Assessing the Impact of Andhra Pradesh Community Managed Natural Farming: A Comprehensive Approach Using Crop Cutting Experiments

Third Interim Report
Rabi Season 2020-21

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Project Team

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0.1 Context

In the context of innovation of Pre-Monsoon Dry Sowing (PMDS)[1] by RySS as a part of APCNF, impact assessment of APCNF in 2020-21 has been conducted at PMDS in pre-Kharif season, PMDS+CNF in Kharif, PMDS in pre-Rabi season[2] and PMDS+ CNF in Rabi season, covering the entire agricultural year.

The impact assessment reports on PMDS of pre-Kharif season, and PMDS+ Kharif season were brought out as the first and the second interim reports respectively. The present impact assessment report is the third interim report of 2020-21 study covering pre-Rabi PMDS and the Rabi season of 2020-21 in the series.

The analysis in the Kharif report has brought to the fore the parameter required for assessing the impact of PMDS+CNF. The Kharif report revealed that the intensive use of land and labour: controlled use of water for irrigation; mobilisation of capital from own resources and low -cost credit; adoption of cost reducing and yield improving practices lead to reduction in the cost of cultivation per hectare of CNF crops compared to non-CNF crops. Gross and net value of output increased. These leads are examined in the analysis of the current report for Rabi season.

0.2 Objectives

In the above backdrop, the following issues have been examined**:**

1. Whether the pattern of utilisation factors of production, viz., land, labour, water, and capital by CNF farmers is different from non-CNF farmers in Rabi season?
2. Whether the adoption of cost reducing and yield enhancing practices of CNF have increased over the agricultural years by CNF farmers?

[1] The PMDS practice is a recent breakthrough in CNF. It is a novel method of growing crops. It enables farmers to raise crops in the dry seasons – before the monsoons, and also after the kharif crop. It is a global breakthrough. The exact science is yet to be determined. The enhancement of soil biology through APCNF practices and raising 8 to 15 diverse crops creates some unique conditions. PMDS enables seed germination with very little water and enables plants to harness water from the air. It is a major instrument to harness the water vapor from atmosphere that drops to the land in the form of early morning dew. The dew supplies the required moisture to the soil. This is facilitated by the mulch material spread across the field. It uses this water vapor to provide moisture to the soil for plant to grow. PMDS contributes to cropping intensity, agricultural incomes, soil fertility and continuous green cover. It was taken up by 12,549 farmers in 24,307 acres in 1,800 villages across Andhra Pradesh in 2019-20. This has gone up to over 50,000 farmers and over 50,000 acres of land across the state in 2020-21.

[2] The season of crops grown after Kharif season and before starting of crops grown in Rabi season according to PMDS protocols are considered as Pre-Rabi Season.

3. What is the impact of the pattern of utilisation of factors of production and adoption of the CNF practices on paid-out costs, yields, gross and net value of output of crops grown under CNF and non-CNF farmers in Rabi season and how they differ across the agroclimatic Zones and category of farmers?
4. Whether the utilisation pattern of factors of production and adoption pattern of the CNF practices and their impact on costs and returns of crops grown vary across agroclimatic zones and category of farmers?
5. What are the suggestions that emerged from the analysis for improving the pattern of utilisation of factors of production, and for enhancing the adoption of practices, and their impact on costs and returns of crops grown?

0.3 Methodology

The impact of PMDS+CNF is assessed through the comparison of PMDS+CNF farmers with non-CNF farmers with respect to different impact parameters. This analysis has been conducted at the state level as well as agroclimatic zones level and category of farmers' level. This study was conducted in all the 13 districts of Andhra Pradesh. It adopted a stratified, multi-stage sampling scheme with Gram Panchayats (GPs) as first stage units and cultivators (households) as second stage units.

The analysis in the Rabi report was based on the cross-section data collected for the study. All the households, both CNF and non-CNF, covered in the Kharif season have been covered in the Rabi survey including pre-Rabi households[3]. This method of survey facilitates the estimation of aggregate household incomes from different seasons and sources, estimation of cropping intensity, land productivity, and changes in cropping pattern, among others.

A total of 1140 total farmer households of PMDS+CNF were surveyed in Kharif season. The survey in Rabi Season has revealed that as high as 800 farmers of 1140 PMDS+CNF farmers covered in Kharif season, around 73 per cent of farmers, have grown Rabi crops. It is noteworthy that less than one percent of CNF farmers have grown pre-Rabi crop among the total PMDS+CNF farmers. Around 10 per cent of farmers have raised crops both in Pre-Rabi and Rabi seasons. Furthermore, around 63 per cent of farmers have grown Rabi crop without Pre-Rabi crops on PMDS+CNF plots of the Kharif Season. In the forthcoming analysis of this report, all the farmers who have grown crops in Rabi have been considered, these households

[3] For details on sample design see IDSAP (2021)

constitute around 73 per cent of 1140 households. On the other hand,78 per cent of 646 non-CNF farmers who have grown crops in Kharif season have grown crops in Rabi season. These percentages vary across zones and category of farmers.

In Rabi season, Crop Cutting Experiments (CCEs) were conducted for 10 crops to estimate yields under PMDS+CNF and non-CNF. Cultivation of two crops, viz., cotton and chilies spill over to Rabi season from Kharif season, among the ten crops chosen. They did not have adequate number of CCEs to estimate the yields. Another three crops, among the ten crops namely, Jowar, Bengal Gram and Horse Gram also did not have adequate number of CCEs to assess the impact of PMDS+CNF on the yields of these crops. Thus, the remaining five crops-Paddy, Groundnut, Black Gram, Maize and Green Gram with reasonable number of CCEs were considered for the impact assessment of PMDS+CNF at the state level. Among the five crops considered, the pulse crops (Black Gram and Green Gram) are mostly grown under unirrigated conditions compared to the other crops by both the PMDS+CNF and the non-CNF farmers.

0.4 Major Findings

The findings are organised in to three broad categories and given in the three sub-sections below. The first category of findings relate to the pattern of resource-use of -land, labour, water and capital.[4] The second category is related to the pattern of adoption of cost reducing and yield enhancing CNF practices. The third category includes assessing the impact of these patterns of resource use and adoption of practices of CNF on costs and value of crop output. The report elaborates the inputs used (PNPI)[5], paid out costs[6], yields [7]and gross[8] and net[9] values

[4] Capital funds includes funds mobilised for meeting the expenditure on agricultural operation and marketing of crop outputs and household needs.

[5] The expenditure on biological inputs under CNF and chemical inputs under non-CNF are commonly referred as Plant Nutrients and Protection Inputs (PNPIs) in this study.

[6]Apart from expenditure on PNPIs, the survey has also collected the data about the costs of: (1) seeds, (2) human labour, (3) machine labour, (4) bullock labour, (5) implements, (6) farm yard manure (FYM), and (7) Irrigation. In almost all items, the values of purchased items and own items are also collected. The values of all these purchased and own items used in the crop cultivation, together, are referred as paid-out costs.

[7] the study has conducted CCEs to estimate the crop yields independently to know the correct yields of sample crops. CCEs are being conducted for both CNF and non-CNF crops.

[8] The gross value of crop output (crop output, obtained through CCEs) multiplied by realized or locally prevailing price reported by the sample farmers plus value of by-products, reported by the farmers is to gross value of output.

[9] Net values of output are obtained by subtracting the paid-out cost of a crop from the gross value of that crop.

of crop outputs. The findings are presented for the state, the agroclimatic zones[10] and the category of farmers[11].

0.4.1 Pattern of resource-use: Land, Labour, Water, and Capital (Funds)

PMDS+CNF farmers compared to non-CNF farmers have utilised their cultivated land more intensively in the state, across all the agroclimatic zones and by small as well as large landholders. But there is scope for further improvements in the intensive use of land in scarce rainfall zone. The spread of practice of PMDS by the farmers in this zone can increase the intensive use of land, this is evident from the analysis on land use over the four agricultural years since 2017-18.

The intensive use of hired labour as well as family labour is pronounced among the PMDS+CNF farmers, compared to non-CNF farmers across all the crops in the state, and for paddy across all the agroclimatic zones and for the small and large landholders.

The small as well as the large PMDS+CNF farmers as well as non-CNF farmers depend on irrigation for raising crops in Rabi season at the state level, and in agroclimatic zones. But large landholders depend more on controlled irrigation sources like borewells, while small landholders more on canal irrigation.

The PMDS+CNF farmers, compared to non-CNF farmers, have had lower paid out costs per hectare for all the crops grown in Rabi in the state, across all the zones and for small and large landholders. The paid-out costs of cultivation per hectare indicates the extent of working capital required to grow crops. The lower paid out costs of PMDS+CNF plots over non-CNF reveals that the PMDS+CNF requires lower volumes of working capital for meeting the expenditure on agricultural operations. Hence, the PMDS+CNF farmers have reduced dependency on high-cost credit sources. The reduced dependency of PMDS+CNF farmers on the traders/ money

[10]The 13 districts of Andhra Pradesh State have been classified into six agroclimatic zones. They are: High altitude and Tribal Zone; North Coastal Zone; Godavari Zone; Krishna Zone; Southern Zone; and Scarce Rainfall Zone. High altitude and Tribal areas of Srikakulam, Vizianagaram, Visakhapatnam and East Godavari districts together constitute the High altitude and Tribal areas Zone. North Coastal Zone encompasses the districts, viz., Srikakulam, Vizianagaram, and Visakhapatnam excluding high altitude and tribal areas of these districts. East Godavari (excluding high altitude and tribal areas) and West Godavari together come under Godavari Zone. The districts, viz., Krishna, Guntur and Prakasam together constitute Krishna Zone. Chittoor, YSR Kadapa and PSR Nellore districts are together grouped as Southern Zone. Kurnool and Anantapuramu constitute Scarce Rainfall Zone.

[11] The farmers are classified into four categories, viz., Pure Tenants (landless farmers but cultivating land on lease); Marginal Farmers with less than 2.5 acres, Small Farmers are those with landholding of between 2.5-5.0 acres of land; medium and large farmers are those with more than 5 acres of landholding.

lenders in the state across all the zones and for the small and large landholders is evident in the survey.

0.4.2 Pattern of adoption of CNF practices[12]

The adoption of PMDS+CNF practices leads to reduction in the cost of production of growing crops, compared to non-CNF practices. These practices are labour intensive. Further, the biological inputs prepared and used have been based on the local low-cost raw materials. The adoption of these practices thus leads to cost reduction and yield enhancement. Each additional adoption of CNF practice results in additional reduction in cost and additional yield enhancement. The number of practices adopted has been on the increase by the CNF farmers during the four agricultural years, 2017-21. The number of practices adopted increased after the spread of PMDS-during the last two years compared to the first two years. The practice of mixed cropping was higher among the CNF farmers over non-CNF farmers. This is true in the state, across zones and among both the small and large landholders.

0.4.3 Costs and returns of crops

The expenditure on plant nutrition and plant protection inputs (PNPI) and the overall paid-out costs per hectare were lower for all the five crops considered in Rabi season under PMDS+CNF plots over non-CNF plots in the state. This is true across all the agroclimatic zones in case of paddy. However, both the small and large landholders have higher paid out cost under PMDS+CNF over non-CNF plots in case of paddy. This is due to higher use of hired labour by small as well as large landholders.

The yields of the crops are either higher or the same under PMDS+CNF over those of non-CNF. This is true across all the agroclimatic zones, except Godavari Zone. Further, small landholders have obtained higher yield compared to large landholders for PMDS+CNF over non-CNF.

The gross value of crop output per hectare is invariably higher under PMDS+CNF compared to non-CNF across all the crops considered for the analysis. The yield responses to inputs have contributed to the higher gross value of output in case of pulses-black gram and green gram, while higher yield and higher prices together have contributed to higher gross value of output

[12] Fourteen CNF practices i.e., No chemicals, Beejamrutham, Ghana Jeevamrutham, Drava Jeevamrutham, Kashayams/Asthrams, FYM, Inter cropping, Border cropping, Bund cropping, Layer models, Integrated farming, 36*36, PMDS, SRI cultivation are considered.

in case of cereals-(paddy and maize) and oil seeds-(groundnut). All the agroclimatic zones except Godavari Zone have higher gross value of output under PMDS+CNF compared to non-CNF. Small landholders, compared to large landholders, have obtained higher gross value of output.

The net value of output of crops grown under PMDS+CNF is invariably higher than those grown under non-CNF across all five crops considered for the analysis. This indicates that lower paid-out costs have contributed consistently for the higher net value of output under PMDS+CNF over non-CNF. Thus, it is evident that the lower paid-out costs in case of all crops; higher yields and realized prices in case of paddy and maize and groundnut; and yields in case of pulse crops- black gram and green gram have contributed to the higher net value of crop outputs under PMDS+CNF over non-CNF. The net value of paddy is higher for PMDS+CNF over non-CNF across all agroclimatic zones, except Godavari Zone. This is due to lower paid out cost as well as higher yields. Similarly, it is higher for the small landholders compared to large landholders. This is also due to low paid out cost and higher yields of the small landholders over large landholders.

0.5 Conclusions

The analysis has revealed that the net value of output per hectare has been determined by the paid-out costs, yield and realised prices of crops. The intensive use of land and labour; less intensive use of water for irrigation and capital funds for meeting expenditure on agricultural operation including marketing; and more adoption of CNF practices including PMDS have contributed to reduction in the paid-out costs and enhancement in yield of crops in the ultimate analysis of costs and returns of crops. Thus, higher volume of outputs has been achieved by CNF farmers at lower costs of production. This, is in contrast to the chemical-based (non-CNF) agriculture. Small landholders (marginal and small farmers) obtained higher yields in comparison to large landholders (medium and large farmers) for paddy. In other words, cost of production is lower for small landholders.

The analysis has also served as a pointer to agricultural growth and output market risks. The intensive use of land throughout the agricultural year, improvement in yields of crops and higher net and gross value of output of PMDS+CNF can contribute more to agricultural growth compared to chemical-based (non-CNF) agriculture. The reduced cost of production and enhanced yields of crops under CNF can protect the income of the farmers in the situation of

falling prices of crop outputs. Thus, CNF has enabled farmers to withstand the risk of falling prices of crop outputs in the output markets.

Thus, it is evident from the analysis that practice of CNF led to higher intensive use of land and labour, less intensive use of water and capital funds, cost reduction in growing crops, yield enhancement of crops, and inclusiveness of scarce rainfall areas and small landholder of the farming community.

0.6 Policy Suggestions

The analysis has also highlighted concerns to be addressed. They are as follows:

1. The expansion of cultivated area under PMDS, especially in rainfall dependent zones, more so in scarce rain fall zones to enhance land use intensity for obtaining potential benefits of PMDS+CNF is a concern that need to be addressed. The existing women Self-Help Groups (SHGs) and their federation need to be leveraged. The kitchen garden intervention as entry point through PMDS for women groups can result in the motivation of women in each household. The women in turn can motivate their men to go in for PMDS practices in their field. The RySS also can go in for the Model development of Plot(s) at the village level on common lands through Internal Community Resource Persons (ICRPs) to demonstrate the practices of CNF including PMDS. This enables farmers to get motivated by the real demonstration of CNF practices including PMDS.
2. The increase in the cost of production especially in case of paddy crop due to increase in the use of hired labour by small landholders needs to be addressed because this results in less net value of output. Yield enhancement and achievement of higher prices in output markets enable PMDS+CNF farmers to address this challenge. The adoption of all the practices of CNF especially PMDS to enhance yield of crops and reduce cost of production simultaneously; and output market support through public procurement by the government to start with and formation of Farmer Producer Organizations (FPOs) along with natural farming certification may enable the smallholders to grapple with this challenge.
3. The lower use of biological inputs due to higher wages of labour for preparation and application of biological inputs needs policy attention. This is pronounced in case of farmer households having family labour shortage. This ultimately results in lower yields of crops and thereby effects net value of output. Hence, biological inputs should

be made available through Non-Pesticides Management (NPM) shops managed by women Self-Help Groups and their federations, wherever possible. Also, physical structures like small tanks to store and apply these biological inputs to the fields through pipelines by gravity flow may be encouraged under Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) and Andhra Pradesh Minor Irrigation Project (APMIP) for small as well as large landholders. Decentralised technology provides solution to the labour scarcity issue to that extent. These practices are observed in the field survey of the Institute for Development Studies, Andhra Pradesh (IDSAP).

Chapter 1

Context, Objectives and Methodology

1.1 Introduction

The Government of Andhra Pradesh has introduced the Zero Budget Natural Farming (ZBNF) in 2016 as an alternative to chemical-based agriculture. Later, the name was changed to Andhra Pradesh Community Managed Natural Farming (APCNF). It is a paradigm shift in agricultural development in the state and in the country. An independent organization, known as Rythu Sadhikara Samastha (RySS), a not-for-profit company, was established to implement the programme effectively. Recently, RySS has made one of the major breakthroughs in APCNF in the form of the ***Pre-Monsoon Dry Sowing (PMDS).***

PMDS is a global breakthrough. The exact science is yet to be determined. The enhancement of soil biology through APCNF practices and raising 8 to 15 diverse crops creates some unique conditions. PMDS enables seed germination with very little water and enables plants to harness water from the air. It is a major instrument to harnesses the water vapor from atmosphere that drops to the land in the form of early morning dew. The dew supplies the required moisture to the soil. This is facilitated by the mulch material spread across the field. Therefore, farmers grow PMDS during March-June on plot(s) cultivated followed by Kharif crops, PMDS in pre-Rabi and Rabi crops. The crop grown in PMDS is used ultimately as green manure, apart from some income to farmer and green fodder to animals. Thus, PMDS contributes to cropping intensity, agricultural incomes and continuous green cover for 365 days in a year.

Institute for Development Studies Andhra Pradesh (IDSAP), Visakhapatnam has been assigned the task of assessing the impact of APCNF on farming and farmers for the year 2020-21 by RySS, the Government of Andhra Pradesh. The current study is in continuation of the impact studies undertaken for 2019-20 by the same Institute. The impact assessment of APCNF in 2020-21 at PMDS in pre-Kharif season, PMDS+APCNF in Kharif, PMDS in pre-Rabi season and PMDS+ APCNF in Rabi season in the context of innovation of PMDS by RySS has been conducted. The impact assessment reports on PMDS of pre-Kharif season, and PMDS+ Kharif season were submitted already as the first and the second interim reports respectively to RySS. The present impact assessment report is the third interim report of 2020-21 study covering Pre-Rabi PMDS and the Rabi 2020 season. The analysis in the Kharif report has brought out the fact that the intensive use of land, labour and less intensive use of water and capital funds

mobilised from sources of relatively lower cost of credit under PMDS+CNF over non-CNF have led to reduction in input costs, improvement in yields and thereby enhancement in gross and net value of output of crops grown under CNF over non-CNF and adoption of CNF practices. These leads are examined in the analysis of the current report of Rabi season.

1.2 Objectives

In the above backdrop, this present study of 2020-21 is to assess the impact of (PMDS) in pre-Rabi+ APCNF in Rabi on farming and farmers of Andhra Pradesh with the following specific objectives:

1. Whether the pattern of utilisation factors of production, viz., land, labour, water, and capital funds by CNF farmers is different from non-CNF farmers in Rabi season?
2. Whether the adoption of cost reducing, and yield enhancement practices of CNF have increased over the agricultural years by CNF farmers?
3. What is the impact of pattern of utilisation of factors of production and adoption of the CNF practices on paid-out costs, yields, gross and net value of output of crops grown under CNF and non-CNF farmers in Rabi season?
4. Whether the utilisation pattern of factors of production and adoption pattern of the CNF practices and their impact on costs and returns of crops grown vary across agroclimatic zones and category of farmers?
5. What are the suggestions that emerged from the analysis for improving the pattern of utilisation of factors of production, and for enhancing the adoption of practices, and their impact on costs and returns of crops grown?

1.3 Methodology

1.3.1 The Basic Approach

The study has deployed “with and without” method to assess the impact of PMDS+APCNF in Rabi season. In this method, the outcomes of different categories of PMDS+APCNF of Rabi farmers, cultivating a particular crop, are compared with the outcomes of the non-APCNF farmers cultivating the same crop, using chemical inputs.

1.3.2 Sample Design

The study is conducted in all the 13 districts of the State of Andhra Pradesh. The study has considered the entire area where PMDS+CNF is practiced as PMDS+CNF area. Rest of Andhra Pradesh is covered under non-CNF. All the GPs, where CNF+PMDS practices were followed, constitutes the sample frame for drawing PMDS+CNF samples. This list with number of cultivators following PMDS+CNF *as of September 2020* is provided by RySS. According to the data provided by RySS, the universe for PMDS+CNF cultivators consists of 3,135 GPs with 63,812 cultivators practicing PMDS+CNF as of September 2020.

The total list of GPs in the state excluding the GPs of PMDS+CNF formed the sample frame for non-CNF samples. In the sample design, each district is treated as a stratum. The total sample allocations are based on the stratum size. The sampling frame for selecting the cultivators is derived from a household listing carried in each GP covering all the PMDS+CNF cultivators. At the time of listing information on whether the cultivator is practicing PMDS+CNF is collected to *eliminate non-CNF cultivators in sample selection*. This formed the universe for the selection of sample PMDS+APCNF farmers. From this, a sample of 10 cultivators was selected randomly from each sample GP, totalling 1040 cultivators. Wherever 10 cultivators were not available in a GP, the deficit is compensated from another nearby sample GP, preferably from the same Mandal. While drawing samples, care has been taken to make sure that each of the 12 major crops be covered with at least 50 samples. This was achieved by increasing sample size of GPs and cultivators. As a result, the survey covered a total sample size of 1,140 cultivators from 107 GPs.

In case of non-CNF samples, the listing was carried out as in the case on PMDS+CNF. However, to save time and costs, the listing is confined to about 250 cultivators. In GPs with less than 250 cultivators, entire GP is listed. When the number of cultivators is more than 250, the listing is confined to 3 randomly selected Panchayat Wards of GP and in another randomly selected ward in case of deficit. As in case of PMDS+CNF, the listing operation of non-CNF collected all the relevant information for selecting of sample cultivators. From each GP a sample of 10 cultivators was selected randomly for the survey. However, total sample size has been increased from 520 to 646 to get the required minimum number of observations for each the selected crops.

All the CNF farmers surveyed in Kharif season have been surveyed in pre-Rabi and Rabi seasons. Thus, farmers selected with PMDS (pre-Kharif) plot(s) have been surveyed in Kharif, pre-Rabi and Rabi season also to obtain the data on the annual income of the PMDS+CNF as well as non-CNF farmer households from different sources of economic activity.

There are a total of 1140 households of PMDS+CNF surveyed in Kharif season. The survey in Rabi Season has revealed that as high as 800 farmers of 1140 PMDS+CNF farmers covered in Kharif season, around 73 per cent of farmers, have grown Rabi crops (Annexure Table 1.1). It is interesting to note that less than one percent of farmers have grown pre-Rabi crop among the total farmers. Further, around 10 per cent of the farmers have raised crops both in Pre-Rabi and Rabi seasons (Annexure Table 1.2). Furthermore, around 63 per cent of farmers have grown Rabi crop without pre-Rabi crops on PMDS+CNF plots of the Kharif Season. In the forthcoming analysis of this report, all the farmers who have grown crops in Rabi have been considered, these households constitute around 73 per cent of 1140 households. On the other hand, 78 per cent of 646 farmers of non-CNF farmers who have grown crops in Kharif have grown crops in Rabi seasons. These percentages vary across zones and category of farmers.

