The KVKs were selected from three different categories:

1. KVKs functioning under SAUs
2. KVKs functioning under NGOs
3. KVKs functioning under ICAR

The KVKs which have completed five years of existence under each category were listed out. As it is generally understood that at least five years of continuous functioning of any institution is needed to create measurable impact over its periphery, one KVK from SAUs (Acharya N.G. Ranga Agricultural University), one from NGO (Shri Pendekanti Educational & Charitable Society) and one from ICAR (Indian Council of Agriculture Research, Govt. of India) were selected for the study. Each KVK represents different agro-climatic zones of Andhra Pradesh state. Among the three KVKs one is from the North Coastal Andhra Pradesh, one is from Scarce Rainfall zone and one is from Godavari zone of the state which has adequate representation of the area. The details of the sampled KVKs were given in table 3.1.

Table 3.1 Details of selected KVKs

S. No.	Name of the KVK & District	Name of the host organisation	Year of establishment	Agro-climatic zone covered
1	Krishi Vigyan Kendra, Amadalavalsa, Srikakulam District.	Acharya N.G. Ranga Agricultural University, Guntur.	1984	North Coastal Zone, High Altitude & Tribal Area Zone
2	Krishi Vigyan Kendra, Yagantipalli, Kurnool District.	Shri Pendekanti Educational & Charitable Society, Kurnool.	1989	Scarce Rainfall zone
3	Krishi Vigyan Kendra, Kalavacharla, East Godavari District.	ICAR - CTRI Central Tobacco Research Institute, Rajahmundry.	1992	Godavari Zone

3.1.2 Selection of sample

Sample size: From each KVK 170 respondents were selected making the total sample size to 510.

- i) **Selection of farmers:** From each KVK, 60 beneficiary farmers and 60 non - beneficiary farmers were selected randomly, thus making a sample size of 120 farmers.
- ii) **Selection of vocational trainees:** A list of trainees of various villages who received vocational training on tailoring & stitching, blouse designing, millet processing, bag making, paper plate making, coconut climbing and mushroom cultivation, etc., was prepared with the help of KVK scientists and other officials. From each KVK 50 trainees were selected for the study by random sampling method.

3.2 SOURCES AND COLLECTION OF DATA

The study is based on secondary as well as primary data.

3.2.1 Secondary Data

The secondary data was collected from KVKs, Agricultural Technology Application Research Institute (ATARI, Zone-X, Hyderabad), Research stations, Agriculture offices, Statistical departments publications, websites, etc., Data regarding crop specific issues, frontline demonstrations, beneficiary farmers, training programmes conducted, details of trainees and employment generation was collected from the corresponding KVKs.

3.2.2 Primary Data

Primary data on general profile of respondents, yields and returns from selected crops and the factors for technology adoption were collected by personal interview of sample respondents through pre tested schedules.

3.3 ANALYTICAL TOOLS AND TECHNIQUES

For the quantitative assessment of the data to achieve the objectives of the present study, the following analytical tools, techniques and statistical methods were employed.

3.3.1 Tabular Analysis

Tabular analysis involving the computation of means, percentages etc., was employed to present the socio-economic profile like family size, age-wise distribution, educational status of sample respondents, yields and returns from the cultivation of crops, impact of frontline demonstrations, vocational training programmes, etc.

3.3.2. Yield Gap Analysis

The impact of frontline demonstrations was studied through yield gap analysis. Tabular analysis was used to estimate the magnitude of yield gaps. The percentage and the appropriate indices relating to yield gaps were computed and compared. For the present study, the methodology formulated by the International Rice Research Institute (IRRI) i.e. Yield Gap-I and Yield Gap-II was adopted.

Total Yield Gap (GT)

It is the difference between the potential yield (Y_p) and the actual farm yield (Y_a).

Thus,

$$GT = Y_p - Y_a \dots\dots\dots(1)$$

The total yield gap has been split into two components, viz., Yield Gap- I and Yield Gap - II.

$$GT = (Y_p - Y_d) + (Y_d - Y_a) \dots\dots\dots(2)$$

Where,

Y_p = Potential yield as obtained in the research station

Y_a = Actual farm yield taken as the average of the yield of the farms

Y_d = Average yield obtained in the demonstration plots

Yield Gap-I (Technology gap)

This refers to the difference between the potential yield (Y_p) and average demonstration yield (Y_d).

$$YG-I = Y_p - Y_d \dots\dots\dots(3)$$

Yield Gap - II (Extension gap)

This refers to the difference between the average demonstration yield (Y_d) and the actual farm yield (Y_a).

Thus,

$$YG-II = Y_d - Y_a \dots\dots\dots(4)$$

Index of Yield Gap (I_y) (Technology Index)

It is defined as ratio of the difference between the potential yield (Y_p) and the actual farm yield (Y_a) to the potential yield (Y_p).

Thus,

$$I_y = \{ (Y_p - Y_a) / Y_p \} * 100 \dots\dots\dots(5)$$

Index of Realized Potential Yield (I_p)

It is the ratio of the actual farm yield (Y_a) to the potential yield (Y_p) expressed in percentage.

Thus,

$$I_p = (Y_a / Y_p) * 100 \dots\dots\dots(6)$$

Index of Realized Demonstration Yield (I_d)

It is defined as the ratio of the actual farm yield (Y_a) to the demonstration yield (Y_d) expressed in percentage.

Thus,

$$I_f = (Y_a / Y_d) * 100 \dots\dots\dots(7)$$

Per cent yield increase over farmers Practice = ((Average demonstration plot yield - Average farmers plot yield)/ Average farmers plot yield)*100

3.3.3 Production Function Analysis

A production function is a mathematical description of the various technical production possibilities faced by a firm. The production function gives the maximum output(s) in physical terms for each level of the inputs in physical terms. It can be mathematically expressed as:

$$Y = f(X_1, X_2, \dots, X_n, X) \dots\dots\dots(8)$$

Where Y denotes output, f is a function, X_1, X_2, \dots, X_n are variable inputs and X is fixed input. There are several types of agricultural production functions to study the resources productivity. Hence it is essential to choose an appropriate form of production function taking into consideration the data to be analyzed. The impact of various resources on productivity for selected crops was studied by fitting the Cobb-Douglas type production function to the farm level data.

Cobb-Douglas type of production function in log-linear form was fitted to study the important factors affecting the productivity of the selected crops in both improved and traditional methods of cultivation. It was fitted on account of its well known properties that justify its wide application in analyzing

production relations. This function has become a conventional tool in production function analysis mainly because of its theoretical simplicity and computational manageability. The model specified for the present study is furnished below:

$$Y = a X_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4} X_5^{b_5} X_6^{b_6} e_u \dots\dots\dots(9)$$

where,

Y = Output of main produce (quintal per ha)

a = Intercept

X₁ = Human labour (human-days per ha) or Machine labour (machine hours per ha)

X₂ = Quantity of seed (kg per ha)

X₃ = Quantity of nitrogen (kg per ha)

X₄ = Quantity of phosphorus (kg per ha)

X₅ = Quantity of potash (kg per ha)

X₆ = Number of irrigations for the entire crop period

e_u = Error component

Converting both sides of the above equation in the log form, we have

$$\ln Y = \ln a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + u \dots\dots\dots(10)$$

The regression coefficients (b_i : i =1..... 6) were tested for their significance using "t" test at chosen significant level, which is given below:

$$t = b_i / \text{SE of } b_i \dots\dots\dots(11)$$

Where:

b_i is the regression coefficient of ith input

SE of b_i is the standard error of b_i

When 't' calculated value is greater than t table value then that particular coefficient is considered to be statistically significant and the corresponding explanatory variable can be concluded as a significant contributing factor for the changes in the dependent variable.

In order to ascertain the goodness of fit, coefficient of multiple determination (R^2) was calculated by using the formula given below:

$$R^2 = \text{RSS} / \text{TSS} \dots\dots\dots(12)$$

Where,

RSS = Regression sum of squares

TSS = Total sum of squares

Separate functions were fitted for both improved technology and farmers' practice.

3.3.4 Decomposition Analysis

In order to further study the yield gap, an attempt was made to examine the nature of technological change in crop production through the measurement of productivity difference between improved technology/ variety and farmers practice/ local variety and thereafter to analyze and evaluate the constituent sources of such a difference. To decompose the total productivity difference between improved technology and farmers practice into its constituent sources, Bisalial's (1977) output decomposition model was used. The model requires the production function to be specified on unit area basis. Therefore, the Cobb-Douglas production functions on per hectare basis, for the improved and traditional/local variety or technology as specified below in log-linear form was estimated:

$$\ln Y_2 = \ln b_0 + b_1 \ln H_2 + b_2 \ln M_2 + b_3 \ln S_2 + b_4 \ln N_2 + b_5 \ln P_2 + b_6 \ln K_2 + b_7 \ln I_2 + U_2 \dots\dots\dots (13)$$

$$\ln Y_1 = \ln a_0 + a_1 \ln H_1 + a_2 \ln M_1 + a_3 \ln S_1 + a_4 \ln N_1 + a_5 \ln P_1 + a_6 \ln K_1 + a_7 \ln I_1 + U_1 \dots\dots\dots (14)$$

Where,

Y = Quantity of output per hectare

H = Human labour (man days per hectare)

M = Machine labour (machine hours per hectare)

S = Quantity of seed (kg per hectare)

N = Quantity of nitrogen (kg per hectare)

P = Quantity of phosphorous (kg per hectare)

K = Quantity of potash (kg per hectare)

I = Number of irrigations per hectare

u = Error term

1 and 2 stand for farmers practice/ traditional variety and improved technology/ variety respectively.

Subtracting equation (14) from (13) we get,

$$\ln Y_2 - \ln Y_1 = \ln b_0 - \ln a_0 + b_1 \ln H_2 - a_1 \ln H_1 + b_2 \ln M_2 - a_2 \ln M_1 + b_3 \ln S_2 - a_3 \ln S_1 + b_4 \ln N_2 - a_4 \ln N_1 + b_5 \ln P_2 - a_5 \ln P_1 + b_6 \ln K_2 - a_6 \ln K_1 + b_7 \ln I_2 - a_7 \ln I_1 + U_2 - U_1 \dots\dots\dots (15)$$

Adding some term and subtracting the same term in the above equation, we have,

$$\ln Y_2 - \ln Y_1 = (\ln b_0 - \ln a_0) + b_1 \ln H_2 - a_1 \ln H_1 + b_2 \ln M_2 - a_2 \ln M_1 + b_3 \ln S_2 - a_3 \ln S_1 + b_4 \ln N_2 - a_4 \ln N_1 + b_5 \ln P_2 - a_5 \ln P_1 + b_6 \ln K_2 - a_6 \ln K_1 + b_7 \ln I_2 - a_7 \ln I_1 + U_2 - U_1 + b_1 \ln H_1 - b_1 \ln H_1 + b_2 \ln M_1 - b_2 \ln M_1 + b_3 \ln S_1 - b_3 \ln S_1 + b_4 \ln N_1 - b_4 \ln N_1 + b_5 \ln P_1 - b_5 \ln P_1 + b_6 \ln K_1 - b_6 \ln K_1 + b_7 \ln I_1 - b_7 \ln I_1 \dots\dots\dots (16)$$

Rearranging the terms, we get

$$\ln Y_2 - \ln Y_1 = [\ln b_0 - \ln a_0] + [(b_1 - a_1) \ln H_1 + (b_2 - a_2) \ln M_1 + (b_3 - a_3) \ln S_1 + (b_4 - a_4) \ln N_1 + (b_5 - a_5) \ln P_1 + (b_6 - a_6) \ln K_1 + (b_7 - a_7) \ln I_1] + [b_1 (\ln H_2 - \ln H_1) + b_2 (\ln M_2 - \ln M_1) + b_3 (\ln S_2 - \ln S_1) + b_4 (\ln N_2 - \ln N_1) + b_5 (\ln P_2 - \ln P_1) + b_6 (\ln K_2 - \ln K_1) + b_7 (\ln I_2 - \ln I_1)] + [U_2 - U_1] \dots\dots\dots (17)$$

Equation (17) was used for decomposing the sources of yield gap. The left hand side of the equation indicates the total difference in production expressed as percentage over farmers' practice/ traditional variety. The summation of 1st and 2nd square bracketed terms on the right hand side represents the yield gap, attributable to the difference in the technology. The 3rd term represents the yield gap attributable to the difference in the input use between improved and traditional methods. The last term represents the random disturbance.

3.3.5. Technological Adoption Index

The technological adoption index is a catch-all measure of technology adoption of the farmers. The technology adoption practices include area under high-yielding varieties (HYVs) or improved technologies, appropriateness of irrigation level and dosages of fertilizers.

$$TAI_i = \frac{1}{5} \left[\frac{AH_i}{CA_i} + \frac{NA_i}{NR_i} + \frac{PA}{PR_i} + \frac{KA}{KR_i} + \frac{IA}{IR_i} \right] \times 100 \dots\dots\dots (18)$$

where,

i = Number of farmers, say 1, 2, 3, ..., n

TAI_i = Technology adoption index of the i^{th} farmer

AH_i = Area under improved technology / variety in hectare

CA_i = Total area of crop in hectare

NA_i = Quantity of nitrogen applied for crop in kg per hectare

NR_i = Recommended dose of nitrogen for crop in kg per hectare

PA_i = Quantity of phosphorous applied for crop in kg per hectare

PR_i = Recommended dose of phosphorous for crop in kg per hectare

KA_i = Quantity of potash applied for crop in kg per hectare

KR_i = Recommended amount of potash applied for crop in kg per hectare

IA_i = Actual number of irrigations applied

IR_i = Recommended number of irrigations for crop

3.3.6 Determinants of Technology Adoption

The determinants of technology adoption index (TAI) were examined by employing regression function of the following form:

$$TAI = f (AGE, EDU, LHS, EXP, FMS, AIA, SAI, KTP, E) \dots\dots\dots (19)$$

where,

AGE = Age of the farmer in years

EDU = Education level of the farmer in years

LHS = Land holding size in hectare

EXP = Experience of the farmer in cultivation of the crop in years

FMS = Family size in number

AIA = Annual income from agriculture in Rupees

SAI = Subsidiary annual income of the family in Rupees

KTP = KVK training programme; as dummy variable taking values of '1' if yes, '0' otherwise

E = Error-term

3.3.7 Distribution Pattern of Income of Beneficiaries and non-Beneficiaries

3.3.7.1 Lorenz Curve

Lorenz curve was developed by Max O. Lorenz in 1905 for representing inequality of the wealth distribution. Lorenz curve is a graphical representation of the cumulative distribution function of the empirical probability distribution of income. It is a graph showing the proportion of the distribution assumed by the bottom y per cent of the values. It is often used to represent income distribution, where it shows for the bottom x per cent of households, what percentage y of the total income they have. The percentage of households is plotted on the x -axis and the percentage of income on the y -axis. It can also be used to show distribution of assets. In such use, it is considered as a measure of social inequality.

These curves relate to the cumulative percentage of aggregate benefits to the cumulative percentage of population receiving these benefits. If every member of the population receives the same benefit (income) Lorenz curve will coincide with the diagonal line sometimes referred to as egalitarian line. If not the Lorenz curve will fall below the diagonal line. More the concentration of the distribution of benefit (income) the farther would be placement of the Lorenz curve from the diagonal line.

A perfectly equal income distribution would be the one in which every person has the same income. In this case, the bottom " N "% of society would always have " N "% of the income. This can be depicted by the straight line " $y = x$ "; called the "line of perfect equality." By contrast, a perfectly unequal distribution would be one in which one person has all the income and everyone else has none. In that case, the curve would be at " $y = 0\%$ " for all " $x < 100\%$ ", and " $y = 100\%$ " when " $x = 100\%$ ". This curve is called the "line of perfect inequality."

Although the Lorenz curve is useful for determining the degree of inequality it does not give a precise value that can be used for comparison. The Gini coefficient on the other hand has this convenient property.

3.3.7.2 Gini coefficient

Gini coefficient is a very popular tool for studying income distribution. The Gini coefficient is a measure of statistical dispersion developed by the Italian statistician and sociologist Corrado Gini and published in his 1912 paper "Variability and Mutability" (Italian: Variabilità e mutabilità). The Gini coefficient is a measure of the inequality of a distribution, a value of 0 expressing total equality and a value of 1 maximal inequality.

The Gini coefficient is usually defined mathematically based on the Lorenz curve, which plots the proportion of the total income of the population (y axis) that is cumulatively earned by the bottom x% of the population. The line at 45 degrees thus represents perfect equality of incomes. The Gini coefficient can then be thought of as the ratio of the area that lies between the line of equality and the Lorenz curve over the total area under the line of equality. The Gini coefficient is the area between the line of perfect equality and the observed Lorenz curve, as a percentage of the area between the line of perfect equality and the line of perfect inequality. The higher the coefficient, the more unequal the distribution is.

The Gini coefficient can range from 0 to 1; it is sometimes expressed as a percentage ranging between 0 and 100. More specifically, the upper bound of the Gini coefficient equals 1 only in populations of infinite size. In a population of size N, the upper bound is equal to $1 - 2 / (N + 1)$.

A low Gini coefficient indicates a more equal distribution, with zero corresponding to complete equality, while higher Gini coefficients indicate more unequal distribution, with '1' corresponding to complete inequality. To be validly computed, no negative goods can be distributed. Thus, if the Gini coefficient is being used to describe household income inequality, then no

household can have a negative income. When used as a measure of income inequality, the most unequal society will be one in which a single person receives 100% of the total income and the remaining people receive none ($G=1$); and the most equal society will be one in which every person receives the same income ($G=0$). That is if the Gini coefficient is '0', then it means that every individual receives exactly same benefit, while the ratio of '1' means one individual receives all the benefits.

$$GC = 1 - [\sum_{j=1}^n P_j(Q_j + Q_{j-1})] \dots\dots\dots (20)$$

Where,

P_j = Proportion of household in j th group

Q_j = Cumulative proportion of income in j th group

Q_{j-1} = Cumulative proportion of income in (j-1) group

N = Total number of groups

Table 4.44. Pattern of distribution of income generated from Farmers' practice in Rice: KVK-Amadalavalasa

S. No.	Income groups (Rs./ha)	No. of households	Per cent of households	Cumulative Per cent households	Total aggregate income in each group (Rs.)	Per cent of aggregate income	Cumulative per cent income
1	Less than 22000	3	10.00	10.00	64347	7.42	7.42
2	22001-24000	1	3.33	13.33	23649	2.73	10.15
3	24001-26000	6	20.00	33.33	153894	17.74	27.89
4	26001-28000	1	3.34	36.67	27049	3.12	31.01
5	28001-30000	12	40.00	76.67	352588	40.65	71.66
6	30001-32000	1	3.33	80.00	31249	3.60	75.27
7	32001-34000	1	3.33	83.33	33049	3.81	79.08
8	34001-36000	4	13.34	96.67	141796	16.35	95.43
9	More than 36000	1	3.33	100	39649	4.57	100.00
	Total	30	100.00		867270	100.00	

Table 4.45. Pattern of distribution of income generated from MSRI in Rice: KVK-Amadalavalasa

S.No.	Income groups (Rs./ha)	No. of households	Per cent of households	Cumulative Per cent households	Total aggregate income in each group (Rs.)	Per cent of aggregate income	Cumulative per cent income
1	Less than 32000	3	10.00	10.00	92800	8.18	8.18
2	32001-34000	5	16.67	26.67	161667	14.26	22.44
3	34001-36000	1	3.33	30.00	34033	3.00	25.44
4	36001-38000	7	23.33	53.33	255733	22.55	47.99
5	38001-40000	6	20.00	73.33	236000	20.81	68.80
6	40001-42000	1	3.34	76.67	40733	3.59	72.39
7	42001-44000	4	13.33	90.00	168533	14.86	87.25
8	44001-46000	1	3.33	93.33	44933	3.96	91.21
9	More than 46000	2	6.67	100.00	99667	8.79	100.00
	Total	30	100.00		1134099	100.00	

Table 4.46. Pattern of distribution of income generated from Farmers' practice in Maize: KVK-Amadalavalasa

S. No.	Income groups (Rs./ha)	No. of households	Per cent of households	Cumulative Per cent households	Total aggregate income in each group (Rs.)	Per cent of aggregate income	Cumulative per cent income
1	Less than 26000	4	13.33	13.33	69947	7.29	7.29
2	26001-28000	3	10.00	23.33	80052	8.34	15.63
3	28001-30000	1	3.34	26.67	29187	3.04	18.67
4	30001-32000	1	3.33	30.00	30547	3.18	21.85
5	32001-34000	6	20.00	50.00	199656	20.80	42.66
6	34001-36000	8	26.67	76.67	277110	28.87	71.53
7	36001-38000	5	16.66	93.33	186803	19.46	91.00
8	38001-40000	1	3.34	96.67	38054	3.97	94.96
9	More than 40000	1	3.33	100.00	48347	5.04	100.00
	Total	30	100.00		959704	100.00	

Table 4.47. Pattern of distribution of income generated from Zero tillage in Maize: KVK-Amadalavalasa

S. No.	Income groups (Rs./ha)	No. of households	Per cent of households	Cumulative Per cent households	Total aggregate income in each group (Rs.)	Per cent of aggregate income	Cumulative per cent income
1	Less than 45000	1	3.33	3.33	43925	2.86	2.86
2	45001-47000	3	10.00	13.33	136710	8.90	11.76
3	47001-49000	7	23.33	36.67	337230	21.96	33.72
4	49001-51000	6	20.00	56.67	296725	19.32	53.04
5	51001-53000	5	16.67	73.33	258970	16.86	69.90
6	53001-55000	3	10.00	83.33	162010	10.55	80.45
7	55001-57000	1	3.33	86.67	55781	3.63	84.08
8	57001-59000	2	6.67	93.33	117490	7.65	91.73
9	More than 59000	2	6.67	100.00	127042	8.27	100.00
	Total	30	100.00		1535883	100.00	

Table 4.48. Pattern of distribution of income generated from Farmers' practice in Rice: KVK-Yagantipalli

S.No.	Income groups (Rs./ha)	No. of households	Per cent of households	Cumulative Per cent households	Total aggregate income in each group (Rs.)	Per cent of aggregate income	Cumulative per cent income
1	Less than 40000	11	36.67	36.67	436403	31.54	31.54
2	40001 – 45000	8	26.66	63.33	358016	25.88	57.42
3	45001 – 50000	5	16.67	80.00	245010	17.71	75.13
4	50001 – 55000	3	10.00	90.00	164637	11.90	87.03
5	55001 – 60000	2	6.67	96.67	116050	8.39	95.42
6	More than 60000	1	3.33	100.00	63402	4.58	100.00
	Total	30	100.00		1383518	100.00	

Table 4.49. Pattern of distribution of income generated from STCR (Soil test crop response) in Rice: KVK-Yagantipalli

S.No.	Income groups (Rs./ha)	No. of households	Per cent of households	Cumulative Per cent households	Total aggregate income in each group (Rs.)	Per cent of aggregate income	Cumulative per cent income
1	Less than 45000	4	13.33	13.33	171668	10.16	10.16
2	45001 – 50000	6	20.00	33.33	292181	17.30	27.46
3	50001 – 55000	4	13.33	46.67	212072	12.56	40.02
4	55001 – 60000	6	20.00	66.67	352734	20.88	60.90
5	60001 – 65000	3	10.00	76.67	190104	11.26	72.16
6	More than 65000	7	23.33	100	470225	27.84	100.00
	Total	30	100.00		1688984	100.00	

**Table 4.50. Pattern of distribution of income generated from Farmers' practice in Redgram (Conventional varieties):
KVK-Yagantipalli**

S.No.	Income groups (Rs./ha)	No. of households	Per cent of households	Cumulative Per cent households	Total aggregate income in each group (Rs.)	Per cent of aggregate income	Cumulative per cent income
1	Less than 10000	9	30.00	30	65415	13.57	13.57
2	10001-15000	6	20.00	50.00	86513	17.94	31.51
3	15001-20000	4	13.33	63.33	70640	14.65	46.16
4	20001-25000	6	20.00	83.33	124983	25.92	72.08
5	25001-30000	4	13.34	96.67	103035	21.37	93.45
6	More than 30000	1	3.33	100.00	31575	6.55	100.00
	Total	30	100.00		482160	100.00	

Table 4.51. Pattern of distribution of income generated from HYV Redgram: KVK-Yagantipalli

S.No.	Income groups (Rs./ha)	No. of households	Per cent of households	Cumulative Per cent households	Total aggregate income in each group (Rs.)	Per cent of aggregate income	Cumulative per cent income
1	Less than 25000	3	10.00	10	72897	7.38	7.38
2	25001 – 30000	8	26.67	36.67	236892	23.98	31.35
3	30001 – 35000	11	36.66	73.33	350220	35.45	66.80
4	35001 – 40000	2	6.67	80.00	75161	7.61	74.41
5	40001 – 45000	4	13.33	93.33	160947	16.29	90.70
6	More than 45000	2	6.67	100.00	91900	9.30	100.00
	Total	30	100.00		988017	100.00	

**Table 4.52. Pattern of distribution of income generated from farmers' practice in Rice (Traditional varieties):
KVK-Kalavacharla**

S.No.	Income groups (Rs./ha)	No. of households	Per cent of households	Cumulative Per cent households	Total aggregate income in each group (Rs.)	Per cent of aggregate income	Cumulative per cent income
1	Less than 20000	4	13.33	13.33	61451	7.16	7.16
2	20001 – 23000	2	6.67	20.00	41433	4.83	12.00
3	23001 – 25001	5	16.67	36.67	118265	13.79	25.78
4	25001 – 28000	9	30.00	66.67	232701	27.13	52.91
5	28001 – 31000	5	16.66	83.33	212985	24.83	77.75
6	31001 – 34000	3	10.00	93.33	98332	11.46	89.21
7	More than 34000	2	6.67	100.00	92543	10.79	100.00
	Total	30	100		857710	100.00	

Table 4.53. Pattern of distribution of income generated from high yielding varieties of Rice: KVK-Kalavacharla

S.No.	Income groups (Rs./ha)	No. of households	Per cent of households	Cumulative Per cent households	Total aggregate income in each group (Rs.)	Per cent of aggregate income	Cumulative per cent income
1	Less than 35000	4	13.33	13.33	121040	9.58	9.58
2	35001 – 38000	7	23.33	36.67	250164	19.81	29.39
3	38001 – 41000	2	6.67	43.33	79045	6.26	35.65
4	41001 – 44000	8	26.67	70	343481	27.20	62.85
5	44001 – 49000	3	10	80	140841	11.15	74.00
6	49001 – 53000	3	10	90	155992	12.35	86.36
7	More than 53000	3	10	100	172290	13.64	100.00
	Total	30	100		1262853	100.00	

Table 4.54. Pattern of distribution of income generated from Farmers' practice in Banana: KVK-Kalavacharla

S.No.	Income groups (Rs./ha)	No. of households	Per cent of households	Cumulative Per cent households	Total aggregate income in each group (Rs.)	Per cent of aggregate income	Cumulative per cent income
1	Less than 100000	7	23.33	23.33	577050.8	12.95	12.95
2	100001 – 120000	5	16.67	40.00	578846.25	12.99	25.94
3	120001 – 140000	1	3.33	43.33	136479	3.06	29.00
4	140001 – 160000	5	16.67	60.00	768510	17.25	46.25
5	160001 – 180000	1	3.33	63.33	187284	4.20	50.45
6	180001 – 200000	7	23.34	86.67	1375769.5	30.87	81.32
7	More than 200000	4	13.33	100.00	832308	18.68	100.00
	Total	30	100.00		4456247.55	100	

Table 4.55. Pattern of distribution of income generated from Bunch feeding & Skirting of Banana: KVK-Kalavacharla

S. No.	Income groups (Rs./ha)	No. of households	Per cent of households	Cumulative Per cent households	Total aggregate income in each group (Rs.)	Per cent of aggregate income	Cumulative per cent income
1	Less than 150000	2	6.67	6.67	291467	4.58	4.58
2	150001 – 170000	5	16.66	23.33	806133	12.68	17.26
3	170001 – 190000	4	13.34	36.67	749600	11.79	29.06
4	190001 – 210000	4	13.33	50.00	816267	12.84	41.90
5	210001 – 230000	8	26.67	76.67	1867200	29.37	71.27
6	230001 – 250000	5	16.66	93.33	1175333	18.49	89.75
7	More than 250000	2	6.67	100.00	651467	10.25	100.00
		30	100.00		6357467	100.00	

Chapter IV

RESULTS AND DISCUSSIONS

The results are discussed in a logical sequence covering socio-economic aspects of the selected sample farmers, trainees, impact of front line demonstrations conducted by the Krishi Vigyan Kendras in terms of productivity, returns, yield gaps and factors responsible for yield gaps to understand the relative advantage of improved technology over traditional practices/variety. The discussion also covers technology adoption level and various socio-economic factors of beneficiary farmers to the technology adoption.

Comparative economics in terms of income is also discussed giving a brief account of the distribution of income of both beneficiary and non-beneficiary farmers. The results of the ex-post facto evaluation of vocational training programmes conducted by the Krishi Vigyan Kendras in terms of employment and income generation to the trainee beneficiaries were also discussed in this chapter. The results of the analysed data collected for achieving the set objectives of the study are presented in this chapter under the following heads:

- 4.1 Socio-economic profile of sample farmers and trainees
- 4.2 Impact of Krishi Vigyan Kendras on crop yields and returns
- 4.3 Yield gap analysis
- 4.4 Factors affecting the productivity of crops
- 4.5 Decomposition of yield gaps
- 4.6 Impact of vocational training programmes on income
- 4.7 Economic benefits from adoption of improved technologies
- 4.8 Impact on income distribution
- 4.9 Factors contributing to the adoption of improved technologies

4.1.1 Socio-economic profile of the sample farmers

In order to assess the impact of new technologies popularised by KVKs data was collected from the adopted villages of three Krishi Vigyan Kendras in three districts of Andhra Pradesh. A sample size of 360 farmers, of which 120 farmers from KVK-Amadalavalasa, 120 farmers from KVK-Yagantipalli and 120 from KVK-Kalavacharla were selected to assess the impact of new technologies in different crops. From each KVK 60 farmers were beneficiaries and 60 farmers were non-beneficiaries of KVK technology. Some of the socio-economic features of the sample farmers are presented in this section.

4.1.1.1 Age-wise distribution of sample farmers

Age is one of the important factors that influence decision making of individuals which has a bearing on the farmers risk taking attitude and innovativeness in adopting new technologies. The study on the age wise distribution of the farmers was done by classifying them into three age-groups viz. young (below 35 years), middle aged (35-50 years) and old (above 50 years). The result of the study is presented in table 4.1.

The mean age of the total beneficiary farmers was 45.30 years. Out of the total beneficiary farmers 24.44 per cent were young, 47.22 per cent were middle aged and 28.34 per cent were old. The mean age of the beneficiaries of KVK-Amadalavalasa was 43.12 years in which 18.33 per cent were young, 56.67 per cent were middle aged and 25 per cent were old. Similarly, 21.67 and 33.33 per cent of the beneficiaries were young and 41.67 and 43.33 per cent of the farmers belonged to middle aged group in case of Yagantipalli and Kalavacharla KVKs respectively. The mean age of the beneficiaries was 47.77 and 45 in KVK Yagantipalli and Kalavacharla respectively.

Table 4.1. Age wise distribution of sample farmers

S. No.	Age groups	KVK- Amadalavalasa		KVK-Yagantipalli		KVK-Kalavacharla		Beneficiaries	Non Beneficiaries
		Beneficiaries	Non Beneficiaries	Beneficiaries	Non Beneficiaries	Beneficiaries	Non Beneficiaries		
1	Young (<35 years)	11 (18.33)	13 (21.67)	13 (21.67)	12 (20.00)	20 (33.33)	19 (31.67)	44 (24.44)	44 (24.44)
2	Middle aged (35-50 years)	34 (56.67)	20 (33.33)	25 (41.67)	18 (30.00)	26 (43.33)	17 (28.33)	85 (47.22)	55 (30.56)
3	Old (>50 years)	15 (25.00)	27 (45.00)	22 (36.67)	30 (50.00)	14 (23.33)	24 (40.00)	51 (28.34)	81 (45.00)
4	Mean age (years)	43.12	51.06	47.77	48.20	45.00	45.56	45.30	48.27
	Total	60 (100)	60 (100)	60 (100)	60 (100)	60 (100)	60 (100)	180 (100)	180 (100)

(Figures in parentheses indicate percentage to the total numbers)

Among all the KVKs, beneficiaries had the highest proportion of farmers in the middle aged category of age between 35 to 50 years while the non beneficiaries belonged to old age category of age above 50 years. The mean age of the non-beneficiary farmers was more than beneficiary farmers. It was found from the sample that mostly middle aged farmers were adopting new technologies popularised by the sampled Krishi Vigyan Kendras in Andhra Pradesh which could be due to their better awareness about the benefits of cost reducing and yield enhancing technologies, and also due to enthusiasm to face risks and experiment with a new technology.

4.1.1.2 Education profile of sample farmers

The educational status of the farmers plays a vital role in the adoption of any new technology or innovation. In the present study, the sample farmers were categorised into four groups with respect to literacy status, viz. illiterate, primary, secondary and college education. The literacy levels of the farmers are presented in table 4.2.

The percentage of the beneficiary and non-beneficiary farmers who were illiterate was estimated to be 18.33 and 37.78 per cent, respectively which implied that illiteracy level was highest in non-beneficiary farmers than beneficiary farmers. Most of the non-beneficiary farmers were found to be illiterate and were 40 %, 38.33 % and 35 % among the non-beneficiaries of KVK-Yagantipalli, KVK-Amadalavalasa and KVK-Kalavacharla respectively. Among all the KVKs, highest percentage of beneficiaries had secondary level of education which was found to be 33.33 % in KVK-Amadalavalasa, 41.67 % in KVK-Yagantipalli and 38.33 % in KVK-Kalavacharla.

College level education was highest in beneficiary farmers (20 %) compared to non-beneficiary farmers (8.33 %) and was highest among the beneficiaries of KVK-Amadalavalasa (25 %). Education not only helps in better crop management decisions, but also places the farmer in a better position to receive the needful information through media and other extension services.

Table 4.2. Literacy status of sample farmers

S. No.	Education level	KVK Amadalavalasa		KVK Yagantipalli		KVK Kalavacharla		Beneficiaries	Non Beneficiaries
		Beneficiaries	Non Beneficiaries	Beneficiaries	Non Beneficiaries	Beneficiaries	Non Beneficiaries		
1	Illiterate	11 (18.34)	23 (38.33)	12 (20.00)	24 (40.00)	10 (16.67)	21 (35.00)	33 (18.33)	68 (37.78)
2	Primary	14 (23.33)	17 (28.33)	14 (23.33)	20 (33.33)	15 (25.00)	19 (31.67)	43 (23.89)	56 (31.11)
3	Secondary	20 (33.33)	15 (25.00)	25 (41.67)	12 (20.00)	23 (38.33)	14 (23.33)	68 (37.78)	41 (22.78)
4	College	15 (25.00)	5 (8.33)	9 (15.00)	4 (6.67)	12 (20.00)	6 (10.00)	36 (20.00)	15 (8.33)
	Total	60 (100)	60 (100)	60 (100)	60 (100)	60 (100)	60 (100)	180 (100)	180 (100)

(Figures in parentheses indicate percentage to the total numbers)

4.1.1.3 Family size of the sample farmers

Family size in farm families is important as it has a bearing on the extent of family labour available which plays a very important role in order to fulfil all the field operations on timely basis with utmost care and capacity to save and reinvest in farming. Therefore, the details on the family size of the sample farmers were worked out and presented in table 4.3.

The result showed that majority of the beneficiary families (60.56 %) had a family size of 4-6 followed by above 6 (25 %) and 1-3 (14.44 %). KVK wise comparison also showed that beneficiary farmers had the highest number of families having a family size of 4-6, of which 60, 55 and 66.67 per cent farmers belong to beneficiaries of KVK-Amadalavalasa, KVK-Yagantipalli and KVK-Kalavacharla respectively. Most of the non-beneficiary farmers belonged to family size of 1-3 members (40.00 %) which may be the reason for their non adoption of technology due to the less availability of family labour.

4.1.2 Socio-economic Profile of the Sample Trainees

To assess the economic impact of vocational training programmes of the Krishi Vigyan Kendras on the rural community 50 trainee beneficiaries were selected from each of three sampled KVKs totalling to 150. Some of the socio-economic features of the sample trainees are presented in this section.

4.1.2.1 Age-wise distribution of sample trainees

The mean age of sample trainees was 34.94, 33.72 and 36.44 years in Amadalavalasa, Yagantipalli and Kalavacharla KVKs respectively (Table 4.4). The mean age of the sample trainees was found to be 35.03 years. Among the total sample trainees majority were young (54.67 %) below the age of 35 years followed by middle aged (36 %).

Table 4.3. Family size of sample farmers

S. No.	Family Size	KVK Amadalavalasa		KVK Yagantipalli		KVK Kalavacharla		Beneficiaries	Non Beneficiaries
		Beneficiaries	Non Beneficiaries	Beneficiaries	Non Beneficiaries	Beneficiaries	Non Beneficiaries		
1	1-3	9 (15.00)	22 (36.67)	11 (18.33)	24 (40.00)	6 (10.00)	25 (41.67)	26 (14.44)	72 (40.00)
2	4-6	36 (60.00)	27 (45.00)	33 (55.00)	23 (38.33)	40 (66.67)	21 (35.00)	109 (60.56)	70 (38.89)
3	More than 6	15 (25.00)	11 (18.33)	16 (26.67)	13 (21.67)	14 (23.33)	14 (23.33)	45 (25.00)	38 (21.11)
	Total	60 (100)	60 (100)	60 (100)	60 (100)	60 (100)	60 (100)	180 (100)	180 (100)

(Figures in parentheses indicate percentage to the total numbers)

Table 4.4. Age wise distribution of sample trainees

S.No.	Age group	KVK Amadalavalasa	KVK Yagantipalli	KVK Kalavacharla	Pooled
1	Young (<35 years)	32 (64.00)	22 (44.00)	28 (56.00)	82 (54.67)
2	Middle aged (35-45 years)	13 (26.00)	25 (50.00)	16 (32.00)	54 (36.00)
3	Old (>45 years)	5 (10.00)	3 (6.00)	6 (12.00)	14 (9.33)
	Total	50 (100)	50 (100)	50 (100)	150 (100)
	Mean age (years)	34.94	33.72	36.44	35.03

(Figures in parentheses indicate percentage to the total numbers)

In KVK-Amadalavalasa 64 % of the trainees were young, 26 % were middle aged and 10 % were old. Highest percentage of trainees belongs to middle aged category in KVK-Yagantipalli (50 %) whereas 56 per cent were young in KVK-Kalavacharla. It was found that mostly young and middle aged trainees are attending the vocational training programmes conducted by the Krishi Vigyan Kendras and adopting newly acquired skills thereafter in all the selected KVKs in three districts of the state, which could be due to their need to get employment and better awareness about the benefits of the training programmes.

4.1.2.2 Education profile of sample trainees

Average number of years of education undergone by the sample trainees was 7.52 years in pooled category. Among the total trainees 19.33 per cent had college level education, which was highest among the trainees of KVK-Amadalavalasa (24 %) followed by KVK-Kalavacharla. Per cent of illiterate trainees was also highest in KVK-Amadalavalasa, which was 32 per cent of the sample trainees of the KVK. Highest per cent (66 %) of trainees of KVK-Yagantipalli had secondary level education followed by primary education (16%).

Majority of the trainees of KVK-Kalavacharla had primary education (40%) followed by secondary education (24 %). Average number of years of education undergone by trainees was highest in KVK-Yagantipalli (8.67) followed by KVK-Amadalavalasa (7.25). In the three selected KVKs most of people attending training programmes and practicing the new skills had secondary education (40.67 per cent) followed by primary education (22.67 per cent) which is evident from the table 4.5.

Table 4.5. Literacy status of sample trainees

S.No.	Education level	KVK Amadalavalasa	KVK Yagantipalli	KVK Kalavacharla	Pooled
1	Illiterate	16 (32.00)	3 (6.00)	7 (14.00)	26 (17.33)
2	Primary	6 (12.00)	8 (16.00)	20 (40.00)	34 (22.67)
3	Secondary	16 (32.00)	33 (66.00)	12 (24.00)	61 (40.67)
4	College	12 (24.00)	6 (12.00)	11 (22.00)	29 (19.33)
	Total	50 (100)	50 (100)	50 (100)	150 (100)
Average number of years of education		7.25	8.67	6.64	7.52

(Figures in parentheses indicate percentage to the total numbers)

4.1.2.3 Family size of sample trainees

The details on the family size of the sample trainees were worked out and presented in Table 4.6. The result showed that majority of the trainee families (66 %) had a family size of 4-6 followed by 1-3 (23.33 %) and above 6 (10.67%). Among three, KVK-Yagantipalli had the highest number of families (72 %) having a family size of 4-6 and the least were more than 6 size trainee families with 8 per cent in KVK-Kalavacharla. KVK-Amadalavalasa (32 %) had the largest group having the lowest number of family member of 1-3 as compared to other KVKs and KVK-Yagantipalli had the smallest group (16 %) under this category. Among the total sample and also in all the KVKs majority of the trainees belonged to family size of 4-6 followed by 1-3 category who are practicing the newly acquired skills to get economic benefits from employment generation.

Table 4.6. Family size of sample trainees

S.No.	Family size	KVK Amadalavalasa	KVK Yagantipalli	KVK Kalavacharla	Pooled
1	1-3	16 (32)	8 (16)	11 (22)	35 (23.33)
2	4-6	28 (56)	36 (72)	35 (70)	99 (66)
3	More than 6	6 (12)	6 (12)	4 (8)	16 (10.67)
	Total	50 (100)	50 (100)	50 (100)	150 (100)

(Figures in parentheses indicate percentage to the total numbers)

4.2 IMPACT OF KRISHI VIGYAN KENDRAS ON CROP YIELDS AND RETURNS

Frontline demonstration is an efficient technology transfer system and conducting this demonstration on farmer fields was proved as an effective means for creating awareness and acceptance of improved technologies. The three sampled KVKs were conducted frontline demonstrations in farmer's fields on different technological interventions by supplying critical inputs to improve the productivity in various crops. This study focuses on the technological interventions on important crops carried out by three sampled KVKs during the period from 2011-12 to 2015-16.

4.2.1 Impact of Frontline Demonstrations on Yields and Returns: KVK-Amadalavalasa

Rice and maize are important field crops in Srikakulam district cultivated in an area of 2,08,305 ha and 13,952 ha respectively. KVK Amadalavalasa conducted 117 and 65 frontline demonstrations on improved technologies in rice and maize in an area of 81.40 ha and 25.70 ha respectively. These demonstrations were conducted in the selected farmer's fields in the adopted villages of the KVK by providing critical inputs after getting the farmers priority during the interactive meetings with farmers before laying out demonstrations.

Table 4.7. Impact of frontline demonstrations on yields and returns in Rice: KVK-Amadalavalasa

S.No.	Technology demonstrated	Number of FLDs	Area (ha)	Average Yield (q/ha)				Net Returns (Rs./ha)			
				FLD	FP	Increase over FP	Per cent increase	FLD	FP	Increase over FP	Per cent increase
1	Integrated pest management (IPM)	34	16.20	55.2	50.10	5.10	10.18	28808	24028	4780	19.89
2	Green manuring	13	5.40	54.95	48.65	6.30	12.95	25178	22433	2745	12.24
3	Micronutrient management	6	2.40	53	43	10	23.26	25600	21577	4023	18.64
4	Weed management in drum seeder rice	10	10	63.71	60.55	3.16	5.22	39240	34060	5180	15.21
5	Direct sowing with ferti-cum Seed drill	22	14	53.96	47.06	6.90	14.66	27353	20512	6841	33.35
6	Mechanised system of rice intensification (MSRI)	32	33.40	62.13	49.33	12.80	25.96	37813	26454	11359	42.94
Total		117	81.40	57.16	49.78	7.38	14.82	30665	24844	5821	23.43

FLD: Frontline demonstration FP: Farmers practice

The results in the table 4.7 revealed that the highest yield increase of 12.80 q ha⁻¹ was realized in rice under mechanised system of rice intensification (MSRI) followed by micro nutrient management (10 q ha⁻¹) with 25.96 and 23.26 per cent increase in yield respectively over farmers practice. The per cent increase in net returns over farmers practice was also highest in case of MSRI (42.94 %) followed by direct sowing of rice with ferti-cum seed drill (33.35 %). On an average the yield increase was 14.82 per cent and increase in net returns were 23.43 per cent in the all 117 demonstrations conducted by KVK-Amadalavalasa over farmers practice in rice in Srikakulam district. These results are in line with the results Mohanty *et al.* (2014) who reported increased yield and profitability of rice by improved cultivation practice through frontline demonstrations.

Maize is one of the most important field crops after rice in Srikakulam district, which plays a major role in the income levels of farmers. Krishi Vigyan Kendra Amadalavalasa conducted frontline demonstrations on Zero tillage cultivation in maize which is a resource conservation technology at adopted farmers' fields. These demonstrations resulted in an yield of 80.83 q ha⁻¹ with 14.01 per cent increase over farmer's practice of 70.90 q ha⁻¹. Zero tillage maize technology resulted in increased net returns of Rs. 18106 per hectare (53.16 %) over farmers practice. Similar results in zero tillage practice in maize were also reported by Govardhanrao and Ramana (2017) which indicated that the demonstration has given good impact in terms of yield and income thereby changing the farmer's attitude towards following this technology in future.

Table 4.8. Impact of frontline demonstrations on yields and returns in Maize: KVK-Amadalavalasa

S.No.	Technology demonstrated	Number of FLDs	Area (ha)	Average Yield (q/ha)				Net Returns (Rs./ha)			
				FLD	FP	Increase over FP	Per cent increase	FLD	FP	Increase over FP	Per cent increase
1	Zero tillage Maize	65	25.70	80.83	70.90	9.93	14.01	52167	34061	18106	53.16

FLD: Frontline demonstration

FP: Farmers practice

4.2.2 Impact of Frontline Demonstrations on Yields and Returns: KVK - Yagantipalli

Rice is the most important food crop in Kurnool district occupying 11.51 per cent of total cropped area of the district. Krishi Vigyan Kendra, Yagantipalli conducted 359 frontline demonstrations in adopted villages at farmers' fields. Cultivation practices implemented under FLD are use of improved variety, balanced application of fertilizers, weed management, plant protection methods, micro nutrient management, management of problematic soils and resource conservation technologies etc.

The results of frontline demonstrations in rice revealed that the increase in yield was highest in case of management of problematic soils i.e. reclamation of sodic soils with gypsum application as per soil test results (20.88 %) followed by foliar application of zinc (14.98 %) and integrated weed management (9.59 %) over farmers' practice. Integrated weed management in rice was found to be more effective than chemical weed management in Kurnool district (Table 4.9) during the study period from 2011-12 to 2015-16. Management of problematic soils was found to be more beneficial in terms of increased net returns of 54.30 per cent over farmers practice followed by zero tillage rice cultivation (41.90 %). Even though the increase in yields were only 1.47 per cent in STCR technology, increase in net returns were 27.16 per cent with soil test based nutrient application which reduces the cost of cultivation in rice.

Redgram is an important pulse crop in Kurnool district and the productivity continues to be quite low due to technological gaps in adoption of new technologies and other factors. The yield of redgram can be increased by demonstrating the improved technologies/ varieties at the farmers' fields under the supervision of scientists working in the operational area. Keeping in view the importance of frontline demonstrations, KVK-Yagantipalli conducted 190 demonstrations in an area of 84 hectares on improved agricultural technologies of redgram viz. integrated crop management, evaluation of hybrids and high yielding varieties in scientific manner at farmers' fields during the period from 2011-12 to 2015-16.

Table 4.9. Impact of frontline demonstrations on yields and returns in Rice: KVK- Yagantipalli

S.No.	Technology demonstrated	Number of FLDs	Area (ha)	Average Yield (q/ha)				Net Returns (Rs./ha)			
				FLD	FP	Increase over FP	Per cent increase	FLD	FP	Increase over FP	Per cent increase
1	Integrated weed management	30	12	70.88	64.68	6.20	9.59	63867	50092	13775	27.50
2	Chemical weed mgmt	10	4	67.87	67.72	0.15	0.22	69540	68290	1250	1.83
3	Varietal evaluation	96	38.40	74.38	70.63	3.75	5.31	58033	56570	1463	2.59
4	Soil test crop response (STCR)	41	16.40	71.99	70.95	1.04	1.47	58630	46109	12521	27.16
5	Foliar application of Zinc	40	16	68.16	59.28	8.88	14.98	54090	44078	10012	22.71
6	Management of problematic soils	40	16	58.75	48.60	10.15	20.88	42287	27406	14881	54.30
7	Direct Seeding	72	28.80	70.81	69.61	1.2	1.72	47973	41633	6340	15.23
8	Zero tillage	10	4	72.68	71.26	1.42	1.99	47105	33195	13910	41.90
9	Semi dry cultivation	10	4	73.64	71.34	2.3	3.22	83346	70554	12792	18.13
10	Management of blast and sheath blight	10	4	69.75	64.50	5.25	8.14	471580	453016	18564	4.10
Total		359	143.60	69.89	65.86	4.03	6.13	99645	89094	10551	11.84

FLD: Frontline demonstration FP: Farmers practice

Table 4.10. Impact of frontline demonstrations on yields and returns in Redgram: KVK- Yagantipalli

S.No.	Technology demonstrated	Number of FLDs	Area (ha)	Average Yield (q/ha)				Net Returns (Rs./ha)			
				FLD	FP	Increase over FP	Percent Increase	FLD	FP	Increase over FP	Percent increase
1	Hybrids evaluation	60	24	13.65	11.37	2.28	20.05	32042	23275	8767	37.67
2	Varietal evaluation	60	24	13.15	9.40	3.75	39.89	31285	17138	14147	82.55
3	Integrated crop management	70	40	14.75	12.38	2.37	19.14	40071	31113	8958	28.79
Total		190	84	13.85	11.05	2.80	25.34	34466	23842	10624	44.56

FLD: Frontline demonstration FP: Farmers practice

The results revealed that improved technology has registered overall 25.34 per cent increase in yield over the farmers practice with increase in net income of 44.56 per cent (Table 4.10). The increase in yield was highest in varietal evaluation (39.89 %) followed by hybrids evaluation (20.05 %) over the farmers practice. Increase in net returns were highest in varietal evaluation (82.55 %) followed by hybrids evaluation (37.67 %). It was evident from the yield levels recorded in demonstrations that the improved technologies can boost the yields significantly. These results confirm the results of Singh (2005), Yadav *et al.* (2007), Raj *et al.* (2013) and Kumar *et al.* (2014) obtained from FLD trials conducted on various pulse crops.

4.2.3 Impact of Frontline Demonstrations on Yields and Returns: KVK- Kalavacharla

KVK-Kalavacharla conducted 140 front line demonstrations (FLDs) on different technologies of rice in 56 ha of farmer's field at adopted villages in East Godavari district (Table 4.11). The results revealed that increase in yield was highest in chemical weed management (14.50 q h⁻¹) followed by integrated crop management (9.37 q h⁻¹) over farmers' practices. Overall, the yield of demonstration plots exceeds that of farmer's plots in all FLDs at an average of 6.11 q h⁻¹ with 26.18 per cent increase in net returns. This was attributed to better management practices and judicious use of chemicals. Similar results were reported by Suthar *et al.* (2016).

KVK-Kalavacharla conducted 64 front line demonstrations in 25.60 ha of farmers' fields in the adopted villages of East Godavari district to increase the productivity and to reduce the yield gaps in Banana. From the results (Table 4.12), it was found that increase in yield was highest (38.03 percent) in nutrient management with direct feeding of nutrient supplementation of urea, sulphate of potash with cow dung to banana bunches, which resulted healthy fingers in banana. Yields (30.35 t h⁻¹) and net returns (Rs. 2,21,460 per hectare) were found to be highest in the demonstrations of skirting of bunches which was because of the improvement in weight of bunches, thus fetching good prices due to better shape and quality of fingers. The average net returns of the demonstrated technologies were Rs. 1,58,570 per hectare and were 40.48 per cent higher than the farmers practice in banana.

Table 4.11. Impact of frontline demonstrations on yields and returns in Rice: KVK-Kalavacharla

S.No.	Technology demonstrated	Number of FLDs	Area (ha)	Average Yield (q/ha)				Net Returns (Rs./ha)			
				FLD	FP	Increase over FP	Percent Increase	FLD	FP	Increase over FP	Percent increase
1	Varietal Evaluation	35	14	68.29	63.74	4.55	7.14	46070	39538	6532	16.52
2	Introduction of TNAU drum seeder	55	22	88.33	82	6.33	7.72	69181	53874	15307	28.41
3	Chemical weed control	10	4	103.50	89	14.50	16.29	90296	71500	18796	26.29
4	Integrated crop management	10	4	69.37	60	9.37	15.62	43500	32550	10950	33.64
5	Sheath blight management	10	4	26.30	21	5.30	25.24	25952	19969	5983	29.96
6	Stem borer Management	10	4	10.30	9	1.30	14.44	11295	10320	975	9.45
7	Brown plant hopper management	10	4	9.84	8.43	1.41	16.73	10226	7238	2988	41.28
Total		140	56	53.70	47.60	6.11	12.83	42360	33570	8790	26.18

FLD: Frontline demonstration FP: Farmers practice

Table 4.12. Impact of frontline demonstrations on yields and returns in Banana: KVK-Kalavacharla

S.No.	Technology demonstrated	No. of FLDs	Area (ha)	Yield (t/ha)				Net Returns (Rs/ha)			
				FLD	FP	Increase over FP	Percent Increase	FLD	FP	Increase over FP	Percent increase
1	Direct feeding of nutrients to bunches	24	9.60	26.75	19.38	7.37	38.03	205500	151711	53789	35.45
2	Skirting of bunches with non-woven propylene bags	8	3.20	30.35	24.62	5.73	23.27	221460	168800	52660	31.20
3	Viral disease management	32	12.80	12.35	9.75	2.60	26.67	48750	18125	30625	168.97
	Total	64	25.60	23.15	17.92	5.23	29.21	158570	112878.67	45691.33	40.48

FLD: Frontline demonstration FP: Farmers practice

Increased yields and net returns of all the technologies demonstrated by the three sampled KVKs over the farmers practices shows the efforts of the KVKs in improving the farmers yields by conducting frontline demonstrations. The increase in yields due to improved technology/ variety over the farmers' practices proved the hypothesis that the improved technologies have yield advantage over farmers' practice. Similar results of increased yields and returns in the demonstrations of improved technologies over farmers' practices were also reported by Islam *et al.* (2011), Poonia and Pithia (2011), Kumar *et al.* (2012), Ajrawat *et al.* (2013) and Balai *et al.* (2013) in frontline demonstrations.

The results also indicated that the transfer of improved technology was beneficial for increasing the farmer's income, which proves the hypothesis that the income generated from improved cultivation practices is comparatively more than that of farmers' practice.

4.3. YIELD GAP ANALYSIS

KVKs are engaged in identifying the reasons for gaps in the productivity at the farmer's fields and searching ways for reducing the yield gaps. For the present study, the methodology formulated by the International Rice Research Institute (IRRI) i.e. Yield Gap-I (YG-I) and Yield Gap-II (YG-II) was adopted to estimate the yield gaps existed in the technologies selected from the sampled KVKs during the period from 2011-12 to 2015-16. Yield gap-I is the difference between the potential yield and average demonstration yield, and Yield gap-II is the difference between the average demonstration yield and the actual farm yield. Actual farm yield is taken as the average of the yield of the farms and potential yield as obtained in the research station.