Besides cross-sectional surveys in PMDS+CNF and non-CNF farmers, 260 Panel-1 (10 farmers from each of two sample villages of all 13 districts) and 130 panel-2 farmers (5 farmers from each of two villages of all 13 districts) of the CNF households were surveyed in the Rabi season of 2020-21. However, the analysis of panel survey will be included in the forthcoming consolidated report for the Agricultural year-2020-21. ***The present Rabi Report is confined to the analysis of cross section Survey for the Rabi season.***

Further, in a survey of this nature, it is not feasible to cover many crops, given the sample size. Therefore, survey is limited to 12 major crops that are identified based on the cropped area in the state. These crops together account for more than 90% of the gross cropped area in the state. The crops include: (1) Paddy, (2) Groundnut, (3) Cotton, (4) Bengal Gram, (5) Black Gram, (6) Maize, (7) Red Gram, (8) Chillies, (9) Green Gram, (10) Ragi, (11) Sugarcane and (12) Horse gram. Some of these crops are one season crops (e.g., Bengal gram is predominantly a Rabi crop) and some Kharif crops are long duration crops (e.g., Sugarcane, Cotton and Chillies), whose harvesting continues into the Rabi season.

The filed staff have been trained also on collection of data in Rabi season nearly for a week. Further, they are being trained on entering Rabi data in the CS Pro App. For these, external

experts were invited to provide training in filling of the Rabi questionnaire and entering of Rabi data in the App.

Crop Cutting Experiments (CCEs) were conducted to get estimate of crop yields under PMDS+APCNF and non-APCNF. For each of the selected farmer, a plot where the farmer is growing the major crop, is identified. From this parcel of land, a plot of the *size as required by the procedure* has been selected at random for estimating yield through CCEs. It is to be noted that the study has adopted standard methodology of Indian Agricultural Statistical Research Institute (IASRI), which is followed by NSSO and Directorate of Economics and Statistics (DES) of all state, including Andhra Pradesh, for conducting CCEs.

There are 10 crops in Rabi season, for which CCEs are conducted to estimate yields under PMDS+CNF and non-CNF plots for assessing the impact of CNF on yields (Annexure Table 1.3). But two crops, viz., cotton and chilies spill over to Rabi season from Kharif season, among the ten crops, do not have adequate number of CCEs to estimate the yields. Another three crops namely Jowar, Bengal Gram and Horse Gram also do not have adequate number of CCEs for assessing the impact of CNF on the yields of Crops. Thus, the remaining five crops- Paddy, Groundnut, Black Gram, Maize and Green Gram have reasonable number of CCEs for the impact assessment of CNF on the yields at the state level. These five crops are considered for the impact analysis on costs and returns of crops in Rabi season. Among the five crops considered, the pulse crops (Black Gram and Green Gram) are grown relatively in large percentage under unirrigated conditions compared to other crops by both the PMDS+CNF and the non-CNF farmers.

1.3.3 Data Collection and Management Process

Costs and returns for the crops considered for the analysis have been obtained from the farmers through farmer household survey to assess the impact of PMDS+ APCNF of Rabi on costs and returns of crops. Crop Cutting Experiments (CCEs) have been conducted to assess the yields of the crops scientifically.

The household survey for the Rabi season of 2020-21, was conducted from early- November 2020 to end of February 2021. As per the design, each sample farmer is visited a minimum of two times, during the season to collect the household and farming data and to conduct the Crop Cutting Experiments (CCEs). Senior team members have visited the field and cross-checked

the information filled and participated in data collection processes. Senior Investigators with District Project Managers (DPMs) and a few field staff of RySS, participated in the Focus Group Discussions (FGDs), visited fields, especially of the model farmers and observed the farm practices and social entrepreneurs. The analysis of the qualitative data will be presented in the forthcoming consolidated report of the impact of PMDS+CNF.

The data entry Programme was written in CS-Pro software and used for data entry and processing. Data is processed using the SPSS and Excel software. A separate mobile-based app is developed/ generated to enter the CCEs' information; and training is given to all the field staff, after duly installing the app on their mobiles. Descriptive statistics, frequency distributions and cross tabulation are generated at state level, agro-climatic zone wise, and farm category wise. A more rigorous statistical analysis of the data would be carried out in a separate report.

1.3.4 Sample Weights for estimating Impact Parameters

For any estimate of the aggregate for the state, Y_s is derived as the sum of estimates of aggregates of the strata (districts) i.e.

$$Y_s = \sum Y_j$$

where Y_j is estimate of aggregate for the j^{th} Strata (district).

The aggregate estimate for any district Y is given by dropping subscript j

In case of PMDS+CNF

$$\hat{Y} = \frac{Z}{n} \sum_{i=1}^{n} \frac{1}{z_i} \left[\frac{H_i}{h_i} \sum_{k=1}^{h_i} y_{ik} \right]$$

where, Z = total number of CNF+PMDS cultivators in the district,

n = number of Gram Panchayats in the district,

z_i = number of CNF+PMDS cultivators in GP,

H_i = number of households listed,

h_i = number of households selected,

y = any characteristic of household.

'i' stands for the GP and 'k' stands for the farmer

In case of non-CNF

$$\hat{Y} = \frac{N}{n}\sum_{i=1}^{n}\frac{W_i}{w_i}\left[\frac{H_i}{h_i}\sum_{k=1}^{h_i} y_{ik}\right]$$

where, N = total non-CNF GPs of a district,

n = sample number of GPs in the district (which is 4),

W_i = number of Wards in the village,

w_i = number of wards selected for listing,

H_i = number of households listed,

h_i = number of households selected, and

y = any characteristic of household.

Unlike earlier reports, crop wise yield, gross revenue and net revenue are generated from CCE yield data. Crop wise average yield rates for the sample farmers are calculated at the Gram Panchayat level. Crop wise total area at the Gram Panchayat level has been calculated as total area being cultivated by the sample households in the GP multiplied by the total number of households listed in that GP divided by the total number of sample households selected for the survey. The area so arrived is multiplied by yield rate to arrive at the output level for all crop growers at the Gram Panchayat level. The total output and total area at the Gram Panchayat are used for deriving yield estimates for the state, agroclimatic zone level and categories of farmers.

Crop wise average prices are calculated and used while estimating gross value of output at the Gram Panchayat level. From it, gross value of output at state, agroclimatic zone and category of farmers are calculated on similar fashion as estimation of yield rate.

1.4 Scheme of Analysis

A three-stage analysis has been planned to capture the dynamics involved in production conditions of farming. In the first stage, the pattern of utilisation of factors of production has been assessed.in the second stage, the pattern of adoption of cost reduction and yield enhancement practices of CNF have been analysed. The pattern of utilisation of factors of production and the pattern of adoption of CNF practices together determine the costs and

returns of crops grown. In the third stage, the pattern of costs and returns of crops grown in Rabi season has been analysed. Land, labour, water (irrigation) and capital funds are considered as factors of production in the analysis. A comparison of these three sets of indicators between PMDS+CNF and non-CNF enables assessment of the impact of PMDS+CNF on farming and farmers.

The cultivated land use pattern in Rabi season for growing crops has been captured through four indicators, viz., the cultivated land in Rabi season as a percentage of Kharif cultivated area during the agricultural year 2020-21; cropping intensity to capture intensive use of land in the agricultural year 2020-21;the cultivated area in acres per farmer to assess the land under cultivation in Rabi seasons of four agricultural years, 2017-18 to 2020-21; the percentage of the cultivated area in Rabi as a percentage of cultivated area in Rabi during the agricultural years, 2017-18 to 2020-21.Among the four indicators, the first indicator measure the extent of Kharif area brought under plough in Rabi season. This has implication for the intensity of land use. The second indicator capture the intensity of land use throughout the agricultural year, 2020-21. These two indicators are related to 2020-21, but they do not provide the clue regarding the land use dynamic over time. The cross-section data pooled over four agricultural years are adequate to understand the dynamics of land use due to PMDS+CNF. This has implication for agricultural growth.

The per hectare use of hired labour, family labour and total labour in labour days per hectare capture the intensive use of labour for crop production. A comparison of these indicators between PMDS+CNF and non-CNF farmers capture the impact of PMDS+CNF on labour use intensity.

It is evident from the earlier studies that CNF under control irrigation compared to flood irrigation contributes more to improvements in yields of crops. Farmers who have irrigation sources for growing crops have grown the crops under CNF and non-CNF in Rabi season. However, farmers in canal irrigated areas mainly dependent on flood irrigation, while farmers in rainfall dependent areas dominantly dependent on borewell irrigation (controlled irrigation) source. Hence, the proportion of area under irrigation in total cultivated area and proportion of area irrigated under borewell irrigation (controlled) have been considered as proxy indicators to measure water use.

The farmers can mobilise funds from different sources that include own saving, friends and relatives, formal institutions such as banks and informal institutions like traders and money lenders for meeting the expenditure on agricultural operations and household needs. The terms and conditions of credit vary across these institutions. The working capital requirements of the farmers of CNF farmers are lower compared to the requirements under non-CNF. As a result, the farmers reduced their dependency on the informal institutions and avoid costly credit. In this context two indicators are formulated to examine whether the farmers dependency on informal institutions has come down. The percentage of farmers depending on different sources of credit and the percentage of funds mobilised from different sources along with paid out costs incurred in growing crops are compared between CNF and non-CNF to assess the impact of CNF on the credit markets in terms of the dependency of farmers on costly informal credit required for growing crops.

Every practice of CNF adopted has implications for cost of cultivation of crops on one hand and yield of crops on the other, among other benefits. Hence, the number of practices adopted as measure is considered. Similarly, the mixed cropping pattern may also have implications for cost of cultivation of crops as well as yields of crops. The percentage of farmers growing mixed cropping and the percentage of area under mixed cropping are considered to assess the impact of PMDS+CNF.

The expenditure incurred per hectare on biological inputs, that includes Beejamurutham, Ghana and Dravajeevamrutham, Kashyams and Ashtrams etc., under CNF and expenditure incurred on chemical inputs per hectare under non-CNF are considered as plant nutrient and protective inputs (PNPIs). The biological inputs are made from the locally available lower cost materials. The chemical inputs are the industrial inputs. A comparison has been made between the expenditures PNPIs between PMDS+CNF and Non-CNF. This indicator enables to capture the extent of saving per hectare due to the use of biological inputs compared to the chemical inputs.

Apart from expenditure on PNPIs, the survey has also collected the data about the costs of: (1) seeds, (2) human labour, (3) machine labour, (4) bullock labour, (5) implements, (6) farm yard manure (FYM), and (7) Irrigation. In almost all items, the values of purchased items and own items are also collected. The values of all these purchased and own items used in the crop cultivation, together, are referred as paid-out costs. Comparison has been made between CNF and non-CNF in respect of this indicator. The indicator enables to assess the cost of production

of growing crops under CNF and non-CNF. The study has conducted CCEs to estimate the crop yields to know the yields of sample crops. CCEs are being conducted for both CNF and non-CNF crops. The comparison of yields between CNF and non-CNF at the state level enable to assess the impact of CNF on yields. Another indicator namely gross value of crop output has been derived through crop output, obtained through CCEs multiplied by realized or locally prevailing price reported by the sample farmers plus value of by-products, reported by the farmers. This enables to assess the impact of yield and prices of crop output on the gross value of out under CNF and non-CNF. Another indicator, viz., net values of output are obtained by subtracting the paid-out cost of a crop from the gross value of that crop. This facilitates the impact assessment of paid out costs, yield and prices of crop output on the net value of output between CNF and non-CNF farmers.

This costs and returns analysis of crops for CNF and non-CNF have been conducted at agroclimatic zones level also. The classification of districts into Zones is as follows. The 13 districts of Andhra Pradesh State have been classified into six agroclimatic zones. They are: High altitude and Tribal Zone; North Coastal Zone; Godavari Zone; Krishna Zone; Southern Zone; and Scarce Rainfall Zone. High altitude and Tribal areas of Srikakulam, Vizianagaram, Visakhapatnam and East Godavari districts together constitute the High altitude and Tribal areas Zone. North Coastal Zone encompasses the districts, viz., Srikakulam, Vizianagaram, and Visakhapatnam excluding high altitude and tribal areas of these districts. East Godavari (excluding high altitude and tribal areas) and West Godavari together come under Godavari Zone. The districts, viz., Krishna, Guntur and Prakasam together constitute Krishna Zone. Chittoor, YSR Kadapa and PSR Nellore districts are together grouped as Southern Zone. Kurnool and Anantapuramu constitute Scarce Rainfall Zone. Further analysis has been conducted at the farmers category level also to assess whether small landholders (marginal and small farmers) have derived gains from CNF in relation to large landholders (medium and large farmers). The farmers are classified into three categories, viz., Marginal Farmers with less than 2.5 acres, Small Farmers are those with landholding of between 2.50-5.0 acres of land; medium and large farmers are those having more than 5.0 acres of land (For indicators see Annexure Table 1.4).

1.5 Structure of the Report

The context, objectives and methodology of the study have been presented in Chapter 1. Chapter 2 consists of the comparative analyses between the PMDS+CNF and non-CNF farmers with regard to the pattern of utilization factors production such as land, labour, water and capital (mobilized funds for meeting the expenditure for agricultural operation and household needs); pattern of adoption of CNF practices; the changes in expenditure on Plant Nutrient and Plant protection inputs (PNP), paid out costs, crop yields, gross and net values of output at state level. In chapter 3, the issues covered in the chapter 2 have been analyzed at agroclimatic level. In Chapter 4, the same analysis has been conducted at category of farmers' level. Chapter 5 contains summaries, conclusions and policy suggestions. Apart from all these chapters, executive summary is also presented in the Report.

Annexure to Chapter 1

Annexure Table 1.1: Number of sample farmers cultivating in Rabi season

Farm category/ Agroclimatic zone	PMDS+CNF		Non-CNF	
	Growing crops during Pre-Kharif PMDS and Kharif season	Also growing crops during Rabi season	Growing crops in Kharif season	Also growing crops during Rabi season
Farm category				
Pure Tenant	96	75	20	20
Marginal	677	507	385	302
Small	292	174	180	131
Medium & Large	75	44	61	41
Total	1140	800	646	494
Agroclimatic zone				
High Altitude Zone	42	29	98	53
North Coastal Zone	362	276	109	88
Godavari Zone	150	96	70	70
Krishna Zone	219	161	140	122
Southern Zone	270	211	124	111
Scarce Rainfall Zone	97	27	105	50
Total	1140	800	646	494

Source: IDSAP Field Survey, 2020-21

Annexure Table 1.2: Percentage of Sample PMDS+CNF farmers growing crops in pre-Rabi PMDS and Rabi season

in percentage

Farm category/ Agroclimatic zone	Both PMDS & Rabi Crop	Only PMDS Crop	Only Rabi Crop
Farm category			
Pure Tenant	2.6	0.2	74.8
Marginal	12.5	0.5	65.1
Small	6.8	0.3	51.6
Medium & Large	0.2	0.2	67.9
Total	9.7	0.4	62.8
Agroclimatic zone			
High Altitude Zone	0.0	0.0	71.9
North Coastal Zone	3.2	0.0	83.0
Godavari Zone	14.7	0.0	45.7
Krishna Zone	0.2	1.3	77.4
Southern Zone	19.7	0.7	58.2
Scarce Rainfall Zone	0.0	0.0	21.4
Total	9.7	0.4	62.8

Source: IDSAP Field Survey, 2020-21

Annexure Table 1.3: Crop wise number of CCEs conducted during Rabi season

Crop	PMDS+CNF	Non-CNF	Total
Paddy	131	102	233
Groundnut	38	36	74
Cotton	16	10	26
Chillies	8	17	25
Maize	65	13	78
Bengal Gram	13	3	16
Green Gram	23	16	39
Horse Gram	0	5	5
Black Gram	57	26	83
Jowar	5	6	11
Total	356	234	590

Source: IDSAP Field Survey, 2021

Annexure Table 1.4: Impact indicators of PMDS+CNF on the farming and farmers during Rabi season

S.No	Description of the impact domain of APCNF	Description of the Indicators
1	Pattern of utilization of factors of production	
	a. Land	i. Area cultivated in Rabi season as a percentage of area cultivated in Kharif Season ii. Trend in average area under CNF in Rabi season since 2017-18 iii. Area cultivated under CNF in Rabi season as a percentage of total cultivated area in Rabi season during 2017-18 to 2020-21 iv. Cropping intensity (in percentage)
	b. Labour	i. Family labour used per hectare ii. Hired labour used per hectare iii. Total labour used per hectare
	c. Water	i. Percentage of cultivated area under irrigation. ii. Percentage of cultivated area under borewells. iii. Percentage of cultivate area under canals
	d. Capital Funds	i. Percentage of farmers accessed funds from traders/money landers ii. Percentage of funds, to the total funds, accessed from traders/money landers by the farmers
2	Pattern of adoption of APCNF practices	i. Number of CNF practices adopted per farmer ii. Percentage of CNF farmer adopted mixed cropping iii. Percentage of cultivated area under mixed cropping
3	Costs and returns of crop (in INR)	i. Expenditure of PNPIs per hectare ii. Paid out cost per hectare iii. Yield per hectare iv. Cost of production per quintal v. Gross value of output vi. Net value of output

Source: IDSAP, 2021

Chapter 2

Impact of PMDS+CNF on the farming conditions in Rabi Season: A State Level Analysis

2.1 Introduction

The analysis in the Kharif report has revealed that the intensive use of land and labour, controlled use of water for irrigation, biological input use, adoption of cost reducing and yield enhancing practices; and borrowings mobilised from relatively cheaper sources, led to reduction in paid out costs, improvement in yields and resulted in higher gross and net values of output of crops grown under CNF over non-CNF. These leads are examined in the analysis of the current report of Rabi season at the state level.

2.2 Objectives

In the above context, this chapter assesses the impact of PMDS+CNF practice on the farming condition in Rabi season. This chapter addresses the following broad objectives:

2.2.1 Broad Objectives

1. What is the pattern of utilisation of land, labour, water, and capital funds by the PMDS+CNF farmers in relation to non-CNF farmers?
2. What is the patten of adoption of CNF practices by the PMDS+CNF farmers over a period of time?
3. What is the impact of PMDS+APCNF on the paid-out costs, yields, gross and net value of output of crops grown in Rabi season?

2.2.2 Specific Objectives

More precisely, this chapter addresses to the following specific objectives:

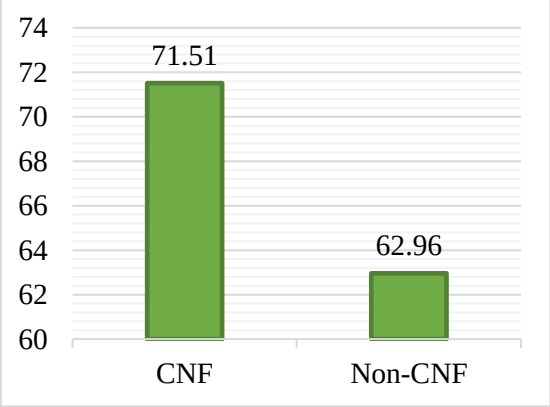
1. How much of PMDS+CNF area of the Kharif season has been cultivated in Rabi season, under PMDS+CNF in relation to non-CNF?
2. What is the impact of PMDS+CNF on the utilisation of the land under the cultivation of PMDS+CNF plot throughout the agricultural year?
3. What is the impact of PMDS+CNF on the employment of labour in crop production?

4. Whether water use by PMDS+CNF farmers has been reduced due to adoption of CNF practices?
5. How much of the dependency on informal credit institutions has been reduced due to the adoption of PMDS+CNF practice?
6. What is the extent of mixed cropping and CNF practices adopted by PMDS+CNF farmers?
7. What is the impact of PMDS+CNF on PNPIs and paid-out costs in Rabi season?
8. How far PMDS+CNF has impacted crop yields grown in Rabi season?
9. Whether PMDS+CNF farmers have received higher prices for their crop outputs over those of non-CNF farmers?
10. How far have the gross and the net values of crop outputs gone up due to PMDS+CNF in relation to non-CNF in Rabi season?

2.3 Pattern of utilization of Land, Labour, Water and Capital Funds

The PMDS+CNF farmers had reported that they were able to cultivate 72 percent of the cultivated area of Kharif PMDS+CNF in Rabi season at the state level, while the farmers of non-CNF had reported that they were able to cultivate 63 per cent of Kharif area under non-CNF in Rabi. Thus, it is evident that farmers were able to utilise more of land cultivated of Kharif, in Rabi season by 9 percentage points due to PMDS+CNF (Figure 2.1 and Annexure Table 2.1). Further, the average area cultivated under CNF in Rabi season in absolute terms as well as a percentage of cropped area in Rabi season has been increasing for the past four years since 2017-18 (Figure 2.2 and Figure 2.3 and Annexure Table 2.2).

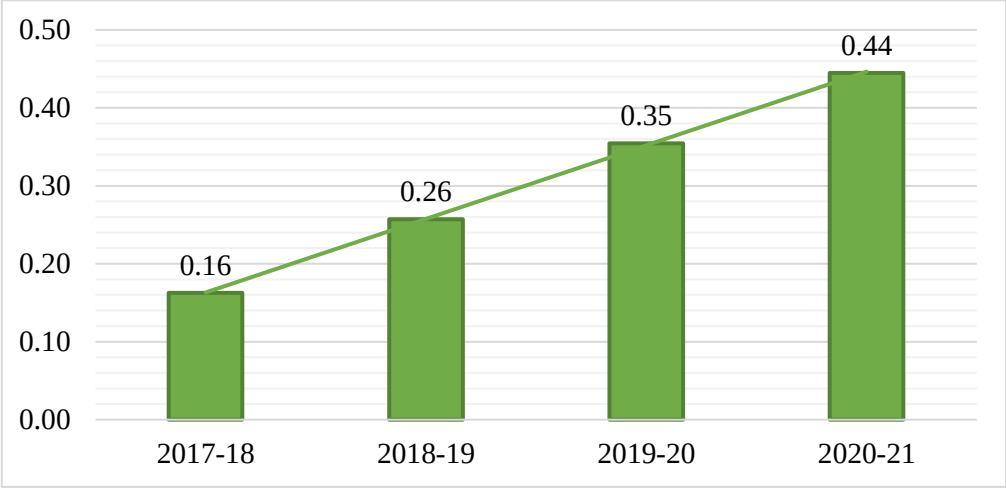
Figure 2.1: Area cultivated in Rabi season as a % of area cultivated in Kharif season



Source: IDSAP Field Survey, 2021

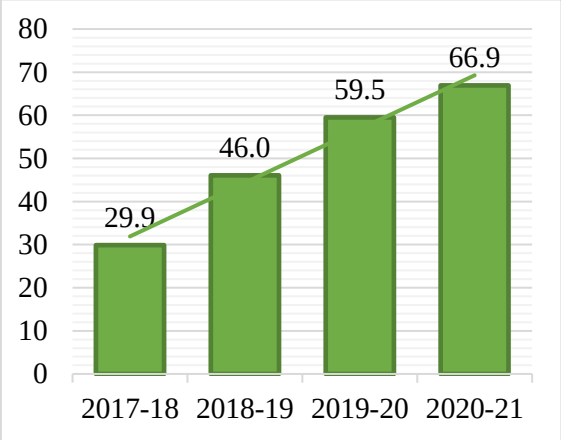
Figure 2.2: Average cultivated area per farmer under CNF in Rabi season during 2017-18 to 2020-21

(in hectare)



Source: IDSAP Field Survey, 2021

Figure 2.3: CNF cultivated area as a % of total cultivated area in Rabi season during 2017-18 to 2020-21

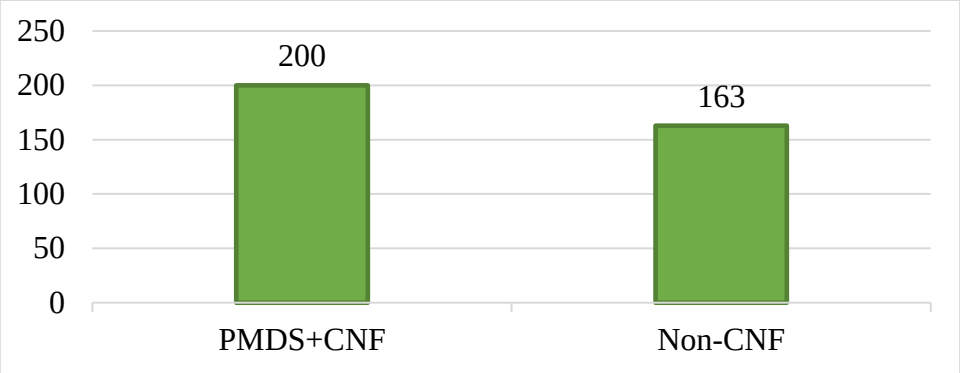


Source: IDSAP Field Survey, 2021

Then the issue in question is how far has the PMDS+CNF contributed to the utilisation of land throughout the agricultural area. A comprehensive picture regarding the utilisation of cultivated land throughout the agricultural year can be captured through the estimation of intensity of cropping. Intensity of cropping is estimated by dividing the gross cropped area by net cropped area and multiplying with hundred. This indicates the number of times the net cropped area has been utilised for growing crops throughout the agricultural year. The data in this regard has revealed that the intensity of cropping was 200 per cent in case of the utilisation of the land by the PMDS+CNF farmers and 163 per cent in case of non-CNF farmers. Thus,

cropped land was put to use two times by PMDS+CNF, while it was used one-and-half times by non-CNF farmers (Figure 2.4 and Annexure Table 2.1). Increased cropping intensity under PMDS+CNF is obvious.