4.3.1. Yield gaps: KVK-Amadalavalasa

Extension gap (YG-II) in rice cultivation ranged from 3.16 q ha⁻¹ to 12.80 q ha⁻¹ (Table 4.13). Total yield gap (3.19 q ha⁻¹) and technology index (5 %) was lowest in weed management in drum seeder rice. Indices of realized potential yield and realized demonstration yield were highest in weed management in drum seeder technology followed by integrated pest

management in rice showing the feasibility of these technologies in the study area. Highest extension gap (12.80 q ha⁻¹) and total yield gap (13.71 q ha⁻¹) were observed in rice under mechanised system of rice intensification. The highest gaps may be due to improper application of technology at farmers' fields, unavailability of machinery at farmers' level and partial adoption of the technology by the farmers which implies that there is much more potential to be tapped from the technology adoption at field level by the farmers.

During the study period extension gap of 9.93 q ha⁻¹ was found to be more than technology gap of 6.17 q ha⁻¹ which emphasized the need to educate the farmers through various means for the adoption of this resource conservation technology for improved maize production with reduced cost of cultivation (Table 4.14). Technology index of 18.51 per cent, indices of realised potential yield of 81.49 per cent and demonstration yield of 87.71 per cent had shown the feasibility of the demonstrated technology at the farmers' fields. These results were similar with the results reported by Meena *et al.* (2015) who evaluated the performance of frontline demonstrations organised by Krishi Vigyan Kendra, to know the production and economic benefits of scientific maize production technology in Ernakulum district of Kerala on traditional farmer's field.

4.3.2. Yield Gaps: KVK- Yagantipalli

Form the table 4.15 it was observed that the total yield gap was lowest in chemical weed management (0.23 q ha⁻¹) followed by STCR (1.57 q ha⁻¹) and zero tillage practice in rice (2.29 q ha⁻¹) showing the maximum adoption level of these technologies by the farmers. Whereas technology index was highest in management of problematic soils (19.53 %) followed by plant protection measures (16.09 %) and micro-nutrient management (15.01 %) which stresses the need to educate the farmers about these technologies to increase the rice yields in Kurnool district. The lower value of technology index in case of chemical weed management (0.34 %) followed by STCR (2.16 %) shows the feasibility for the adoption of technology in the study area. Lower the values of technology index more is the feasibility for the adoption of the technology demonstrated. On an average in all the technologies demonstrated by KVK-Yagantipalli in rice crop the indices of realised potential yield and demonstration

yield were found to be 91.91 per cent and 94.23 per cent respectively which shows acceptance and feasibility of these technologies in the district. These results confirm the results of Khedkar *et al.* (2016) and Suthar *et al.* (2016) studied the impact of frontline demonstrations and reported the acceptance and satisfaction of the farmers to the new technologies demonstrated.

In the frontline demonstrations conducted by KVK-Yagantipalli on different technologies in redgram crop, the technology index ranging from 21.50 per cent to 40.39 per cent (Table 4.16) indicates the feasibility of adopting new technology at the farmer's field. Lowest technology index of 21.50 per cent was recorded in redgram due to the intervention of the integrated technologies through the FLDs. On an average, extension gap was observed to be 2.8 q ha⁻¹ whereas technology index of 29.17 per cent. The wide gap in technology index emphasizes the need to educate the farmers for adoption of improved technologies through FLDs which will certainly change such gap and production of redgram could be increased to a large extent. Similar findings were reported by Singh *et al.* (2009), Gavaria *et al.* (2010), Hasan and Islam (2010) and Gavali *et al.* (2011) who estimated the yield gaps in different crops and indicated a good potential for increasing output with new technology and levels of inputs coupled with education and training to the farmers.

Table 4.13. Yield gaps in Rice: KVK-Amadalavalasa

S. No.	Technology demonstrated	Yield Gaps (q ha ⁻¹)			Index of Yield Gaps (%)		
		YG-I Technology Gap	YG-II Extension Gap	Total Yield Gap	Technology Index	Index of Realized Potential Yield	Index of Realized Demonstration Yield
1	Integrated pest management (IPM)	0.39	5.10	5.49	9.88	90.12	90.76
2	Green manuring	0.64	6.30	6.94	12.48	87.52	88.54
3	Micronutrient management	2.59	10.00	12.59	22.65	77.35	81.13
4	Weed management in drum seeder rice	0.03	3.16	3.19	5.00	95.00	95.04
5	Direct sowing with ferti cum Seed drill	1.01	6.90	7.91	14.38	85.62	87.21
6	Mechanised systems of rice intensification (MSRI)	0.91	12.80	13.71	21.75	78.25	79.39
	Average	0.93	7.38	8.31	14.30	85.70	87.09

Table 4.14: Yield gaps in Maize: KVK-Amadalavalasa

Technology demonstrated	Yield Gaps (q ha ⁻¹)			Index of Yield Gaps (%)		
	YG-I Technology Gap	YG-II Extension Gap	Total Yield Gap	Technology Index	Index of Realized Potential Yield	Index of Realized Demonstration Yield
Zero tillage Maize	6.17	9.93	16.10	18.51	81.49	87.71

Table 4.15. Yield gaps in Rice: KVK -Yagantipalli

S.No.	Name of the technology demonstrated	Yield Gaps (q ha ⁻¹)			Index of Yield Gaps (%)		
		YG-I Technology Gap	YG-II Extension Gap	Total Yield Gap	Technology Index	Index of Realized Potential Yield	Index of Realized Demonstration yield
1	Integrated weed management	0.54	6.74	6.74	9.44	90.56	90.56
2	Chemical weed management	0.08	0.15	0.23	0.34	99.66	99.78
3	Varietal evaluation	1.56	5.31	5.31	6.99	93.01	93.01
4	Soil test crop response (STCR)	0.53	1.04	1.57	2.16	97.84	98.56
5	Foliar application of Zinc	1.59	8.88	10.47	15.01	84.99	86.97
6	Management of problematic soils	1.65	11.80	13.45	19.53	80.47	80.47
7	Direct Seeding	2.44	1.195	3.64	4.97	95.03	98.31
8	Zero tillage	0.87	1.42	2.29	3.11	96.89	98.05
9	Semi dry cultivation	1.24	2.30	3.54	4.71	95.29	96.88
10	Management of blast and sheath blight	7.12	5.25	12.37	16.09	83.91	92.47
	Average	4.41	1.76	6.17	8.09	91.91	94.23

Table 4.16. Yield gaps in Redgram: KVK-Yagantipalli

S.No.	Technology demonstrated	Yield Gaps (q ha ⁻¹)			Index of Yield Gaps (%)		
		YG-I Technology Gap	YG-II Extension Gap	Total Yield Gap	Technology Index	Index of Realized Potential Yield	Index of Realized Demonstration Yield
1	Hybrids evaluation	1.03	2.28	3.31	22.55	77.45	83.30
2	Varietal evaluation	2.62	3.75	6.37	40.39	59.61	71.48
3	Integrated crop management (ICM)	1.02	2.37	3.39	21.50	78.50	83.93
	Average	1.75	2.80	4.55	29.17	70.83	79.78

4.3.3. Yield Gaps: KVK- Kalavacharla

Technology index was found to be lowest in evaluation of high yielding varieties of rice (6.95 %) followed by using TNAU drum seeder (7.57 %) showing the adoptability of these technologies in East Godavari district. Indices of realization of potential yield and demonstration yield were also highest in high yielding varietal evaluation and TNAU drum seeder technology proving the feasibility of these technologies in the study area. Highest technology index was observed in stem borer management (28.68 %) followed by sheath blight management (26.32 %) stressing the need of extension activities in popularising these technologies among the farmers of these technologies. Similar findings were reported by Hussain *et al.* (2011), Jha *et al.* (2011) and Mondal (2011) who discussed the need for research and extension collaboration to transfer the new technologies as strategies to minimize yield gaps.

Among the improved technologies of banana demonstrated by KVK-Kalavacharla, extension gap (2.60 q ha⁻¹) and total yield gap (6.07 ha⁻¹) were found to be lowest in viral disease management but there is a lot to achieve because of highest technology index (38.37 %). Technology gap was lowest in direct feeding of nutrients to bunch (0.75 ha⁻¹) showing less difference between research station and demonstration farms, but extension gap was highest to the tune of 7.37 q ha⁻¹. In skirting of banana bunches realization of potential and demonstration yields were found to be highest i.e. 75.75 per cent and 81.12 per cent respectively. The results also indicated that the technology index of 24.25 per cent, 29.53 per cent and 38.37 per cent in skirting technology of banana bunches, direct feeding of nutrients to banana bunches and viral disease management respectively, gave evidence that there was a scope for further improvement in the productivity and the need to strengthen the extension network to further bridge the yield gaps in banana (Table 4.18). The results are similar with the results of Singh *et al* (2013) who assessed the yield gaps at farmers' fields and concluded that there is further scope to increase productivity on the farms by managing the constraints such as providing quality inputs to the farmers at right time in sufficient quantity which can help in bridging the yield gap, ultimately leading to increase in production.

The yield gap analysis tries to project or compare the differences in yield in different technologies/ varietal groups. From the results of yield gap analysis, yield gap-I and yield gap-II were found in all the technologies demonstrated by the sampled KVKs and remedial measures are thus required to bridge the yield gaps. The yield gaps can be reduced by educating the farmers towards more use of latest production technology, which will eventually lead to the discontinuance of old methods with the new technology. KVKs are working hard towards reducing the total yield gaps in various crops by way of conducting frontline demonstrations of proven technologies at farmers fields finally aimed at increasing the yields and income of farming sector. It was found from the study that the yields and returns in all the demonstrations of improved technologies/ varieties were highest than the farmers' practices/ traditional varieties. Therefore, the hypothesis that improved technologies have yield advantage over farmers' practice was accepted.

Table 4.17. Yield gaps in Rice: KVK-Kalavacharla

S.No.	Technology demonstrated	Yield Gaps (q ha ⁻¹)			Index of yield gaps (%)		
		YG-I Technology Gap	YG-II Extension Gap	Total yield gap	Technology Index	Index of Realized potential yield	Index of Realized Demonstration yield
1	Varietal Evaluation (HYV)	0.21	4.55	4.76	6.95	93.05	93.34
2	Introduction of TNAU drum seeder	0.39	6.33	6.72	7.57	92.43	92.83
3	Chemical weed control	1.50	14.50	16	15.24	84.76	85.99
4	Integrated crop management	2.28	9.37	11.65	16.26	83.74	86.49
5	Sheath blight management	2.20	5.30	7.5	26.32	73.68	79.85
6	Stem borer Management	2.32	1.30	3.62	28.68	71.32	87.38
7	Brown plant hopper management	0.70	1.41	2.11	20.02	79.98	85.67
	Average	1.37	6.11	7.48	13.58	86.42	88.63

Table 4.18. Yield gaps in Banana: KVK- Kalavacharla

S.No.	Technology demonstrated	Yield Gaps (q ha ⁻¹)			Index of yield gaps (%)		
		YG-I Technology Gap	YG-II Extension Gap	Total yield gap	Technology Index	Index of Realized potential yield	Index of Realized Demonstration yield
1	Direct feeding of nutrients to bunches	0.75	7.37	8.12	29.53	70.47	72.45
2	Skirting of bunches with non-woven propylene bags	2.15	5.73	7.88	24.25	75.75	81.12
3	Viral disease management	3.47	2.60	6.07	38.37	61.63	78.95
	Average	2.12	5.23	7.36	29.11	70.89	77.39

4.4. FACTORS AFFECTING PRODUCTIVITY OF CROPS

Factors affecting the productivity of different crops were estimated by fitting Cobb-Douglas type of production function. This function was used to establish input-output relationship in crops and the regression coefficients of different inputs used in the production function were also estimated.

4.4.1 Factors affecting the productivity of crops in KVK-Amadalavalasa

Among the seven improved technologies of rice and maize demonstrated by KVK-Amadalavalasa, two popular technologies viz. mechanized system of rice intensification (MSRI) and zero tillage cultivation of maize were selected and the factors affecting the yields of crops under improved technology and farmers practice were compared between 30 beneficiary farmers and 30 non-beneficiary farmers from each technology.

4.4.1.1 Factors affecting the productivity of Rice in KVK-Amadalavalasa

The results of the analysis in MSRI and farmers practice of rice were summarized in Table 4.19. In MSRI rice farms, the coefficient of multiple determination was 0.81 indicating that the variables included in the model explained about 81 per cent of variation in the yield. Of the seven variables included in the model, machine labour (0.219) and phosphorous (0.259) were positively significant at one per cent level respectively. This means that keeping other variables constant, one per cent increase in use of machine labour and application of phosphorous over their geometric mean levels would result in an increase of 0.219, and 0.259 per cent respectively in rice yields with the adoption of MSRI technology. The other variables like human labour (0.0003), nitrogen (0.042) and potash (0.081) were positive but non-significant.

Table 4.19. Factors affecting the productivity of Rice in MSRI (Mechanized System of Rice Intensification) and Farmers practice

S.No.	Particulars	Method of cultivation	
		MSRI	Farmers practice
1.	Intercept	1.911*** (0.4024)	3.084** (1.348)
2.	Human labour (X ₁)	0.0003 (0.117)	-0.134 (0.243)
3.	Machine Labour (X ₂)	0.219*** (0.086)	-0.074 (0.054)
4.	Seed (X ₃)	-0.009 (0.054)	0.325*** (0.052)
5.	Nitrogen (X ₄)	0.042 (0.087)	0.023 (0.031)
6.	Phosphorous (X ₅)	0.259*** (0.067)	-0.023** (0.010)
7.	Potash (X ₆)	0.081 (0.071)	0.162*** (0.058)
8.	Irrigation (X ₇)	-0.017 (0.025)	0.006 (0.016)
	R ²	0.81	0.84
	F value	23.66***	56.94***
	N	30	30

Note: (1) * = significant at 10%, ** = significant at 5%, ***= significant at 1% level of significance.

(2) Figures in parentheses indicate standard errors of the regression coefficients.

In farmers practice the regression coefficients of seed (0.325) and potash (0.162) were positively significant at one per cent level. This means that 1 per cent increase in seed and potash over its geometric mean level, keeping other factors constant would result in an increase of 0.325 and 0.162 per cent respectively in the yield of traditional rice farms. Phosphorous (-0.023) was negative and significant which implies the excess use of this input and need to reduce in order to increase the yield. The coefficient of multiple determination (R²) was 0.84 which implied that 84 per cent of variation in the rice output in case of farmers practice was explained by the selected variables.

4.4.1.2. Factors affecting productivity of Maize in KVK-Amadalavalasa

The Cobb-Douglas type of production function was fitted for the estimation of coefficients of important variables contributing to the yield of maize crop under both zero tillage cultivation and farmers practice (Table 4.20).

Table 4.20. Factors affecting the productivity of Maize yield in Zero tillage and Farmers practice

S. No.	Particulars	Method of cultivation	
		Zero tillage	Farmers practice
1.	Intercept	3.769*** (0.527)	3.261*** (0.596)
2.	Human labour (X ₁)	-0.135 (0.113)	-0.114 (0.111)
3.	Seed (X ₂)	-0.060 (0.054)	0.049 (0.065)
4.	Nitrogen (X ₃)	0.138*** (0.031)	0.222*** (0.061)
5.	Phosphorous (X ₄)	0.050 (0.041)	0.00006 (0.029)
6.	Potash (X ₅)	0.105** (0.055)	-0.008 (0.022)
7.	Irrigation (X ₆)	0.112** (0.051)	-0.207*** (0.073)
	R ²	0.87	0.69
	F value	24.81***	8.73***
	N	30	30

Note: (1) * = significant at 10%, ** = significant at 5%, ***= significant at 1% level of significance.

(2) Figures in parentheses indicate standard errors of the regression coefficients.

The value of coefficient of multiple determinations (R²) was found to be 0.87 under zero tillage cultivation and 0.69 under farmers practice. Nitrogen impacted the yields of maize in both zero tillage and farmers practice positively

and significantly with coefficient values of 0.138 and 0.222 which shows the need of increasing the application of nitrogen for improving the yields. The coefficient of this variable was higher in farmers practice than zero tillage maize, which shows more response of farmers practice for nitrogenous fertilizer in comparison with zero tillage maize cultivation. Irrigation contributed positively and significantly in zero tillage (0.112) where its contribution was negative and significant (-0.207) in farmers practice, which shows that the yields can be improved by using less number irrigations by adopting zero tillage maize cultivation which is a water conserving technology. Application of potash (0.105) also had positive and significant impact on the yields of zero tillage maize as one per cent increase in the application of potash can increase the yield of zero tillage maize by 0.105 per cent. All the other variables were found to be non significant.

4.4.2. Factors Affecting the Productivity of Crops in KVK-Yagantipalli

Among the thirteen improved technologies of rice and redgram demonstrated by KVK-Yagantipalli, two popular technologies viz. soil test crop response (STCR) in rice and cultivation of high yielding varieties (HYV) in redgram were selected and the factors impacting the yields of improved technology and farmers practice were compared between 30 beneficiary farmers and 30 non-beneficiary farmers from each technology.

4.4.2.1. Factors affecting the productivity of Rice in KVK-Yagantipalli

Human labour (1.945), seed (0.162) and potash (0.204) had positive and significant impact on the yield when there is soil test based nutrient application in rice cultivation where as nitrogen (-0.159) had significant negative impact on the yields. These results clearly indicate that increase in the use of human labour, seed and potash and reduced application of nitrogen will increase the yields of STCR rice (Table 4.21). In farmers' practice of rice cultivation the coefficients of phosphorous (0.270), potash (0.406) and irrigation (0.374) were found to be positively significant, indicating that one per cent increase in the application of

phosphorous, potash and irrigation in rice under farmers practice will increase the yields by 0.27 per cent, 0.406 per cent and 0.374 per cent respectively. Whereas excess seed rate (-0.134) and excess application of nitrogen (-0.022) contributed negatively to the yields.

Table 4.21. Factors affecting the productivity of Rice in STCR and Farmers practice

S.No.	Particulars	Method of cultivation	
		STCR Rice	Farmers practice
1	Intercept	-6.089*** (-5.940)	1.625*** (0.372)
2	Human Labour (X ₁)	1.945*** (0.223)	-0.011 (0.077)
3	Seed (X ₂)	0.162** (0.079)	-0.134*** (0.042)
4	Nitrogen (X ₃)	-0.159* (0.087)	-0.022 (0.044)
5	Phosphorous (X ₄)	-0.005 (0.051)	0.270*** (0.034)
6	Potash (X ₅)	0.204** (0.087)	0.406*** (0.038)
7	Irrigation (X ₆)	0.096 (0.064)	0.374*** (0.044)
	R ²	0.83	0.89
	F value	63.52***	15.69***
	N	30	30

Note: (1) * = significant at 10%, ** = significant at 5%, ***= significant at 1% level of significance.
(2) Figures in parentheses indicate standard errors of the regression coefficients.

4.4.2.2. Factors affecting the productivity of Redgram in KVK-Yagantipalli

In high yielding varieties of redgram use of proper seed rate (0.378), application of nitrogen (0.440) and potash (0.138) were found to be significant contributors to the yield. Phosphorous (-0.023) and irrigation (-0.005) were negative but not significant, indicating that phosphorous and irrigation were not found to have much depressing affect on yield. In case of traditional varieties only human labour (0.639) and phosphorous (0.224) contributed positively and significantly to the yields, whose increase will improve the yields. All the remaining factors have contributed positively to the yields but were found to be non significant. The variables fitted in the model explained 0.88 per cent and 0.84 per cent variability in the yields of redgram under HYV and traditional varieties (Table 4.22).

Table 4.22. Factors affecting the productivity of Redgram in HYVs and Traditional varieties

S.No.	Particulars	Method of cultivation	
		HYVs	Traditional varieties
1	Intercept	-0.235 (0.318)	2.400** (0.931)
2	Human labour (X ₁)	0.010 (0.039)	0.639** (0.242)
3	Seed (X ₂)	0.378*** (0.116)	0.343 (0.27)
4	Nitrogen (X ₃)	0.440*** (0.11)	0.029 (0.148)
5	Phosphorous (X ₄)	-0.023 (0.076)	0.224** (0.124)
6	Potash (X ₅)	0.138*** (0.036)	0.014 (0.117)
7	Irrigation (X ₆)	-0.005 (0.02)	0.044 (0.057)
	R ²	0.88	0.84
	F value	12.87***	18.56***
	N	30	30

Note: (1) * = significant at 10%, ** = significant at 5%, ***= significant at 1% level of significance.
(2) Figures in parentheses indicate standard errors of the regression coefficients.

4.4.3. Factors affecting the productivity of crops in KVK-Kalavacharla

In KVK-Kalavacharla, among the ten demonstrated technologies of rice and banana, two popular technologies viz. high yielding varieties of paddy and direct feeding and skirting of bunches in banana were selected and the factors impacting the yields of improved technology/ variety and farmers practice/ traditional variety were compared between 30 beneficiary farmers and 30 non-beneficiary farmers from each technology.

4.4.3.1. Factors affecting the yields of rice in KVK-Kalavacharla

In cultivation of high yielding varieties of rice, all the inputs except potash had positive impact on the yields (Table 4.23). Human labour (0.26), phosphorous (0.666) and irrigation (0.24) had positive and significant impact on the yields of rice implying increase in yields of rice in high yielding varieties with increased use of human labour, phosphorous and irrigation. Seed (0.012) and nitrogen (0.047) also shown positive contribution to the yields but were not significant. In traditional varieties of rice, human labour (0.256), seed rate (0.124), nitrogen (0.120) and irrigation (0.170) contributed positively and significantly to the yields. Human labour and irrigation were found to be positively significant in both the varieties indicating that increased use of these inputs will further lead to increase in yield. The value of coefficient of multiple determination was 0.73 per cent and 0.81 per cent indicating that the input variables taken up explained 73 per cent and 81 per cent of the total variability in the yield in HYV and traditional varieties of rice, respectively.

Table 4.23. Factors affecting productivity of Rice in HYVs and Traditional varieties

S.No.	Particulars	Method of cultivation	
		HYVs	Traditional varieties
1.	Intercept	-0.363 (0.620)	0.987* (0.523)
2.	Human labour (X ₁)	0.260** (0.125)	0.256** (0.11)
3.	Seed (X ₂)	0.012 (0.211)	0.124* (0.065)
4.	Nitrogen (X ₃)	0.047 (0.127)	0.120*** (0.044)
5.	Phosphorous (X ₄)	0.666*** (0.171)	0.081 (0.134)
6.	Potash (X ₅)	-0.015 (0.121)	0.045 (0.085)
7.	Irrigation (X ₆)	0.240*** (0.054)	0.170* 0.087
	R ²	0.73	0.81
	F value	24.54***	30.79***
	N	30	30

Note: (1) * = significant at 10%, ** = significant at 5%, ***= significant at 1% level of significance.
(2) Figures in parentheses indicate standard errors of the regression coefficients.

4.4.3.2. Factors affecting the productivity of Banana in KVK-Kalavacharla

In direct feeding of nutrients and skirting of bunches technology in banana, human labour (0.104), planting material (0.944) potash (0.035) and irrigation (0.094) had positive and significant impact on the yields. Whereas coefficients of nitrogen (-0.026) and phosphorous (-0.026) were found to be negative but not significant. In case of farmers practice in banana cultivation nitrogen (0.416), potash (0.25) and irrigation (0.351) had positive impact on the yields while planting material (-0.156) had negative impact. Potash and irrigation were found to be significant in both the practices and implying increased use of these inputs for improved yields in banana. The variables fitted in the model explained the variability in yields by 87 per cent and 86 per cent in improved technology and farmers practice respectively (Table 4.24).

Table 4.24. Factors affecting the productivity of Banana in Direct feeding & skirting of bunches and Farmers practice

S.No.	Particulars	Method of cultivation	
		Direct feeding & skirting of bunches	Farmers practice
1	Intercept	-2.413 (1.901)	-1.608** (0.766)
2	Human labour (X ₁)	0.104*** (0.026)	0.111 (0.246)
3	Planting Material (X ₂)	0.944*** (0.26)	-0.156* (0.087)
4	Nitrogen (X ₃)	-0.026 (0.032)	0.416* (0.209)
5	Phosphorous (X ₄)	-0.026 (0.023)	0.042 (0.052)
6	Potash (X ₅)	0.035** (0.015)	0.250* (0.15)
7	Irrigation (X ₆)	0.094*** (0.023)	0.351*** (0.14)
	R ²	0.87	0.86
	F value	11.93***	10.44***
	N	30	30

Note: (1) * = significant at 10%, ** = significant at 5%, ***= significant at 1% level of significance.
(2) Figures in parentheses indicate standard errors of the regression coefficients.

4.5. DECOMPOSITION OF YIELD GAPS

From the yield gap analysis, the gap in yields between the improved technology/ variety and farmers practice/ traditional variety in different crops was noticed. Decomposition analysis (Bisaliah, 1977) was carried out to examine the nature of productivity change in crop production through the measurement of productivity difference between the improved and the traditional variety/ technology and thereafter to analyze and evaluate the constituent sources of such a difference. The decomposition was worked out on

per hectare basis. The decomposition analysis requires geometric mean values of different inputs used in addition to the estimates of per hectare production functions.

4.5.1. Decomposition of Yield Gaps in KVK-Amadalavalasa

To measure the yield gaps of two technologies viz. mechanized system of rice intensification (MSRI) and zero tillage technology in maize were selected from KVK-Amadalavalasa and the productivity difference between the improved technology and farmers practice was analyzed and sources of yield gap were evaluated.

4.5.1.1 Decomposition of yield gap between mechanized system of rice intensification (MSRI) and farmers practice in Rice

The inputs considered for the study in MSRI technology and farmers practice in rice were seed, human labour, machine labour, nitrogen, phosphorous, potash and irrigation. Table 4.25 revealed that the average levels of fertilizers and machine labour used were more in MSRI technology than farmers' practice, where as seed, human labour and irrigation used were less in MSRI technology than farmers' practice. It could be due to less requirement of seed, irrigation and use of more machine labour in MSRI when compared to traditional farmers' practice. Average output obtained from improved technology was found to be more than farmers' practice.

Table 4.25. Geometric mean level of inputs and output in MSRI and Farmers' practice in Rice

S.No.	Input/ Output	Method of cultivation	
		MSRI	Farmers' practice
1	Human labour (man days)	83.09	127.46
2	Machine labour (hours)	41.39	23.17
3	Seed rate (kg)	6.20	18.95
4	Nitrogen (kg)	96.45	90.26
5	Phosphorous (kg)	60.03	54.44
6	Potash (kg)	46.19	43.84
7	Irrigation (no.)	8.00	11.00
8	Output (q)	62.13	51.52

Table 4.26. Sources of yield gap between MSRI and Farmers practice in Rice

Sources of yield gap	Per cent
Difference in technology	41.85
Difference in input use	7.57
a) Human labour	-0.01
b) Machine labour	5.51
c) Seed rate	0.44
d) Nitrogen	0.12
e) Phosphorous	1.10
f) Potash	0.18
g) Irrigation	0.23
Total	49.42

The results of the decomposition analysis of yield gaps in the table 4.26 implied that 49.42 per cent of the potential farm yield was left untapped under the traditional method of rice cultivation. Difference in technology contributed highly at the tune of 41.85 per cent, which means without incurring extra expenditure on required inputs only by adopting recommended improved technology, the yield can be increased by 41.85 per cent. The appropriate usage of inputs can reduce the yield gap between MSRI and farmers practice in rice to the extent of 7.57 per cent. Similar results were reported by Rama Rao (2011) by decomposing the yield gap between SRI and traditional methods of rice cultivation in North Coastal zone of Andhra Pradesh.