Figure 2.4: Cropping intensity during the agricultural year 2020-21 (%)

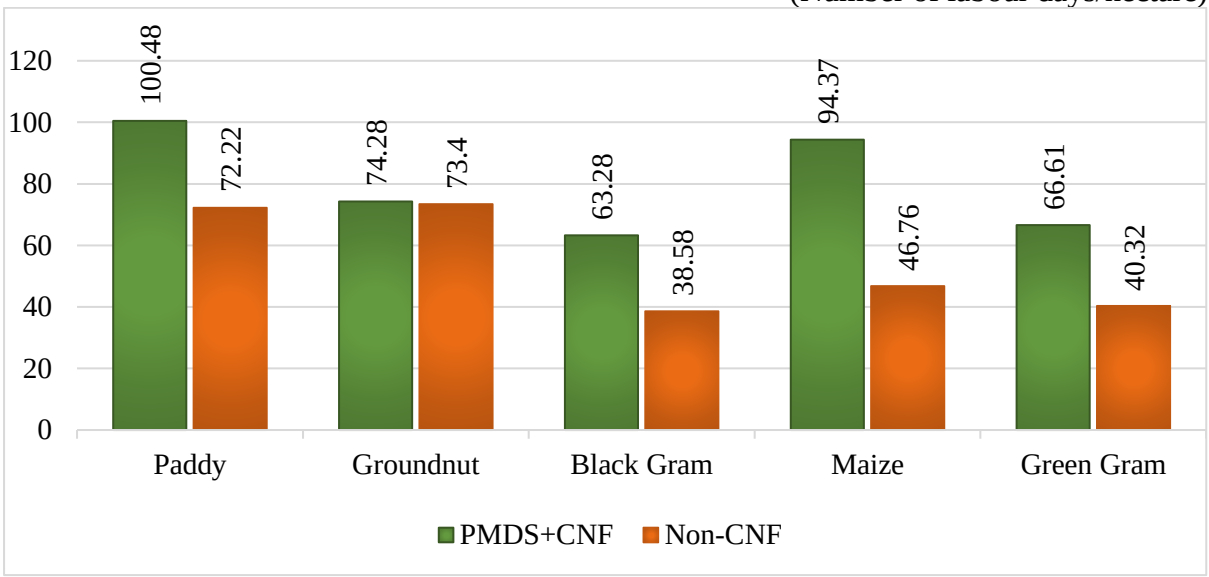


Source: IDSAP Field Survey, 2021

The labour absorption measured in terms of the labour days used per hectare was found to be higher for PMDS+CNF over non-CNF across all the crops considered. This stands as a testimony to the labour-intensive nature of PMDS+CNF. Moreover, it is also evident that the family labour use per hectare was higher in PMDS+CNF in relation to that of non-CNF across all crops (Figure 2.5 and Annexure Table 2.5). This indicates that the natural farming is highly family-labour intensive.

Figure 2.5: Crop-wise number of Human Labour Days (Family and Hired) per hectare used by PMDS+CNF and non-CNF farmers in Rabi Season

(Number of labour days/hectare)

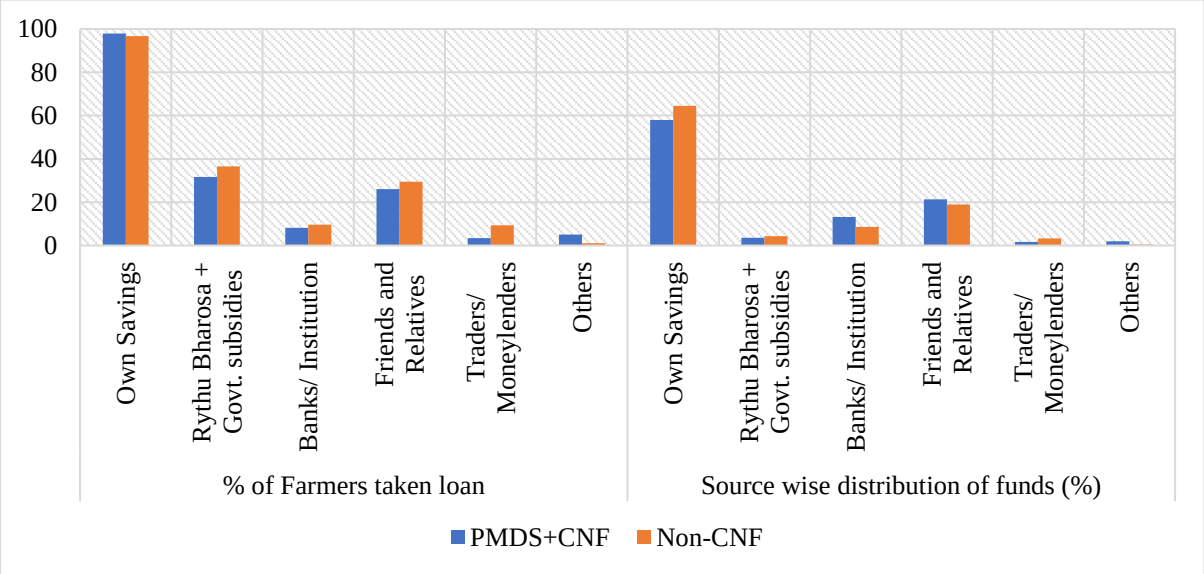


Source: IDSAP Field Survey, 2021

It is striking to note that the share of credit received from the traders/money lenders by the PMDS+CNF farmers was relatively lower by 5 percentage points compared to that of non-CNF farmers (Figure 2.6 and Annexure 2.6). Thus, it is evident that the PMDS+CNF had enabled farmers to reduce their dependency on the exploitative informal institutions for mobilising funds to meet working capital requirements for crop production as well as for other needs of the farmers.

Figure 2.6: Source wise funds mobilised for agriculture and other purposes by PMDS+CNF and Non-CNF farmers in Rabi season

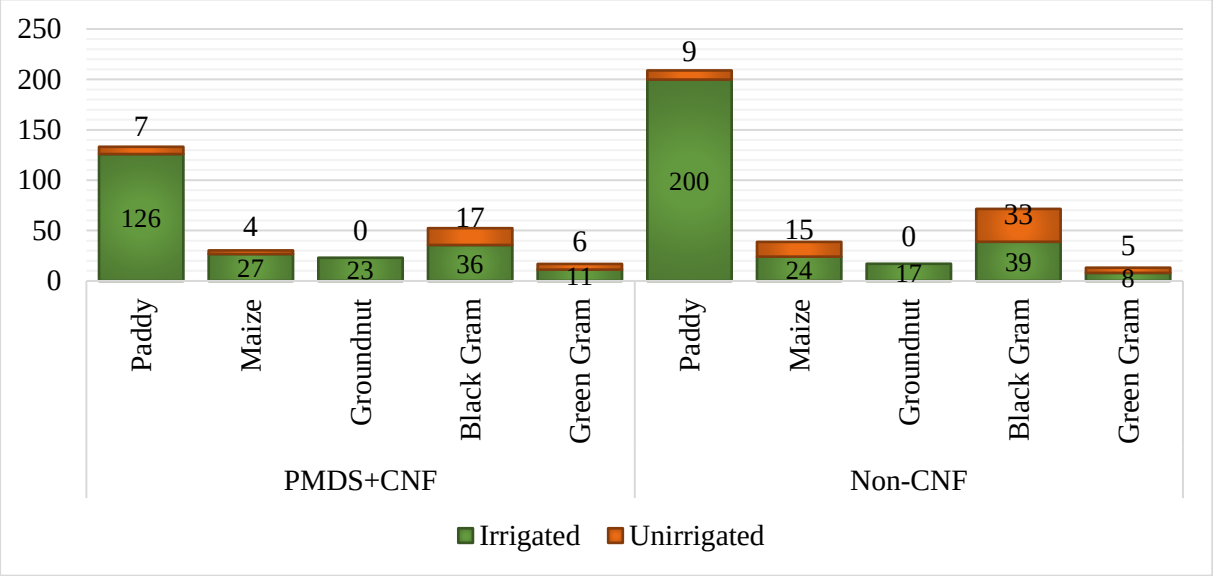
(Percentages)



Source: IDSAP Field Survey, 2021

Larger proportion of cropped area in the Rabi season was irrigated by both the PMDS+CNF and non-CNF farmers (Figures 2.7 and 2.8 and Annexure Tables 2.3). But it is higher for the CNF farmers compared to that of for the non-CNF farmers. Interestingly, the percentage of cultivated area under controlled irrigation (borewell irrigation) in the total cultivated area is higher for CNF farmers in relation to non-CNF farmers across all the crops.

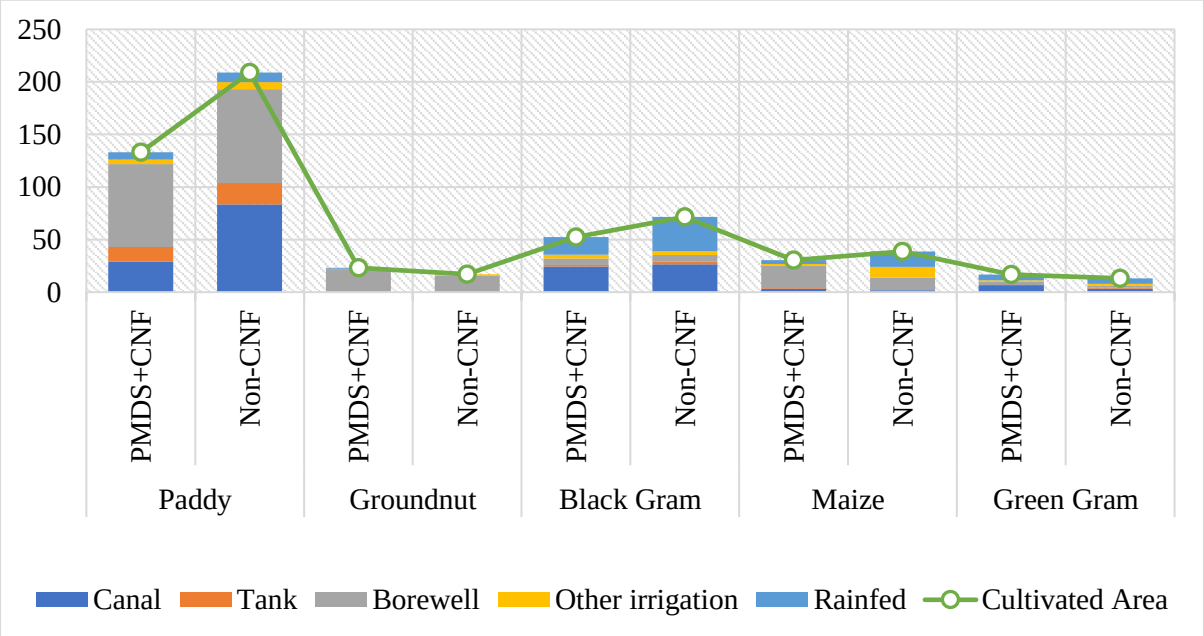
Figure 2.7: Crop wise and irrigation status wise cultivated area by PMDS+CNF and non-CNF farmers in Rabi season



Source: IDSAP Field Survey, 2021

Figure 2.8: Irrigation source wise area under different crops by the PMDS+CNF and non-CNF farmers

In hectare



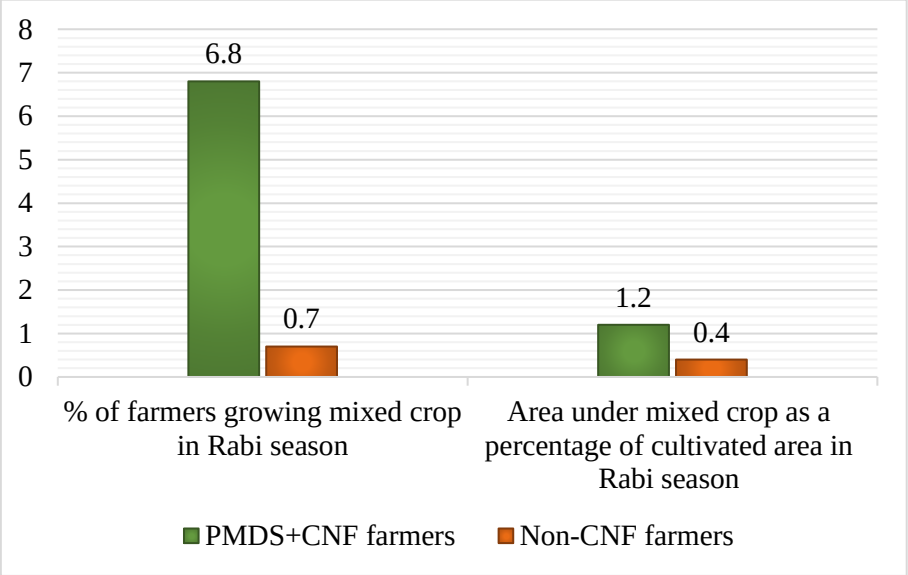
Source: IDSAP Field Survey, 2021

2.4 Pattern of adoption of CNF Practices

The percentage of farmers growing mixed crops and the area put under mixed cropping was higher in percentage terms for the PMDS+CNF farmers over non-CNF farmers (Figure 2.9 and Annexure Table 2.1).

Figure 2.9: Status of Mixed Farming between the PMDS+CNF and non-CNF farmers

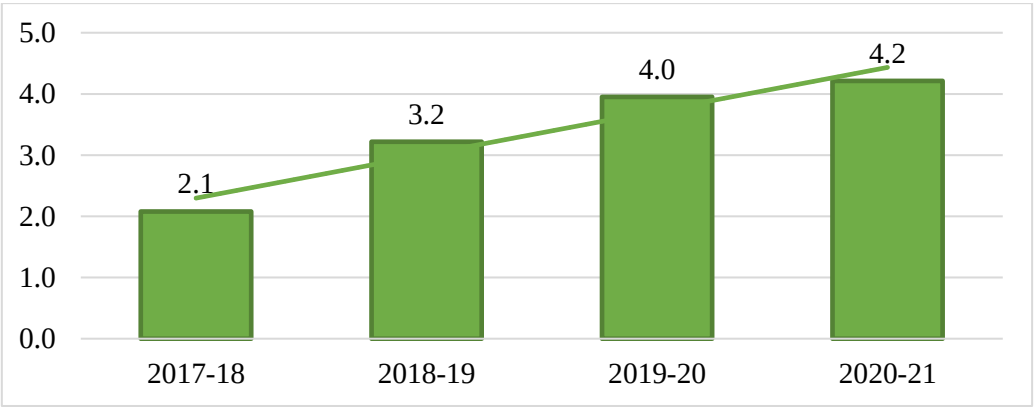
(Percent)



Source: IDSAP Field Survey, 2021

The CNF farmers adopted, on an average, four natural farming practices in Rabi season of 2020-21. Further, it is striking to note that the adoption of number of practices has been increase during the four-year period since 2017-18 (Figure 2.10 and Annexure Table 2.2)

Figure 2.10: Number of CNF practices, on average, adopted by PMDS+CNF farmers in Rabi season



Source: IDSAP Field Survey, 2021

2.5 Costs and Returns of Crops Grown

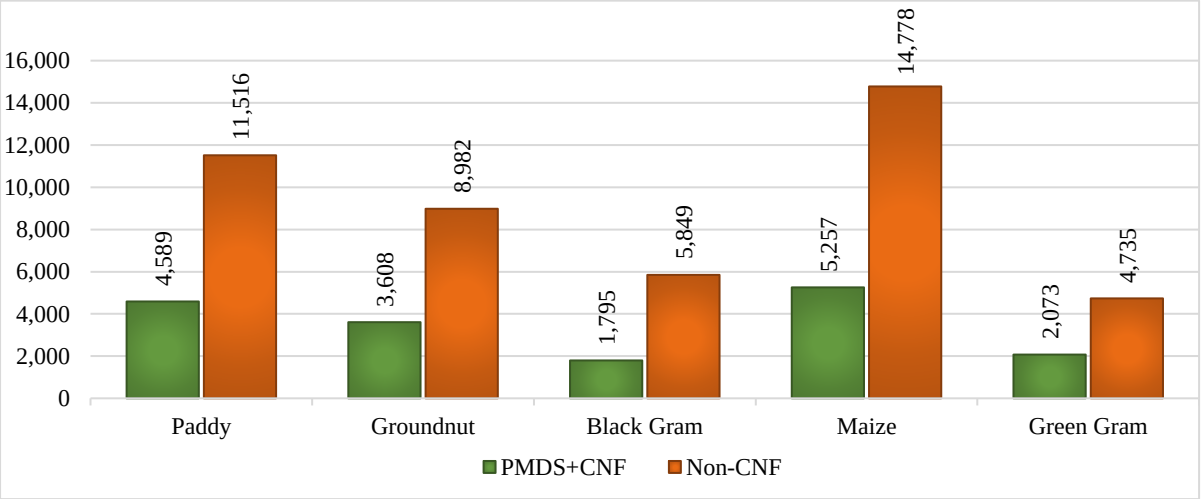
Crop Cutting Estimates (CCEs) were conducted for 10 crops in Rabi season to estimate yields under PMDS+CNF and non-CNF plots for assessing the impact of CNF on yields. But two crops, viz., cotton and chilies spill over to Rabi season from Kharif season did not have adequate sample size. Another three crops namely Jowar, Bengal Gram and Horse gram also do not have adequate number of CCEs. Thus, remaining five crops- Paddy, Groundnut, Black Gram, Maize and Green Gram have reasonable number of CCEs for the impact assessment of CNF on the yields at state level (Annexure Table 2.7). These five crops are considered for the impact analysis on costs and returns of crops in Rabi season. Among the five crops considered, majority of the pulse crops (Black Gram and Green Gram) were grown under unirrigated conditions compared to other crops by both the PMDS+CNF and the non-CNF farmers (Annexure Table 2.8).

2.5.1 Expenditure on Plant Nutrients and Protection Inputs(PNPIs)

The biological inputs under CNF and the chemical inputs under non-CNF, together, are referred to as plant nutrients and protection inputs (PNPIs). The expenditure on PNPIs per hectare was considerably lower for CNF in relation to that of non-CNF across all the crops (Figure 2.11 and Annexure Table 2.9). This indicates that the biological input use under CNF has contributed to the reduction in the expenditure on PNPIs across all the crops substantially. The reduction in the expenditure on input use per hectare had varied between Rs. 2,662 in case of Green Gram and Rs 9521 in case of maize. In percentage terms, it had varied between 56 for Green Gram and 69 for Black Gram. It is interesting to note that the reduction was relatively more per hectare among the input intensive crops such as paddy, groundnut and maize; and lower among the less input intensive crops like Green Gram and Black Gram in absolute terms. Thus, it is clear that the scope for the reduction in expenditure on PNPIs is relatively lower among less input intensive crops such as pulses-Green Gram and Black Gram. On the whole, it is evident that the input- substitution of biological inputs made with local resources for chemical inputs, manufactured externally, had led to substantial cost reduction in growing crops under CNF over non-CNF, the chemical-based agriculture.

Figure 2.11: Crop-wise expenditure on PNPIs incurred during Rabi season under PMDS+ CNF and non-CNF

(Rs. /Hectare)



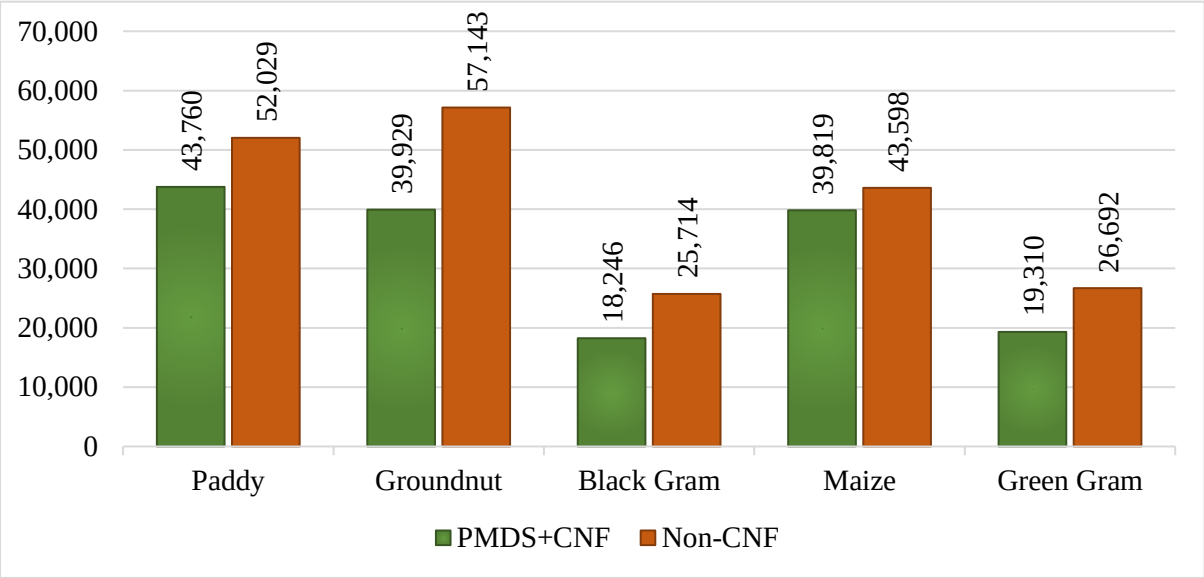
Source: IDSAP Field Survey, 2021

2.5.2 Paid-out costs of cultivation

It is examined whether CNF also reduces costs of other inputs for growing crops, apart from reduction due to input-substitution of biological inputs prepared out of local resources for chemical inputs manufactured externally. The other inputs considered include seeds; human labour; machine labour; bullock labour; implements; farm-yard manure (FYM); and Irrigation. The values of all these purchased and owned items used in the crop cultivation, together, including PNPIs are referred as paid-out costs. The paid-out costs per hectare were lower under CNF over those under non-CNF across all the crops. They were substantially lower among the highly input intensive crops, viz., Groundnut and paddy across all the crops by Rs.17,214; and Rs.8,269 respectively, but the reduction is not much in case of Maize, one of the input intensive crops . The reduction in percentage terms was higher among less input intensive crops such as pulses-green gram and black gram, but in absolute terms was lower in relation to that of input intensive crops, except maize (Figure 2.12, Annexure Table 2.10). The estimate of paid-out cost per quintal of output also gives similar results (Figure 2.13). Thus, CNF has contributed to the reduction in the overall paid costs of growing crops. The yields of these crops have increased over time also (Annexure Table 2.)

Figure 2.12: Crop-wise paid-out costs incurred during Rabi season under PMDS+CNF and non-CNF

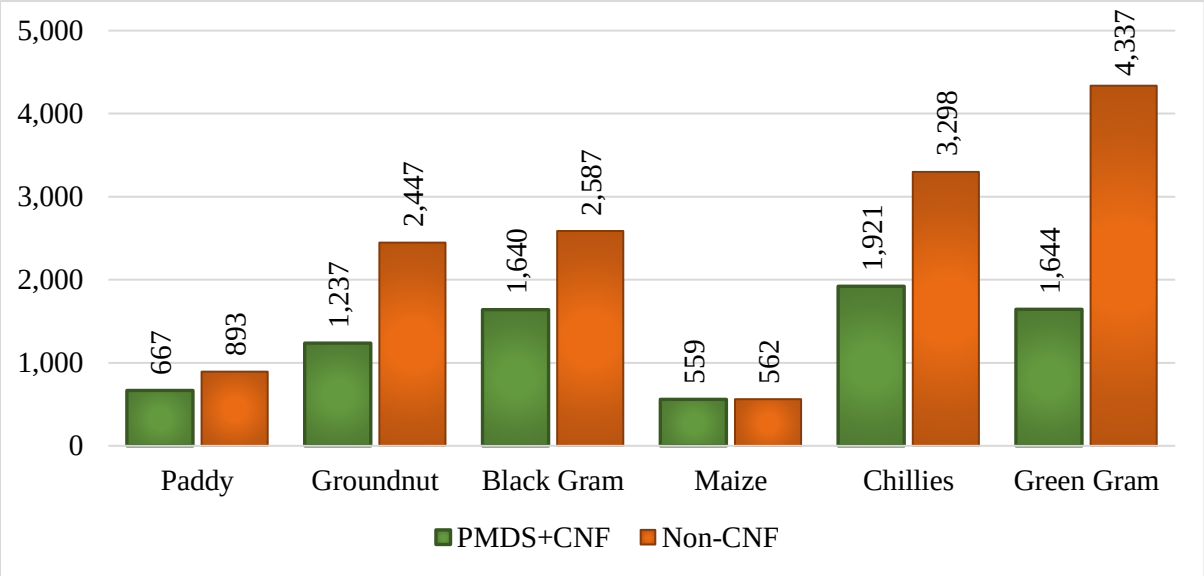
(Rs. /Hectare)



Source: IDSAP Field Survey, 2021

Figure 2.13: Crop wise paid out cost per quintal of output by PMDS+CNF and non-CNF farmers

Rs. / Qtil.



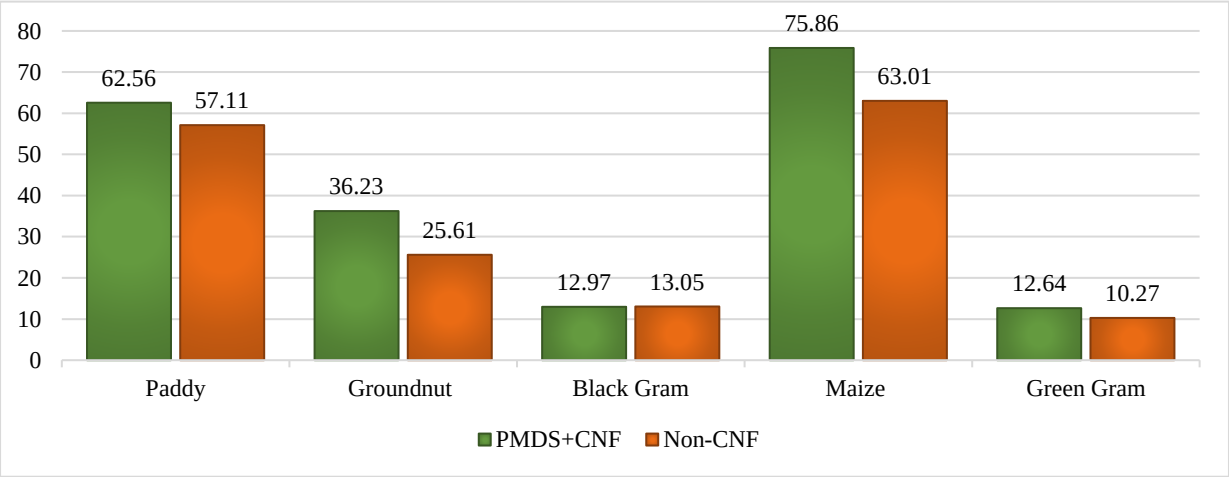
Source: IDSAP Field Survey, 2021

2.5.3 Yields of Crops

The yields, in quintal per hectare, are found to be consistently higher under PMDS+CNF over non-CNF across the four crops-Paddy, Groundnut, Maize and Green Gram from among the five crops considered for the analysis. However, the yield of Black Gram was more or less the same under both the farming situations. This means the yields of the crops are either higher or the same under PMDS+CNF in relation to non-CNF. On the other hand, the paid-out cost per hectare is found to be lower for crops under CNF over non-CNF as noted above. Thus, the higher/ the same yields under PMDS+CNF are obtained at lower paid-out costs per quintal compared to the costs under non-CNF. Therefore, it is clear that the yield response to inputs of PMDS+CNF is higher over that of chemical inputs. Further, the yield response is higher for pulses- Black Gram and Green Gram, and oilseeds-Groundnut compared to cereals- Paddy and Maize (Figure 2.14 and Annexure Table 2.11). By and large, a cursory look into the data on yields in Rabi season over the past three years since 2018-19 shows that the yields of crops increasing and getting stabilized (Figure 2.15).

Figure 2.14: Crop wise yield under CNF and non-CNF in Rabi season

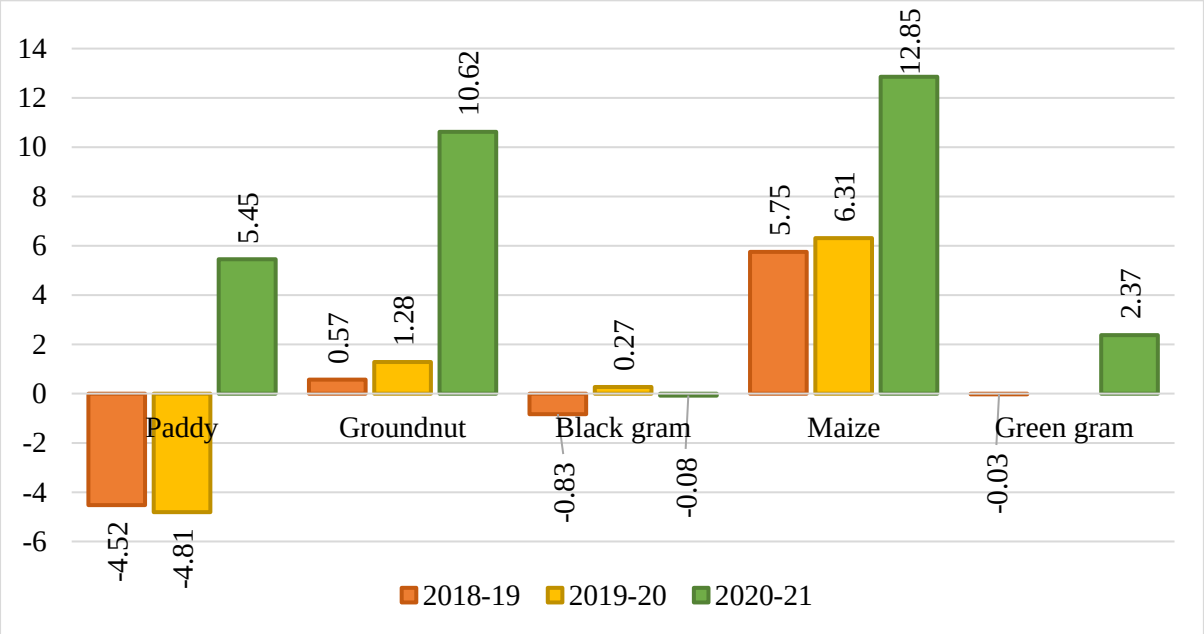
(Quintal/hectare)



Source: IDSAP Field Survey, 2021

Figure 2.15: Year wise differences in CNF and non-CNF yields in select crops during 2018-19 and 2020-21

Qtil. /hectare



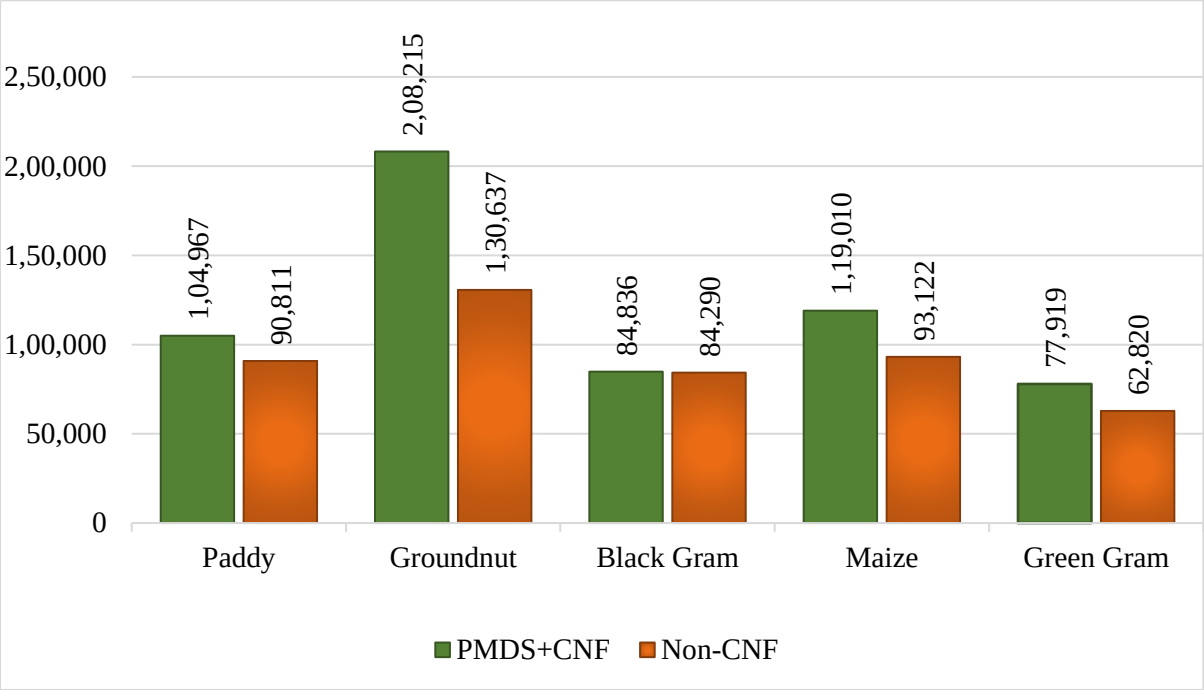
Source: IDSAP Field Survey, 2021

2.5.4 Gross value of output

The gross value of crop output per hectare was estimated as crop output obtained through CCEs multiplied by realized or locally prevailing price reported by the sample farmers plus value of by-products reported by the farmers. This is invariably higher under PMDS+CNF compared to non-CNF across all the crops considered for the analysis (Figure 2.16 and Annexure 2.12). It may be due to higher prices obtained for PMDS+CNF crop output in relation to those of non-CNF, given the higher yields achieved under PMDS+CNF. However, the data revealed that the realized prices per quintal were lower for PMDS+CNF over non-CNF in case of pulse crops (Figure 2.17 and Annexure Table 2.13). This means the yield has contributed to the higher gross value of output in case of pulses such as - Black Gram and Green Gram, while yield and prices together have contributed to higher gross value of output in case of cereals such as - Paddy and Maize and oil seeds such as Groundnut under PMDS+CNF.

Figure 2.16: Crop wise gross value of CNF and non-CNF output and differences between them

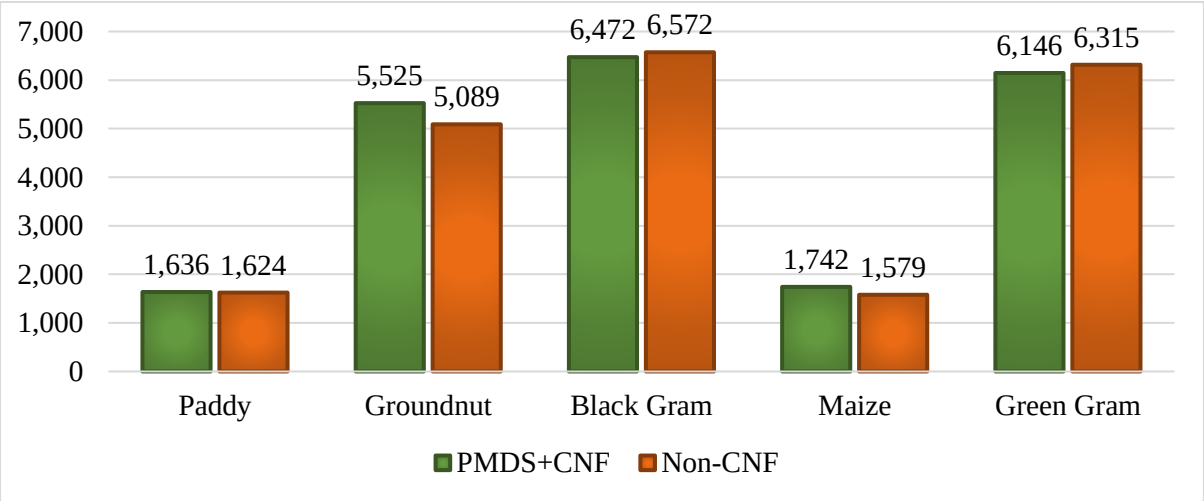
(Rs./Hectare)



Source: IDSAP Field Survey, 2021

Figure 2.17: Crop wise Price realised by the PMDS+CNF and non-CNF farmers

Rs. /Qtil



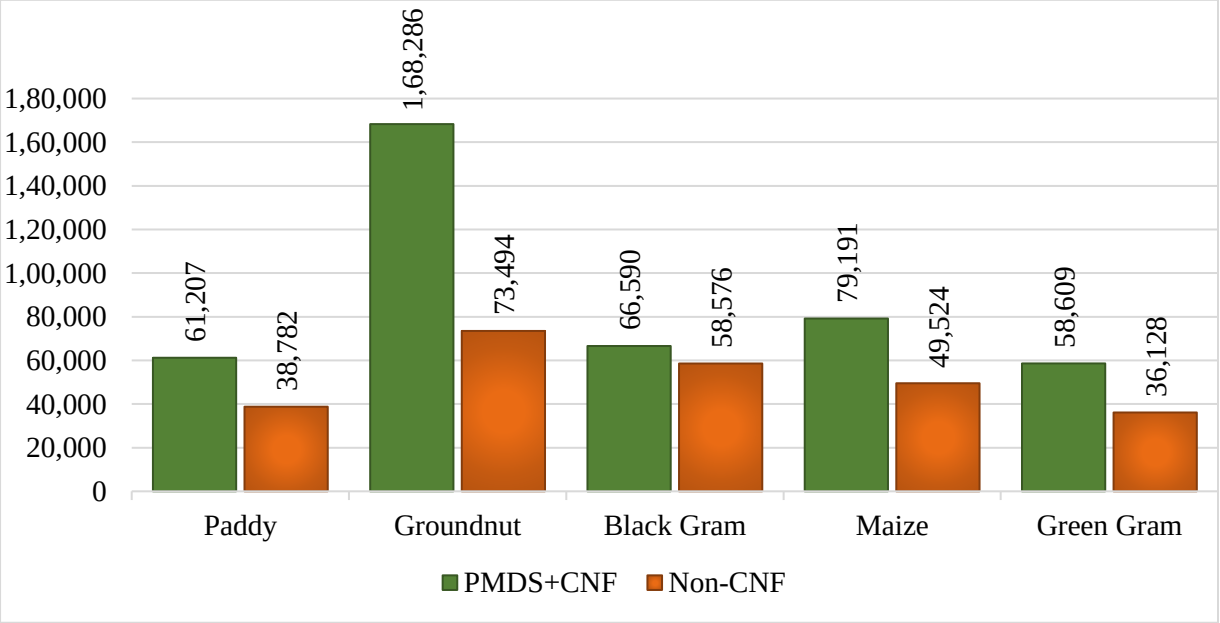
Source: IDSAP Field Survey, 2021

2.5.5 Net value of output

The crop wise net values of output were obtained by subtracting the paid-out cost of a crop from the gross value of that crop. The net value of output of crops grown under PMDS+CNF is invariably higher than those grown under non-CNF, across all five crops considered for the analysis (Figure 2.18 and Annexure Table 2.14). This indicates that lower paid-out costs have contributed consistently for the higher net value of output under PMDS+CNF over non-CNF. Thus, it is evident that the lower paid-out costs in case of all crops; higher yields and realized prices in case of cereals-paddy and maize and oil seeds-groundnut; and yields in case of pulse crops- black gram and green gram have contributed to the higher net value of crop outputs under PMDS+CNF over non-CNF.

Figure 2.18: Crop wise net value of CNF and non-CNF outputs and differences between them

(Rs./Hectare)



Source: IDSAP Field Survey, 2021

2.6 Conclusions

The reduction in cost of cultivation due to CNF acts as a hedge against the fluctuating prices in output markets. Farmers can protect themselves from the risk of falling prices as the reduced costs of growing crops ensure minimum net returns from the crops. The increased yields, under CNF also reduce cost of production per unit of the crop and thereby protect farmers from falling

prices of crop outputs in obtaining minimum net value of output. Thus, reduction in the cost of growing crops either due to reduction in the paid-out costs or due to increase in the yields of crops enables farmers to cope up with the output price risks. Hence, reduction in paid-out costs due to increased yields ensure protection of farmers from the falling prices. CNF contributes to agricultural output growth. Increased adoption of CNF practices are the pointers to the increased yields of crops grown under CNF and thereby increased agricultural growth over time. The increased area in Rabi season as percentage of Kharif cropped area is also a pointer to the increased area under crop cultivation The increased yields coupled with expansion in the cropped area is an indicator of agricultural growth. Thus, the dynamics in the utilization of factors of production, coupled with the gains in the cost and returns of crops demonstrate the potential of CNF in the years to come. The potential of CNF ensures strong linkages between agricultural growth and farmers well-being, in contrast to the growth of chemical-based agriculture (non-CNF).

Annexure to Chapter 2

Annexure Table 2.1: Utilisation of cultivated Land in Rabi season by PMDS+CNF and non-CNF farmers

Sl. no	Indicators	PMDS+CNF farmers	Non-CNF farmers
1.	% of farmers growing crops in Rabi season	72.5	77.5
2.	Area cultivated in Rabi season as a % of area cultivated in Kharif season	71.51	62.96
3.	Cropping intensity during the agricultural year 2020-21 (%)	200	163
4.	% of farmers growing mixed crop in Rabi season	6.8	0.7
5.	Area under mixed crop as a percentage of cultivated area in Rabi season	1.2	0.4

Source: IDSAP Field Survey, 2021

Annexure Table 2.2: Utilisation of Cultivated Land in Rabi season by PMDS+CNF farmers during Agricultural years 2017-18 to 2020-21

Indicators	2017-18	2018-19	2019-20	2020-21
Cultivated area under CNF in Rabi season, on average, in hectare	0.16	0.26	0.35	0.44
CNF cultivated area as a % of total cultivated area in Rabi season	29.88	46.03	59.52	66.91
Number of CNF practices, on average, adopted by PMDS+CNF farmers in Rabi season	2.08	3.22	3.95	4.21

Source: IDSAP Field Survey, 2021

Annexure Table 2.3: Area cultivated under different sources of irrigation by the PMDS+CNF and non-CNF farmers during Rabi season (%)

Sl. no	Source of irrigation	Area cultivated (%)	
		PMDS+CNF	Non-CNF
a.	Canal	22.89	30.94
b.	Tank	6.77	5.83
c.	Borewell	50.95	34.31
d.	Other irrigation	4.82	6.08
e.	Not irrigated (Rainfed)	14.57	22.83

Note: Other irrigation sources include lift irrigation, other well, stream, and purchasing water.