4.5.1.2 Decomposition of yield gap between Zero tillage and Farmers' practice in Maize

The inputs considered for the study in zero tillage technology and farmers practice in maize were seed, human labour, nitrogen, phosphorous, potash and irrigation (Table 4.27). Quantity of seed used was almost same in both the technologies, where as nitrogen application was more in zero tillage farms than traditional farmer's fields. There was less use of human labour in zero tillage

cultivation because this technology does not require land preparation and application of manure and fertilizer and the seed could be directly sown in rice fallows. The output obtained from improved technology was appreciably more than the traditional farmers' practice.

Table 4.27. Geometric mean level of inputs and output in Zero tillage and Farmers' practice in Maize

S.No.	Input/ Output	Method of cultivation	
		Zero tillage	Farmers' practice
1	Human labour (man days)	83.51	101.13
2	Seed rate (kg)	22.11	22.78
3	Nitrogen (kg)	99.99	88.57
4	Phosphorous (kg)	56.87	54.57
5	Potash (kg)	38.47	34.35
6	Irrigation (No.)	4.00	7.00
7	Output (q)	80.83	70.99

Table 4.28. Sources of yield gap between Zero tillage and Farmers practice in Maize

Sources of yield gap	Per cent
Difference in Technology	23.96
Difference in Input use	-0.19
a) Human Labour	1.12
b) Seed Rate	0.08
c) Nitrogen	0.73
d) Phosphorous	0.09
e) Potash	0.52
f) Irrigation	-2.73
Total	23.77

The decomposition analysis of yield gaps showed that 23.77 per cent of the potential farm yield was left untapped under farmers practice (Table 4.28) of maize cultivation. Among different sources of yield gap, difference in technology (23.96 %) turned out to be the major contributor than input use (-0.19 %). In input-use, human labour (1.12 %) turned out to be a crucial factor followed by nitrogen (0.73 %), potash (0.52 %) and phosphorous (0.09 %) fertilizers. But, irrigation (-2.73 %) contributed negatively. Contribution of inputs in the yield gap was negligible, and adoption improved technology i.e. zero tillage cultivation of maize in rice fallows can reduce the yield gap in maize by 23.96 per cent without much change in input levels in Srikakulam district.

4.5.2. Decomposition of Yield Gaps in KVK- Yagantipalli

To calculate the yield gap, two technologies demonstrated by KVK-Yagantipalli viz. soil test crop response (STCR) in rice and high yielding varieties of redgram were selected and the difference in yield between the improved technology and farmers practice/ variety was analyzed and sources of yield gap were calculated.

4.5.2.1 Decomposition of yield gap between soil test crop response (STCR) and Farmers' practice in Rice

The inputs considered for the study in STCR technology and farmers practice in rice were seed, human labour, nitrogen, phosphorous, potash and irrigation (Table 4.29). Even though there is not much difference in yield obtained in the two technologies, fertilizer use was less in soil test crop response technology in rice as there is a judicious use of nutrients in STCR based on the soil test results.

The results of decomposition analysis were depicted in the table 4.30. The results showed that among different sources of yield gap, difference in technology (370.82 %) turned out to be the major contributor than input use (-1.39 %) which contributed negatively. Among the inputs human labour (1.23 %) and nitrogen (1.13 %) were found to be important factor in rice yield

gap. Seed (-1.24 %) and potash (-2.03 %) and irrigation (-0.49 %) contributed negatively, indicating that the reduction in use of these inputs can reduce the yield gap. These results clearly indicated that in farmers practice, they are not following the soil test results for fertilizer application. The yields can be improved with low cost of cultivation in case of STCR cultivation of rice that is with proper application of inputs and better management practices.

Table 4.29. Geometric mean level of inputs and output in STCR and Farmers' practice in Rice

S.No.	Input/ Output	Method of cultivation	
		STCR	Farmers' practice
1	Human labour (man days)	138.00	136.00
2	Seed rate (kg)	21.00	25.04
3	Nitrogen (kg)	145.00	170.83
4	Phosphorous (kg)	87.32	90.00
5	Potash (kg)	40.42	50.83
6	irrigation (no.)	8.00	9.00
7	Output (q)	71.99	69.12

Table 4.30. Sources of yield gap between soil test crop response (STCR) and Farmers practice in Rice

Sources of yield gap	Per cent
Difference in Technology	370.82
Difference in Input use	-1.39
a) Human Labour	1.23
b) Seed Rate	-1.24
c) Nitrogen	1.13
d) Phosphorous	0.01
e) Potash	-2.03
f) Irrigation	-0.49
Total	369.43

4.5.2.2 Decomposition of yield gap between High yielding and Traditional varieties of Redgram

The inputs considered for decomposition analysis of yield gap in redgram were human labour, seed, nitrogen, phosphorous, potash and irrigation (Table 4.31). It was found that the quantity of all the inputs used in cultivation of high yielding varieties of redgram was more than traditional varieties there by getting more yields.

Table 4.31. Geometric mean level of inputs and output in HYVs and Traditional varieties in Redgram

S.No.	Input/ Output	Method of cultivation	
		HYVs	Traditional varieties
1	Human labour (man days)	82.77	72.53
2	Seed rate (kg)	18.04	14.45
3	Nitrogen (kg)	35.80	30.05
4	Phosphorous (kg)	40.50	36.45
5	Potash (kg)	3.98	3.13
6	irrigation (No.)	3.00	2.00
7	Output (q)	13.15	9.02

The results depicted in table 4.32 revealed that 59.52 per cent of the potential farm yield of redgram was left untapped under cultivation of conventional varieties. Among different sources of yield gap, difference in technology (51.17 %) turned out to be the major contributor than input use (8.35 %). Among inputs, seed rate (3.65 %) and nitrogen fertilizer (3.34 %) contributed positively to the yield gap. Therefore, appropriate application of seed and other inputs can reduce the yield gap between high yielding and conventional varieties of redgram by 8.35 per cent. Keeping all the inputs constant, use of high yielding varieties of redgram by the farmers can reduce the yield gap to the tune of 51.17 per cent.

Table 4.32. Sources of yield gap between High yielding and Traditional varieties of Redgram

Sources of yield gap	Per cent
Difference in Technology	51.17
Difference in Input use	8.35
a) Human Labour	0.05
b) Seed Rate	3.65
c) Nitrogen	3.34
d) Phosphorous	-0.10
e) Potash	1.44
f) Irrigation	-0.03
Total	59.52

4.5.3. Decomposition of Yield Gaps in KVK- Kalavacharla

To calculate the yield gap, two technologies demonstrated by KVK-Kalavacharla viz. use of high yielding varieties of rice and direct feeding of nutrients and skirting of bunches in banana were selected and the difference in yield between the improved technology and farmers practice was analyzed and sources of yield gap were evaluated.

4.5.3.1 Decomposition of yield gap between High yielding varieties and Traditional varieties of Rice

The inputs considered for decomposition analysis of yield gap in rice were human labour, seed, nitrogen, phosphorous, potash and irrigation (Table 4.33). It was found that the quantity of all the inputs except phosphorus coupled with number of irrigations used in cultivation of high yielding varieties of rice was more than traditional varieties there by getting more yields.

The decomposition of yield gap showed that 28.95 per cent of the potential farm yield of rice was left untapped under cultivation of traditional varieties (Table 4.34). Difference in technology (32 %) turned out to be the major contributor than input use (-3.05 %). Nitrogen (0.25 %), seed rate

(0.05 %) and irrigation (0.91 %) contributed positively to the yield gap. Human labour (-0.24 %), phosphorous (-3.94 %) and potash (-0.08%) had contributed negatively to the yield gap which implied that with the reduction in use of these inputs can reduce the yield gap in rice in East Godavari district (Table 4.34).

Table 4.33. Geometric mean level of inputs and output in HYVs and Traditional varieties in Rice

S.No.	Input/ Output	Method of cultivation	
		HYVs	Traditional varieties
1	Human labour (man days)	141.20	144.24
2	Seed rate (kg)	20.88	18.96
3	Nitrogen (kg)	83.01	73.52
4	Phosphorous (kg)	55.90	64.05
5	Potash (kg)	56.94	50.71
6	irrigation (No.)	12.00	11.00
7	Output (q)	68.29	59.75

Table 4.34. Sources of yield gap between High yielding varieties and Traditional varieties of Rice

Sources of yield gap	Per cent
Difference in Technology	32.00
Difference in Input use	-3.05
a) Human labour	-0.24
b) Seed rate	0.05
c) Nitrogen	0.25
d) Phosphorous	-3.94
e) Potash	-0.08
f) Irrigation	0.91
Total	28.95

4.5.3.2 Decomposition of yield gap between direct feeding & skirting of bunches and farmers practice in Banana

The inputs considered for decomposition analysis of yield gap in banana were human labour, suckers, nitrogen, phosphorous, potash and irrigation (Table 4.35). It was found that the quantity of all the inputs used in direct feeding and skirting of bunches in banana was more than traditional practice there by getting more yields.

The decomposition of yield gaps in banana revealed that there was total yield gap of 158.53 per cent of which difference in technology (154.88 %) contributed highly to the yield gap (Table 4.36). Difference in input use contributed to 3.65 per cent of yield, negative contribution of nitrogen (-0.10 %) and phosphorous (-0.45 %) implied that the reduced use of these inputs will drastically reduce the yield gap in banana cultivation in East Godavari district. Planting material contributed positively to the yield gap, which signifies that with increase in the number of suckers, yields can be increased up to 3.54 per cent in traditional farmers practice in banana.

Table 4.35. Geometric mean level of inputs and output in Direct feeding & Skirting of bunches and Farmers practice in Banana

S.No.	Input/ Output	Method of cultivation	
		HYVs	Traditional varieties
1	Human labour (man days)	88.00	82.00
2	Suckers (No.)	2258.80	2071.67
3	Nitrogen (kg)	470.33	432.00
4	Phosphorous (kg)	117.17	79.00
5	Potash (kg)	494.17	424.33
6	irrigation (No.)	38.00	37.00
7	Output (q)	244.21	198.57

The results of the decomposition of yields in all the selected technologies of the sampled KVKs proved that the difference in technology between improved practices/ varieties and traditional practices/ varieties is the main

contributing factor to the yield gap than the difference in input use. These results were contradicting with those of Patole *et al.*, (2008) who reported the higher role of input use than technology difference in the yield gap of chickpea in Ahmednagar district of Maharashtra.

Table 4.36. Sources of yield gap between Direct feeding & Skirting of bunches and Farmers practice in Banana

Sources of yield gap	Per cent
Difference in Technology	154.88
Difference in Input use	3.65
a) Human labour	0.32
b) Suckers	3.54
c) Nitrogen	-0.10
d) Phosphorous	-0.45
e) Potash	0.23
f) Irrigation	0.11
Total	158.53

4.6. IMPACT OF VOCATIONAL TRAINING PROGRAMMES ON INCOME

Vocational training refers to a certain type of training whose main objective is preparing people for work. Vocational training includes initial training and continuing professional development. It is a training for a specific vocation in industry or agriculture or trade and is a training for career or trade excluding the professions. It is an important policy instrument for enhancing employment and can develop appropriate skills and there by improve labour supply and the employability of work force. Vocational education and training is compulsory that develops knowledge, skill and attributes linked to particular forms of employment.

One of the main aims of KVKs is to develop entrepreneurship among the rural people especially the farmers, farmwomen and rural youth. Various vocational training programmes were conducted for rural community at KVK-Amadalavalasa, KVK-Yagantipalli and KVK-Kalavacharla during 2011-2016 to provide the knowledge on different income generating activities. The main target in conducting the trainings was to convert the unemployed rural community to employed one.

To evaluate the impact of training programmes, 50 trainee beneficiaries were selected from each KVK, who have undergone training on different vocational skills. The Percentage change in Income levels of the different trainees was checked before and after trainings in the present study.

4.6.1 Impact of training programmes conducted by KVK – Amadalavalasa

KVK – Amadalavalasa conducted 27 various need based and skill oriented vocational training programmes during 2011-16 in Srikakulam district. KVK trained about 633 people, among which 202 people were employed and 35 units were established (Table 4.37). The percentage of employment generation was 31.91 which created income for rural people and played a positive role for their empowerment.

Table 4.37. Vocational training programmes conducted by KVK-Amadalavalasa

Year	No. of Programmes	No. of Trainees	No. of units established	Employment generation	
				No. of trainees employed	Per cent to total trainees
2011-12	1	20	6	9	45.00
2012-13	5	84	5	23	27.38
2013-14	5	134	7	55	41.04
2014-15	7	150	9	48	32.00
2015-16	9	245	8	67	27.35
Total	27	633	35	202	31.91

The change in income was highest in case of beneficiaries of micro shade net nursery raising (Rs. 93667) followed by mushroom cultivation (Rs. 81444) (Table 4.38). Per cent share of the trainee in total family income was increased highly for the beneficiaries of millet processing (31.41 %) followed by tailoring (18.96 %) because the trainee beneficiaries are women and housewives who contributed very less to the total family income before the training and adoption of the skill for income generation.

Trainee beneficiaries of FOCT (Friends of coconut trees) increased their income by Rs. 62946 per annum. They are unemployed rural youth and coconut climbers who increased their income by 103.65 per cent after adopting the skill of coconut climbing with machine. The adoption of vanaraja backyard poultry and natural dying of mesta fibre products also generated employment and increased their income by 70.72 per cent and 24.66 per cent respectively.

Table 4.38. Impact of Training Programmes on income: KVK- Amadalavalasa

S. No.	Training programme	No. of Trainees	Income per year (Rs.)				Per cent share in total family income		
			Before Adoption	After Adoption	Change	Per cent change	Before Adoption	After Adoption	Change
1	Mushroom cultivation	3	74667	156111	81444	109.08	58.33	74.54	16.20
2	Friends of coconut trees (FOCT)	17	60727	123673	62946	103.65	80.68	89.36	8.68
3	Tailoring	8	5075	25460	20385	401.67	6.98	25.95	18.96
4	Micro shadenet nursery raising	3	77325	170992	93667	121.13	56.44	74.13	17.69
5	Millet processing	10	15522	57200	41678	268.51	31.79	63.20	31.41
6	Mesta products with natural dyes	5	29244	36456	7212	24.66	39.19	44.55	5.36
7	Vanaraja Backyard poultry	4	58079	99155	41076	70.72	80.08	87.28	7.20
	Pooled	50	45805	95578	49773	108.66	50.50	65.57	15.07

4.6.2 Impact of Training Programmes conducted by KVK – Yagantipalle

Krishi Vigyan Kendra, Yagantipalle organized various skill oriented training programmes in Kurnool district in farm and non farm sector. During 2011-16, 693 rural youth and women were trained by the KVK through 55 vocational training programmes. Among the total trainees 62.19 % were employed and 215 commercial units were established (Table 4.39). KVK identified 31 local trainees in the villages with good communication skills and vocational skills and trained them as master trainers to take up vocational training programmes like tailoring, maggam embroidery and fabric painting.

Table 4.39. Vocational training programmes conducted by KVK-Yagantipalle

Year	No. of Programmes	No. of Trainees	No. of units established	No. of Master trainers	Employment generation	
					No. of trainees employed	Per cent to total trainees
2011-12	7	75	39	7	52	69.33
2012-13	6	62	54	10	45	72.58
2013-14	17	255	62	7	175	68.63
2014-15	13	168	26	5	73	43.45
2015-16	12	133	34	2	86	64.66
Total	55	693	215	31	431	62.19

From the table 4.40 the increase in income after training programmes with the adoption of the skill and establishment of entrepreneurship was highest in case of trainees who are working as master trainers along with tailoring and blouse designing (Rs. 50,143) followed by trainees who established millet processing units (Rs. 39,900) and trainees who adopted tailoring and blouse designing (Rs. 30,063) per annum. Per cent share of the trainee in the family income after training and adoption was increased by 30.88, 28.05 and 18.37 per cent respectively in all the above categories.

Table 4.40. Impact of Training Programmes on income: KVK-Yagantipalli

S.No.	Training programme	No. of Trainees	Income per year (Rs.)				Per cent share in total family income		
			Before Adoption	After Adoption	Change in income	Percent change	Before Adoption	After Adoption	Change
1	Tailoring& Muggam work	8	9000	24000	15000	166.67	8.11	19.05	10.94
2	Millet processing	4	11100	51000	39900	359.46	9.87	37.92	28.05
3	Tailoring&Blouse designing	23	4063	34125	30063	740	2.97	21.34	18.37
4	Tailoring, blouse designing, Master trainer	9	8143	58286	50143	615.79	8.24	39.12	30.88
5	Fabric Painting, Bag making	6	7800	21060	13260	170	8.16	18.19	10.04
	Pooled	50	8021	37694	29673	369.94	7.23	27.51	20.28

Table 4.42. Impact of Training Programmes on income: KVK-Kalavacharla

S.No.	Training programme	No. of Trainees	Income per year (Rs.)				Percent share in total family income		
			Before Adoption	After Adoption	Change in income	Percent change	Before Adoption	After Adoption	Change
1	Tailoring	8	4250	20625	16375	385.29	13.39	42.86	29.47
2	Pickle making	4	5265	31269	26004	493.90	11.13	42.66	31.53
3	Friends of Coconut (FOCT)	6	36257	72054	35797	98.73	69.84	82.15	12.31
4	Paper plate making	15	18417	53333	34917	189.59	49.89	65.17	15.29
5	Coir rope making	4	5298	30125	24827	468.61	5.95	26.40	20.44
6	Coir doormat making	4	3356	13684	10328	307.75	5.10	17.97	12.87
7	Embroidery and Painting	4	4123	15782	11659	282.78	7.83	24.54	16.71
8	Garment making	4	3825	18365	14540	380.13	10.54	36.14	25.59
9	Tailoring, Jute products, Food processing, Master trainer	1	6577	294000	287423	4370.12	2.43	52.69	50.26
	Pooled Average	50	9708	61026	51319	528.65	19.57	43.40	23.83

The overall impact of the training programme increased the income of the trainee by 369.94 per cent and the increase in their share in the overall family income by 20.28 per cent. All these vocational trainings have given a boost to women and giving supplementary income and employment especially to house wives.

4.6.3 Impact of Training Programmes conducted by KVK – Kalavacharla

KVK, Kalavacharla organized 54 vocational training programmes and trained 1046 rural people and women. 34.61 per cent of the trainees were employed and 156 commercial units were established. The KVK had produced 29 master trainers during 2011-2016 by giving special trainings to the active and efficient trainees of different training programmes to train the other people in their respective training programmes (Table 4.41).

Table 4.41. Vocational training programmes conducted by KVK – Kalavacharla

Year	No. of Programmes	No. of Trainees	No. of units established	No. of Master trainers	Employment generation	
					No. of trainees employed	Per cent to total trainees
2011-12	4	90	2	2	44	48.89
2012-13	19	430	39	12	143	33.26
2013-14	4	97	2	1	22	22.68
2014-15	11	194	38	6	50	25.77
2015-16	16	235	75	8	103	43.83
Total	54	1046	156	29	362	34.61

From the table 4.42 it was evident that after training all the beneficiaries improved their income by setting up their own units or getting employment elsewhere. The increase in income was highest in case of a women master trainer, who is practicing tailoring, making jute products and millet products (4370.12 %). The share of her income in the total family income was increased from 2.43 per cent to 52.69 per cent. On an average the training programmes improved the income of the trainee beneficiaries by Rs. 51,319 per annum. The

share of trainee beneficiary in the total family income was increased between 12.31 per cent to 50.26 per cent. The average increase in trainee's share in total family income was 23.83 percent.

The impact evaluation results shows that the vocational training programmes conducted are augmenting the trainee's income substantially. These results are similar with those of Singh *et al.* (2010), Lal and Tandon (2011) and Nazir *et al.* (2012) who assessed the impact of vocational training programmes and reported the improved economic status of trainee beneficiaries. Hence it can be concluded that Krishi Vigyan Kendras plays a positive role for the empowerment of rural community. These results proved the hypothesis that the vocational training programmes conducted by Krishi Vigyan Kendras improved the income levels of trainee beneficiaries.

4.7. ECONOMIC BENEFITS FROM THE ADOPTION OF TECHNOLOGIES

To assess the economic benefits from the adoption of improved technologies, the costs and returns collected from beneficiary and non-beneficiary farmers of the sampled KVKs were presented in table 4.43.

The total yield of 62.13q ha⁻¹ with Net return of Rs. 37803 was recorded by the beneficiary farmers of mechanized system of rice intensification (MSRI) while the corresponding figures for non-beneficiary farmers who are cultivating rice in traditional methods were 51.52 q ha⁻¹ and Rs. 28909. The increase in net returns to the beneficiary farmers was 30.77 per cent over the non-beneficiary farmers. Per hectare cost of cultivation of maize has been worked out to be Rs. 37904 for beneficiary farmers of zero tillage maize and Rs. 42266 for non-beneficiary farmers who are following traditional methods of maize cultivation. The results revealed that the adoption of zero tillage cultivation in maize has increased the net returns by 60.04 per cent over the traditional practice, showing clear impact of the technology on productivity and returns in beneficiary farms over non-beneficiary farms. These results are on par with the results of Thakare and Nagpure (2004) who assessed the impact of agricultural technology in Yavatmal district of central Vidarbha zone of Maharashtra.

It was found from the results that average cost of cultivation of non-beneficiary farms, not practicing soil test crop response in rice (Rs. 67585) was more than those of considering soil test results in nutrient application (Rs. 61302) and net returns were increased by 27.14 per cent by the adoption of STCR in beneficiary farms. In redgram the yields increased from 9.02 q ha⁻¹ to 13.15 q ha⁻¹, thereby increasing the net returns by 104.92 per cent by the adoption of high yielding varieties over traditional varieties. Similar results were reported by Rane, *et al.* (2004) by the assessment of improved technology on increased returns from different crops.

The results revealed that the beneficiary farmers of high yielding varieties of rice have yield advantage over the non-beneficiary farmers who are cultivating traditional varieties. The net returns recorded were Rs. 42095 and Rs. 28590 per hectare for beneficiary and non-beneficiary farmers, respectively. The adoption of high yielding varieties in rice increased the net returns by 47.24 per cent over the traditional varieties. The beneficiary farmers of direct feeding of nutrients and skirting of bunches in banana received net returns of Rs. 211916, even though there was an increase in cost of cultivation due to feeding of nutrients directly to bunches and skirting of bunches, they received more net returns of 42.66 per cent over the non-beneficiary farmers who are practicing traditional methods in banana cultivation. These results corroborated with those reported by Raveendaran, *et al.* (2004) who investigated the impact of new technologies in cotton cultivation by Government of India.

Comparison of costs and returns of beneficiary and non-beneficiary farms of improved technology/ variety and farmers practice/ traditional variety revealed that all the selected technologies increased the returns of the beneficiary farmers over the non-beneficiary farmers. These results are on par with the results of Sinha and Gupta (2004) who assessed the impact of new agricultural technology disseminated by Krishi Vigyan Kendra (KVK) on crop productivity and returns in Bihar and they advocated the establishment of more KVKs and strengthening of the existing ones.

Table 4.43. Comparison of Costs and Returns under Beneficiary and non-Beneficiary farms

Particulars	Yield (q/ha)	Cost of cultivation (Rs./ha)	Gross Returns (Rs./ha)	Net Returns (Rs./ha)	Per cent increase in Net Returns
KVK-Amadalavalasa					
Mechanized system of rice intensification (MSRI)					
Beneficiary farmers	62.13	44303	82106	37803	30.77
Non-Beneficiary farmers	51.52	45898	74807	28909	
Zero tillage in Maize					
Beneficiary farmers	80.83	37904	89100	51196	60.04
Non-Beneficiary farmers	70.99	42266	74256	31990	
KVK-Yagantipalli					
Soil test crop response in Rice (STCR)					
Beneficiary farmers	71.99	61302	119935	58633	27.14
Non-Beneficiary farmers	69.12	67585	113702	46117	
High yielding varieties of Redgram					
Beneficiary farmers	13.15	25780	58714	32934	104.92
Non-Beneficiary farmers	9.02	23300	39372	16072	
KVK-Kalavacharla					
High yielding varieties of Rice					
Beneficiary farmers	68.29	44497	86592	42095	47.24
Non-Beneficiary farmers	59.75	46277	74867	28590	
Direct feeding & Skirting of bunches in Banana					
Beneficiary farmers	244.21	107611	319527	211916	42.66
Non-Beneficiary farmers	198.57	102053	250595	148542	

4.8. IMPACT ON INCOME DISTRIBUTION

4.8.1. Pattern of Income Distribution

To assess the pattern of distribution of income, the sample farmers were divided into different groups based on the extent of income generated from improved technologies and farmers practices.

4.8.1.1. Pattern of income distribution: KVK-Amadalavalasa

4.8.1.1.1. Pattern of distribution of income generated from Farmers practice and MSRI in Rice

The pattern of distribution of income generated from farmers practice in rice cultivation is presented in table 4.44. The lowest income earning families accounted for 10 per cent of the total non-beneficiary farmers and their share in the total income earned by all the non-beneficiary farmers was 7.42 percent. The average income of the lowest income group was Rs. 21,449. The percentage of households in the highest income group was 3.33 percent of the total households and their share in the total income earned by all the non beneficiary households was 4.57 per cent. The average income of the highest income group was Rs. 39,649.

The beneficiary farmers were categorised into nine groups based on the income generated by Mechanised SRI cultivation in rice. It can be observed from table 4.45 that the lowest income group was those beneficiary farmers who received less than Rs. 32,000 per hectare from MSRI rice cultivation. The share of the lowest income group in the total income earned by all the beneficiary farmers was 8.18 per cent and the average income of the lowest income group was Rs. 30,993.3. The highest income group was those beneficiary farmers who received more than Rs. 46,000 per hectare income from MSRI rice. The average income of the highest income group was Rs. 49,833.3 per hectare. The share of highest income group was 6.67 percent to the beneficiary farmers and accounted for 8.79 per cent of the total income of the beneficiary farmers. Around 25 per cent of the total income was received by 30 per cent of the beneficiary households (lower income group).

4.8.1.1.2. Pattern of distribution of income generated from Farmers practice and Zero tillage practice in Maize

It can be noted from the table 4.46 that the sample non-beneficiary farmers of maize were divided into ten groups based on income accrued from farmers practice in maize cultivation. The lowest income group was the one which was received less than Rs. 26000 per hectare and the highest income group was the one which received more than Rs. 40000 per hectare. The lowest income group had accounted for 13.33 per cent and its share was 7.29 per cent of the total income of the non-beneficiary farmers. Whereas the share of the highest income group was 3.33 per cent and it contributed 5.04 percent to the total income of the non-beneficiary farmers. The average income received by the lowest and highest income groups was Rs. 17486.79 and Rs. 48347.16 per hectare respectively.

In case of zero tillage maize cultivation the beneficiary farmers were categorised into nine groups based on the income generated by zero tillage maize cultivation (Table 4.47). The lowest income group constituted the farmers who received less than Rs. 45000 per hectare and 3.33 percent of the sample famers fall under the category of lowest income group. The share of the lowest income group was 2.86 per cent whereas the share of the highest income group was 8.27 per cent to the total income earned by all the beneficiary farmers. The average income received by the lowest and highest income groups was Rs. 43925 and Rs.63521 per hectare respectively, from the cultivation of zero tillage maize.

4.8.1.2. Pattern of income distribution: KVK-Yagantipalli

4.8.1.2.1. Pattern of distribution of income generated from Farmers practice and Soil Test Crop Response (STCR) in Rice

Table 4.48 reveals that the sample non-beneficiary farmers were categorised into six groups based on the income generated from farmers practice in rice cultivation in KVK-Yagantipalli of Kurnool district. The lowest income group received less than Rs. 40000 per hectare, whereas the highest income group received more than Rs. 60000 per hectare. Out of the 30 non-beneficiary farmers, 11 farmers fall under the lowest and one farmer fall under the highest

income group. The lowest income group shared around 31.54 per cent as against the highest income group farmers whose share was around 4.58 per cent of the total income earned from farmers practice in rice cultivation. The average income received in lowest and highest income groups was Rs. 39673 and Rs. 63402 per hectare respectively.