Source: IDSAP Field Survey, 2021

Annexure Table 2.4: Crop wise and irrigation status wise cultivated area by PMDS+CNF and non-CNF farmers in Rabi season

Crop	PMDS+CNF			Non-CNF		
	Cultivated Area (in hectare)	Percentage of cultivated area		Cultivated Area (in hectare)	Percentage of cultivated area	
		Irrigated	Unirrigated		Irrigated	Unirrigated
Paddy	133.16	94.58	5.42	208.89	95.67	4.33
Maize	30.32	88.12	11.88	38.76	62.24	37.76
Groundnut	23.03	100.00	0.00	17.05	100.00	0.00
Black Gram	52.37	68.15	31.85	71.51	54.44	45.56
Green Gram	16.88	66.79	33.21	13.15	60.76	39.24

Source: IDSAP Field Survey, 2021

Annexure Table 2.5: Crop-wise number of Human Labour days (Family and Hired) per hectare used by PMDS+CNF and non-CNF farmers in Rabi Season

(Number/hectare)

Crop	PMDS+CNF			Non-CNF		
	Family Labour Days (per hectare)	Casual Labour Days (per hectare)	Total Labour days (per hectare)	Family Labour Days (per hectare)	Casual Labour Days (per hectare)	Total Labour days (per hectare)
Paddy	58.02	42.46	100.48	34.05	38.17	72.22
Groundnut	37.28	37.00	74.28	23.88	49.52	73.40
Black Gram	44.36	18.92	63.28	22.54	16.03	38.58
Maize	43.91	50.46	94.37	23.97	22.79	46.76
Green Gram	50.64	15.97	66.61	24.31	16.01	40.32

Source: IDSAP Field Survey, 2021

Annexure Table 2.6: Source wise funds mobilised for agriculture and other purposes by PMDS+CNF and Non-CNF farmer in Rabi season

(Percentages)

Source	PMDS+CNF		Non-CNF	
	% of Farmer	Source wise distribution of funds (%)	% of Farmer	Source wise distribution of funds (%)
Own Savings	97.9	58.00	96.7	64.44
Rythu Bharosa + Govt. subsidies	31.7	3.66	36.5	4.26
Banks/ Institution	8.1	13.26	9.7	8.61
Friends and Relatives	26.0	21.32	29.5	18.90
Traders/ Moneylenders	3.5	1.73	9.4	3.34
Others	5.0	2.03	1.0	0.43

Source: IDSAP Field Survey, 2021

Annexure Table 2.7: Crop wise number of CCEs conducted during Rabi season

Crop	PMDS+CNF	Non-CNF	Total
Paddy	131	102	233
Groundnut	38	36	74
Cotton	16	10	26
Chillies	8	17	25
Maize	65	13	78
Bengal Gram	13	3	16
Green Gram	23	16	39
Horse Gram	0	5	5
Black Gram	57	26	83
Jowar	5	6	11
Total	356	234	590

Source: IDSAP Field Survey, 2021

Annexure Table 2.8: Area cultivated by PMDS+CNF and non-CNF farmers in Rabi season according to crop and irrigation status

	PMDS+CNF						Non-CNF					
	Cultivated Area in hectare	Percentage of cultivated area					Cultivated Area in hectare	Percentage of cultivated area				
Crop		Rainfed	Canal	Tank	Borewell	Others		Rainfed	Canal	Tank	Borewell	Others
Paddy	133.16	5.42	21.67	10.61	59.15	3.15	208.89	4.33	39.92	9.76	42.75	3.24
Groundnut	23.03	3.25	.00	2.64	92.36	1.76	17.05	.00	5.93	.00	84.57	9.49
Black Gram	52.37	31.85	46.32	3.40	11.24	7.19	71.51	45.56	36.93	3.68	8.74	5.08
Maize	30.32	11.88	11.34	2.00	69.44	5.34	38.76	37.76	5.12	.00	30.59	26.54
Green Gram	16.88	33.21	38.97	.00	17.99	9.83	13.15	39.24	25.33	6.16	17.39	11.88

Source: IDSAP Field Survey, 2021

Annexure Table 2.9: Crop-wise expenditure on PNPIs incurred during Rabi season under PMDS+ CNF and non-CNF

(Rs. /Hectare)

	PMDS+CNF	Non-CNF	Difference in Rs.	Difference in %
1	2	3	4 (2-3)	5 (4/3*100)
Paddy	4,589	11,516	-6,927	-60.15
Groundnut	3,608	8,982	-5,374	-59.83
Black Gram	1,795	5,849	-4,054	-69.31
Maize	5,257	14,778	-9,521	-64.42
Green Gram	2,073	4,735	-2,662	-56.21

Source: IDSAP Field Survey, 2021

Annexure Table 2.10: Crop-wise paid-out costs incurred during Rabi season under PMDS+CNF and non-CNF

(Rs. /Hectare)

Crop	PMDS+CNF	Non-CNF	Difference in Rs.	Difference in %
1	2	3	4 = (2-3)	5 = (4/3*100)
Paddy	43,760	52,029	-8,269	-15.89
Groundnut	39,929	57,143	-17,214	-30.12
Black Gram	18,246	25,714	-7,468	-29.04
Maize	39,819	43,598	-3,779	-8.67
Green Gram	19,310	26,692	-7,382	-27.66

Source: IDSAP Field Survey, 2021

Annexure Table 2.11: Crop wise yield under CNF and non-CNF in Rabi season

(Quintal/hectare)

Crop	PMDS+CNF	Non-CNF	Difference in Qtil.	Difference in %
1	2	3	4 = (2-3)	5 = (4/3*100)
Paddy	62.56	57.11	5.44	9.53
Groundnut	36.23	25.61	10.62	41.46
Black Gram	12.97	13.05	-0.07	-0.57
Maize	75.86	63.01	12.85	20.40
Green Gram	12.64	10.27	2.37	23.13

Source: IDSAP Field Survey, 2021

Annexure Table 2.12: Crop wise gross value of output of PMDS+CNF and non-CNF in Rabi season

(Rs. /Hectare)

Crop	PMDS+CNF	Non-CNF	Difference in Rs.	Difference in %
1	2	3	4 = (2-3)	5 = (4/3) *100
Paddy	1,04,967	90,811	14,156	15.59
Groundnut	2,08,215	1,30,637	77,579	59.39
Black Gram	84,836	84,290	546	0.65
Maize	1,19,010	93,122	25,888	27.80
Green Gram	77,919	62,820	15,099	24.03

Source: IDSAP Field Survey, 2021

Annexure Table 2.13: Crop wise price realized, on average, for CNF and non-CNF crops in Rabi season

(Rs. /Qtil.)

Crop	PMDS+CNF	Non-CNF	Difference in Rs.	Difference in %
1	2	3	4 = (2-3)	5 = (4/3*100)
Paddy	1,636	1,624	12	0.74
Groundnut	5,525	5,089	435	8.55
Black Gram	6,472	6,572	-100	-1.53
Maize	1,742	1,579	163	10.34
Green Gram	6,146	6,315	-169	-2.67

Source: IDSAP Field Survey, 2021

Annexure Table 2.14: Crop wise net value of output of PMDS+CNF and non-CNF in Rabi season

(Rs. /Hectare)

Crop	PMDS+CNF	Non-CNF	Difference in Rs.	Difference in %
1	2	3	4 = (2-3)	5 = (4/3*100)
Paddy	61,207	38,782	22,425	57.82
Groundnut	1,68,286	73,494	94,793	128.98
Black Gram	66,590	58,576	8,014	13.68
Maize	79,191	49,524	29,667	59.90
Green Gram	58,609	36,128	22,481	62.23

Source: IDSAP Field Survey, 2021

Chapter 3

Impact of PMDS+CNF on the farming conditions in Rabi Season in different Agroclimatic Zones

3.1 Introduction

The analysis in the preceding chapter reveals that intensity of cropping and yield of crops grown under CNF have been higher than those of non-CNF. The increase in yields have been achieved at lower paid-out costs that resulted in higher gross and net value of output of crops grown under CNF over non-CNF at the realised prices of crop outputs in Rabi season. These issues also need to be analysed for different agroclimatic zones in the state to examine whether this impact of CNF has varied across agroclimatic zones and whether farmers from dominant rainfall dependent zones, viz., north coastal, scarce rainfall and southern, gained from CNF along with other agroclimatic zones- Godavari and Krishna. In this context, this chapter addresses to the following objectives:

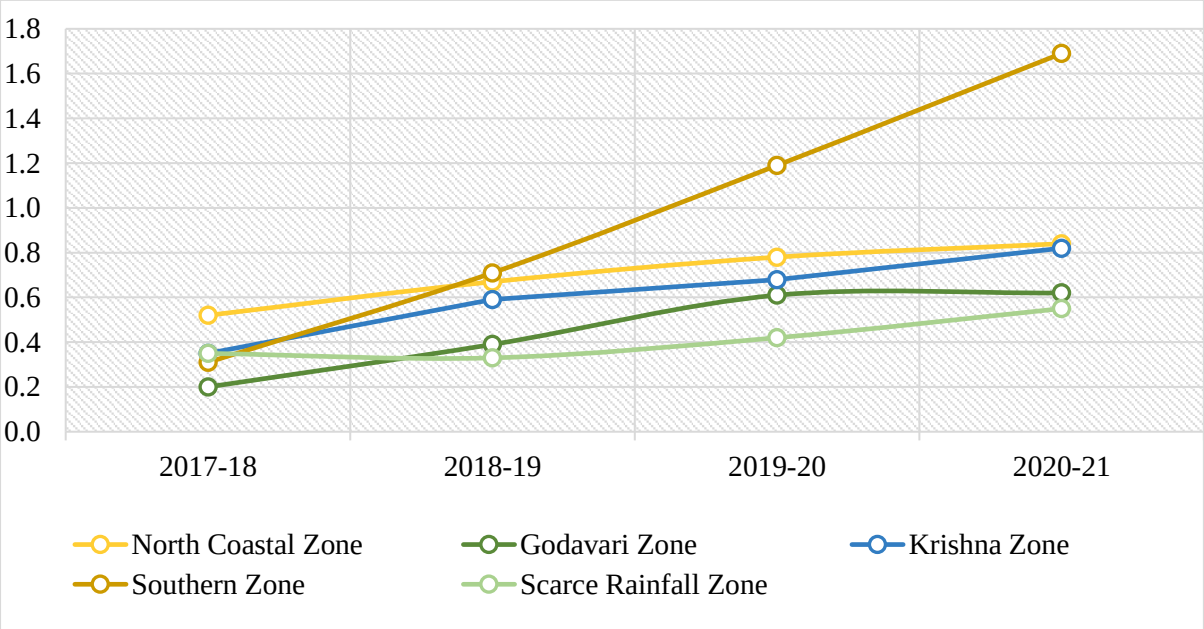
1. Whether pattern of utilisation of land, labour, water, and capital funds to grow crops differs between CNF and non-CNF farmers across the agroclimatic zones?
2. How far pattern of adoption of CNF practices by CNF farmers varies across zones?
3. What was the impact of the pattern of utilisation of factors of production and adoption of CNF practices, on paid out costs, yields, and gross and net value of output across different agroclimatic zones?
4. Whether CNF farmers from high rainfall zones, (north coastal, southern), and scarce rainfall zones (Rayalaseema) have derived benefits of CNF on par with those of highly irrigated zones namely Godavari and Krishna?

3.2 Pattern of utilisation of Land, Labour, Water and Capital Funds

The cultivated area per farmer under CNF in Rabi season has increased over agricultural years of 2017-21 across all the agroclimatic zones (Figure 3.1 and Annexure Table 3.1). It also has increased as a percentage of cultivated area per farmer during the same period in all the zones (Figure 3.2 and Annexure Table 3.2). But the area cultivated in Rabi season as a percentage of Kharif cultivated area is lower for the CNF farmers compared to the non-CNF farmers across all the zones except southern zone during the agricultural year 2020-21 (Figure 3.3 and Annexure Table 3.3). This is because farmers from the north coastal zones traditionally grow

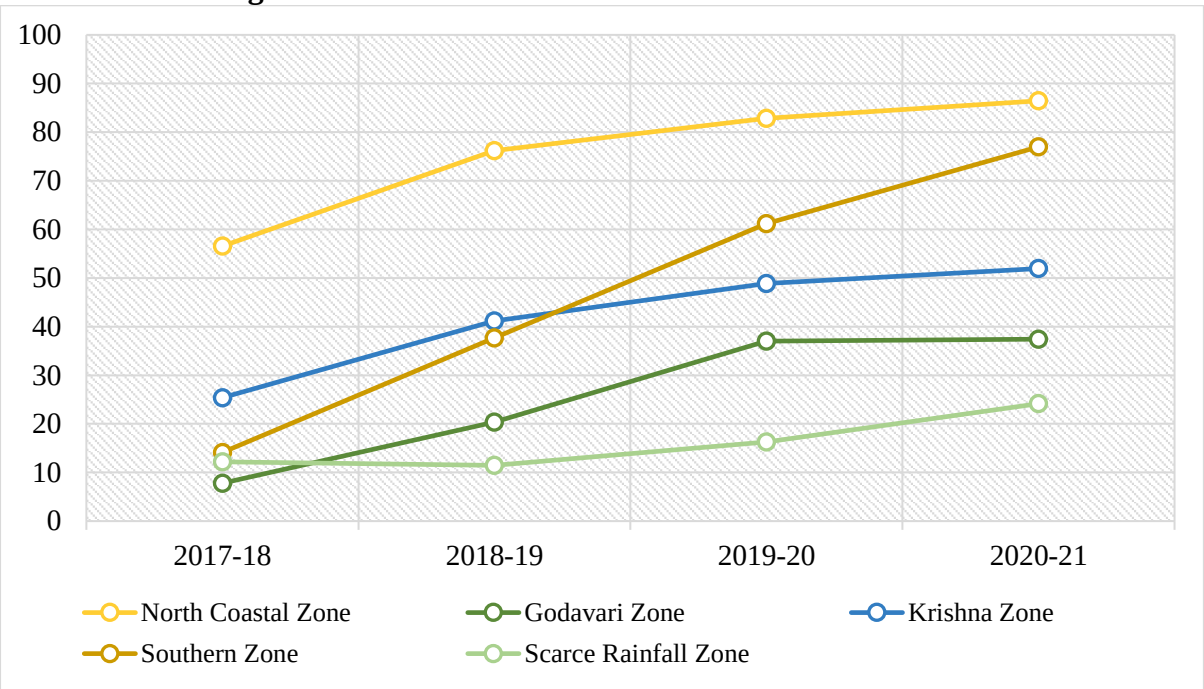
crops in Rabi with diversified cropping pattern. Similarly, the Godavari and Krishna zones with dominant canal irrigation base, farmers grow crops in Rabi season as grown in Kharif season. The Rayalaseema district that are in Southern and Scarce Rainfall zones who dominantly depend on borewell irrigation to raise crops in Rabi also, but not to the extent as grown Kharif. However, the intensity of cropping for the agricultural year 2020-21 was higher for the CNF farmers over non-CNF farmers across all the zones (Figure 3.4 and Annexure Table 3.4). This is because, the CNF farmers, unlike non-CNF farmers, have grown crops in pre-Kharif, Kharif, Pre-Rabi and Rabi throughout the agricultural year under CNF across all the zones. Moreover, the increase in area cultivated per farmer in Rabi season has increased considerably for CNF farmers across all the zones particularly in the last two agricultural years, 2019-20 and 2020-21, compared to the first two years-2017-18 and 2018-19, during which the PMDS has spread among the farmers in all the zones. Thus, PMDS has contributed to the increase in intensive use of land to grow crops. However, the farmers in the scarce rainfall have lagged behind in the intensive use of cultivated land, compared to other zones. It is noteworthy that the intensive use of cultivated land by CNF farmers from southern zone (rainfall dependent zone) is as much as that of those from Godavari zone. This indicates the potential of PMDS +CNF in promoting intensive use of cultivated land in rainfall dependent zones. However, there is a need to focus on the spread of PMDS in scarce rainfall zone to improve the intensive use of land.

Figure 3.1: Agroclimatic zone wise cultivated area under CNF in Rabi season, on average, in Acres, during 2017-18 to 2020-21



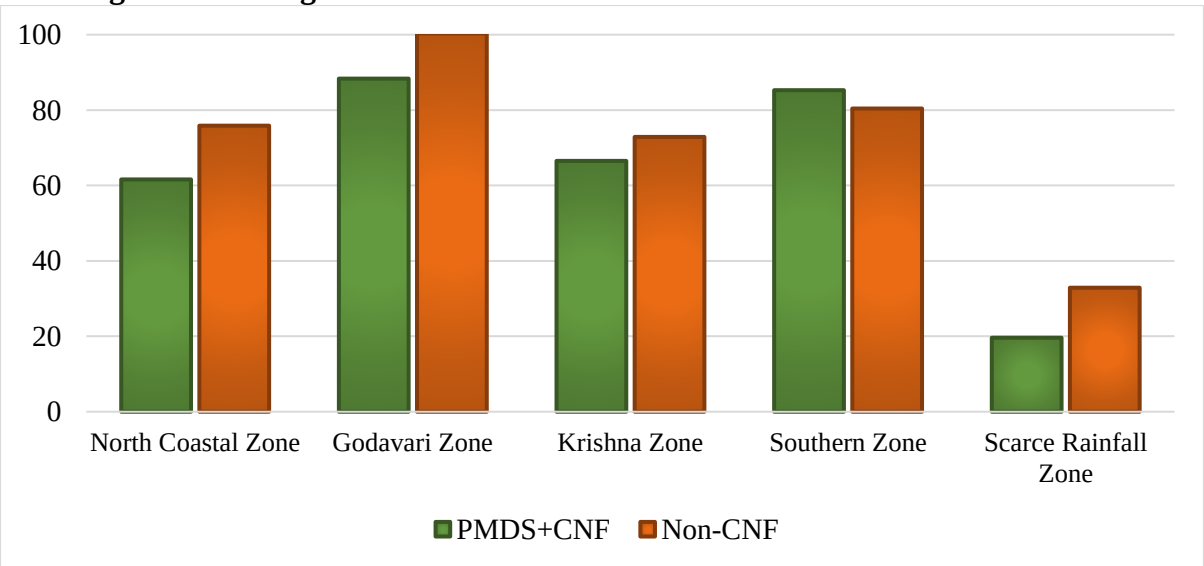
Source: IDSAP Field Survey, 2021

Figure 3.2: Agroclimatic zone wise CNF cultivated area as a % of total cultivated area in Rabi season during 2017-18 to 2020-21



Source: IDSAP Field Survey, 2021

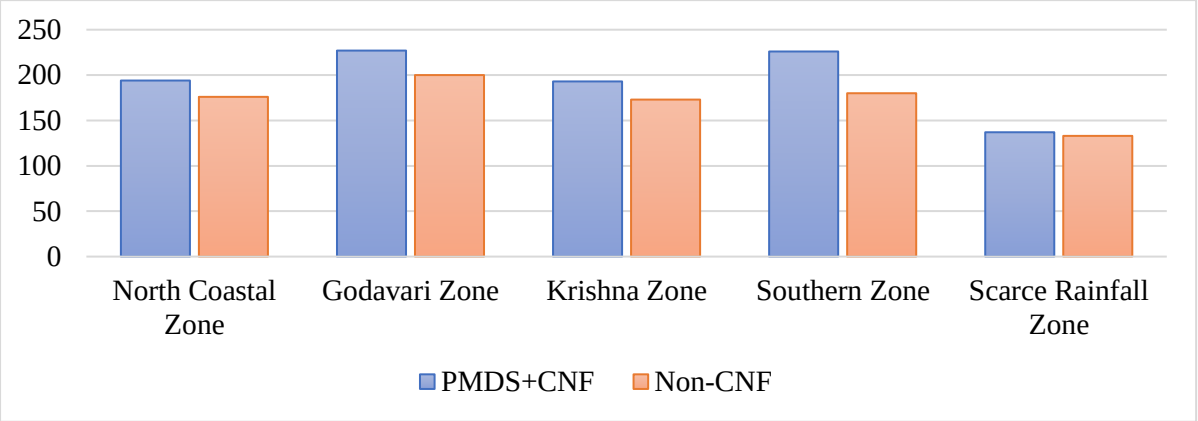
Figure 3.3: Area cultivated in Rabi season as a % of area cultivated in Kharif season across agroclimatic regions



Source: IDSAP Field Survey, 2021

Figure 3.4: Cropping intensity across agroclimatic zones during the agricultural year 2020-21

In percent

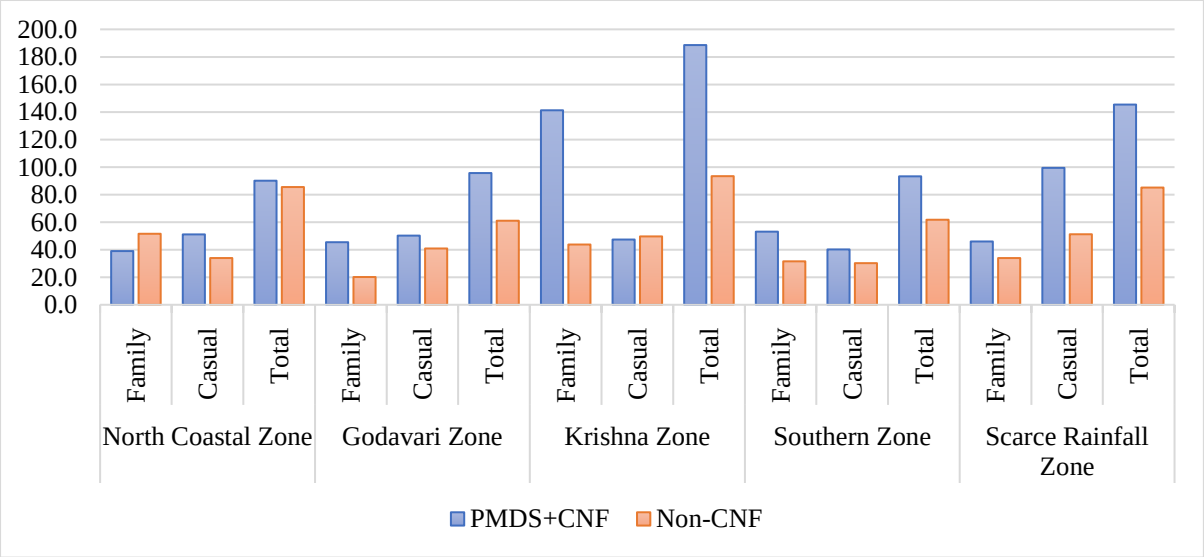


Source: IDSAP Field Survey, 2021

The use of labour (hired and family) is higher under CNF compared to that of non-CNF farmers in case of paddy crop grown under irrigated conditions across all the zones (Figure 3.5 and Annexure Table 3.5). This indicates that human labour has been intensively used by CNF farmers compared to non-CNF farmers across all the zones. This again reiterates the labour-intensive nature of CNF. It indicates increased demand for labour across all the zones, more so in the scarce rainfall zone under PMDS+CNF. The has implication to the paid-out cost of growing paddy.

Figure 3.5: Agroclimatic zone wise number of Human Labour Days (Family and Hired) per hectare used by PMDS+CNF and non-CNF Paddy farmers in Rabi Season

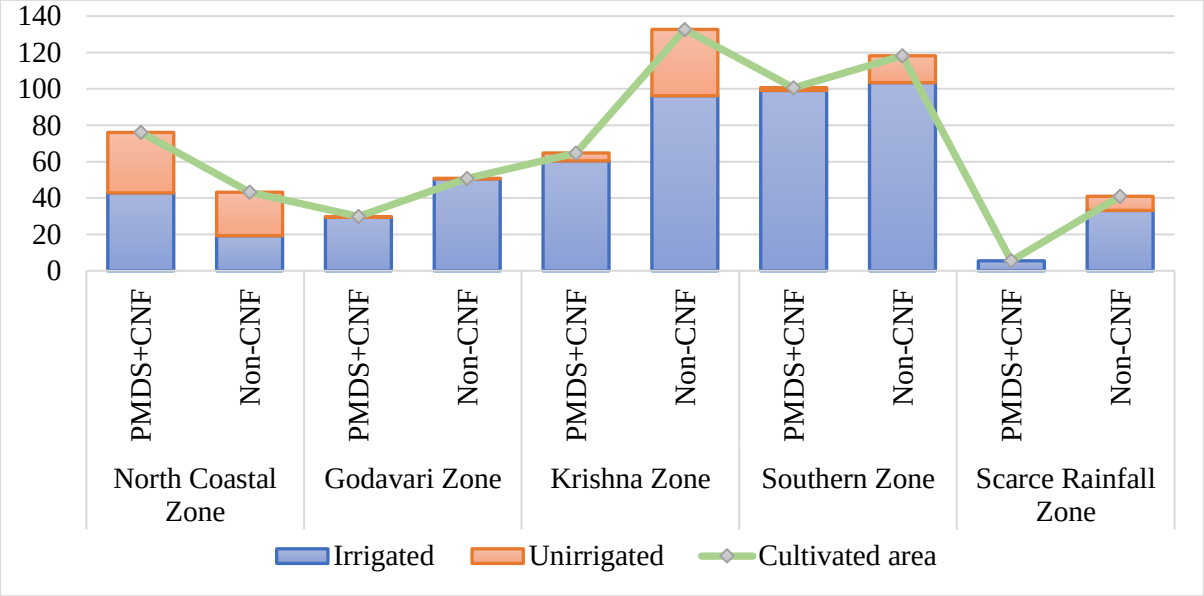
(Number/hectare)



Source: IDSAP Field Survey, 2021

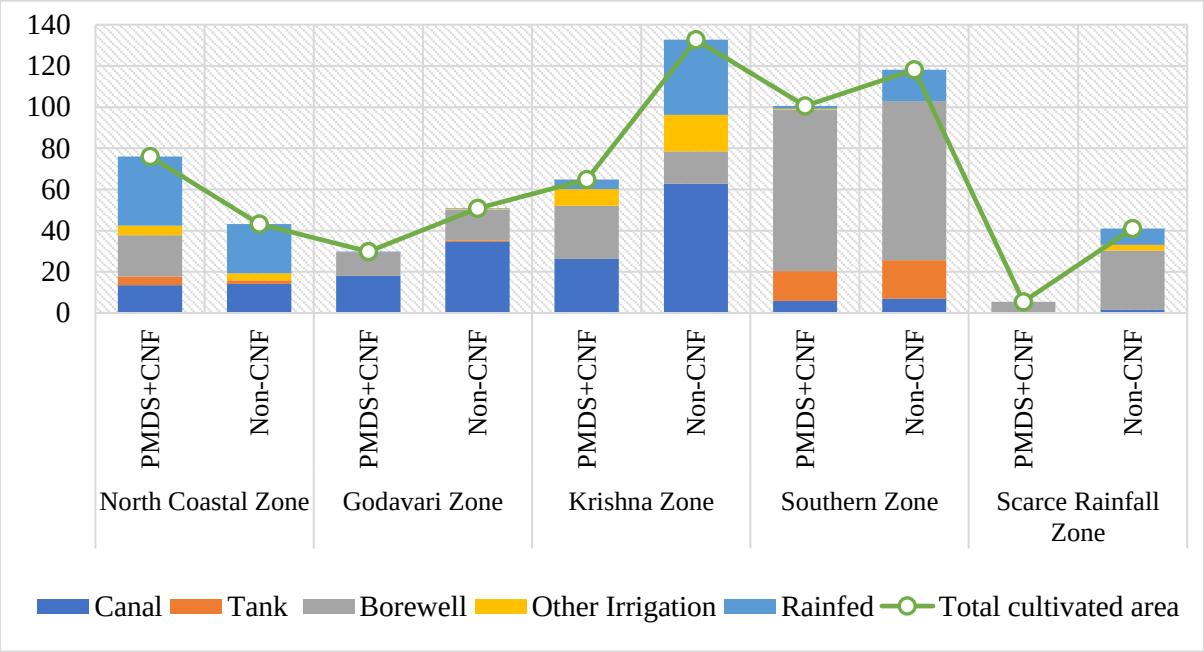
The cultivated area under irrigated conditions is pronounced for the CNF farmer compared to non-CNF farmers across all the zones except Godavari zone (Figure 3.6 and Annexure 3.11). Further, the area under controlled irrigation such as borewell irrigation is higher for the CNF farmers compared to the non-CNF farmers across all the zones (Figure 3.7 and Annexure 3.12).

Figure 3.6: Agroclimatic zone wise and irrigation status wise cultivated area by PMDS+CNF and non-CNF farmers in Rabi season



Source: IDSAP Field Survey, 2021

Figure 3.7: Agroclimatic zone wise and irrigation source wise total area under cultivation in Rabi season



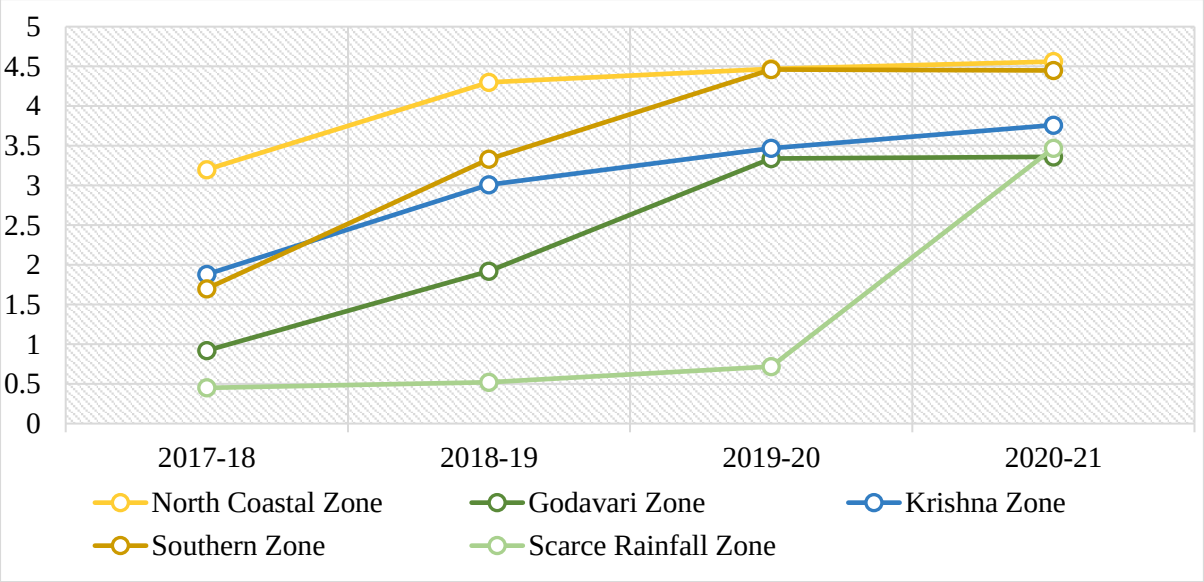
Source: IDSAP Field Survey, 2021

The dependency, measured in percentage of farmers and funds mobilised for meeting expenditure on agricultural operations and household needs, on informal credit institution such as traders/money lenders is lower for CNF farmers over non-CNF farmers across all the zones except southern and scarce rainfall zones (Annexure Tables 3.6 and 3.7). The reduced dependency of PMDS+CNF farmers may contribute to the lower paid out costs as the interest on working capital is lower due to mobilisation of funds from relatively low- cost credit sources.

3.3 Pattern of adoption of CNF practices

The number of CNF practices adopted by CNF farmers has been on the increase during the agricultural years 2017-21 in all the zones (Figure 3.8 and Annexure Table 3.8). The percentage of farmers growing mixed crops and percentage of area under mixed crop allocated by the farmers under CNF indicate that the mixed cropping has to pick up in all the zones (Annexure Tables 3.9 and 3.10).

Figure 3.8: Number of CNF practices, on average, adopted by PMDS+CNF farmers across agroclimatic zones in Rabi season



Source: IDSAP Field Survey, 2021

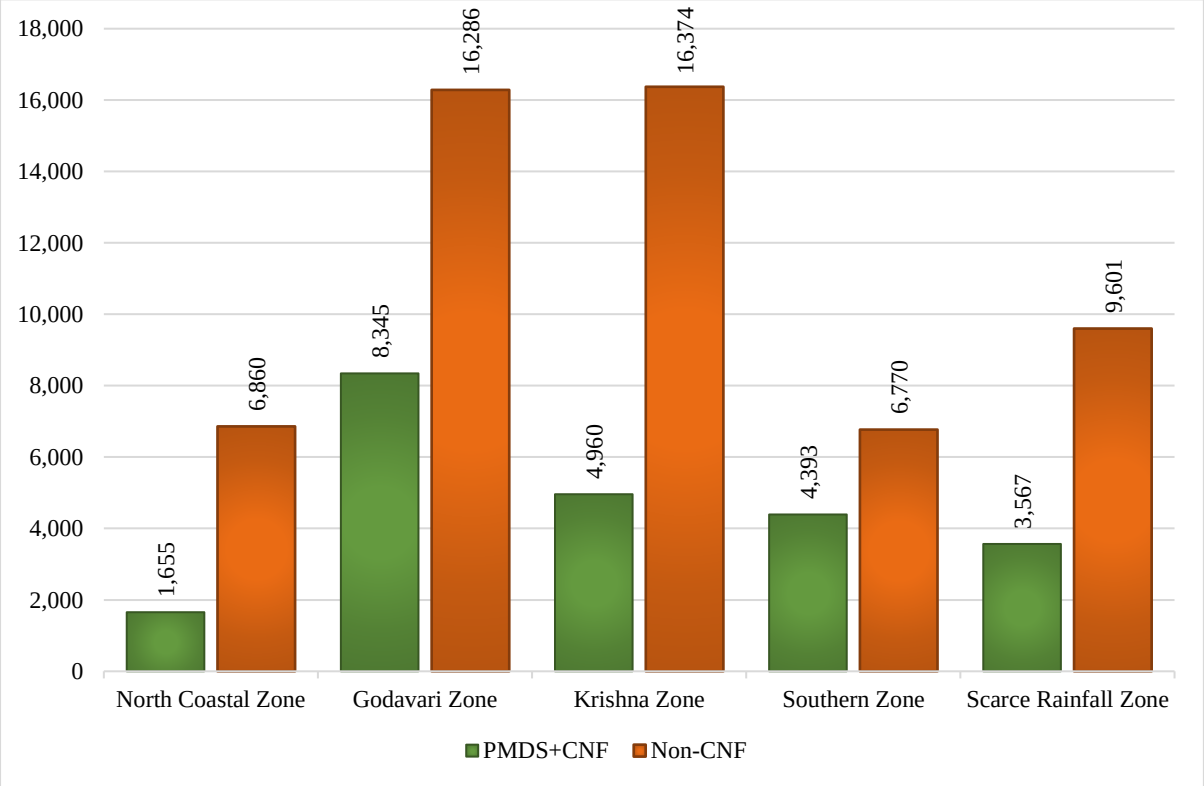
3.4 Costs and Returns

The paddy crop is considered for the analysis since it has reasonably adequate sample size of farmers from each of the agroclimatic zones.

The costs of biological inputs per hectare for CNF plots is found to be consistently lower than that of the chemical inputs for non-CNF plots (Figure 3.9 and Annexure Table 3.13). These costs of PNPI are higher in Delta zones, viz., Godavari and Krishna among the zones. Thus, it is evident that the zones such as north coastal, southern, and scarce rainfall zones that depend dominantly on rainfall have used relatively lower levels of PNPI, compared to Godavari and Krishna Zones that predominantly grow paddy on canal irrigation. It is noteworthy that the paid-out costs are higher under CNF over those under non-CNF, except in north coastal zone among the zones (Figure 3.10 and Annexure Table 3.14). One of the reasons of higher use of hired labour days by farmers under CNF over non-CNF farmers in these zones is the intensity of farming.

Figure 3.9: Agroclimatic zone wise expenditure on PNPIs incurred by the Paddy farmers during Rabi season under PMDS+ CNF and non-CNF

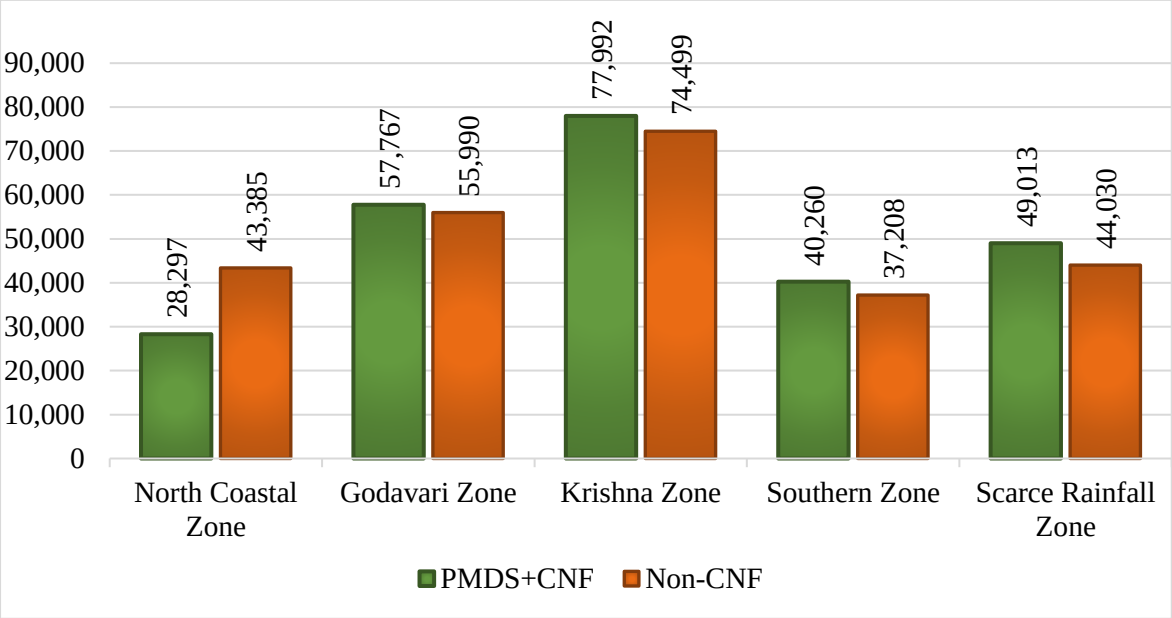
(Rs. /Hectare)



Source: IDSAP Field Survey, 2021

Figure 3.10: Agroclimatic zone wise paid-out costs incurred by the paddy farmers during Rabi season under PMDS+CNF and non-CNF

(Rs. /Hectare)



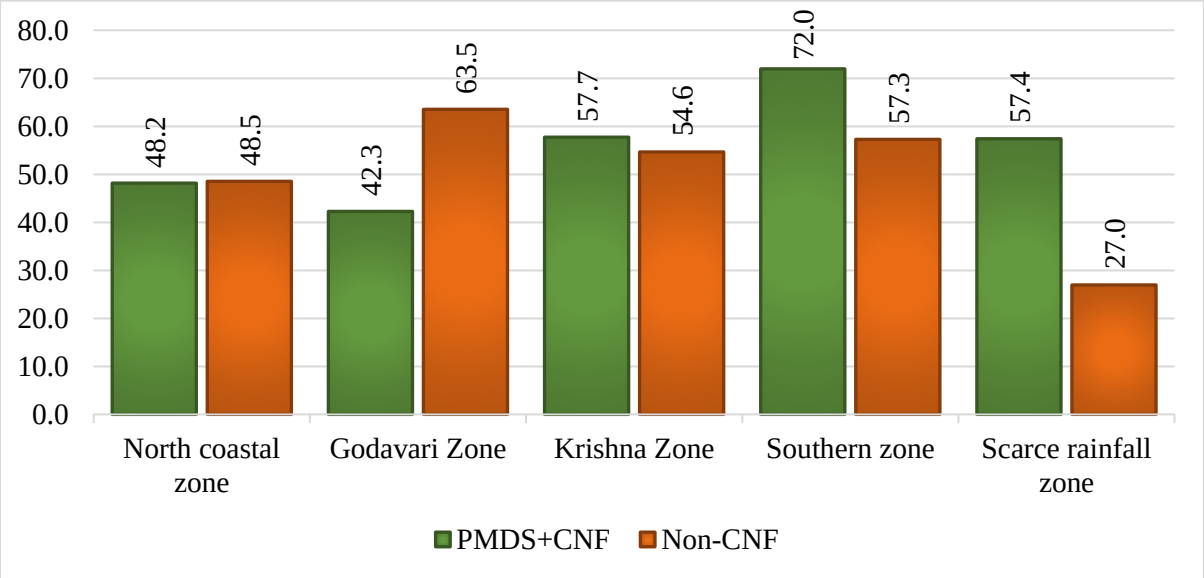
Source: IDSAP Field Survey, 2021

All the zones except Godavari zone have consistently experienced higher gross value of output under CNF plots compared to non-CNF plots. The variations in gross value of output are determined by yield, price realised per quintal and value of by-product (Figures 3.11, 3.12 & 3.13 and Annexure Tables 3.15, 3.16, & 3.17). The yields of the CNF plots have been lower than those of non-CNF in Godavari zones, given the realised price and value of by product. It is reported that yield of paddy crop in Rabi season under CNF plots are lower than that of non-CNF in Godavari zone. The is because the farmers in non-CNF plots use more of chemical inputs that respond better to irrigation, to obtain higher yields. The is the reason why the farmers have demanded higher prices for CNF output to compensate for the lower yields. However, the yield response to inputs of PMDS+CNF have been higher in scarce rainfall zone due to controlled irrigation, compared to yield response to inputs of non-CNF under controlled irrigation (borewell irrigation). Thus, it is evident that under controlled irrigation yield response to CNF in Scarce Rainfall Zone is very high. This reflects the less resource absorption nature of CNF. The net value of output is invariably higher among CNF plots over non-CNF plots in all the zones except Godavari zone. Farmers in scarce rainfall zone have experienced 1,386 per cent of increase over non-CNF in net value of output. Thus, the yield responses to inputs of

PMDS+CNF farmers is higher over inputs of non-CNF across all the zones (including scarce rainfall zones) except that of Godavari Zone. Thus, higher yields have contributed to the higher net value of output across the zones (excluding Godavari zone) of paddy (Figure 3.14 and Annexure Table 3.18).

Figure 3.11: Agroclimatic zone wise yield of paddy output generated by the PMDS+CNF and non-CNF paddy farmers in Rabi season

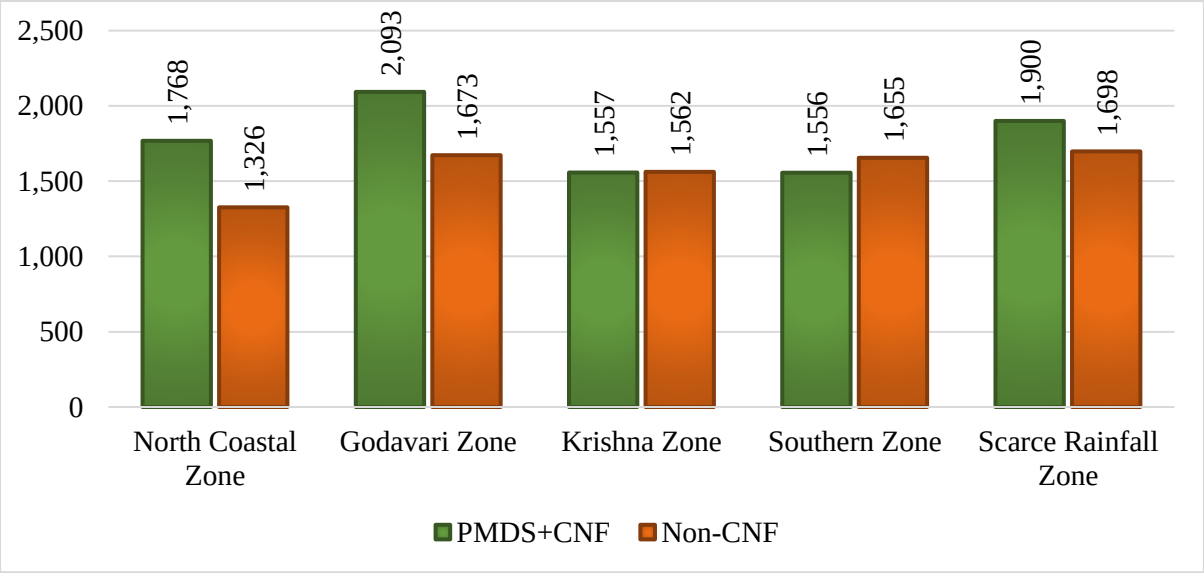
Qtil/hectare



Source: IDSAP Field Survey, 2021

Figure 3.12: Agroclimatic zone wise price realised for Paddy output by the PMDS+CNF and non-CNF farmers in Rabi season

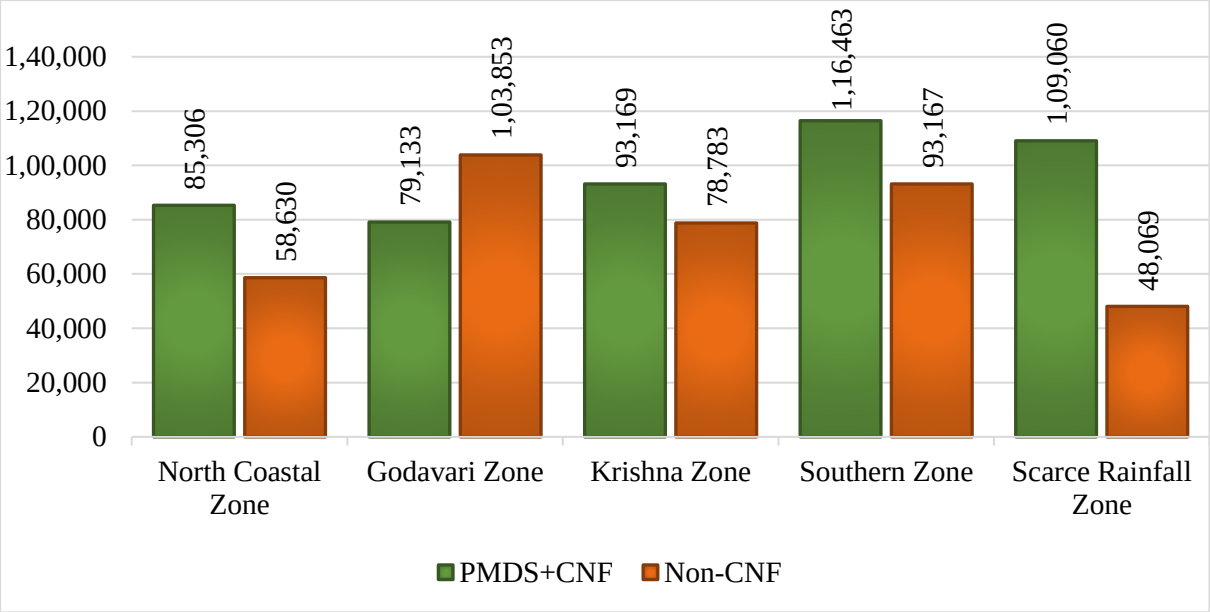
Rs. /Qtil



Source: IDSAP Field Survey, 2021

Figure 3.13: Agroclimatic zone wise gross value of paddy output generated by CNF and non-CNF farmers in Rabi season

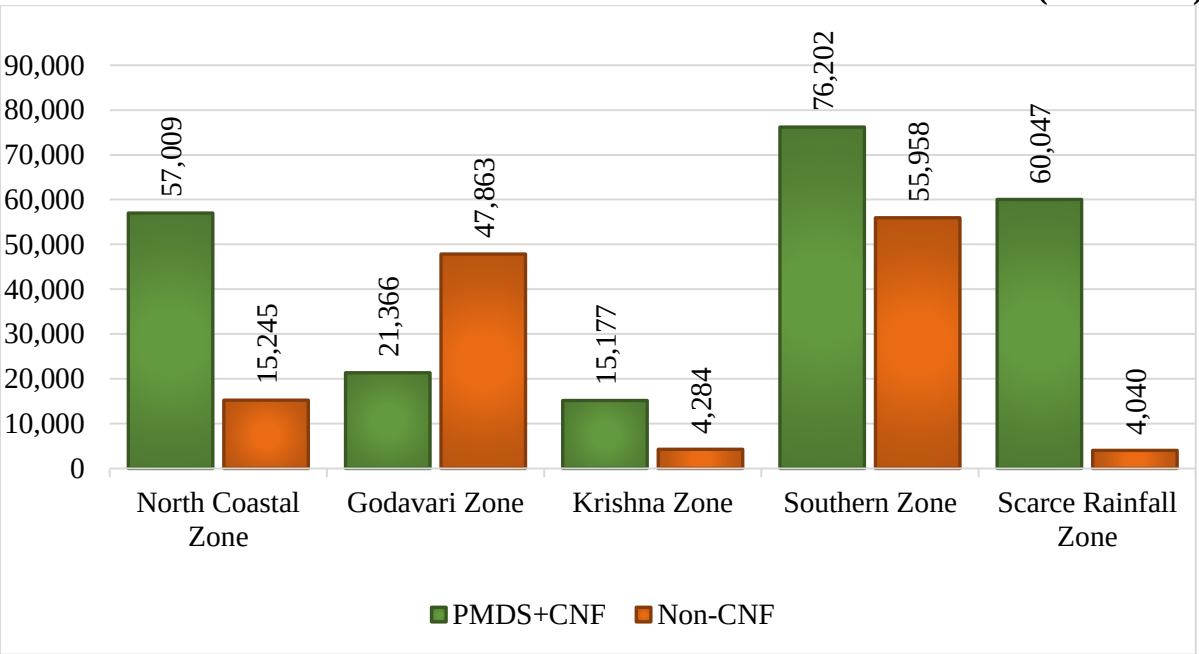
(Rs./Hectare)



Source: IDSAP Field Survey, 2021

Figure 3.14: Agroclimatic zone wise net value of output generated by the PMDS+CNF and non-CNF paddy farmers in Rabi season

(Rs/hectare)



Source: IDSAP Field Survey, 2021

3.5 Conclusions

The analysis has divulged many critical impact dimensions of CNF. One of the crucial dimensions that has been highlighted is that the intensive use of resources like land and labour. The intensity of cropping has provided substantial evidence to the intensive use of land. The intensive use of land is higher in all the agroclimatic zones under CNF over that of non-CNF. But there is scope for further increase in the use of the land in scarce rainfall zone. On the other hand, the data has revealed that the area expansion under CNF in this zone is more after the spread of PMDS, over the last four agricultural years. Thus PMDS, one of the components of CNF, has generated momentum in the intensive use of land even in scarce rainfall zone. Hence the wider spread of PMDS in the highly scarce rainfall zones enable farmers to utilise land intensively.