The beneficiary farmers were classified into six groups for income accrued by practicing Soil Test Crop Response in rice cultivation (Table 4.49). The lowest income group was the one which received less than Rs. 45000 per hectare, whereas the highest income group was the one which received more than Rs. 65000 per hectare. The lowest income group had accounted for 13.33 per cent of total beneficiary farmers and their share was around 10.16 per cent of the total income earned by all the beneficiary farmers. The average income received in lowest income group was Rs. 42917 per hectare. The share of the highest income group was 23.33 per cent which accounted for 27.84 per cent of the total income earned by the beneficiary farmers. The average income received in highest income group was Rs. 67175 per hectare.

4.8.1.2.2 Pattern of distribution of income generated from Farmers practice (Traditional varieties) and High Yielding varieties of Redgram

The non-beneficiary farmers were categorised into six groups based on the income obtained from cultivation of conventional varieties of redgram (Table 4.50). The lowest income group farmers received an income of less than Rs. 10000 per hectare and the average income received by the lowest income group was Rs. 7268.33 per hectare. The highest income group farmers received an income of more than Rs. 30000 per hectare. The average income received by the highest income group was Rs. 31575 per hectare. The lowest income group accounted for 30 per cent of the total non-beneficiary farmers and the share of the lowest income group was only 13.57 per cent of the total income earned by the sample non beneficiary farmers. The highest income group accounted for 3.33 per cent of the total non beneficiary farmers and the share of the highest income group was around 6.55 per cent of the total income accrued from the cultivation of conventional varieties.

The distribution pattern on income generated from cultivation of high yielding redgram varieties is presented in table 4.51. The sample beneficiary farmers were categorised into six groups. Among the six groups the lowest income group was constituted by the farmers who received an income of less than Rs. 25000 per hectare. The lowest income group accounted for 10 per cent of the sample farmers and the share of the lowest income group was 7.38 per cent of the aggregate income received of all the beneficiary farmers. The average income received by the lowest income group was Rs. 24298.85 per hectare, whereas the highest income group received an income of around Rs. 45950 per hectare. The highest income group accounted for 6.67 per cent of the total beneficiary farmers and their share was around 9.30 per cent of the aggregate income. About 90.70 per cent of the aggregate income obtained from the high yielding redgram cultivation by the beneficiary farmers was shared by 93.33 per cent of the households.

4.8.1.3. Pattern of income distribution: KVK-Kalavacharla

4.8.1.3.1 Pattern of distribution of income generated from Farmers' practice (Traditional varieties) and High yielding varieties of Rice

The pattern of distribution of income generated from farmers practice in rice cultivation is presented in table 4.52. The lowest income earning families accounted for 13.33 per cent of the total sample farmers and their share in the total income earned by all the non-beneficiary farmers was 7.16 per cent. The average income of the lowest income group was Rs. 15363. The percentage of households in the highest income group was 6.67 per cent of the total households and their share in the total income earned by all the sample households was 10.79 per cent. The average income of the highest income group was Rs. 46272.

The beneficiary farmers were categorised into seven groups based on the income generated by cultivation of high yielding varieties of rice. It can be observed from table 4.53 that the lowest income group was those farmers who received less than Rs. 35000 per hectare. The share of the lowest income group

in the total income earned by all the beneficiary farmers was 9.58 percent and the average income of the lowest income group was Rs. 30260. The highest income group was those beneficiary farmers who received more than Rs. 53000 per hectare income. The average income of the highest income group was Rs. 57430 per hectare. The share of highest income group was 10 per cent to the sample beneficiary farmers and accounted for 13.64 per cent of the total income of the beneficiary farmers. About 74 per cent of the total income was received by 80 per cent of the households.

4.8.1.3.2. Pattern of distribution of income generated from Farmers practice and Direct feeding of nutrients & Skirting of bunches in Banana

The sample non-beneficiary farmers were categorised into seven groups based on the income obtained from farmers practice in banana cultivation (Table 4.54). The lowest income group farmers received an income of less than Rs. 100000 per hectare and the average income received by the lowest income group was Rs. 82436 per hectare. The highest income group farmers received an income of more than Rs. 200000 per hectare. The average income received by the highest income group was Rs. 208077 per hectare. The lowest income group accounted for 23.33 per cent of the total non-beneficiary farmers and the share of the lowest income group was only 12.95 per cent of the total income earned by the sample non beneficiary farmers. The highest income group accounted for 13.33 per cent of the total non beneficiary farmers and the share of the highest income group was around 18.68 per cent of the total income accrued from the cultivation of banana in traditional method.

The distribution pattern on income generated from direct feeding of nutrients and skirting of banana bunches is presented in table 4.55. The sample beneficiary farmers were categorised into seven groups. Among the seven groups the lowest income group was constituted by the beneficiary farmers who received an income of less than Rs. 150000 per hectare. The lowest income group accounted for 6.67 per cent of the sample beneficiary farmers and the share of the lowest income group was 4.58 per cent of the aggregate income received by all the beneficiary farmers. The average income received by the

lowest income group was Rs. 145733 per hectare, whereas the highest income group received an average income of around Rs. 325733 per hectare. The highest income group accounted for 6.67 per cent of the total sample farmers and their share was around 10.25 per cent of aggregate income of all the sample beneficiary farmers.

In order to compare the pattern of distribution of income obtained from farmers practices and improved technologies, the above values for the selected crops in KVK- Amadalavalasa, KVK-Yagantipalli and KVK-Kalavacharla, were presented in the form of Lorenz curves in fig.1 to fig.12.

4.8.2. Lorenz Curves

It is clear from the Lorenz curves (figures 1 to 12) that there exists inequalities in distribution of income obtained from improved technology/ variety and farmers practice/ traditional variety in all the sampled KVKs. Both the curves fall below the egalitarian line. To compare the two curves, the curve which represents the improved technology showed lesser inequality against the other curve which represents the farmers' practice of crop cultivation. This implies that the income generated from improved technology/ variety is more equally distributed than the income generated from the farmers practice/ variety in all the sampled KVKs of three districts.

4.8.3. Quantification Measures of Distribution of Income

The distribution of income among the sample beneficiary and non-beneficiary farmers, obtained from improved technology/ variety and farmers practice/ traditional variety in the sampled KVKs were quantified with the help of gini concentration ratios presented in table 4.56, 4.57 and 4.58.

It can be observed from the table 4.56 that the gini coefficient in KVK- Amadalavalasa was 0.15 in case of farmers' practice of rice cultivation, which got reduced to 0.07 for MSRI rice cultivation. The average income of the 10 per cent of the lowest income group was Rs. 21,449 for non-beneficiary farmers and Rs. 30,993.30 for beneficiary farmers. The share of the lowest income group in

the total income of the non-beneficiary farmers was 7.42 per cent while it was 8.18 per cent in case of beneficiary farmers. In case of beneficiary farmers per cent share of income in the total income of all the farmers for lowest income group (8.18 %) and highest income group (8.79 %) was almost similar.

The gini coefficient for farmers' practice of maize cultivation was 0.11 and the value got reduced to 0.05 for zero tillage maize cultivation. The distribution of income was more unequal in non-beneficiary farmers ranging from 3.04 per cent to 28.87 per cent, than the beneficiary farmers ranging from 2.86 per cent to 21.96 per cent in different income groups. The relatively equal distribution of incomes in MSRI rice cultivation and zero tillage maize cultivation compared to farmers practice was due to adoption of improved technologies by the beneficiary farmers.

The gini coefficient in KVK-Yagantipalli for farmers' practice was 0.14 which was reduced to 0.08 for soil test crop response in rice cultivation. The per cent of households in the lower two groups constitutes 63.33 per cent and the upper two income groups constitute 10 per cent of the total households for non-beneficiary farmers. In beneficiary farmers the per cent of households in the lower two groups (33.33 %) and the upper two income groups (33.33 %) were equal.

In case of redgram the gini coefficient was 0.24 and 0.09 for farmers' practice/ traditional varieties and high yielding redgram varieties respectively (Table 4.57). In case of non-beneficiary farmers 50 per cent of the total households belong to lower two income groups contributing only 31.51 per cent of the total income and it was 36.67 per cent households contributing 31.35 per cent of income in beneficiary farmers. The income distribution was comparatively more unequal in farmers' practice in both rice and redgram crops which can be reduced by the adoption of improved technologies by the non-beneficiary farmers.

The findings from the table 4.58 indicates that the gini coefficient in KVK-Kalavacharla was 0.17 in case of farmers practice/ traditional varieties, which got reduced to 0.11 in cultivation of high yielding varieties of rice. The lowest income group having 13.33 per cent households in non-beneficiary

farmers contributed 7.16 per cent of the total income and it was increased to 9.58 per cent in beneficiary farmers. The distribution of income in non-beneficiary farmers ranged from 4.83 per cent to 27.13 per cent while it ranged from 6.26 per cent to 27.20 per cent in beneficiary farmers.

The gini coefficient for farmers' practice of banana cultivation was 0.18 and the value got reduced to 0.11 for direct feeding & skirting of bunches in banana cultivation. In non-beneficiary farmers 40 per cent of the total households belonged to lower two income groups contributing only 25.94 per cent of the total income and 36.67 per cent of the total households belonged to upper two income groups who contributed 49.55 per cent of the total income. In case of beneficiary farmers 23.33 per cent of the households belonged to lower two income groups contributing 17.26 per cent of the total income and 23.33 per cent of the total households belonged to upper two income groups contributing to 28.74 per cent of the total income. The income distribution was more skewed in case of farmers' practice compared improved technology adopted by beneficiary farmers in KVK-Kalavacharla.

The gini coefficient closer to zero indicates less inequalities and the ratio nearer to the value one indicates higher inequalities in income distribution. It can be concluded from the above findings that there were comparatively lesser inequalities in distribution of income of beneficiary farmers obtained from improved technology/ variety of crops when compared with the inequalities in distribution of income of non-beneficiary farmers obtained from traditional practices/ variety.

4.9. FACTORS CONTRIBUTING TO THE ADOPTION OF IMPROVED TECHNOLOGIES

4.9.1. Adoption of New Technology by the Farmers

The adoption of new technology means using the entire package of practices for cultivation along with improved varieties/ cultivars. To capture this, the technology adoption index was calculated for individual farmer which included adoption of improved cultivar, recommended doses of chemical fertilizers, recommended number of irrigations, etc.

The technological adoption index (TAI) was calculated for 180 beneficiary farmers under the three selected Krishi Vigyan Kendras which ranged between 0 and 100. Thereafter, they were classified into three categories, viz. low adopters (< 33% TAI), medium adopters (34-66% TAI) and high adopters (> 66% TAI).

4.9.1.1. Adoption of new technology by the farmers: KVK - Amadalavalasa

In case of MSRI rice cultivation most of the beneficiary farmers belonged to medium adoption group contributing to 70 per cent of the total beneficiaries (Table 4.59). It may be due to small holdings in which adoption of mechanization becomes a problem and there is a need to create awareness among the farmers and encourage them to follow complete adoption of the technology.

Table 4.59. Levels of adoption of new technology on sample beneficiary farms: KVK- Amadalavalasa

Adoption level	Technology			
	MSRI Rice		Zero tillage Maize	
	Number	Per cent	Number	Per cent
Low adoption (0-33%)	0	0	0	0
Medium adoption (34-66%)	21	70	2	8
High adoption (67-100%)	9	30	23	92
Total	30	100	30	100

In zero tillage cultivation of maize, 92 per cent of the beneficiary farmers fall under the category of high adoption and only eight per cent belonged to the medium adoption category and no farmer was found having adoption less than 34 per cent under zero tillage cultivation of maize. There is a whole village adoption of zero tillage maize cultivation in some of the adopted villages of KVK-Amadalavalasa which may be due to less requirement of the resources and improved profits compared to farmers practice in maize cultivation.

4.9.1.2. Adoption of new technology by the farmers: KVK - Yagantipalli

The technological adoption index was calculated for 30 beneficiary farmers of rice and 30 beneficiary farmers of redgram who are adopting improved technology provided by KVK, Yagantipalli. From the results it was observed that all the sample beneficiary farmers were medium and high adopters of technology in both soil test crop response (STCR) in rice and high yielding varieties of redgram. TAI ranged between 62.82% to 98.33% in case of STCR rice and 64.17 to 93.11% in case of high yielding varieties of redgram. For STCR in rice 63.33% (Table 4.60) of the sample beneficiary farmers were high adopters of technology, which may be due to less cost of cultivation by soil test based nutrient application in STCR. Around 73.33% of the sample redgram beneficiary farmers were high adopters of technology in the region, which may be due to farmers' awareness of the benefits of the new technology in the way of economic returns and reduced pest and disease incidence. This is also be due to continuous efforts of the KVK in educating the farmers regarding the benefits of the technology and giving continuous technical support.

Table 4.60. Levels of adoption of new technology on beneficiary farms: KVK- Yagantipalli

Adoption level	Technology			
	STCR in Rice		High yielding varieties of Redgram	
	Number	Per cent	Number	Per cent
Low adoption (0-33%)	0	0	0	0
Medium adoption (34-66%)	11	36.67	8	26.67
High adoption (67-100%)	19	63.33	22	73.33
Total	30	100	30	100

4.9.1.3. Adoption of new technology by the farmers: KVK - Kalavacharla

In KVK-Kalavacharla, technological adoption index was calculated for 30 beneficiary farmers of high yielding varieties of rice and 30 beneficiary farmers of direct feeding of nutrients and skirting of bunches in banana. Results showed that majority of the beneficiary farmers in both the technologies were high adopters of the technology with 60 per cent and 76.67 per cent of the beneficiaries belong to high level of adoption in rice and banana technologies, respectively (Table 4.61).

Table 4.61. Levels of adoption of new technology on sample beneficiary farms: KVK- Kalavacharla

Adoption level	Technology			
	High yielding varieties of Rice		Direct feeding and Skirting of bunches in Banana	
	Number	Per cent	Number	Per cent
Low adoption (0-33%)	0	0	0	0
Medium adoption (34-66%)	12	40	7	23.33
High adoption (67-100%)	18	60	23	76.67
Total	30	100	30	100

Among all the technologies highest and lowest per cent of high adopters belonged to zero tillage in maize (92 %) and MSRI technology in rice (30 %) in KVK-Amadalavalasa. Highest medium adoption rate was observed in MSRI rice technology in KVK-Amadalavalasa which was similar with the findings of Rao and Rao (1993) who reported medium adoption of rice technology by the sample respondents in high altitudes of Andhra Pradesh. All the sample beneficiary farmers of the technologies provided by the sampled KVKs belonged to medium and high adoption levels which proved the efforts of the KVKs in technology transfer to the farming community for improved yields.

4.9.2. Determinants of Technology Adoption by the Farmers

The adoption of improved technologies has increased the yield levels of the crops in the sample to a considerable extent. The determinants of technology adoption index (TAI) were examined by employing regression function for each crop separately.

4.9.2.1. Determinants of technology adoption in KVK-Amadalavalasa

The results from the table 4.62 revealed that in beneficiary farmers of mechanised system of rice intensification (MSRI), education (0.748), experience in cultivation of rice (1.648), family size (0.881) along with annual subsidiary income (0.00001) of the farmers proved to be significant determinants and had a positive impact on the technology adoption rate of the farmers. KVK training

(10.806 and 21.218) was a significant positive determinant in the adoption of both the technologies. Whereas Age of the farmer (-0.857 and -0.317) was a negative significant contributor in both the technologies. That means with the increase in age of the farmer technology adoption level decreases.

Table 4.62. Determinants of technology adoption: KVK-Amadalavalasa

S.No.	Particulars	Method of cultivation	
		MSRI Rice	Zero tillage Maize
1	Intercept	51.064*** (9.055)	52.900*** (8.145)
2	Age	-0.857*** (0.310)	-0.317* (0.173)
3	Education	0.748*** (0.185)	-0.753 (1.400)
4	Land holding size	0.952 (0.625)	1.577 (2.491)
5	Experience in the cultivation of the crop	1.648*** (0.312)	1.719** (0.717)
6	Family size	0.881*** (0.325)	1.034 (1.165)
7	Annual income from Agriculture	-0.00002 (0.00001)	0.00001 (0.00004)
8	Annual subsidiary income	0.00001*** (0.000003)	0.00001 (0.00001)
9	KVK training	10.806*** (2.469)	21.218*** (4.402)
	R ²	0.76	0.64
	F value	16.61***	4.69***
	N	30	30

Note: (1) * = significant at 10%, ** = significant at 5%, ***= significant at 1% level of significance.
(2) Figures in parentheses indicate standard errors of the regression coefficients.

Experience in the cultivation of maize (1.719) was a positive significant contributor in zero tillage maize adoption. Irrespective of the education, land holding size, family size and annual income level, farmers are adopting new technology in maize due to less resource requirement and increased yields in case of zero tillage maize cultivation. The coefficient of multiple determination (R²) indicates that these factors are contributing to the technology adoption of the farmers by 76 per cent and 64 per cent respectively in rice and maize crops.

4.9.2.2 Determinants of technology adoption in KVK-Yagantipalli

In KVK-Yagantipalli education level of the farmer (2.117) and training programmes by the KVK (20.968) were found to be positive significant contributors (table 4.63) to the technology adoption of beneficiaries of soil test crop response in rice. Age (-0.403) and annual income from agriculture (-0.0002) had negative impact but were not significant in technology adoption. Irrespective of all other factors, farmers were able to adopt the new technology.

Table 4.63. Determinants of technology adoption: KVK- Yagantipalli

S.No.	Particulars	Method of cultivation	
		STCR in Rice	HYV Redgram
1	Intercept	60.280*** (21.929)	69.703*** (11.976)
2	Age	-0.403 (0.408)	-0.200 (0.139)
3	Education	2.117*** (0.792)	1.028** (0.464)
4	Land holding size	2.783 (3.018)	-0.365 (1.219)
5	Experience in the cultivation of the crop	0.081 (0.430)	-0.189 (0.480)
6	Family size	2.553 (3.074)	1.630** (0.754)
7	Annual income from Agriculture	-0.0002 (0.0002)	-0.00001 (0.00002)
8	Annual subsidiary income	0.0002 (0.0002)	0.00006 (0.00005)
9	KVK training	20.968** (9.171)	4.940 (5.144)
	R ²	0.88	0.67
	F value	2.86***	2.57***
	N	30	30

Note: (1) * = significant at 10%, ** = significant at 5%, ***= significant at 1% level of significance.

(2) Figures in parentheses indicate standard errors of the regression coefficients.

Less resource requirement and increased yields in STCR rice cultivation are encouraging even the resource poor farmers to adopt this new technology. Adoption of HYV redgram was determined by the education level (1.028) and family size (1.630) of the farmers. Irrespective of the negative impact of age and annual income from agriculture, farmers are adopting the new technology by recognising its economic benefits, resistance to pests and diseases, input support from KVK and buy back agreement from research stations.

4.9.2.3 Determinants of technology adoption in KVK-Kalavacharla

In KVK- Kalavacharla, land holding size (1.222) and annual income from agriculture (2.650) had shown positive and significant impact on the adoption of high yielding varieties of rice. Age (-1.139), experience in the cultivation of crop (-0.751) and family size (-1.225) were found to be negative and significant contributors of HYV technology in rice (Table 4.64). With the increase in age, family size and cultivation experience farmers were not showing interest in the adoption new technology in rice.

Education (0.750) was found to be significant positive determinant in the adoption of direct feeding of nutrients and skirting of bunches in banana by the beneficiary farmers. Age (-0.158) and family size (-0.275) were found to have negative impact on technology adoption but were not significant. KVK training had positive influence in both the technologies.

The results from the regression of technology adoption index in all the six technologies provided by the sampled KVKs corroborated with that of Mankar *et al.* (2004) who reported that the socio-economic characteristics had significant relation with the extent of technology adoption in Ratnagiri district of Maharashtra. These results proved the hypothesis that Socio-economic characteristics of the farmers impacted their decision of technology adoption.

Table 4.64 Determinants of technology adoption: KVK- Kalavacharla

S.No.	Particulars	Method of cultivation	
		HYV Rice	Banana (Bunch feeding & Skirting)
1.	Intercept	96.841*** (10.292)	69.29*** (8.09)
2.	Age	-1.139** (0.465)	-0.158 (0.333)
3.	Education	-0.111 (0.404)	0.750*** (0.285)
4.	Land holding size	1.222** (0.498)	-0.078 (0.559)
5.	Experience in the cultivation of the crop	-0.751** (0.397)	0.206 (0.342)
6.	Family size	-1.225* (0.722)	-0.275 (1.304)
7.	Annual income from Agriculture	2.650* (1.573)	6.812 (8.893)
8.	Annual subsidiary income	0.0001 (0.0001)	4.624 (1.071)
9.	KVK training	11.646*** (3.44)	5.831** (2.42)
	R ²	0.64	0.76
	F value	4.68***	8.09***
	N	30	30

Note: (1) * = significant at 10%, ** = significant at 5%, ***= significant at 1% level of significance.
(2) Figures in parentheses indicate standard errors of the regression coefficients.

Chapter II

REVIEW OF LITERATURE

This chapter presents a brief review of concepts and literature pertaining to the present study. Scientific analysis begins with process of perusing and critically analysing the works earlier completed on the related research problem and its related aspects. Conceptualisation is an essential part in any research study. Review of concepts used in earlier studies is to adopt, modify and improve the conceptual framework and provide a link to past approaches.

Review of literature helps the researcher in getting better ideas regarding appropriate sampling design and preparation of structured interview schedule to obtain best solution to the research problem. Considering the objectives of the study as laid out, studies made in the relevant field and or related fields were thoroughly reviewed in this chapter. This facilitated to have a better and precise understanding of research problem which led for the development of this study based on its relevance and utility in the country. The literature available on present study was furnished chronologically in the following order:

- 2.1. Studies on the impact of frontline demonstrations
- 2.2. Studies on yield gap analysis
- 2.3. Studies on the impact of vocational training programmes
- 2.4. Studies on the economic benefits from the adoption of improved technologies
- 2.5. Studies on income distribution
- 2.6. Studies on the factors contributing to the adoption of improved technologies by the farmers

2.1 IMPACT OF FRONTLINE DEMONSTRATIONS CONDUCTED BY KRISHI VIGYAN KENDRAS

Farmers in India are still producing crops based on the knowledge transmitted to them by their forefathers leading to a grossly unscientific agronomic, nutrient management and pest management practices. As a result of these, they often fail to achieve the desired potential yield of various crops and new varieties. However, with the available improved technologies it is possible to bridge the yield gap and increase the productivity up to the potential level. In this context, it deserves mention that participatory Frontline Demonstration (FLD) is an efficient approach for reducing gap between potential yield and farmers yield, dissemination of technology, generation of primary data and collection of feedback for subsequent use in the process of large scale adoption of technology in farmers' field under different agro-ecological and farming situations.

The main aim of Krishi Vigyan Kendra is to reduce the time lag between generation of technology at the research institution and its transfer to the farmers for increasing productivity and income from agriculture and allied sectors on sustained basis. Hence one of the objectives of this study is to find out impact of FLDs on bridging the yield gap in terms of technology gap, extension gap and technology index, an attempt was made to review some of the important literature available from the past studies on this objective.

Singh (2005) conducted frontline demonstrations at different KVKs of the states Uttar Pradesh and Uttaranchal on major pulse crops with improved varieties in an area of 194 hectare during 1997-2000. They found that high yielding varieties of pigeon pea, urdbean, chickpea and field pea were suitable under demonstration conditions and recorded almost 59, 55, 45, 70.4 and 61.5 per cent yield increase over local check, respectively. The study further observed that bio-fertilizers and integrated pest management enhanced the grain yields significantly.

Mishra *et al.* (2007) analyzed the yield gap, technology gap, extension gap and technology index of frontline demonstrations conducted by KVK, Kasturbagram, Indore during 2002-2007 and recorded that Potato yield of demonstrated plot recorded 13 to 19 per cent higher over farmer practice, on an average technology gap, extension gap and technology index were recorded as 63.79 q ha⁻¹, 29.8 q ha⁻¹ and 21.2 % respectively. The yield gap analysis emphasized the need to educate the farmers through various extension means for adoption of improved agricultural technologies to revert the trend of wide extension gap.

Singh *et al.* (2007) studied the impact of frontline demonstrations over the farming community of Lucknow district conducted by Krishi Vigyan Kendra under IISR, Lucknow and found that there is a large gap in demonstration yield over potential yield. The results indicated that the frontline demonstration had given a good impact over the farming community of Lucknow district as they were motivated by the new agricultural technologies applied in the FLD plots and the data further showed that the yield of mustard in the following years increased successively which clearly speaks of the positive impact of FLD over existing practices of mustard cultivation and the variety wise location specific recommendation appears to be necessary to minimize the technology gap for yield level in different situations.

Yadav *et al.* (2007) analysed the performance of frontline demonstrations conducted by KVK, Faridabad on improved agricultural technologies of pulse crops in scientific manner at farmers' fields during the year 2003-04, 2004-05 and 2005-06 to exhibit the performance of recommended high yielding varieties in moong and gram, performance of recommended dose of phosphatic fertilizers in arhar and lentil and reported that the yield of demonstrated plots was higher than local check plots.

Choudhary *et al.* (2009) studied the technological and extension yield gaps of oilseeds for two years (*Kharif* 2006 to *Rabi* 2007-08) under frontline demonstration programme in oilseeds in Mandi district of Himachal Pradesh and found that the improved technology package has enhanced the profitability of oilseeds in terms of net returns besides incremental benefit-cost ratio which raised from 2.58 to 3.87 and also increased the water use efficiency in oilseed crops in the district. They also reported that technology index varied between 28.46 % and 53.21 % indicating that there is dire need to educate the farmers to adopt economically viable technologies for maximizing profits of oilseeds through intensification of productive inputs.

Islam *et al.* (2011) conducted a study on frontline demonstrations (FLD) undertaken by the Krishi Vigyan Kendra, East Sikkim, for 4 consecutive years starting from 2005 to 2008 to disseminate the improved agro-technology of urdbean for boosting productivity and to assess the economic viability and technological feasibility of the latest urdbean production technologies over the existing one. The results revealed that even in case of lowest yield under FLD, the increase was recorded to be 43 per cent over the farmers' practice in the year 2005. The economic viability and profitability showed that the benefit cost ratio was higher in the case of improved agro-technologies (FLD) with 2.60 as against 1.94 in farmers' practice (FP). The net return from improved agro-technologies (FLD) was Rs. 20,005 per hectare as against Rs. 1,2205 per hectare from farmers' practices.

Kumar *et al.* (2012) reported an increase in the yield of ginger by 44.22 per cent for recommended practice over control. An average net profit of Rs.2,55,258 was recorded in recommended practice wherein it was Rs.1,31,677 in farmer's practice. Benefit cost ratio varied from 5.75 to 5.90 under demonstrations while it was 3.54 to 3.75 for control. They concluded that yield potential and net income from ginger cultivation can be enhanced to greater extent through frontline demonstration of recommended technology.

Ahmad *et al.* (2013) assessed the impact of 37 frontline demonstrations of Indian Mustard conducted by Krishi Vigyan Kendra, Tepla, Ambala district of Haryana. The results revealed that Indian mustard registered 14.80 % higher yield over farmer's practice on an average. The highest yield (12.75 q ha⁻¹) was recorded in 2009-10 in FLD, which was 21.75 percent more yield over the farmer's practice (10.00 q ha⁻¹). Average extension gap was recorded 1.60 q ha⁻¹ and average technology gap was recorded 7.18 q ha⁻¹. The technology index ranged from 22.96 per cent to 64.14 per cent. The results indicated that the frontline demonstration made a good impact on the farming community of Ambala district as they were motivated by the new agricultural technologies applied in the FLD plots.

Ajrawat *et al.* (2013) evaluated the frontline demonstrations conducted by Krishi Vigyan Kendra, Kathua on oilseed crops Gobhi Sarson and Toria during 2009-10 and 2010-11. The results showed that in Rabi 2009, the Toria cultivars RSPT-1, RSPT-2 and T-9 gave 70.8 %, 74.1 % and 63 % increase in yield over local variety. In 2010, the yield increase of Toria cultivars RSPT-2 and T-9 respectively were 89 % and 67.3 %. In Rabi 2009 and 2010, the Gobhi Sarson cultivar DGS-1 gave 78.9 % and 86.7 % increase in yield over local variety.