Labour is another dimension of resource use that has been analysed. The analysis has revealed that the labour (hired and family) use, more so, the family labour use, is relatively more intensive under CNF across the zones. The requirements of working capital and household needs are met from low- cost of credit.

The adoption CNF practices has implication for reduction in the cost of inputs because biological inputs are made out of locally available lower cost raw materials. The increased adoption of CNF practices over time is indication to the reduction in the paid-out costs for growing crops. Yield response to biological inputs of CNF is higher than that to chemical inputs (non-CNF). Thus, the adoption PMDS practices of CNF have been lowering paid out costs on one hand and fetching higher yield responses to the biological inputs, on the other hand.

Thus, it is evident from the analysis that practice of PMDS+CNF led to higher intensive use of land and labour, less intensive use of water and, cost reduction in growing crops, yield enhancement of crops, and inclusiveness of scarce rainfall areas.

Annexure to Chapter 3:

Annexure Table 3.1: Agroclimatic zone wise cultivated area under CNF in Rabi season, on average, in acres

Agroclimatic zone	2017-18	2018-19	2019-20	2020-21
North Coastal Zone	0.52	0.67	0.78	0.84
Godavari Zone	0.20	0.39	0.61	0.62
Krishna Zone	0.35	0.59	0.68	0.82
Southern Zone	0.31	0.71	1.19	1.69
Scarce Rainfall Zone	0.35	0.33	0.42	0.55

Source: IDSAP Field Survey, 2021

Annexure Table 3.2: Agroclimatic zone wise CNF cultivated area as a % of total cultivated area in Rabi season

Agroclimatic zone	2017-18	2018-19	2019-20	2020-21
North Coastal Zone	56.55	76.21	82.87	86.44
Godavari Zone	7.80	20.33	37.05	37.42
Krishna Zone	25.39	41.19	48.88	51.94
Southern Zone	14.13	37.69	61.20	76.97
Scarce Rainfall Zone	12.18	11.47	16.30	24.15

Source: IDSAP Field Survey, 2021

Annexure Table 3.3: Area cultivated in Rabi season as a % of area cultivated in Kharif season across agroclimatic zones

Agroclimatic zone	PMDS+CNF	Non-CNF
North Coastal Zone	61.61	75.87
Godavari Zone	88.35	100.32
Krishna Zone	66.53	72.89
Southern Zone	85.28	80.42
Scarce Rainfall Zone	19.63	32.89

Source: IDSAP Field Survey, 2021

Annexure Table 3.4: Agroclimatic zone wise cropping intensity during the agricultural year 2020-21 (%)

Agroclimatic zone	PMDS+CNF Farmer	Non-CNF Farmer
North coastal Zone	194	176
Godavari Zone	227	200
Krishna Zone	193	173
Southern Zone	226	180
Scarce Rainfall Zone	137	133

Source: IDSAP Field Survey, 2020-21

Annexure Table 3.5: Agroclimatic zone wise number of Human Labour days (Family and Hired) per hectare used by PMDS+CNF and non-CNF farmers in Rabi Season

(Number/hectare)

	PMDS+CNF			Non-CNF		
Agroclimatic zone	Family Labour Days per hectare	Casual Labour Days per hectare	Total Labour days in hectare	Family Labour Days per hectare	Casual Labour Days per hectare	Total Labour days in hectare
North Coastal Zone	38.98	51.10	90.09	51.56	33.93	85.49
Godavari Zone	45.43	50.22	95.65	20.15	40.88	61.03
Krishna Zone	141.23	47.37	188.59	43.75	49.64	93.39
Southern Zone	53.09	40.18	93.27	31.54	30.22	61.75
Scarce Rainfall Zone	45.96	99.42	145.38	33.92	51.20	85.12

Source: IDSAP Field work, 2021

Annexure Table 3.6: Agroclimatic zone wise source wise percentage of farmers taken loan for agriculture and non-agriculture purposes during Rabi season

In percent

Source of fund	North Coastal Zone		Godavari Zone		Krishna Zone		Southern Zone		Scarce Rainfall Zone	
	PMDS+CNF	Non-CNF	PMDS+CNF	Non-CNF	PMDS+CNF	Non-CNF	PMDS+CNF	Non-CNF	PMDS+CNF	Non-CNF
Own Savings	99.4	92.7	96.8	94.6	96.1	94.7	97.8	100.0	96.2	99.4
Rythu Bharosa	9.5	7.2	78.8	72.8	33.7	71.6	37.1	18.2	30.3	49.3
Banks	15.6	23.5	23.5	18.1	3.8	13.7	4.0	0.0	0.0	0.0
Friends and Relatives	13.9	25.5	29.8	22.6	33.5	37.6	33.6	19.0	48.6	58.5
Traders	10.0	26.9	1.8	21.9	0.4	0.0	2.3	2.3	9.3	9.2
Others	14.8	1.4	0.0	0.0	0.0	0.0	0.0	0.0	28.2	3.8

Source: IDSAP Field Survey, 2021

Annexure Table 3.7: Agroclimatic zone wise and source wise share of loan taken for agriculture and other purposes during Rabi season

Percentage

Source	North Coastal Zone		Godavari Zone		Krishna Zone		Southern Zone		Scarce Rainfall Zone	
	PMDS+CNF	Non-CNF	PMDS+CNF	Non-CNF	PMDS+CNF	Non-CNF	PMDS+CNF	Non-CNF	PMDS+CNF	Non-CNF
Own Savings	54.98	45.32	27.58	61.10	38.90	60.90	68.74	83.95	47.78	53.48
Rythu Bharosa	3.87	2.50	2.57	10.39	4.31	4.77	3.52	1.91	2.19	3.85
Banks	10.12	19.48	54.03	9.34	15.41	14.10	2.65	0.00	0.00	0.00
Friends and Relatives	10.77	14.97	7.86	10.13	41.35	20.22	23.70	13.35	24.01	36.69
Traders	8.06	16.43	7.96	9.05	0.03	0.00	1.39	0.79	2.23	3.98
Others	12.20	1.30	0.00	0.00	0.00	0.00	0.00	0.00	23.79	2.00

Source: IDSAP Field Survey, 2021

Annexure Table 3.8: Agro-climatic zone wise number of CNF practices, on average, adopted by PMDS+CNF farmers during 2017-21 period

Agroclimatic zone	2017-18	2018-19	2019-20	2020-21
North Coastal Zone	3.2	4.3	4.47	4.56
Godavari Zone	0.92	1.92	3.34	3.36
Krishna Zone	1.88	3.01	3.47	3.76
Southern Zone	1.7	3.33	4.46	4.45
Scarce Rainfall Zone	0.45	0.52	0.72	3.47

Source: IDSAP Field Survey, 2021

Annexure Table 3.9: Agroclimatic zone wise percentage of PMDS + CNF and non-CNF Farmers growing mixed crop during Rabi Season

	Growing mixed crop	
Agroclimatic zone	PMDS+CNF	Non-CNF
North Coastal Zone	1.6	0.0
Godavari Zone	0.0	0.0
Krishna Zone	0.0	0.0
Southern Zone	1.0	0.0
Scarce Rainfall Zone	0.0	0.0

Source: IDSAP Field Survey, 2021

Annexure Table 3.10: Agroclimatic zone wise percentage of cultivated area under mixed crop in Rabi season

Agroclimatic zone	PMDS+CNF	Non-CNF
North Coastal Zone	0.5	0.0
Godavari Zone	0.0	0.0
Krishna Zone	0.0	0.0
Southern Zone	0.6	0.0
Scarce Rainfall Zone	0.0	0.0

Source: IDSAP Field Survey, 2021

Annexure Table 3.11: Agroclimatic zone wise and irrigation status wise total area under cultivation in Rabi Season

Agroclimatic zone	PMDS+CNF			Non-CNF		
	Cultivated Area in hectare	% of Cultivated area		Cultivated Area in hectare	% of Cultivated area	
		Unirrigated	Irrigated		Unirrigated	Irrigated
North Coastal Zone	76.07	43.68	56.32	43.18	55.35	44.65
Godavari Zone	29.76	0.68	99.32	50.82	0.68	99.32
Krishna Zone	64.75	6.69	93.31	132.67	27.46	72.54
Southern Zone	100.64	1.51	98.49	118.18	12.48	87.52
Scarce Rainfall Zone	5.46	0.00	100.00	40.95	19.01	80.99

Source: IDSAP Field Survey, 2021

Annexure Table 3.12: Agroclimatic zone wise and irrigation source wise total area under cultivation in Rabi season

Agroclimatic zone	PMDS+CNF						Non-CNF					
	Cultivated Area in hectare	Percentage of net cultivated area					Cultivated Area in hectare	Percentage of net cultivated area				
		Rainfed	Canal	Tank	Borewell	Others		Rainfed	Canal	Tank	Borewell	Others
North Coastal Zone	76.07	44.24	17.71	5.48	26.45	6.12	43.18	55.35	32.71	4.03	0.00	7.91
Godavari Zone	29.76	0.68	60.44	0.00	38.89	0.00	50.82	0.68	67.93	1.19	29.68	0.52
Krishna Zone	64.75	7.19	40.50	0.00	39.97	12.34	132.67	27.46	47.34	0.00	11.83	13.37
Southern Zone	100.64	1.51	5.77	14.52	77.80	0.40	118.18	13.00	5.95	15.71	65.34	0.00
Scarce Rainfall Zone	5.46	0.00	0.00	0.00	100.00	0.00	40.95	19.01	3.95	0.00	70.12	6.92

Note: Other irrigation sources include lift irrigation, other well, stream, and purchasing water.
Source: IDSAP Field Survey, 2021

Annexure Table 3.13: Agroclimatic zone wise expenditure on PNPIs incurred for paddy cultivation during Rabi season under PMDS+ CNF and non-CNF

(Rs. /Hectare)

Agroclimatic zone	PMDS+CNF	Non-CNF	Difference in Rs.	Difference in %
1	2	3	4 = (2-3)	5 = (4/3) *100
North Coastal Zone	1,655	6,860	-5,206	-75.88
Godavari Zone	8,345	16,286	-7,941	-48.76
Krishna Zone	4,960	16,374	-11,414	-69.71
Southern Zone	4,393	6,770	-2,377	-35.11
Scarce Rainfall Zone	3,567	9,601	-6,034	-62.84

Source: IDSAP Field Survey, 2021

Annexure Table 3.14: Agroclimatic zone wise paid-out costs incurred for paddy cultivation during Rabi season under PMDS+CNF and non-CNF

(Rs. /Hectare)

Agroclimatic zone	PMDS+CNF	Non-CNF	Difference in Rs.	Difference in %
1	2	3	4 = (2-3)	5 = (4/3) *100
North Coastal Zone	28,297	43,385	-15,088	-34.78
Godavari Zone	57,767	55,990	1,777	3.17
Krishna Zone	77,992	74,499	3,493	4.69
Southern Zone	40,260	37,208	3,052	8.20
Scarce Rainfall Zone	49,013	44,030	4,984	11.32

Source: IDSAP Field Survey, 2021

Annexure Table 3.15: Agroclimatic zone wise yield rate of paddy crop in Rabi season by the PMDS+CNF and non-CNF paddy farmers

Qtil/hectare

Agroclimatic zone	PMDS+CNF	Non-CNF	Difference in Rs.	Difference in %
1	2	3	4 = (2-3)	5 = (4/3) *100
North coastal zone	48.16	48.53	-0.37	-0.77
Godavari Zone	42.27	63.53	-21.26	-33.47
Krishna Zone	57.73	54.65	3.08	5.64
Southern zone	71.96	57.27	14.68	25.64
Scarce rainfall zone	57.40	26.95	30.45	112.95

Source: IDSAP Field Survey, 2021

Annexure Table 3.16: Agroclimatic zone wise price realised by the PMDS+CNF and non-CNF Paddy farmers during Rabi season

Rs. /Qtil

Agroclimatic zone	PMDS+CNF	Non-CNF	Difference in Rs.	Difference in %
1	2	3	4 = (2-3)	5 = (4/3) *100
North Coastal Zone	1768	1326	442	33.30
Godavari Zone	2093	1673	420	25.14
Krishna Zone	1557	1562	-5	-0.29
Southern Zone	1556	1655	-99	-6.00
Scarce Rainfall Zone	1900	1698	202	11.92

Source: IDSAP Field Survey, 2021

Annexure Table 3.17: Agroclimatic zone wise Gross value of output generated during Rabi season by the PMDS+CNF and non-CNF paddy farmers

Rs. /Hectare

Agroclimatic zone	PMDS+CNF	Non-CNF	Difference in Rs.	Difference in %
1	2	3	4 = (2-3)	5 = (4/3) *100
North Coastal Zone	85,306	58,630	26,676	45.50
Godavari Zone	79,133	1,03,853	-24,720	-23.80
Krishna Zone	93,169	78,783	14,386	18.26
Southern Zone	1,16,463	93,167	23,296	25.00
Scarce Rainfall Zone	1,09,060	48,069	60,991	126.88

Source: IDSAP Field Survey, 2021

Annexure Table 3.18: Agroclimatic zone wise net value of output generated by the PMDS+CNF and non-CNF paddy farmers in Rabi season

Rs. /Hectare

Agroclimatic zone	PMDS+CNF	Non-CNF	Difference in Rs.	Difference in %
1	2	3	4 = (2-3)	5 = (4/3) *100
North Coastal Zone	57,009	15,245	41,764	273.96
Godavari Zone	21,366	47,863	-26,497	-55.36
Krishna Zone	15,177	4,284	10,893	254.26
Southern Zone	76,202	55,958	20,244	36.18
Scarce Rainfall Zone	60,047	4,040	56,007	1386.40

Source: IDSAP Field Survey, 2021

Chapter 4

Impact of PMDS+CNF on the farming conditions of Small Landholders in Rabi Season

4.1 Introduction

The analysis in the preceding two chapters have shown that yield of crops grown by CNF farmers were higher than those by non-CNF farmers. Yield increase was achieved at lower paid-out costs that resulted in higher gross and net value of output of crops grown under CNF over non-CNF in the Rabi season. These issues also need to be analysed at category of farmers in the state. The disaggregate analysis enables us to examine whether this impact of CNF differ between small landholders (marginal and small farmers) and large landholders (medium and large farmers). More specifically, the issue in question is whether pattern of utilised resources, viz., land, labour, water and capital funds and pattern of adoption of CNF practices and their impact on input use, paid out costs, yield, and gross and net value of output differ between small landholders and large landholders.

In the above backdrop, this chapter has the following objectives:

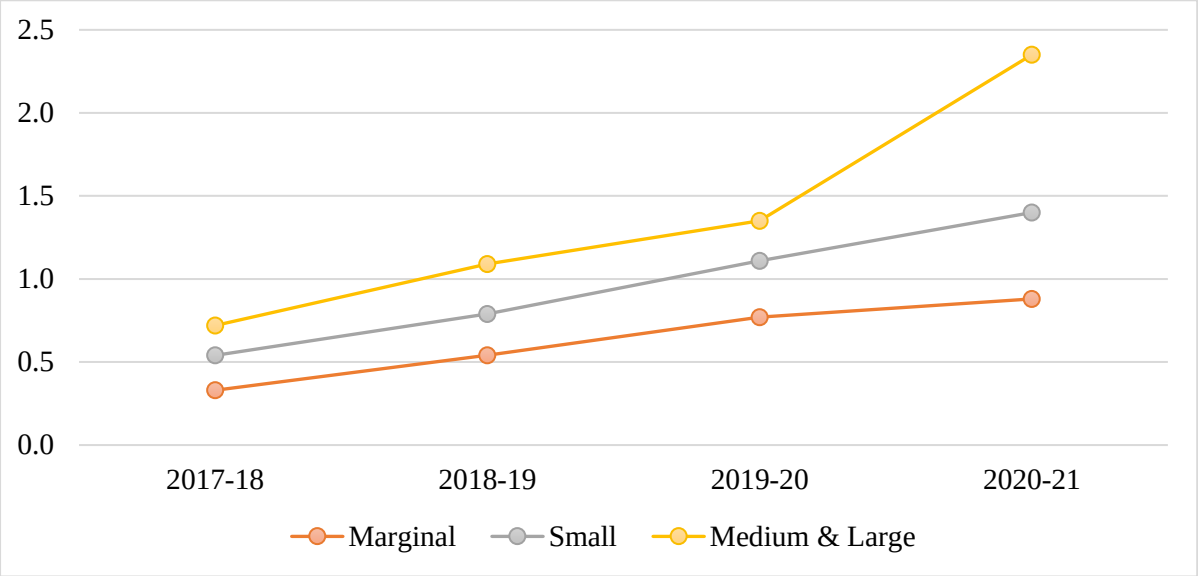
1. Whether the pattern of utilisation of land, labour, water, and capital funds to grow crops differ between small landholders and large landholders for PMDS+CNF farmers over non-CNF farmers?
2. How far has the adoption of CNF practices differs between small landholders and large landholders?
3. What is the impact of pattern of utilisation of factors of production and adoption of CNF practices on the input use, paid out costs, yield, gross and net value of output of paddy between small landholders and large landholders?

4.2 Pattern of utilisation of Land, Labour, Water, and Capital Funds

The cultivated area per farmer under CNF has been on increase during agricultural years 2017-21 for the small landholders (marginal and small farmers) and large landholders (medium and large farmers) (Figure 4.1 Annexure Table 4.1). This as a percentage of cultivated area in Rabi season has been on the rise during the same period for the two categories of farmers. The surge in the increase of the area seems to be during the last two agricultural years (2019-21) compared to the first two years (2017-19) (Figure 4.2 and Annexure Table 4.2). This is due to the spread

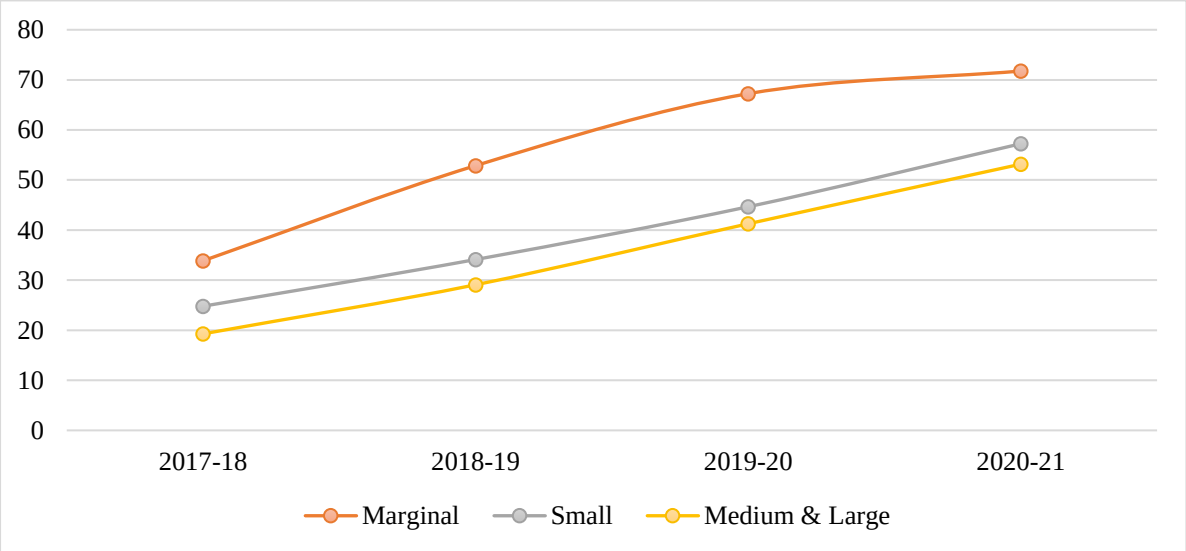
of PMDS. The cultivated area in Rabi season as percentage of Kharif is higher for CNF farmers over non-CNF farmers in case of large landholders compared to the small landholders. For small holders this percentage is higher for non-CNF farmers over CNF farmers during the agricultural year- 2020-21 (Figure 4.3 and Annexure 4.3). However. the overall cropping intensity during the agricultural year -2020-21 was higher for the CNF farmers compared to the non-CNF farmers for both the small as well as large landholders (Figure 4.4).