Balai *et al.* (2013) evaluated the impact of frontline demonstrations laid down by krishi vigyan kendra, Dungarpur on three vegetable crops under NAIP project by introducing improved and hybrid varieties and applying scientific package of practices in their cultivation. The productivity and economic returns of okra, onion and brinjal in improved technologies were calculated and compared with the corresponding farmer's practices (local checks), all the three vegetable crops recorded higher gross returns, net returns and benefit cost ratio in improved technologies as compared to the plots where farmers were using traditional practices in their cultivation. It was suggested that location-specific integrated approaches would be needed to bridge the productivity gap of the vegetable crops grown in the district.

Kumawat *et al.* (2013) described the achievements of 718 FLDs conducted on mustard covering 321 ha by 19 KVKs of Zone-VI under different management practices, during Rabi 2009 to 2010. The results of the FLDs conducted on varietal evaluation revealed that variety GM-3 produced maximum grain yield (2080 kg ha⁻¹) as well as, net returns of 35,354 Rs/ha among the eight varieties tested. The yield and net returns were also varied with the soil type and technology demonstrated under FLDs in the Zone. It was inferred that mustard variety GM-3 performed well with all the components of production and soils of Rajasthan and Gujarat and might be distributed in these states at larger scales for improvement of mustard production in the zone.

Raj *et al.* (2013) carried out a study on 400 frontline demonstrations on pigeon pea, chick pea, black gram and green gram crops in an area of 160 ha in 50 villages of Narmada, Gujarat during 2012-13. The results revealed that the improved technology recorded higher yield of 1880 kg ha⁻¹, 1480 kg ha⁻¹, 880 kg ha⁻¹ and 927 kg ha⁻¹ in pigeon pea, chick pea, black gram and green gram, respectively than 1450, 1130, 680 and 711 kg ha⁻¹ in case of traditional practices. In spite of increase in yield of pulses, technological gap, extension gap and technology index existed. The improved technology gave higher gross returns and net returns with higher benefit cost ratio over farmer's practices.

Singh *et al.* (2013) assessed the impact of frontline demonstrations (FLDs) for dissemination of Cumin technology conducted by KVK, CAZRI in Pali district of Rajasthan. It was observed that the farmers adopted new high yielding variety followed by crop rotation, integrated nutrient management and recommended seed rate after acquiring trainings from the KVK. The results clearly showed that due to enhanced knowledge and adoption of scientific practices, the yield of cumin increased by 75 %, 74.28 % and 67.25 % over the yield obtained under farmers practices during the year 2008-09, 2009-10 and 2010-11, respectively. The reduction of technology index from 34.31 % observed during 2008-09 to 19.46 % in 2010-11 exhibited the feasibility of technology demonstrated. Thus, the study suggested the need of conducting intensive trainings and FLDs to educate the cumin growers for achieving higher production of cumin in the district.

Dutta (2014) carried out a study to know the yield gaps between improved package of practices (IP) under frontline demonstrations (FLDs) conducted by at krishi vigyan kendra, Lakhimpur, Assam and farmer's practice (FP) in rapeseed and mustard crops and found that the yield of rapeseed–mustard in IP under irrigated conditions ranged from 9.8 to 10.8 q ha⁻¹ whereas in FP it ranged between 6.2 to 6.5 q ha⁻¹. The per cent increase in yield with IP over FP was recorded in the range of 36.73 to 41.67. The extension gap and technological index ranged from 3.6 to 4.5 q ha⁻¹ and 10 to 18.33 %, respectively. The trend of technology gap reflected the farmer's cooperation in carrying out demonstrations with encouraging results in subsequent years.

Jain (2014) evaluated the performance of high yielding isabgol (*Plantago ovata*) variety RI 89 in Barmer district of Rajasthan under frontline demonstration programme and reported that the grain yield increased significantly by 27 and 25 per cent over farmers practice during 2009-10 and 2010-11, respectively. The farmers gained an additional return of Rs. 6713 and 6050 against an additional investment of Rs. 1500 and 2300 during 2009-10 and 2010-11, respectively.

Joshi *et al.* (2014) undertook a study to find out the yield gap through FLDs on wheat crop. Krishi vigyan kendra, JAU, Amreli, Gujarat conducted 100 demonstrations on wheat since 2006-07 to 2009-10 in seven adopted villages treating prevailing farmers' practices as control for comparison with recommended practices. It was observed from the average four years data that average yield obtained from demonstrated plot was 43.26 q ha⁻¹ over control (36.59 q ha⁻¹) with an additional yield of 6.67 q ha⁻¹ and the average wheat productivity increased by 18.22 per cent. The average technology gap and technology index were found to be 6.74 and 13.48 per cent.

Kumar *et al.* (2014) studied the performance of frontline demonstrations on pulses conducted in Hamirpur district of Himachal Pradesh from 2007-08 to 2011-12 to demonstrate and popularize the improved technologies on farmers' fields for effective transfer of generated technology and fill the gap between

recommended practices and farmers' practices. Results indicated that increase in yield over farmers' practice ranged from 31.1 % to 76.6 % in black gram crop where as in case of chickpea the range was 39.4 % to 63.6 % over five years. It was further observed that in terms of economics, both black gram and chickpea crops recorded higher net returns per hectare compared to farmer's practice during all the years. The benefit cost ratio of demonstration plots ranged from 1.30 to 2.99 in black gram and 0.42 to 3.00 in chickpea. Technology index varied from 26 to 56 % in black gram and 27 to 62 % in chickpea indicating the urgent need to motivate the farmers to adopt economically viable technologies for increasing production, productivity and profitability of pulse crops.

Mohanty *et al.* (2014) assessed the performance of SRI technology over farmers' TRP method of rice cultivation in terms of yield and profitability through frontline demonstrations (FLDs) in East Sikkim district of Sikkim and the results showed an increasing trend in yield performance accounting for 25.44% more yield over Traditional Random Planting (TRP) method. Comparative economics of SRI and TRP method of rice cultivation revealed that SRI method realized 61.23 % higher net returns than TRP method of rice cultivation. The B:C ratio of 1.70 in case of SRI over and above the TRP (1.40) proved the efficacy of SRI in terms of productivity.

Sarma *et al.* (2014) evaluated the frontline demonstrations conducted by krishi vigyan kendra, Barpeta of Assam to find out the yield gaps between demonstrated HYV of Toria variety TS-36 and variety grown by farmers. Toria yield of demonstration variety (TS-36) registered 29.70 % to 42.85 % higher over farmers' variety, on an average technology gap was recorded to be 1.93 q ha⁻¹ while average extension gap was observed to be 3.51 q ha⁻¹ and average technology index was recorded as 16.07 per cent.

Singh *et al.* (2014) studied the technological interventions on soybean crop carried out by three sampled KVKs during the period from 2008-09 to 2010-11. The results showed 16.72 to 34.70 percent yield increase over farmer's practice. The highest yield of 21.42 q ha⁻¹ was recorded in the demonstration

plots, which was 27 per cent more over the farmer's practice (16.83 q/ha). The extension gap ranged from 1.85 q ha⁻¹ to 5.05 q ha⁻¹ during the reporting period. The benefit cost ratio of the demonstration plots and farmers' plots ranged as 2.91 to 4.04 and 2.44 to 3.79, respectively.

Singh *et al.* (2014) reported the results of frontline demonstration (FLDs) on chickpea conducted by Krishi Vigya Kendra, Sidhi, Madhya Pradesh during the year 2008 to 2010 in two villages viz. Chabari and Hadbado of district Sidhi. The results indicated that in frontline demonstration on chickpea, highest grain yield (15.32 q ha⁻¹) was recorded in variety JG-226 which was 92.7 % higher yield over the farmers practice (7.95 q ha⁻¹). The average technology gap, extension gap and technology index of 16.89 q ha⁻¹, 5.05 q ha⁻¹ and 56.30 % respectively, were obtained between demonstrated and farmers' practice. The average yield of chick pea increased by 62.42 % over farmer's practice while year wise variation in yield increase was 49.8 to 92.7 per cent.

Singh *et al.* (2014) investigated the impact of frontline demonstrations (FLDs) conducted during 2008 to 2010 by the active participation of farmers with the objective to demonstrate the improved technology of mustard production potential. The result showed that the improved technology gave higher gross returns and net returns with higher benefit cost ratio over farmer's practice.

Barua and Tripathi (2015) assessed the impact of frontline demonstrations conducted during 2004-05 to 2011-12 in different villages of Ri-Bhoi district of Meghalaya to disseminate the production technology of high yielding (237.6 q ha⁻¹) Megha turmeric variety having high curcumin content (6.8 %), and reported that with frontline demonstrations (FLD) of proven technology yield potential and net income from turmeric cultivation could be enhanced to a great extent resulting in higher income to the farming community.

Manjarekar *et al.* (2015) conducted a study to show the impact of frontline demonstrations on adoption of okra production technologies at Krishi Vigyan Kendra, Roha, Raigad district of Maharashtra. The study revealed that there was significant difference observed in yield of okra before and after FLD programme. B:C ratio of okra crop after FLD was higher than before FLD.

Meena *et al.* (2015) evaluated the performance of frontline demonstrations organised by Krishi Vigyan Kendra, ICAR Central Marine Fisheries Research Institute during 2012-13 to 2014-15 to know the production and economic benefits of scientific maize production technology in Ernakulam district of Kerala on traditional farmer's field, and observed reduced trend in technology index over the years of technology demonstration which showed the economic feasibility of improved technology over traditional farmer's practices, which thereafter initiated the small scale farming of maize in the district with the technical guidance provided from KVK.

Srinivas *et al.* (2015) reported that frontline demonstrations conducted on the improved technologies consisting use of balanced fertilizer application, integrated pest management and use of high yielding Bt cotton variety (Tulasi) in agency area of Rampachodavaram division of East Godavari district during the year 2014 recorded higher yield (9 q) as compared to farmer's local practice (6 q) and higher gross (Rs. 32,690) and net returns (Rs. 27,000) with higher benefit cost ratio of 5.74 than the farmer's practice.

Teggelli *et al.* (2015) evaluated the impact of 133 frontline demonstrations organized on 54 farmer's field to demonstrate the impact of integrated crop management technology on pigeonpea productivity over four years during Kharif 2010-10 to 2013-14. The results revealed that an average yield of 11.9 q ha⁻¹ was recorded under demonstrated plots as compared to farmer's practice of 10.1 q ha⁻¹. The highest yield in the FLD plot was 13.62 q ha⁻¹ in 2013-14 with net returns of Rs. 34,883 compared to check trial net return of Rs. 26,194.

Khedkar *et al.* (2016) studied the performance of frontline demonstrations on recommended package of practices of mustard conducted by Krishi Vigyan Kendra in different villages of Shajapur district to know the yield gap with farmer's practices at farmer's field. Results of frontline demonstrations conducted during 2008-09 to 2011-12 produced an average 30.89 % more yield of mustard as compared to local practices (14.25 q ha⁻¹). The extension gap, technology gap and technological index were found in the ranges between 3.06

to 6.00 q ha⁻¹, 2.40 to 9.34 q ha⁻¹ and 9.6 to 37.36 %, respectively. The trend of technology gap reflected the farmer's cooperation in carrying out demonstrations with encouraging results in subsequent years.

Suthar *et al.* (2016) studied the impact of frontline demonstrations conducted at different locations in Surat district which focused on increased productivity and replacement of old variety with promising high yielding improved rice variety GNR-3. The study revealed that over the years, GNR-3 variety was superior over traditional farmer practices with net returns (Rs. 34432/ha), extension gap (395 kg ha⁻¹) and technology index (26.55 %). By conducting frontline demonstrations (FLDs) on farmer's field there was significant increase in knowledge level of the farmers and majority of farmer's showed high level of satisfaction about demonstrated technology.

Govardhanrao and Ramana (2017) evaluated the impact of frontline demonstrations on maize laid out in 11 agency mandals of East Godavari District of Andhra Pradesh from 2011-12 to 2015-16. In demonstration fields, they strictly followed zero tillage practice to minimize the cost of cultivation, effective utilization of residual moisture and nutrients. Improved practice resulted in better performance when compared to farmers practice in number of cob per plant and 1000 grain weight (221 - 250 g) under demonstration compared to the farmer's practice (186 - 211.5 g) which ultimately resulted in higher grain yield of 8.44 t ha⁻¹. On an average, maize grain yield under frontline demonstration was higher by 40.66 % as compared to farmer's practices (6.04 t ha⁻¹). Zero tillage rabi maize resulted higher net returns when compared to conventional tillage grown rabi maize. The results indicated that the demonstration has given good impact in terms of yield and income thereby changing the farmer's attitude towards following this technology in future and now the technology came to the pipeline of Department of Agriculture.

2.2 YIELD GAP ANALYSIS

In spite of the technological breakthrough in Indian agriculture during the last two decades, there still exists an untapped yield potential. The performances of technology on farmers' fields are not as satisfactory as at the research stations and demonstrations plots.

"Yield Gap" is a term which is defined differently by various research workers. Yield Gap analysis is a technique that emerged formally in the early 1970s based on the work conducted at the International Rice Research Institute (IRRI, Manila), Philippines. It was extensively used to analyze the yield gaps in yield under different situations. It has gained wide popularity with researchers and policy makers. Subsequently, studies on yield gap analysis have been conducted in India and abroad. Some of these studies deal with methodological aspects, while others are related to estimation of yield gaps in different situation pertaining to different crops of different regions. An attempt is made to review some of the important studies and this review which will provide a basis for developing the analytical framework for the present study.

2.2.1 Methodology for Yield Gap Analysis

Herdt and Wickham (1975) defined yield gap as the difference between the yield potential at experimental station during the dry season and in a good year and the average national yield. They divided the gap into year to year yield variation, seasonal effects (dry and wet), water control, economic constraints, lack of availability of inputs and non-adoption of technology.

The International Rice Research Institute (IRRI) has pioneered a methodology to identify yield gap factors and to estimate the magnitude of their impact on rice production (Gomez, 1977; De Dutta *et al.*, 1978; Gomez *et al.*, 1979). The total yield gap was conceptually divided into two parts, viz. Yield Gap-I and Yield Gap-II. Yield Gap-I represented the difference between research station yield and potential farm yield (demonstration plot yield i.e. yield obtainable in farmers' field by adopting the improved technology) and was caused by uncontrolled environmental factors. Yield Gap-II was the difference between the potential farm yield and the actual yield at the farm level and was explained by various biological and socio-economic factors operating at farm level. The main focus of IRRI was on Yield Gap-II. Hence the factors causing the difference between the potential and farm level yields were identified and evaluated. The IRRI methodology thus provided a major improvement in the field of yield gap analysis.

2.2.2 Magnitude of Yield Gaps

The study on the magnitude of the yield gap is important to determine the extent of the yield gap prevailing at the farm level and to formulate appropriate measures and policy implications to bridge the yield gap.

Yadav and Gangwar (1986) reported that the HYV rice yield (35.56 q ha^{-1}) was about 160 % higher than that of local varieties in Bihar. Comparatively more use of important inputs such as fertilizers, plant protection chemicals, irrigation, etc. was felt necessary for higher production of HYVs. A potential for increase in production of rice was indicated by the high yield gap between farm yield and actual realized yield. Partial adoption of new rice technology was mainly held responsible for this yield gap and therefore, strategies to strengthen extension and input supply services were suggested as remedial measures to reduce the yield gap.

Reddy *et al.* (1996) had conducted a study based on a sample of 126 farmers from two selected villages in the Guntur district of Andhra Pradesh, India. The study revealed that the highest yield gap in rice for the period 1992-93 was observed between research station farms and sample farms, followed by the yield gap between demonstration farms and sample farms. The major factors influencing low yield at sample farms identified by them were less use of all inputs (except nitrogen) on sample farms in comparison to demonstration farms.

Ramasamy *et al.* (1997) pointed out that Yield Gap II constitutes 17 % (658 kg ha^{-1}) of the actual farm yield (3892 kg ha^{-1}). Yield Gap I constitutes 47 % (4050 kg ha^{-1}) of the experiment station yield in kharif season.

Sinha and Singh (1997) identified constraints of rice production in Bihar by surveying 80 randomly selected farmers of Patna and Gaya districts. They found that the average sample farm yield at farm level was 1.4 t ha^{-1} against the potential yield of 4.0 t ha^{-1} . Credit problems, marketing problems, labor problems and tenancy of land were identified as the main constraints in rice production. Technological constraints such as imbalanced use of fertilizers, no plant protection measures and lack of irrigation found to be important factors responsible for low yield.

Duwayri *et al.* (1999) reported that in many countries the gaps between yields at research station and in farmers' field are still substantially large, owing to a combined lack of initiatives, resources and support for narrowing them.

Yadav *et al.* (1999) conducted a study on potential yield and demonstration plot yield of mustard in western region of Haryana. They observed that there was a wide gap between potential yield and frontline demonstration yield, mainly due to less soil fertility, site specific management problems and rain fed conditions in some demonstrations. They emphasized the need to educate farmers for adoption of improved technology.

Basavaraja (2000) from his study on major crops in Northern Dry Zone of Karnataka reported that Yield Gap-I and Yield Gap-II were more or less identical and 10 % in irrigated rice. He also stated that higher doses of nitrogen in rice were used by farmers. Lack of adequate soil moisture regime has been attributed for 10 per cent of the yield gap. The major constraints faced by rice farmers are inadequate use of fertilizers, incidence of pests and disease, labour problem, soil problem, etc.

Narayanmoorthy (2000) observed the relationship between farmer's education and productivity of paddy in two seasons from highly irrigated villages of Pudukkottai district of Tamil Nadu. The estimates of production function indicated that the coefficient of education was positive but not significant in influencing productivity of paddy. The use of fertilizers significantly influenced the consistency of productivity of paddy in both the seasons.

Roy and Datta (2000) found that Yield Gap I was 1325 kg ha⁻¹ and Yield Gap II was 1810 kg ha⁻¹ in rice crop. The total yield gap was 3135 kg ha⁻¹. The yield at experiment station, on-farm experiment yield and farms are 8350 kg ha⁻¹, 7025 kg ha⁻¹ and 2515 kg ha⁻¹, respectively.

Singh and Singh (2000) reported the yield under irrigated land with HYV rice ecosystem as 3.86 t ha^{-1} against the potential yield of 6 t ha^{-1} . The Yield Gap II was 35.67 per cent.

Dat (2001) in his study observed the existence of yield gaps in rice production in many countries and knowledge gap was the main cause of yield gap and consequently suggested that yield gap can be minimized by minimizing knowledge gap.

Gaddi *et al.* (2002) observed that, in Karnataka, sorghum yield realized on the research on the research station (2472 kg ha^{-1}) and on the demonstration plots ($1458.53 \text{ kg ha}^{-1}$) were sufficiently higher than on farmers' field ($1017.80 \text{ kg ha}^{-1}$). The magnitude of total yield worked out to be $1454.20 \text{ kg ha}^{-1}$. This comprised of relatively higher magnitude of Yield Gap-I ($1013.47 \text{ kg ha}^{-1}$) than Yield Gap-II ($441.06 \text{ kg ha}^{-1}$).

Kaul (2002) studied the yield gaps in Mohindergarh district of Haryana, it was observed that there is a wide gap on farm field in gram production. Research cum-management gap in gram production is 7.43 q ha^{-1} whereas techno-economic gap is 4.20 q ha^{-1} .

Ram and Nayak (2002) in a study to find the causes of low productivity in coastal agro-ecological region of Orissa comprising Balasore, Bhadrak, Jagatsingpur, Kendrapara, Ganjam and Puri districts revealed that lack of drainage, absence of tenancy reforms, small size of operational holding, paucity of capital and credit facilities, illiteracy and ignorance, non-availability of essential inputs (HYV seed, fertilizers and chemicals) in proper time at reasonable prices, labour problems during peak periods, under developed and poor infrastructure are the major constraints to coastal rice productivity.

Sharma *et al.* (2002) in a study conducted in Pabo block in Pauri district of Uttaranchal to find the yield gap in finger millet it was found that highest yield gap was in high-hills (42 %) and the lowest yield gap was in mid-hills (23 %).

Srinivas *et al.* (2002) indicated that resources viz., land, human labour, bullock labour, manures, fertilizers and pesticides which were used inefficiently in the production process were to be recognized in order to raise the productivity on paddy farms.

Thakur and Hossain (2002) in a research carried out in Bihar to study the yield gap in rice, it was found that the yield gap II was about 1500 kg ha⁻¹, which was 38.75% of the attainable rice yield at the best farmer's field. By rice ecosystem, the yield gap II was higher in rainfed upland followed by irrigated, rainfed lowland and deepwater ecosystem.

Narayanmoorthy and Kalamkar (2004) in Maharashtra, it was observed that introduction of drought resistance cum HYV s, promoting balanced use of fertilizers (appropriate ratio of NPK) and well designed location specific policies/programmes can help to increase the productivity of crops appreciably.

Naik and Pradhan (2005) conducted a study in Orissa and it appears from the study that rice and other crops have not responded properly to the application of irrigation, fertilizers and HYV during the study period (1961-1962 to 2003-2004). In spite of increase in area under HYV, fertilizer used and irrigation facilities, the productivity of rice and foodgrains have declined even to the extent of 13 to 20 per cent "in the irrigated area. The yield potential of paddy crop can be exploited by resorting to increased levels of fertilizer consumption, seed replacement, increased level of irrigation for yield and profit maximization.

Sananse *et al.* (2005) conducted a study in the North Konkan Coastal zones of Maharashtra to find the yield gap in rice-based cropping system. The zone comprises of two districts viz. Thane and Raigad. It was observed that Yield Gap II (Research Station Yield - Average Sample Farmers Yield) and Yield Gap III (Progressive Farmers Yield - Average Farmers Yield) were high in both the districts in Kharif rice. Yield Gap II was recorded to be 1635 kg ha⁻¹ and 1705 kg ha⁻¹ in Raigad and Thane, respectively and Yield Gap III was recorded to be 1175 kg ha⁻¹ and 1495 kg ha⁻¹ in Raigad and Thane, respectively. However, Yield Gap I (Research Station Yield - Progressive Farmers Yield) was

found to be less. For Rabi rice, Yield Gap II (2377 kg ha⁻¹ in Raigad and 2499 kg ha⁻¹ in Thane) was the highest followed by Yield Gap III (1747 kg ha⁻¹ in Raigad and 1569 kg ha⁻¹) and Yield Gap I (630 kg ha⁻¹ in Raigad and 930 kg ha⁻¹ in Thane).

Khosta and Chandrakar (2006) in Raipur and Bastar districts. of Chhattisgarh, it was found that in irrigated rice the influence of fertilizer to gross income was the maximum. The influence of irrigation, manure and hired human labour was not found to be statistically significant but it was positive. For rainfed rice family labour, seed, fertilizer and tractor hours were found to be significant. Bullock pair days were found to be positive but not significant. Under both the situations, resources were not utilized up to their potential, which retarded the gross income in rice production.

Razzaque and Rafiquzzaman (2006) carried out a field experiment at multilocation testing site Barguna in kharif seasons of 1999-2000 to find out the probable reason of yield gap of T. aman rice (BR-23) between demonstration plot (DP) with research management and non-demonstration plot (NDP) with farmer management practices. Over the years, there existed a big gap in yield between DP and NDP. DP gave about 25.15% higher yield than NDP due to use of best quality seed, appropriate age of seedlings (30 days), closer spacing, optimum number of seedlings per hill, use of balanced fertilizer and pest control in proper time. They found that cultivation cost of DP was higher than that of NDP.

Verma (2006) conducted a study in Madhya Pradesh using secondary data for the period from 1986-87 to 2000-01 to find the factors responsible for increasing productivity among the principal crops and it was found that the increase in irrigated area by 1.74 per cent per annum was the main reason for the increased yield.

Patole *et al* (2008) revealed that total yield for the production zones ranged from 550 to 770 kg ha⁻¹ for pigeonpea and 610 to 1150 kg ha⁻¹ for chickpea. They reported the higher role of input use than technology difference in the yield gap of chickpea in Ahmednagar district of Maharashtra.

Singh *et al.* (2009) conducted a study on productivity, yield gaps and constraints in the adoption of improved technology of sugarcane and wheat in Upper Gangetic plain zone of Uttar Pradesh. Sugarcane being the highly profitable crop in the state, the productivity was almost stagnant or meagrely increased during the last ten years. The existence of wide yield gaps indicated the constraints in the adoption of improved production protection technologies.

Gavaria *et al.* (2010) estimated the production response functions for both modern and traditional technology to understand the advantage of modern technology over traditional technology. The results revealed that the modern technology of wheat increased the productivity by 62.30% over the traditional variety. The major component of this productivity gap was the difference in varietal technology contributing nearly 46 %, while remaining 14 % was shared by complementary inputs in terms of use levels between the modern and traditional wheat production technology.

Hasan and Islam (2010) identified and analyzed the inefficiency and yield gaps of wheat production in Bangladesh. The average technical inefficiency of wheat production in Bangladesh is 16 %. This indicates a good potential for increasing wheat output by 16 % with the existing technology and levels of inputs. Education and training was found to have significant effect on yield and technical efficiency of wheat production.

Gavali *et al.* (2011) conducted a study in Maharashtra and found that jowar is the main cereal crop in the state and the actual yields obtained were considerably lower than those recorded in the demonstration plots and research stations/farms. They suggested that the use of recommended level of inputs is the most essential to bridge the yield gaps.

Hussain *et al.* (2011) analyzed the crop productivity of farmer families in the selected districts of rice-wheat zone (Sialkot, Gujranwala and Sheikhpura) and mixed-cropping zone (Faisalabad, Jhang and Toba Tek Singh) in Punjab, Pakistan. They found that yields of major crops were 35-50 % less than the potential anticipated yields. Moreover, yield gaps for major crops were almost same across both the zones. They found that the use of previous years non graded crop produce as seed, less than recommended seed use and fertilizer application were the main reasons for yield gaps.

Jha *et al.* (2011) analyzed the yield gap for major oilseed crops in India by using the frontline demonstrations data conducted under the All India Coordinated Research Projects on different oilseed crops in various states. This gap calls for on farm assessment of the production technology developed for the individual oilseed crops besides ensuring the requirement of production input related packages and knowledge to minimize yield gap I and yield gap II.

Mondal (2011) conducted a study in Bangladesh on yield gap of different crops and found that yield gaps exist in different crops ranging up to 60%. The yield gaps were mainly caused by biological, socio-economic, climate and institutional or policy related factors. Different strategies such as integrated crop management practices, timely supply of inputs including credit to farmers, research and extension collaboration to transfer the new technologies have been discussed as strategies to minimize yield gaps.

Poonia and Pithia (2011) reported that the yield gap between conventional practices and improved package of practices was much higher ranging from 21 kg ha⁻¹ to 349 kg ha⁻¹. Under varietal demonstration, the technology gap was much higher i.e. 349 kg ha⁻¹ followed by management of fertilizers in chickpea (191 kg ha⁻¹).

Rama Rao (2012) studied the economics of yield gap in irrigated and rainfed sugarcane cultivation in North Coastal Zone of Andhra Pradesh for the period 2008-09. The study has shown that the value of BCR is higher for plant crop in irrigated (1.49) than in rainfed (1.43) regions. The decomposition analysis of yield gaps between irrigated and rainfed regions has been found to be 67.79 %, in which input usage had a higher (41.86 %) effect than cultural practices (25.93 %). Therefore, appropriate usage of inputs can reduce the yield gap between rainfed and irrigated methods to the tune of 67.79 per cent.

Balasaheb (2013) in his study tried to estimate the magnitude of yield gaps, causative factors and constraints for attaining greater farm potential in adsali, suru, pre seasonal and ratoon sugarcane production in Maharashtra. Results revealed that the magnitude of yield gap-I was higher, which implies that

the technology developed at research station cannot be duplicated on demonstration plots to exploit the full potential of sugarcane. The orthodox practices being followed on farmers' field lead to yield gap-II. The yield gaps cannot be completely eliminated, but can be minimized by efficient and effective resource management.

Singh *et al* (2013) conducted a study in Agra region of western Uttar Pradesh to assess yield gap at farmers' field area under rice-wheat system and found that there was yield gap on all the farms, where as the yield gap-II was more than the yield gap-I. They concluded that there is further scope to increase productivity on the farms by managing the constraints such as providing quality inputs to the farmers at right time in sufficient quantity which can help in bridging the yield gap, ultimately leading to increase in production.

Elum and Sekar (2015) carried out a study in Tamil Nadu to examine the extent of yield gap in seed cotton and the results showed that potash gap had a statistically significant but negative effect on yield while nitrogen had a statistically significant and positive effect. Total yield gap in Bt cotton (1658 kg ha^{-1}) was significantly higher than that of conventional cotton (594 kg ha^{-1}). Further analysis showed that the yield gap in various districts of the state were significantly different.

Existence of yield gaps could be confirmed from the above reviews. Yield gaps were found in the research field and the demonstration farm. Various problems are encountered by the farmer in the process of cultivation. There is a serious need for a call for bridging the yield gap by better management strategy, area specific packages of cultivation practices, development initiatives including massive production and supply of quality seed, timely supply of fertilizer nutrients and pesticides, extensive technology transfer programmes of various kinds, favourable policy support measures, etc if the efficiency of production and total production has to be increased.

For the present study, the methodology formulated by the International Rice Research Institute (IRRI) i.e. Yield Gap-I and Yield Gap-II was adopted but with some modification according to the data availability. In order to further study the yield gap, Bisalial's (1977) output decomposition model was used in the study.

2.3 IMPACT OF VOCATIONAL TRAINING PROGRAMMES CONDUCTED BY KRISHI VIGYAN KENDRAS

Deharia (2009) reported in her study “Impact of Krishi Vigyan Kendra in changing the knowledge and socio-economic status of the tribal women in Chhindwara district of Madhya Pradesh” that there is clear variation in frequency obtained by trainees and non-trainees tribal women in respect of socio-economic status including income generation. It is evident that the tribal women, who have got training, fetched higher frequency of socio-economic status as per the different level than those who have not got training regarding improved crop production technology.

Singh *et al.* (2010) undertaken a study to do a formative and summative (outcome and impact) evaluation of the beekeeping and mushroom growing vocational training programmes in the Indian state of Punjab. One-group pre and post evaluation design was employed for conducting a formative and outcome evaluation. Ex-post-facto one-shot case study design was applied for this impact analysis. The vocational training programmes have resulted in continued-adoption of beekeeping and mushroom cultivation enterprises by 20 % and 51 % trained farmers, respectively. The continued adopters of beekeeping and mushroom growing had increased their family income by 49 % and 24 %, respectively. These training programmes are augmenting the dwindling farm income of the farmers in Indian Punjab.

Lal and Tandon (2011) conducted a study in Reasi and Udhampur districts of Jammu and Kashmir to analyse the impact of training programmes conducted by the KVK, Reasi on the rural youth. Six different vocational training programmes of 2 to 5 days duration were imparted by the KVK scientists, which included cutting and stitching, seed production in vegetables, raising of fruit plant nursery for self employment, modern dairy farming, mushroom (dhingri) cultivation, value added products from fruits and vegetables. It can be concluded from the study that vocational trainings play an important role in developing the skills among the rural youths and also benefiting the rural women for generation of income.

Nazir *et al.* (2012) assessed the impact of vocational training courses on knowledge and adoption of rural women in Kashmir. Majority of the women beneficiaries after going through vocational training programmes and adopting the recommended techniques became independent and were socially, economically, psychologically empowered. The training of cutting and tailoring, knitting, fruit and vegetable preservation and tilla work had increased the economic status of the trainees and also of their families. The positive change in their living status was also visible.

Murthy *et al.* (2013) checked the percentage change in income levels of different trainees before and after trainings in BCT KVK, Visakhapatnam. It was evident from the study that the every trainee of apparel making & embroidery training became an earner, with 28.6 % trainees earning between Rs. 10001 to 20000, 34.7 % trainees earning between Rs. 20001 to 30000, 19.3 % trainees earning between Rs. 30001 to 40000, 10.7 % trainees earning between Rs. 40001 to 50000 and 6.7 % trainees earning between Rs. 50001 to 60000. Backyard poultry program is found to economically viable and technically feasible to be handled at village level, the study reveals that on an average there was 127.7 % increase in income. Among the trainees of Food Processing Training conducted during 2011-2013, 38.5 % were self employed and 3.8 % were employed in local companies. In gardening training it was found that almost 58.55 % increase in the knowledge and work efficiency of the rural community and the average income of the trainee was increased by 2.55 times due to real practical experience given at KVK.

Bar *et al.* (2014) conducted a study to evaluate the impact of KVK training programmes designed for the development of farming communities with emphasis on weaker sections. The results revealed that satisfactory developments have been made on technological adoption, social and environmental aspects. Much improvement has not been observed on economical, infrastructural, material possession and farm activities. They suggested that KVKs have to strengthen training programmes on vocational and income generating activities, use of farm implements, diversified farming,

conservation of soil and moisture along with access to credit for increase in production, productivity and regular income for the development of tribal farmers.

Sharma *et al.* (2014) carried out a study to examine the overall impact of training programmes conducted by KVK, Kapurthala in the field of dairy husbandry to investigate the changes in dairy management practices adopted by them, and to probe the economic benefits gained by them. It was found that the average herd size with dairy farmers increased from 7.68 to 9.21 after the training. There was adoption of demonstrated technologies among the dairy farmers. Because of improved management at dairy farms, besides gain in knowledge the average milk production increased from 6.76 litres to 6.93 litres per animal per day (2.51 %). The increased milk production resulted in increase in income from Rs. 10,982 to Rs. 13,590 per animal per year. The average reduction in cost of management of disease per animal per year was approximately Rs. 708.22. Increase in net profit per animal per year was Rs.2607.82. It can, therefore, be inferred that dairy training programmes carried out by KVK Kapurthala were instrumental in increasing the productivity and profitability of dairy enterprise and in enhancing the socio-economic status of dairy farmers.

Veeranjaneyulu *et al.* (2014) evaluated the impact of apparel making and embroidery training given by KVK, Kampasagar and found that every trainee has become an earner of supplementary income. The beneficiaries got hands on experience during the training programme, some of them started individual units in their respective villages earning a minimum amount of Rs. 4500 per month and others got employment in the nearby apparel company getting a minimum salary of Rs. 6000 per month which has given a boost to livelihoods of rural women.

Arora (2015) conducted a study to ascertain the impact of vocational training programme on mushroom cultivation for self employment for the establishment of mushroom units and adoption (%) rate of the mushroom

farming among the trainees who acquired trainings from the Krishi Vigyan Kendra (Tepla) Ambala, Haryana during 2010-2013. The numbers of mushroom units established were also increased progressively from 6 to 22. The adoption rates were increased from 9.83 per cent to 42.30 per cent.

Prasad and Kushwaha (2015) studied the impact of training programmes organised by KVK's on socio-economic status of farm women at Krishi Vigyan Kendra, Dileepnagar, Ramabainagar. The significant impact was observed in age group, caste group, education level, type of family, size of family, type of houses, occupation, size land holdings, farm power, material possession, mass media exposure and social participation. Thus, it indicates that kvk impart need based and skill oriented vocational training which is helpful for the development of beneficiaries. The total beneficiaries have better and improved level of socio-economic status than non-beneficiaries farmers.

Singh *et al.* (2016) carried out a study in the operational area of KVK, Kandhamal on the impact of vocational training programme on income and employment generation towards the farmers. Most of the respondents belonged to medium socio-economic status. The majority of the respondents were from low number of vocational training attended. The maximum respondents had medium economic motivation, medium market orientation, medium risk preferences. The majority of the respondents belonged to low category of income and employment generation. Significant association between socio-economic status, number of vocational training attended, market orientation, risk preference with income and employment generation. Majority of the respondents felt that marketing facilities may be created at village level for sell out their product, provide proper guidance after training, loan procedure should be easy and less time consuming.

Panwar *et al.* (2017) studied the impact of vocational training programme conducted by KVK for rural women in Khandwa block of Khandwa district of Madhya Pradesh and found that training programme might be attributed by incremental advancement of skill orientation resultant income generating activities. Rural women change towards increasing trend in high level of employment skill and income generation before training to after.

Human Capital is an essential determinant of economic growth. It comprise of different factors like education, health, migration, vocational training, IT development. Vocational training and skill development is among one of them. Vocation training improves the productivity and enhances the efficiency of the labour for better participation in economic development. The efforts put by KVK staff in conducting training programmes helped in capacity building of rural community by creating awareness, increasing the knowledge about innovative technologies and practicing improved skills which will help in their empowerment.

2.4. STUDIES ON THE ECONOMIC BENEFITS FROM THE ADOPTION OF IMPROVED TECHNOLOGIES

Shah (2001) assessed the nature and extent of impact of quality seeds on the productivity of pulses and oil seeds in two districts of Rajasthan, India. Three oilseed crops namely groundnut, soybean and sunflower and five pulse crops, arhar, gram, lentil, urad and moong were chosen. The result indicated that under irrigated conditions, certified seeds were highly effective in generating higher crop yield.

Kumar *et al.* (2002) studied the effects of nitrogen rates, seed rates and sowing methods on the economics of wheat in a field experiment conducted in Hissar, Haryana during 1997-99. They found that grain and straw yields, cost of cultivation, gross and net returns increased with increasing seed and nitrogen rates under both sowing methods. Average net returns were higher under the bed sowing system compared to the conventional sowing system. Benefit cost ratio was highest with 100 kg ha⁻¹ seed rate and 150 kg nitrogen per hectare under both systems of sowing.

Chengappa *et al.* (2003) studied profitability of hybrid rice cultivation in Mandya and Mysore districts of Karnataka. The results of the study indicated that the average yield of hybrid rice was 8.41 t ha⁻¹ while that of inbred rice was 7.42 t ha⁻¹. Thus it emerges that the yield realized by hybrid rice growers was higher by 13.34 per cent compared to inbred (HYV) rice growers in Karnataka.

Nasurudeen *et al.* (2004) conducted study in Karaikal region of the Union territory of Pondicherry and revealed that the cost of production of rice in direct sown method was less than the transplanted method. On account of reduced cost of cultivation the yield level in direct sown method was also low compared to transplanting method. Nevertheless farmers could realize that direct seeding was more efficient method of rice cultivation in terms of net gain.

Rane *et al.* (2004) evaluated the impact of Institution Village Linkage Programme (IVLP) on crop production in terms of increase in area under different crops and their productivity. It has been found that average yield of rice crop increased by 46.80 %, mango by 154.70 % and cashew by 20.50 %. Productivity of vegetable crops was also increased concluding that IVLP has a positive impact on crop productivity.

Raveendran *et al.* (2004) investigated the impact of new technologies in cotton cultivation like new varieties, seed treatment with bio-inputs, planting of inter crops, integrated pest management and DAP foliar spray, etc. It has been found that all these technologies were adopted by the farmers. Overall impact has been noticed encouraging and net net profit has increased from Rs. 6475 to Rs. 13,315 per hectare.

Singh *et al.* (2004) studied the impact of modern rice technologies on growth in area, production and productivity of the rice in Bihar, covering three time periods viz. 1981-82 to 1990-91, 1991-92 to 2000-01 and 1981-82 to 2000-01. The overall annual compound growth rate in the area, production and productivity of rice was found to be 0.02, 2.89 and 2.87 per cent, respectively during the period 1981-82 to 2000-01. The study also revealed that adoption of modern technologies had a positive impact on rice productivity and income to the farming households in Bihar.

Sinha and Gupta (2004) assessed the impact of new agricultural technology disseminated by Krishi Vigyan Kendra (KVK) on crop productivity and input use pattern in Bihar. They found that farmers of the adopted villages are getting more income per hectare than the non-adopted villages which was due to adoption of new farm technology. The study has advocated establishment of more KVKs and strengthening of the existing ones.

Thakur and Khadka (2004) conducted a study with the objective to explore the existing cropping practices of wheat and mustard production and to establish a benchmark for further impact evaluation. The total area of the surveyed households was 79.96 ha with an average farm size of 0.91, 1.02 and 0.60 ha for Surkhet, Salyan and Doti districts, respectively. Recommendation was made to identify the technology on mixed cropping of wheat and mustard for appropriate time of planting to maximize productivity of wheat and mustard crops without disturbing the existing practices adopted by the farmers.

Thakare and Nagpure (2004) assessed the impact of agricultural technology on cotton production in the Yavatmal district of Maharashtra. The total yield of 13.5 q with gross return of Rs. 25,990 was recorded by the beneficiary farmers while the corresponding figures for non-beneficiary farmers were 8.9 q and Rs. 17,130. The net returns have been found out to be Rs. 15,540 for the beneficiary and Rs. 5,850 for the non-beneficiary farmers, showing a clear impact of technology on production of cotton.

Pouchepparadjou *et al.* (2005) studied IPM technology adoption in irrigated rice in Pondicherry Union Territory and reported that the adopter farmers can boost output through the use of best practice technologies of IPM. Output decomposition analysis was used to assess the impact of IPM on rice production. The average output among the IPM adopter farms was higher than the non-adopter farms. It was 1583.81 kg per acre in IPM farm and 1313.76 kg per acre in non-adopter farms. Contributions of input and technology to the output difference revealed that a change due to neutral technology was -468.48% and that due to non-neutral technology was 521.22 % and the net change attributed to technology accounted for 52.74 %.

Goswami and Chatterjee (2006) estimated the trend of determinants of agricultural productivity along with their impact and found that fertilizer consumption had shown a rising trend and area under high yielding varieties had illustrated an increasing trend at a decreasing rate. Impact of technological variables such as fertilizer consumption and area under HYVs had been found positively significant.

Nyaudoh (2010) conducted a study at Epemakinde, a rainforest area of southwestern Nigeria to assess the effects of different tillage practices viz: conventional (CT), minimum (MT), traditional (TT) and zero (ZT) on the yields, cost of production and economic returns to management of maize (*Zea mays*), cassava (*Manihot esculenta*) intercrop. Average of maize across the three years indicated that TT (3.15 t/ha) significantly out yielded both CT and ZT by 16 %. Cassava fresh root yield differed significantly with TT (44.72 t ha⁻¹) producing higher than other tillage practices by 2-24 % while MT (40.60 t ha⁻¹) yielded higher than others by 3-19 %. The CT and MT treatments had the highest cost of production and economic returns and superseded ZT by 21 % and 8 %, respectively. This study has demonstrated the necessity of some level of tillage with MT treatment being the most desirable.

Tekwa *et al.* (2010) examined the effectiveness of technology adoption on sugarcane farmers' income in four locations of Mubi area in Nigeria. Only few conservative farmers (5 %) were noticed after adoption of the modern technologies. Impressive size of farmer population experienced drastic rise in farm output and farmer income from sales of their sugarcane produce after the adoption process.

Rudrapur *et al.* (2015) conducted a study in the Malaprabha command area to evaluate the impact of scientific irrigation methods implemented by the RKVY project. The required data were collected from the 35 farmers each practicing border strip method of irrigation (scientific) and flood method of irrigation (traditional) in the cultivation of wheat, and the data was analysed using the output decomposition model developed by Bisaliah (1977). The results revealed that the adopters of scientific irrigation technology produced 29.39 % higher income from border strip method of irrigation than flood irrigation. The increase in the income was further decomposed into different sources of change such as adoption of scientific irrigation technology and changed input levels. The scientific irrigation technology alone could contribute 31.74 % increase in income, while the contribution of change in input levels was found to be negative (-2.35 %). Amongst the various inputs, seed (-0.18 %), fertiliser (-1.36 %) and cost of irrigation (-3.07 %) contributed negatively whereas human labour (1.38 %), bullock and machine labour (0.76 %) and FYM (0.11 %) contributed positively to the income.

Sahu and Das (2015) assessed the causal effect of adoption of agricultural related technologies on consumption expenditure and poverty measured by different indices. The analysis reveals robust, positive and significant impacts of agricultural related technologies adoption on per capita consumption expenditure and on poverty reduction for the sample households in rural India.

Visalakshi and Sireesha (2015) carried out field experiments during rabi season of 2007-08, 2008-09 and 2009-10 to study the influence of tillage operations on crop establishment and productivity of maize in rice fallows of Vizianagaram district. Higher maize yield was recorded in maize under ridge sowing (76.49 q ha⁻¹) and zero tillage sowing (75.35 q ha⁻¹). The cost of maize cultivation was high in ridge sowing (Rs. 26,333/ha) and low in zero tillage sowing (Rs. 23,000/ha). The comparative economics of maize sowing methods indicated the net income of Rs. 58,337/ ha with zero tillage sowing, net income of Rs. 49,325/ ha with ridge sowing, net income of Rs. 48,752/ha with conventional line sowing and net income of Rs.45,840/ ha with broadcast sowing clearly shown that the zero tillage is economically profitable method of maize cultivation.

Clarke *et al.* (2017) investigated the multi-dimensional impacts of adopting new technology in agriculture at the farm/village and watershed scale in sub-Saharan Africa. Results show significant improvements in family income and nutrition, achieved through the adoption of irrigation technologies, proper use of fertilizer, and improved seed varieties while preserving environmental indicators in terms of soil erosion and sediment loadings. These pilot studies demonstrate the usefulness of adopting new agricultural technologies that aim to improve the livelihoods of subsistence farmers.

2.5 STUDIES ON INCOME DISTRIBUTION

Marciano *et al.* (2001) explored the issue of changes in the structure of rural household income and its distribution. The study used a Gini decomposition analysis to assess changes in the magnitude of income inequality. An important finding is that rice accounts for a small and declining fraction of

the total household income, and that rice income is relatively less unequally distributed than income from nonfarm sources. The inequality in the distribution of education and landholdings is a more important factor behind growing income inequality than the diffusion of modern rice technologies.

Singh *et al.* (2002) examined the income distribution among potato farmers in Agra district of Uttar Pradesh by employing Lorenz curve and Gini concentration ratio. The study revealed a positive value of intercept for Lorenz curve estimated for the distribution of income from potato crop, on-farm income and total farm income. The magnitude of disparities in the income distribution as reflected by GCR was obtained as 0.2839 in the case of total farm income while it was 0.3277 and 0.3951 in the case of on-farm income and income from potato crop respectively.

Chauhan and Kundu (2005) conducted a study in Haryana State covering 3 districts where Intensive Cattle Development Projects were functioning. Lorenz curve and Gini-concentration ratios revealed that the distribution of income in case of the beneficiary households was more equal, because the small herd size farmers of the beneficiary households were able to produce milk relatively at lesser cost than that of medium and large herd size farmers. The new technology had exerted a favourable impact on several economic aspects, hence it might be suggested that the ICDP should extend its area and cover to non-beneficiary households by providing the new technology so that their socioeconomic status could also improve.

Sudha *et al.* (2006) assessed the economic impact of commercial seed production (CSP) in vegetables like tomato and okra in Haveri and Gadag districts of Karnataka. The results indicated that the activity provides stability, equity in income distribution across the group and helps enhance family welfare. Undertaken mainly during the kharif season on a plot of around 0.43 ha, the farmers incur an expenditure of around Rs 49,780/ha for tomato and Rs 38,555/ha for okra. With a seed yield of 0.493 and 5.66 quintals of tomato and okra, respectively, the farmers could realize a net return of Rs 88,338/ha from tomato and Rs 39,440/ha from okra. Measured in terms of Gini's coefficient of income equality, the CSP of tomato and okra with a value of 0.22 and 0.24 has proved to improve income distribution across the group.

Naeem (2008) conducted a study in district Swat during 2007 to assess the degree of inequalities existing among rural rice farmers' income and land holdings. The results obtained from Lorenz square box and Gini-coefficient indicated higher degree of inequality existing among farmers' income and size of land holdings. Based on the findings of the study, appropriate land reforms' structure should be introduced. Government should give incentives to poor farmers for increasing their income which will reduce these inequalities.

Ramegowda *et al.* (2008) analysed inequalities in income distribution among the beneficiaries of several programs and schemes to uplift socio-economic status of the fishermen of Coastal Karnataka. Inequalities in income distribution were analyzed using Lorenz curve and gini ratios. Income was distributed more evenly as compared to assets in the three coastal districts. Income distribution was more even in Mangalore district, as compared to Udupi and Karwar districts. Income distribution was highly uneven in Karwar district.

Manonmani *et al.* (2010) studied the income and employment patterns of hybrid rice seed production in Coimbatore. The average seed yield obtained was 500 kg per acre. A net profit of Rs. 20,000 to Rs. 40,000 per acre was obtained within a period of four months. Apart from this, it generates an employment opportunity to rural women. Hence, it was concluded that hybrid rice seed production provides employment and income through which the farm women are empowered.

Roy (2013) analysed the land relations in prawn farming in West Bengal. The analysis of the structure of ownership holdings showed that there was inequality in the distribution of land in Tentultala. The Gini coefficient of distribution of ownership holdings was 0.66. Fish farming had led to concentration of land among the big farmers of fish in Tentultala. These households had almost 70 per cent of total operated area in Tentultala. The Gini coefficient of distribution of operational holdings was 0.93. The development of a land lease market had enhanced livelihood security of small land owners and bargadars. Thus, unlike many other areas in India, prawn farming had led to improvement in livelihood security for a section of poor people that had ownership and cultivating rights over land.

Chakravorty *et al.* (2016) studied the income generation and inequality in India's agricultural sector. They analysed the National Sample Surveys of agriculture in 2003 and 2013 using descriptive, decomposition, and modelling tools, and estimate income inequality in the agricultural sector at the scale of the nation and its 17 largest states. The results shown that income inequality in India's agricultural sector is very high (Gini Coefficient of around 0.6 during the period), about half of the income inequality is explained by the household-level variance in income from cultivation, which in turn is primarily dependent on variance in landownership and there are significant state-level differences in the structures/patterns of income generation from agriculture.

2.6. STUDIES ON THE FACTORS CONTRIBUTING TO THE ADOPTION OF IMPROVED TECHNOLOGIES BY THE FARMERS.

Rao and Rao (1993) conducted a study to find out the extent of adoption of rice production technology by the tribal farmers in high altitudes of Andhra Pradesh. Results revealed that majority of the respondents adopted the rice production technology to the medium extent. Relational analysis had shown that the extent of adoption was found to be positively and significantly associated with age, farming experience, training received, socio-economic status, cropping intensity, aspiration, economic motivation, innovativeness, utilization and credibility of information source.

Atibudhi and Sahoo (2000) conducted a study in Sambalpur district of Orissa and it was found that the level of adoption of technology leading to high productivity was high in farmer with 5-10 years of formal education and more than 10 years of formal education than the illiterate farm operators.

Kotu *et al.* (2000) assessed technical and socio-economic factors affecting the adoption of wheat technologies. Adopters of improved varieties were young, more educated, had larger families and farms, hired more labour and owned more livestock. The study revealed that access to credit is an important factor in a farmer's decision to adopt improved wheat technologies (variety and

fertilizer). This finding highlights the importance of developing labour saving wheat production technologies to offset the cost of hired labour and expand the adoption of nitrogen fertilizer.

Malik (2000) conducted a survey in Uttar Pradesh, India, during 1994-95 to study the extent of improved sugarcane technology adoption among 150 respondents (low adopter: 0-30 per cent adoption of improved technology (IT); medium adopter: 31-60 % adoption of IT; and high adopter: above 60 % adoption of IT) which were selected (75 each) from reserve (10 km around the sugar factory) and free (more than 10 km from a sugar factory) areas. The difference between actual adoption and recommended technology was also studied. Protective irrigation was used by 45 % of the farmers, but 55 % were still partial adopters. Only 10 and 4 % of farmers (reserve and free areas, respectively) adopted recommended plant protection measures. Ploughing and seed rate were actually adopted at desirable level among all the categories. Farmers applied more than the recommended quantity of nitrogen fertilizers in all the categories. The adoption of plant protection was 82 % in the free area and 73 % in the reserve area.

Mittal and Kumar (2000) attempted to build a simultaneous equation model to assess the impact of rural education on technology adoption, labour employment, use of inputs and yields on rice and wheat crops in India. The study found that literacy has a positive and significant relationship with crop productivity and farm modernization. Literacy emerged as an important factor determining the adoption of technology.

Kamruzzaman *et al.* (2001) examined the extent of adoption of modern technology. It was found that 100 per cent of wheat acreage in the country was planted using modern varieties of seed. Wheat area, production and yield in the country increased by 10 %, 14 % and 3.5 % per annum during 1971-92. The overall data showed a significant difference between the practices recommended and existing technological knowledge of the farmers for different production practices.

Chi and Yamada (2002) found that technology adoption by the farmers was influenced by technical training, meeting, oral transmission, trust on technician and belief level on technology. Factors that trigger adoption of new technologies comprise of progressive, young and educated male farmers.

Vir and Joshi (2003) conducted a study in Muzaffarnagar district of Uttar Pradesh. It was found that majority of respondents fell in the low and medium levels of technology adoption. Maximum gap in sugarcane production technology was found in case of fertilizer application followed by plant protection, seed rate and seed treatment, method of sowing, time of sowing, irrigation, weed control and high yielding varieties.

Mankar *et al.* (2004) conducted a study on the adoption of rice cultivation technology by the scheduled caste farmers in Ratnagiri district of Maharashtra. They found that more than three-fourth of farmers had a medium level of adoption, while only 12.66 % had a high level of adoption. Education, family size, major occupation, social participation, cosmopolitanism, extension contact, mass media exposure and annual income were found to be positively related with the extent of adoption.

Anupama *et al.* (2005) estimated the technical efficiency in maize production in Madhya Pradesh and found that on an average the sample farms operate 23 % below the frontier output levels. Hence, it has been observed that the maize output can be increased through adoption of proper technology by the farmers. It was observed that 97 % of the farmers fell under the category of low adoption and only 3 % belonged to the medium adoption category. The prevalence of small and marginal farmers with poor resource-base may be mainly attributed for such a low level of adoption, whereby the farmers were unable to purchase the required quantity of fertilizers. It was observed that the improved cultivars were able to increase the crop yield and reduce the cost of production significantly.

Matuschke and Qaim (2006) analyzed the adoption and impact of hybrid wheat in India. Based on survey data they showed that farmers can benefit significantly from the proprietary technology. Neither farm size nor the subsistence level influenced the adoption decision, but access to information and credit mattered.

Moser and Barrett (2006) studied the dynamics of technology adoption by the small land holders, with particular reference to a high-yielding, low external input rice production method in Madagascar. They presented a simple model of technology adoption by farm households in an environment of incomplete financial and land markets. They found that seasonal liquidity constraints discourage technology adoption by poorer farmers. Learning effects, both from extension agents and from other farmers, exert significant influence over technology adoption decisions.

Rath *et al.* (2006) analyzed the adoption behaviour of upland rice growers and their different socio economic characteristics related to their adoption level. Fourteen technologies for the upland rice cultivation were selected for the study. The findings of the study revealed that majority of the rice growers exhibited medium level of adoption and 25 % of the farmers adopted rice-pigeon pea mixed cropping. The big farmers were found to adopt more technologies as compared to small farmers, on account of more urban contact, extension agencies contact, mass media exposure, risk performance and knowledge on upland rice cultivation technologies.

Hossain (2007) studied the level of modern technology adoption in rice crop in Bardhaman district of West Bengal. It was found that technology adoption was positively correlated with size of land holding. In Rabi season the technology adoption index was highest on medium farms (77.26) followed by small (58.13) and marginal farms (53.13). Overall, 62 % farmers were higher technology adopters in Rabi season whereas, 58 % farmers were higher technology adopters in Kharif season. The study further revealed that the marginal farmers were lagging in adoption of new farm technology compared to other categories. Overall technology adoption index was 77.69 % for medium, 56.4 % for small and 53.5 % for marginal farmers and it was 60.40 % at aggregate level.

Truong (2008) analyzed main factors affecting farmers' adoption of technologies in Mekong delta. He found that the farmers' perception about technologies, knowledge level of extension staff, methods of organization and management of extension programs and local conditions were the main factors

affecting the adoption of technologies. Low education, low perception, lack of capital, small land, poor infrastructure and limited capacity of extension staff led to low technology adoption. He further observed that extension program for farmers in remote areas and information transmitted orally among trained farmers was not enough to increase the adoption of farm technologies.

Devi and Pannarasi (2009) observed that farm size, income of the farmer, number of earners in the family and number of contacts with extension agencies had positive and high influence on the technology adoption behaviour of the farmers. Lack of skilled labour, awareness, training on new farm technology and experience had been opined as the main problems in adoption of SRI (System of Rice Intensification) technology by the farmers.

Jain *et al.* (2009) explained that the variation in agricultural productivity in different states in India is mainly due to large differences in the level of adoption of selected agricultural technologies and the underlying determinants of adoption of these technologies. The relation between adoption index and status of the infrastructure in the corresponding state has been examined. The strong correlation between adoption index and composite index of infrastructure and development has emphasized the need for improving infrastructure to increase adoption of improved agricultural technologies, which would increase the value of per hectare crop productivity. The functional analysis has revealed that infrastructure like electricity, irrigation, credit and extension organizations positively influence the adoption of improved technologies.

Peiris *et al.* (2009) conducted a study in rain fed sector of Sevenagala. The objectives of this study were (i) to develop the Recommended Technology Adoption Index (RTAI), and (ii) to determine the relationship between socio-economic characteristics of the farmers which affect the technology adoption level of Sugarcane. The average technology adoption index in the study area was found to be 0.72 and the correlation coefficient between this index and yield was 0.623. Multiple Linear Regression technique was used to determine the relationship between RTAI and socio-economic characteristics. The result

showed that monthly income, education, being a member of social association and farmers' visit of extension office have a significant impact on recommended technology adoption.

Singh and Chahal (2009) examined the extent of adoption of various recommended technologies and return from wheat crop in Punjab for the years 2006-09. The result revealed that the area under recommended varieties of wheat had decreased from 95.25 % in 2006-07 to 90.63 % in 2008-09. They observed that the majority of the sample farmers had sown wheat at recommended time by using recommended quantity of seed. Though, the proportion of farmers who treat the seed before sowing had increased from 27.81 % in 2006-07 to 39 % in 2008-09, still majority of the farmers do not follow this technology. Despite various shortcomings it had been found that about 31.82 %, 25.37 % and 29.14 % of the sample farmers had sown the crop through broadcasting method during 2006-07, 2007-08 and 2008-09, respectively. The study had concluded that nitrogen was applied at more than recommended level, whereas phosphorus was used at recommended level. As far as use of potash is concerned, farmers in Punjab rarely applied potash for wheat crop.

Kumbhare and Singh (2011) carried out a study to determine the farmers' adoption behavior on wheat and rice production technologies in Samastipur, Darbhanga and Muzaffarpur districts during 2002-03 to 2004-05. Findings of the study revealed that 53.75 % respondents had adopted the wheat production technology at higher level whereas 31.25 % and 15 % respondents had adopted the wheat production technology at medium and low level respectively. Also in rice, 60 % respondents had adopted the production technology at higher level whereas 21.25 % and 18.75 % respondents had adopted the rice production technology at medium and low level respectively. The major technical, resource and market related constraints perceived by farmers in wheat and rice production were non-availability of quality seeds of wheat, non-availability of rubber milling facility in their locality for rice processing, breakage of grain during milling or processing, lack of transportation and marketing facilities.

Rama Rao (2011) assessed the yield gaps and sustainability of SRI (system of rice intensification) and traditional methods of rice cultivation in North Coastal Zone of Andhra Pradesh for the period 2008-09 and found that there is a 31 per cent yield gap between SRI and traditional methods, in which cultural practices (20.15 %) have shown a stronger effect than input use (10.85 %).

Sarungbam and Prasad (2011) conducted a study in Manipur and identified that availing of institutional credit and educational level are among the important factors which decrease monocropping using logit model for analysis. The study also observed that strengthening of co-operative societies, increasing availability and accessibility to credit facilities, increasing awareness about new technologies, etc. will help in increasing the cropping intensity, thereby using the available rich resources to the optimum level in the state.

Sharma *et al.* (2011) conducted a study through National Research Centre on Rapeseed-Mustard (NRCRM) in Bharatpur district of Rajasthan. Significant difference was observed between beneficiaries and non-beneficiaries farmers in adoption of fertilizer management followed by seed treatment, use of high yielding varieties, seed rate and spacing, pest management, harvesting or threshing and storage and soil treatment. The study also reported that most of the beneficiary respondents had their attitude in positive direction towards FLDs.

Rahman and Haque (2013) conducted a study in two major wheat growing areas of Bangladesh to determine the adoption level and factors affecting the adoption of wheat production practices in the study areas during 2011. The results revealed that most of the farmers (60.91 %) in the study areas were cultivating Shatabdi variety of wheat. Adoption level of seed rate, triple super phosphate (TSP) and muriate of potash (MoP) application were found to be very low. On the other hand, production practices like time of wheat sowing and number of irrigations were highly adopted by the farmers. Most of the farmers (69.09 %) applied TSP below the recommended dose while 81.82 % of the farmers applied MoP over the recommended dose. The study also revealed a

positive and significant relationship between adoption and the variables like education, experience and extension contact. Lack of proper information and technical knowledge were the major problems that hindered the adoption of wheat production technologies in the study areas.

Wani *et al.* (2013) estimated the extent of adoption of an improved rice seed technology in the Kashmir valley and has studied its impact on the economic and the livelihood security of adopters of this technology. The determinants inducing farmers towards adoption of new technology have been identified and technological gaps in its adoption have been estimated. The study has revealed, based on data collected for the agricultural year 2010-11 that by adoption of improved technology, both gross returns and net returns have increased considerably, while the cost of production has decreased. The study has clearly brought out that adoption of new technology has provided better economic and livelihood security at the household level in the study area. The age, education and land size have been identified as the major determinants of technology adoption.

Daniel and Maseko (2015) assessed factors that influenced adoption and continued use of conservation agriculture in the Lowveld agro ecological region of Swaziland. Results from 200 farming households practicing conservation agriculture indicated farmer characteristics such as age, gender, levels of education, extension and wealth influence adoption of Conservation agriculture. The linear regression model results show that if the household head had some form of education, there were three times more likely to adopt conservation agriculture than a household head without any form of education. As the number of people contributing to agricultural labour increased households there was a 165 % chance that these households were more likely to adopt conservation agriculture. Knowing factors that influence adoption will allow development of strategies, policies and plans that take advantage of the main influences of adoption so as to increase adoption and sustainability of use of Conservation agriculture.

Khondoker *et al.* (2015) examined the importance of socio-economic factors and infrastructure in the farmers' adoption rates of hybrid rice in Bangladesh. A comparative analysis has been made on the adoption of hybrid and modern varieties relative to traditional rice varieties and land allocation to these varieties. Econometric results indicate that general land characteristics, loan facilities and general infrastructure, such as roads, irrigation facilities and the availability of government approved seed dealers, significantly influence the adoption of hybrid and modern rice varieties and land allocation to these varieties compared with traditional varieties.

Arthi *et al.* (2016) examined the profitability, sources of productivity improvement and determinants of a new technology - Sustainable Sugarcane Initiative (SSI) adoption in sugarcane cultivation in Tamil Nadu by collecting primary data from 120 sugarcane farms during 2014-15. The cost and return analysis has indicated that sugarcane cultivation is more profitable under SSI method than under the conventional method. The decomposition analysis has shown that the inputs, viz. fertilizers, micro-nutrients and deployment of labour are the major sources of productivity enhancement in the SSI method. It was also found that farmers' educational level and experience are the major determinants for adoption of SSI method in sugarcane cultivation. The major policy options suggested improving production and profitability of sugarcane includes provision of drip irrigation with subsidy, ensuring timely availability of critical inputs and imparting periodical trainings to farmers on SSI method such as fertigation, wide row spacing, etc.

Chen and Xu (2016) made an empirical analysis on influencing factors of the farmer's adoption behaviour for new maize variety by using the binary logistic model. The results showed that farmer's educational level, main source of household income, maize planting area, farmer's awareness of new variety, farmer's risk attitude as well as contract with agricultural inspector had significant positive effect on adoption of new maize variety.

Samson *et al.* (2016) examined the adoption of drought tolerant maize varieties under rainfall stress in Malawi. Drought tolerant maize is a promising technology that has the capacity to help smallholder farmers adapt to drought

risks. Using 2009, 2012 and 2015 data from six districts, results show adoption has increased from 46 % in 2009 to 59 % in 2015. The likelihood of adoption is significantly increased by drought with early droughts having greater impact (31 %) than late droughts (20 %). Early droughts are also associated with an increased acreage of land allocated to drought tolerant maize and quantity of seed planted. However lagged drought variables appear to negatively affect adoption. This was because of the years preceding the surveys were associated with good rains such that farmers responded by buying less of drought tolerant maize anticipating similar rainfall pattern. Another important driver of adoption is the farm input subsidy programme. However, while access to subsidised seed increases both adoption and intensity of adoption, previous year's access has a negative impact. This suggests that the increased adoption is due to availability of cheap seed as opposed to farmers' previous exposure to the varieties. This may indicate limited awareness on the benefits of drought tolerant maize varieties. This is also consistent with extension visits positively affecting adoption. Good extension messages and promotion of drought tolerant maize varieties should be improved to allow farmers make informed decisions.

Tsinigo *et al.* (2016) conducted a study in Ejura-Sekyedumase Municipality of the Ashanti Region and the Atebubu-Amantin municipality in the Brong-Ahafo region to investigate the technological change in rice production in the two municipalities in Ghana using the output decomposition analysis approach. The Cobb-Douglas production and a modified decomposition analysis techniques were used to decompose the sources of productivity differences between the improved rice variety and the unimproved rice variety. The study found that seed, fertiliser and herbicide had a significant influence on the yield of the improved and unimproved rice varieties. The decomposition analysis showed that the estimated productivity differences between the improved and unimproved rice varieties were 39.46 per cent. Productivity differences between the improved and unimproved rice varieties were mainly due to non-neutral technical change, which accounted for 44.65 per cent. The

study concludes that technological change in rice production in the two municipalities was mainly of the non-neutral type. Designing appropriate extension strategies and capacity building for the rice farmers could lead to improvement in their productivity.

Zachary *et al.* (2016) assessed household food insecurity prevalence and the results indicated that food security increased with hybrid maize adoption, maize sales, wealth, education, access to financial services and irrigation water but declined with household size. Hybrid maize adoption reduced the risk of being moderately and severely food insecure by 5 % and 13 % respectively. Results also suggested the need for policies that enhance hybrid seed adoption, surplus production, education, improve welfare and promote family planning.

Chapter V

SUMMARY AND CONCLUSIONS

A brief review of the findings of the study along with the salient features is presented in this chapter. Based on the empirical findings, conclusions are drawn and policy options are suggested.

Agriculture with its allied sectors is the largest livelihood provider in India, more so in the vast rural areas. The agriculture sector employs half of the workforce (54.6 %) and contributes to 17.5 % of the GDP (at current prices in 2015-16). We need to make farming in different resource environments sustainable and profitable in order to bring in financial and livelihood security for rural households. India's production of food grains has been increasing every year, and India is among the top producers of several crops such as wheat, rice, pulses, sugarcane and cotton. However, the agricultural yield is found to be lower in the case of most crops, as compared to other top producing countries such as China, Brazil and the United States (Food and Agriculture Organization of the United Nations). The country's requirement for food grains in order to provide for its population is projected to be 300 million tonnes by 2025. This implies that the crop output needs to grow at an annual average of 2 %, which is close to the current growth trend. Agricultural innovations and diffusion of new technologies are important factors in developing countries' quests for food and nutritional security.

To address the above in agriculture, Indian Council of Agricultural Research (ICAR) has established Krishi Vigyan Kendras (KVK) for the cause of farming community in the country. The first KVK was established in 1974 at Puducherry. The number of KVKs has risen to 680 and new KVKs are to be established in the newly created districts and some larger districts. The present study attempts to evaluate the impact of Krishi Vigyan Kendras on the productivity enhancement and increase in income levels of farmers by technology dissemination on improved cultivation practices and vocational training programmes in Andhra Pradesh.

5.1 OBJECTIVES

1. To study the impact of Krishi Vigyan Kendras in productivity enhancement by bridging the yield gaps.
2. To evaluate the impact of vocational training programmes conducted by Krishi Vigyan Kendras in the study area.
3. To assess the economic benefits from the adoption of improved technologies.
4. To assess the factors contributing to the adoption of improved technologies by the farmers.

5.2 METHODOLOGY

Multistage sampling technique was used for the selection of sample. The state of Andhra Pradesh was purposively selected for the study. Three KVKs, one KVK from SAUs (KVK-Amadalavalasa, Srikakulam district), one from ICAR (KVK-Kalavacharla, East Godavari district) and one from NGOs (KVK-Yagantipalli, Kurnool district) were selected for the study which have completed minimum five years of functioning. From each category of KVK 170 respondents were selected making the total sample size to 510.

i) Selection of farmers: From each KVK 60 are beneficiary and 60 are non-beneficiary farmers were selected randomly making a sample of 120 farmers from each KVK.

ii) Selection of vocational trainees: From each KVK 50 vocational trainees were selected by random sampling method.

The secondary data was collected from KVKs, Agricultural Technology Application Research Institute (ATARI, Zone-X, Hyderabad), Research stations, Agriculture Offices, Statistical departments publications, websites, etc. Primary data was collected by personal interview of sample respondents through pre tested schedules.

Tabular analysis involving the computation of means, percentages etc. was employed to present the data regarding the socio economic profile of sample respondents like family size, age-wise distribution, educational status and impact of vocational training programmes. The impact of frontline demonstrations was studied through yield gap analysis and indices of yield gap. In order to analyze the factors affecting productivity Cobb-Douglas type of production function was computed. Bisalialah's (1977) output decomposition analysis was also carried out to study the difference between the improved technology/ variety and the farmers practice/ traditional variety. The technological adoption index was used to estimate the rate of technology adoption of the beneficiary farmers. The technology adoption practices include area under high-yielding varieties (HYVs) or improved technologies, appropriateness of irrigation level and dosages of fertilizers. The determinants of technology adoption index (TAI) were examined by employing regression function. Lorenz curve and Gini coefficient were estimated to study the distribution pattern of income of beneficiaries and non-beneficiaries of improved technology provided by the KVKs.

5.3 PROFILE OF THE SAMPLE FARMERS

The mean age of the total beneficiary farmers was 45.30 years. Out of the total beneficiary farmers 24.44 per cent were young, 47.22 per cent were middle aged and 28.34 per cent were old. Among all the KVKs, beneficiaries had the highest proportion of farmers in the middle aged category of age between 35 to 50 years while the non-beneficiaries belonged to old age category of age above 50 years. The mean age of the non-beneficiary farmers was more than beneficiary farmers. Among all the KVKs, highest percentage of beneficiaries had secondary level of education which was found to be 33.33 % in KVK-Amadalavalasa, 41.67% in KVK-Yagantipalli and 38.33% in KVK-Kalavacharla. College level education was highest in beneficiary farmers (20 %) compared to non-beneficiary farmers (8.33 %) and was highest among the beneficiaries of KVK-Amadalavalasa (25 %). The percentage of the beneficiary and non-beneficiary farmers who were illiterate was estimated to be 32.67 and 67.33 per cent, respectively which implied that illiteracy level was highest in non-beneficiary farmers than beneficiary farmers. Majority of the beneficiary

families (60.56 %) had a family size of 4-6 followed by above 6 (25 %) and 1-3 (14.44 %). KVK wise comparison also showed that beneficiary farmers had the highest number of families having a family size of 4-6, of which 60, 55 and 66.67 per cent farmers belong to beneficiaries of KVK-Amadalavalasa, KVK-Yagantipalli and KVK-Kalavacharla respectively. Most of the non-beneficiary farmers belonged to family size of 1-3 members (40 %) which may be the reason for their non adoption of technology due to the less availability of family labour.

5.4 PROFILE OF THE SAMPLE TRAINEES

The mean age of the sample trainees was found to be 35.03 years. Among the total sample trainees majority were young (54.67 %) below the age of 35 years. Most of trainees had secondary education (40.67 per cent) followed by primary education (22.67 per cent) and the average number of years of education undergone by the sample trainees was 7.52 years. Majority of the trainee families (66 per cent) had a family size of 4-6 followed by 1-3 (23.33 per cent) and above 6 (10.67 per cent). Among the total sample and also in all the KVKs majority of the trainees belonged to family size of 4-6 followed by 1-3 category who are practicing the newly acquired skills to get economic benefits because of employment generation.

5.5 IMPACT OF KRISHI VIGYAN KENDRAS ON CROP YIELDS AND RETURNS

In KVK-Amadalavalasa, on an average the yield increase was 14.82 per cent and increase in net returns were 23.43 per cent in the 117 demonstrations conducted in rice over farmers' practice. Increase in yield (12.80 q ha⁻¹) and per cent increase in net returns (42.94 %) over farmers' practice was also highest in case of mechanized system of rice intensification. The 65 frontline demonstrations of zero tillage maize resulted in yield of 80.83 q ha⁻¹ with 14.01 per cent increase over farmer's practice of 70.9 q ha⁻¹, which was much more than the district average yield of 47.33 q ha⁻¹. Zero tillage maize technology resulted in increased net returns of Rs. 18,106 per hectare over farmers' practice.

KVK-Yagantipalli conducted 359 and 190 frontline demonstrations in rice and redgram respectively. The results of frontline demonstrations in rice revealed that the increase in yield was highest in case of management of problematic soils i.e. reclamation of sodic soils with gypsum application as per soil test results (20.88 %) followed by foliar application of zinc (14.98 %) and integrated weed management (9.59 %) over farmers' practice. In redgram improved technology registered overall 25.34 per cent increase in yield over the farmers practice with increase in net income of 44.56 per cent. The increase was highest in varietal evaluation (39.89 %) followed by hybrids evaluation (20.05 %) over the farmers practice.

KVK, Kalavacharla conducted 125 and 64 front line demonstrations on different technologies of rice and banana respectively. In rice the yield of demonstration plots exceeded that of farmer's plots in all FLDs. The lowest technology index of 6.95 % in case of varietal evaluation proved the feasibility of new high yielding at the farmers' fields and the acceptance of the technology by the farmers in East Godavari district. Extension gap of 14.5 % in chemical weed control stresses the need to disseminate the technology among the farmers. In case of banana, it was found that increase in yield was highest (38.03 %) in nutrient management with direct feeding of banana bunches, which resulted healthy fingers in banana. The technology index of 24.25 % and 29.53 % in skirting technology of banana bunches and direct feeding of nutrients to banana bunches gave evidence that there was a scope for further improvement in the productivity and the need to strengthen the extension network to further bridge the yield gaps in banana.

5.6 FACTORS AFFECTING PRODUCTIVITY OF CROPS AND DECOMPOSITION OF YIELD GAPS

Factors affecting productivity estimated by Cobb-Douglas production function for the improved technology/ variety revealed that seed in STCR rice (0.162), HYV redgram (0.378) and planting material in direct feeding of nutrients and skirting of bunches in banana (0.944) were positively significant.

Machine labour in MSRI rice (0.219) and human labour in STCR rice (1.945), HYV rice (0.26) and direct feeding and skirting of bunches in banana (0.104) were positively significant. Nitrogen was positively significant in zero tillage maize (0.138), HYV redgram (0.44) while it was negatively significant in STCR rice (-0.159). Phosphorous was positively significant in HYV rice (0.666) and MSRI rice (0.259). Potash was positively significant (0.162) in farmers' practice of rice in KVK-Amadalavalasa, STCR rice (0.204), HYV redgram (0.138) and farmers' practice (0.25) and direct feeding and skirting of banana bunches in banana (0.035). Irrigation was found to be positively significant in zero tillage maize (0.112), HYV rice (0.24) and direct feeding and skirting of bunches in banana (0.094). The decomposition analysis of yield gap between the improved technology/ variety and the farmers practice/ traditional variety indicated that the technology gap was the major contributing factor in the total difference in productivity in all the crops among all the three KVKs which was highest in case of soil test crop response (STCR) in rice (370.82 %) in KVK-Yagantipalli.

5.7 EVALUATION OF TRAINING PROGRAMMES

KVK-Amadalavalasa conducted 27 various need based and skill oriented vocational training programmes during 2011-16 in Srikakulam district and trained about 633 people, among which 202 people were employed and 35 units were established. The percentage of employment generation was 31.91 which created income for rural people and played a positive role for their empowerment. Percent share of the trainee in total family income was increased highly for the beneficiaries of millet processing (31.41 %) followed by tailoring (18.96 %).

Krishi Vigyan Kendra-Yagantipalle organized 55 skill oriented training programmes in Kurnool district and trained 693 participants. Among the total trainees 62.19 % were employed and 215 commercial units were established. The increase in income after training programme was highest in case of trainees who are working as master trainers along with tailoring and blouse designing (Rs. 50143) followed by trainees who established millet processing units (Rs. 39900) and trainees who adopted tailoring and blouse designing (Rs. 30063) per annum.

KVK, Kalavacharla organized 54 vocational trainings programmes and trained 1046 people. 34.61 percent of the trainees were employed and 156 commercial units were established. On an average the training programmes improved the income of the trainee beneficiary by Rs. 51319 per annum and the share of trainee beneficiary in the total family income was increased between 12.31 % to 50.26 %. The average increase in trainee's share in total family income was 23.83 per cent.

All these vocational trainings have given a boost to women and giving supplementary income and employment especially to house wives.

5.8 ECONOMIC BENEFITS FROM THE ADOPTION OF TECHNOLOGIES AND PATTERN OF INCOME DISTRIBUTION

The total yield of 62.13q ha⁻¹ with net return of Rs.37803 was recorded by the beneficiary farmers of mechanized system of rice intensification (MSRI) while the corresponding figures for non-beneficiary farmers who are cultivating rice in traditional methods were 51.52 q ha⁻¹ and Rs. 28909. The increase in net returns was 30.77 per cent over the non-beneficiary farmers. Per hectare cost of cultivation of maize has been worked out to be Rs. 37904 for beneficiary farmers of zero tillage maize and Rs. 42266 for non-beneficiary farmers who are following traditional methods of maize cultivation.

The average cost of cultivation of non-beneficiary farms, not practicing soil test crop response in rice (Rs. 67585) was more than those of considering soil test results in nutrient application (Rs. 61302) and net returns were increased by 27.14 per cent by the adoption of STCR in beneficiary farms. In redgram the yields increased from 9.02 q ha⁻¹ to 13.15 q ha⁻¹, thereby increasing the net returns by 104.92 per cent by the adoption of high yielding varieties over traditional varieties.

The beneficiary farmers of high yielding varieties of rice have yield advantage over the non-beneficiary farmers cultivating traditional varieties. The net returns recorded were Rs. 42095 and Rs. 28590 per hectare for beneficiary

and non-beneficiary farmers, respectively. The adoption of high yielding varieties in rice increased the net returns by 47.24 per cent over the traditional varieties. The beneficiary farmers of direct feeding of nutrients and skirting of bunches in banana received net returns of Rs. 211916, even though there was an increase in cost of cultivation due to feeding of nutrients directly to bunches and skirting of bunches, they received more net returns of 42.66 per cent over the non-beneficiary farmers who are practicing traditional methods in banana cultivation.

To assess the pattern of distribution of income, the sample beneficiary farmers and non-beneficiary farmers were divided into different groups and the income generated from improved technology/ variety and farmers practice/ traditional variety were presented in the form of Lorenz curves, which implied that the income generated from improved technology is more equally distributed than the income generated from the farmers practice of cultivation in all the sampled KVKs of three districts. The distribution of income was quantified with the help of gini concentration ratios and found that there were comparatively lesser inequalities in distribution of income obtained from improved technology/ variety when compared with the inequalities in distribution of income obtained from farmer's practices/ variety.

5.9 FACTORS CONTRIBUTING TO THE ADOPTION OF IMPROVED TECHNOLOGIES

The technological adoption index (TAI) was calculated for 180 beneficiary farmers in the three sampled KVKs. All the sample beneficiary farmers belonged to medium and high adoption category. The determinants of technology adoption index (TAI) were examined by employing regression function. Age of the farmer was a negative contributor in all the crops which revealed that with the increase in age of the farmer technology adoption level decreases. Educational level of the farmer had positive and significant contribution in the technology adoption of MSRI and STCR technology in rice. KVK training is the major contributor in the technology adoption whose impact was positive in all the three KVKs.

Conclusions

The following conclusions have been drawn from the results of the present study:

- ❖ Increased yields and net returns of all the technologies demonstrated by the three sampled KVKs over the farmers practices shows the efforts of the KVKs in improving the farmers yields by conducting frontline demonstrations.
- ❖ The existence of yield gaps in all the technologies implies that there is much more potential to be tapped from the technology adoption at field level by the farmers. The yield gaps can be reduced by educating the farmers towards more use of latest technologies, which will eventually lead to the discontinuance of old methods with the new technology.
- ❖ The results of the decomposition of yields in all the selected technologies proved that the difference in technology existing between improved practices/ varieties and traditional practices/ varieties is the main contributing factor to the yield gap than the difference in input use.
- ❖ The vocational training programmes conducted by Krishi Vigyan Kendras improved the income levels of trainee beneficiaries.
- ❖ Comparison of costs and returns of beneficiary and non-beneficiary farms of improved technology revealed that all the selected technologies increased the returns of the beneficiary farmers over the non-beneficiary farmers.
- ❖ There were comparatively lesser inequalities in distribution of income of beneficiary farmers obtained from improved technology/ variety of crops when compared with the inequalities in distribution of income of non-beneficiary farmers obtained from traditional practices/ variety.
- ❖ All the sample beneficiary farmers of the technologies provided by the sampled KVKs belonged to medium and high adoption levels. KVKs are working hard towards bridging the total yield gaps in various crops finally aimed at increasing the yields and income of farming sector.
- ❖ Socio-economic characteristics of the farmers impacted their decision of technology adoption in all the sampled KVKs.

Policy implications

- Forward linkages in terms of post-harvesting, transportation, packaging and marketing are necessary for new products or high yield products. KVK should focus on post harvest techniques to support farmers especially processing to encourage them to adopt new technologies.
- KVKs should be developed as resource centres which can provide/facilitate the access to inputs for farmers which are the crucial factor in the adoption of new technology.
- Krishi Vigyan Kendra in the district need to provide proper technical support to the farmers through different educational and extension methods to reduce the extension gap for better production in the district by creating awareness among the farmers about new technologies.
- Modernization of soil testing labs, keeping the farmers' needs in focus while providing training, focus upon new emerging areas like climate change, pro-harvest management and non-farm activities are need to be considered by the KVKs, host organizations and ICAR (Indian Council of Agricultural Research).
- Measures to be adopted to increase the outreach of KVKs by adopting innovative techniques viz. forming farmers groups, train farmers-trainer, redefining cluster approach, continuous interaction at village level, need based training, use of ICT (Information and Communication Technology), etc.
- To cope with the future challenges of technical advancement, the existing vocational and technical training system needs to be improved and marked with the needs of the economy.
- To support and to mobilize entrepreneurial skills of the farmers, KVKs should coordinate to start agri-business centres by the farmers in villages.
- Better feedback mechanism is needed and KVKs should follow up the trainee farmers, rural youth and women after the completion of training programmes to make sure that they will adopt the newly acquired skill in creation of employment which will eventually lead to increased income levels and livelihood security.
- The study leads to the observation that KVKs are playing a pro-active role in transferring new technology at field level and with beneficial impacts, but a lot is yet to be done to bridge the yield gaps in crops and entrepreneurial development of rural community.