Figure 4.1: Category of farmers wise cultivated area under CNF in Rabi season, per holding on average, in acres, during 2017-18 to 2020-21



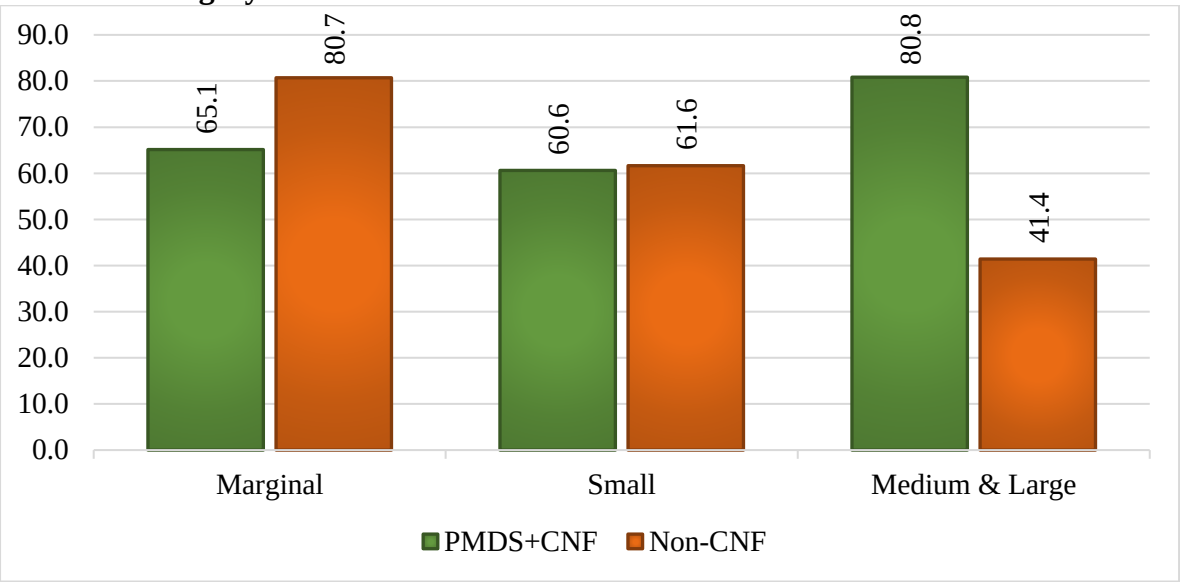
Source: IDSAP Field Survey, 2021

Figure 4.2: Category of farmers wise CNF cultivated area as a % of total cultivated area in Rabi season during 2017-18 to 2020-21



Source: IDSAP Field Survey, 2021

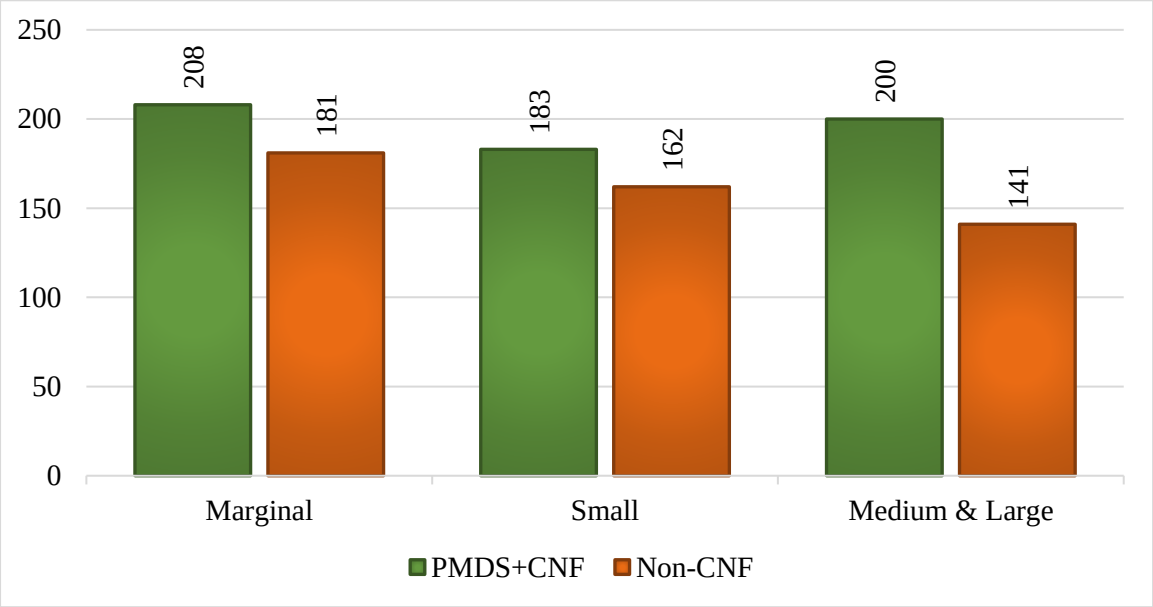
Figure 4.3: Area cultivated in Rabi season as a % of area cultivated in Kharif season across the category of farmers



Source: IDSAP Field Survey, 2021

Figure 4.4: Category of farmers wise cropping intensity during the agricultural year 2020-21

In percent



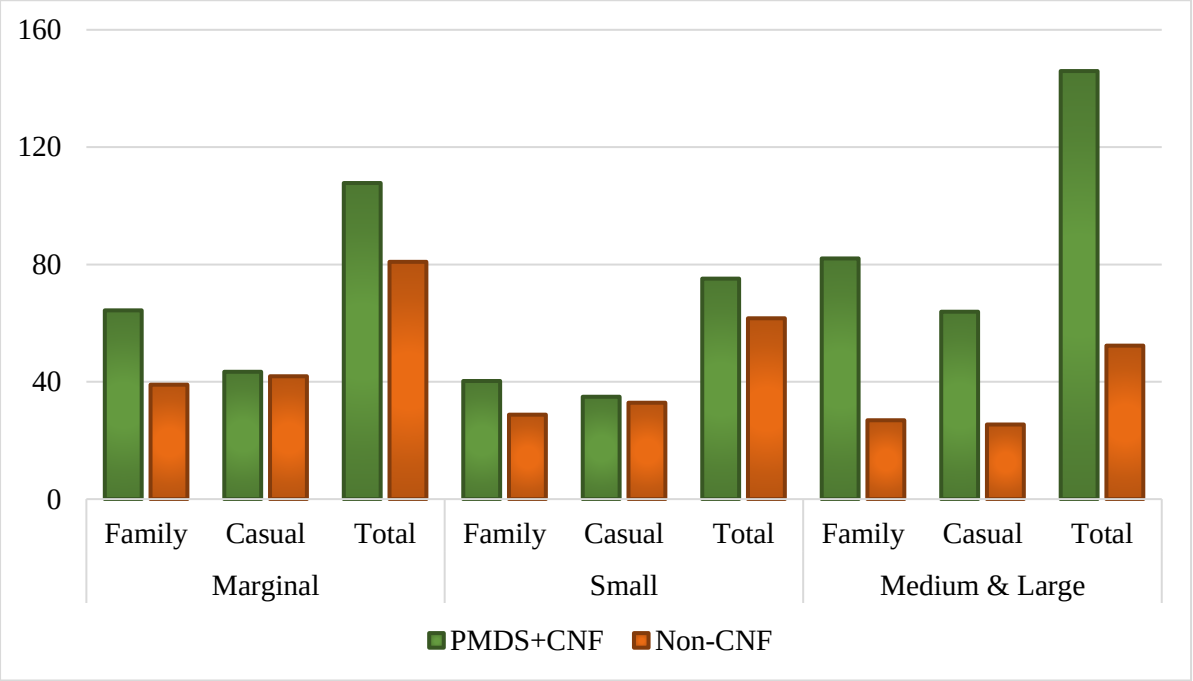
Source: IDSAP Field Survey, 2021

The use of labour as well as family labour is higher under CNF compared to that of non-CNF farmers of paddy crop for both the categories of farmers (Figure 4.5 and Annexure Table 4.5). Interestingly, family labour use is higher for the large holders compared to small landholders under CNF over non-CNF. This again reiterates the labour-intensive nature of CNF. The has

implication on paid out cost of labour in growing paddy. The paid-out costs may be lower for CNF farmers in relation to non-CNF farmers in growing paddy.

Figure 4.5: Category of farmers wise number of Human Labour Days (Family and Hired) per hectare used by PMDS+CNF and non-CNF farmers in Rabi Season

(Number/hectare)

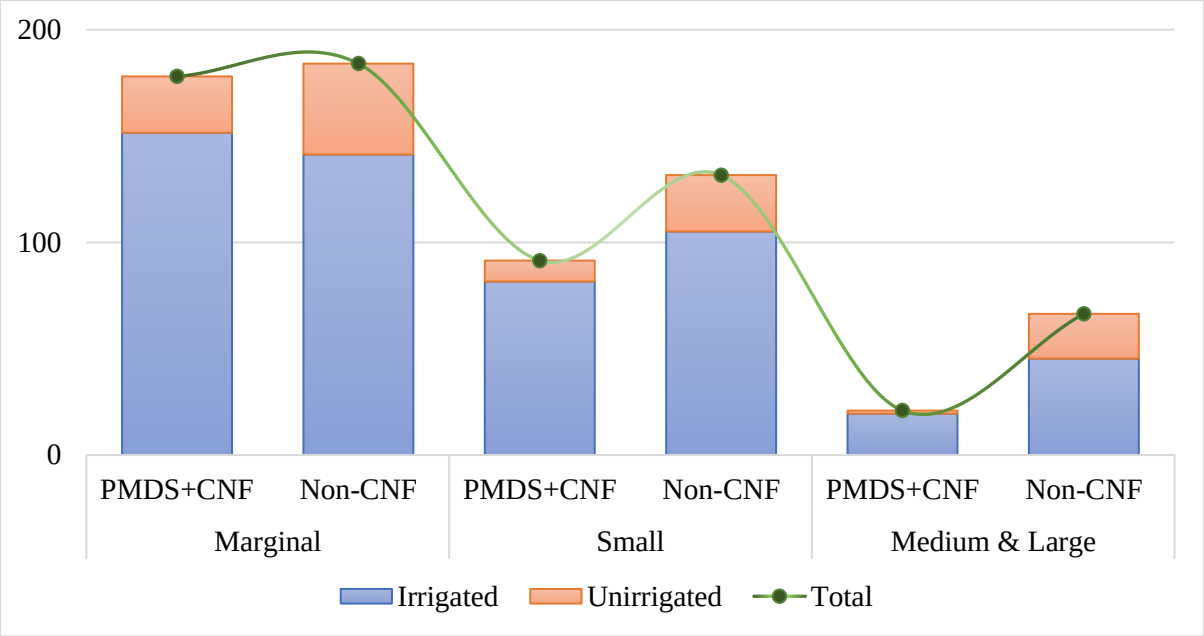


Source: IDSAP Field Survey, 2021

Furthermore, the percentage of area cultivated under irrigation was more for the PMDS+CNF marginal farmers in relation to non-CNF farmers. (Figure 4.6 and Annexure Table 4.11). Moreover, the percentage of area to total cultivated area in Rabi under controlled irrigation such as borewell irrigation was higher for small as well as large landholders among the PMDS+CNF farmers over non-CNF farmers (Figure 4.7 and Annexure Table 4.12).

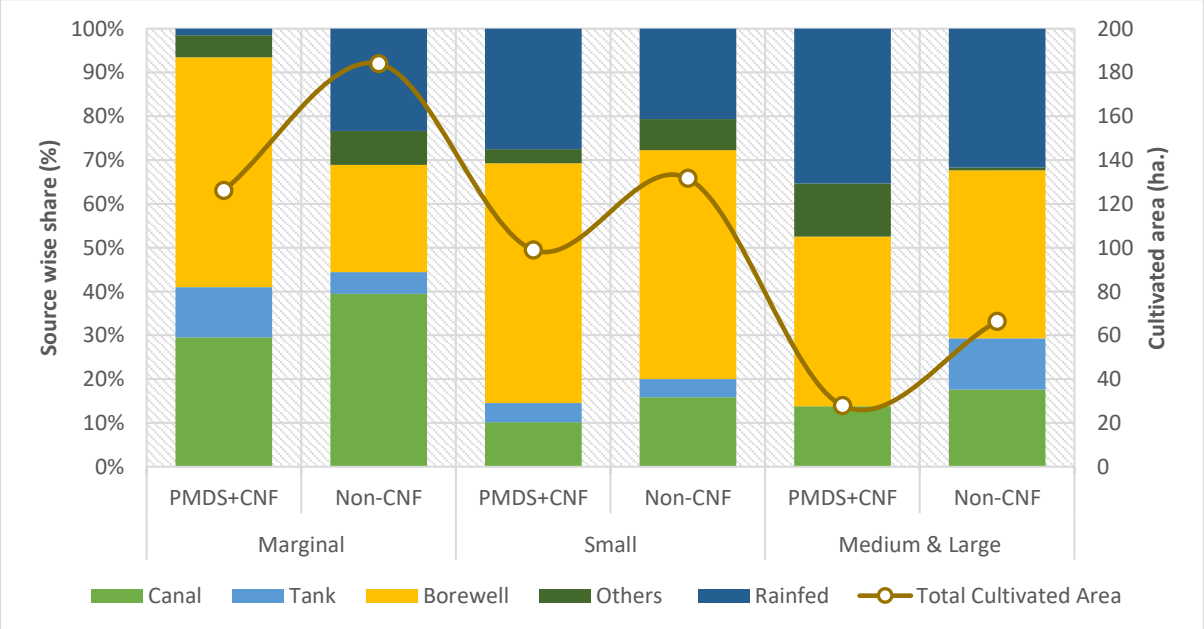
Figure 4.6: Category of farmers wise and irrigation status wise total area under cultivation in Rabi Season

in hectare



Source: IDSAP Field Survey, 2021

Figure 4.7: Category of farmers wise and irrigation source wise total area under cultivation in Rabi season



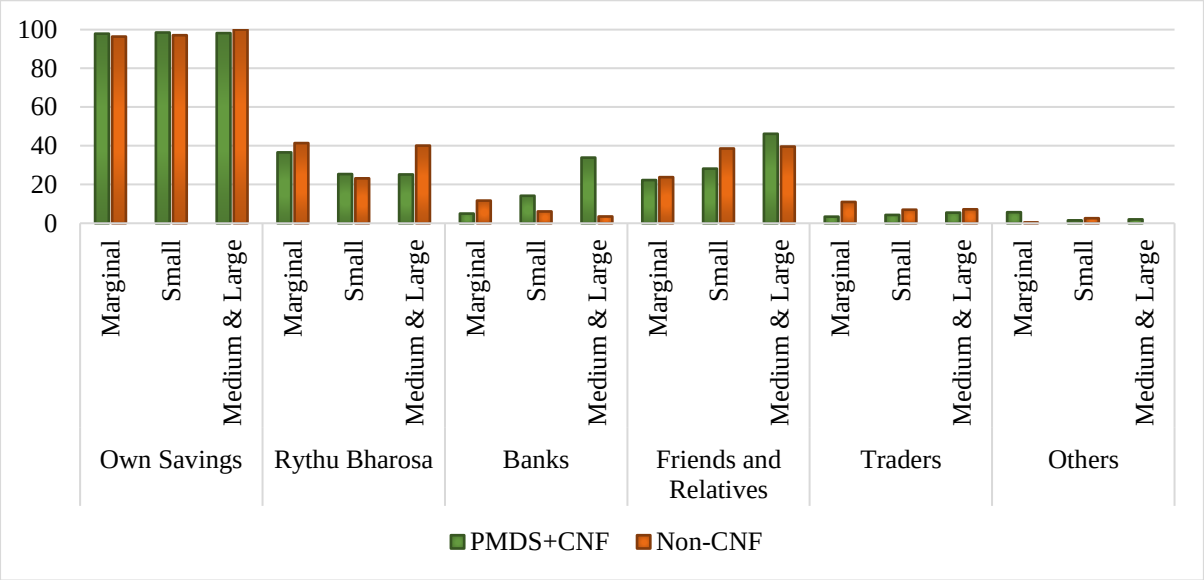
Source: IDSAP Field Survey, 2021

The dependency of farmers for the mobilisation funds for meeting the expenditure for agricultural operation including marketing and household needs on traders was lower for CNF farmers over non-CNF across for both the small and large landholders. Further, the dependency

on the formal institutions (banks) is found to be lower for the small landholders compared to large landholders under CNF over non-CNF (Figures 4.8 and 4.9 and Annexure Tables 4.6 and 4.7).

Figure 4.8: of farmers wise and source wise percentage of PMDS+CNF and non-CNF farmers mobilised funds for agricultural and non-agricultural purposes during Rabi season

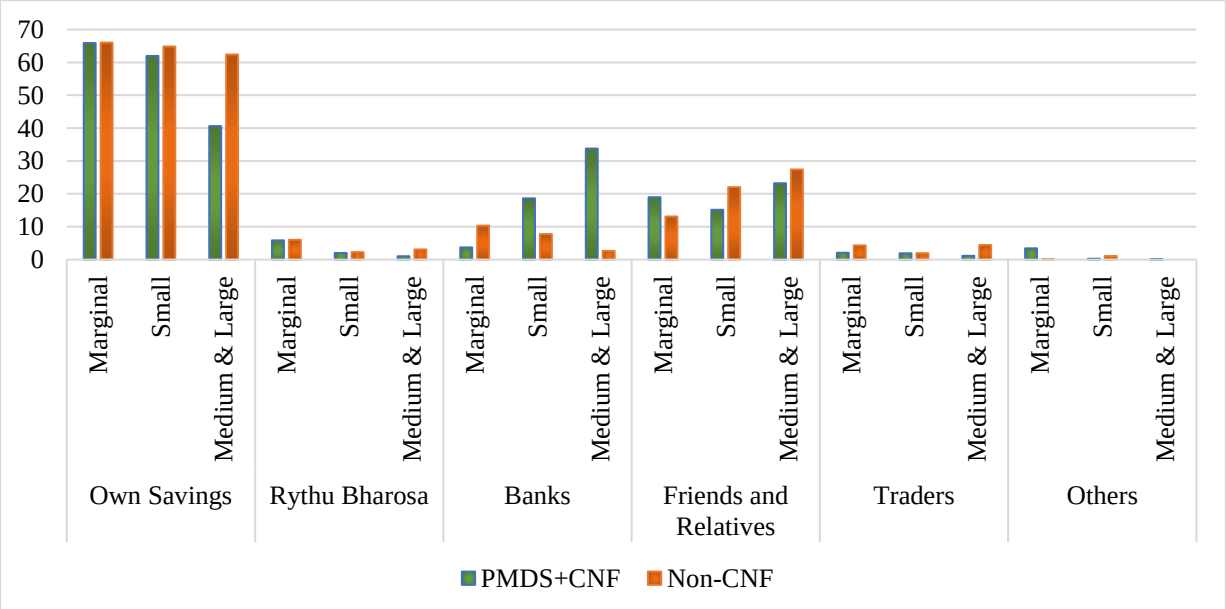
(In percentages)



Source: IDSAP Field Survey, 2021

Figure 4.9:Category of farmers wise and source wise share of funds mobilised for agricultural and non-agricultural purposes during Rabi season

(In percentages)

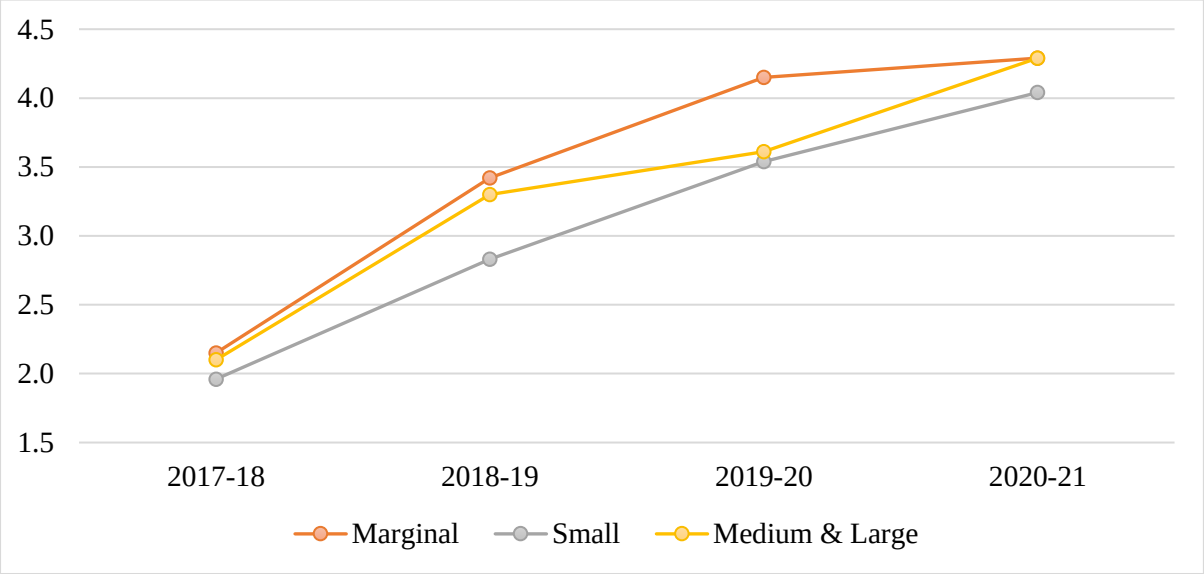


Source: IDSAP Field Survey, 2021

4.3 Pattern of adoption of CNF practices

Mixed cropping, in terms of percentage of farmers as well as percentage of cultivated area in Rabi, was found to be higher for CNF farmers over non-CNF farmers for small landholders over large landholders (Annexure Tables 4.8 and 4.9). Further, the number of CNF practices adopted by CNF farmers has been on increase for all the category of farmers during the agricultural years, 2017-21 (Figure 4.10 and Annexure Table 4.10). It is striking to note that the number of practices of CNF adopted were by and large the same between the farmers. Further, the increase in the number of CNF practices adopted has taken place especially during the last two agricultural years-2019-21 indicating that the PMDS has contributed to this surge.

Figure 4.10: Category of farmers wise number of CNF practices, on average, adopted by PMDS+CNF farmers in Rabi season during 2017-21 period



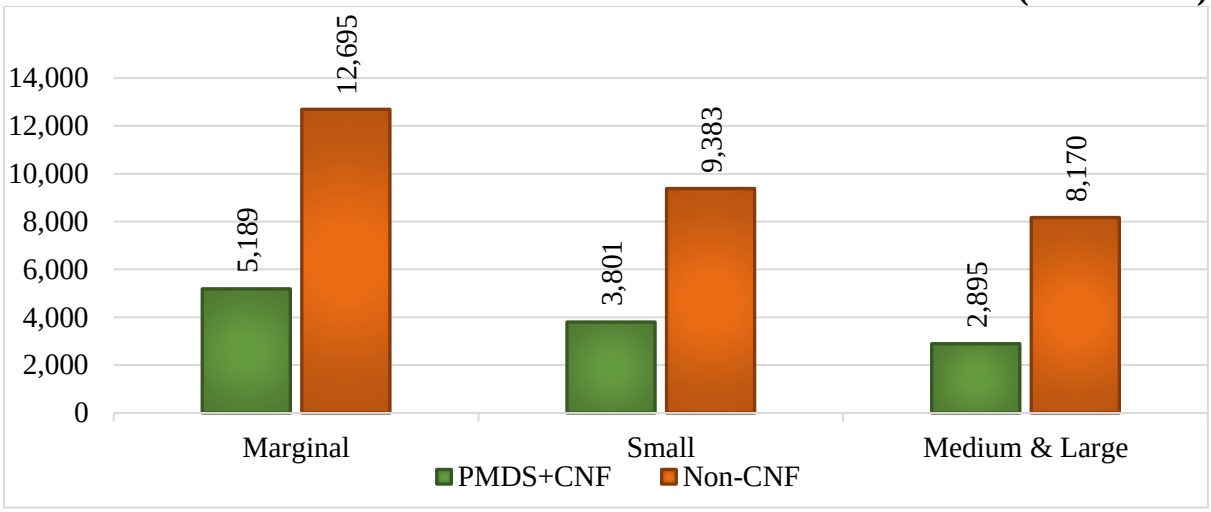
Source: IDSAP Field Survey, 2021

4.4 Costs and Returns

The expenditure incurred per hectare on plant protection and plant nutrient inputs (PNPI) is invariably lower for the CNF farmers over non-CNF farmers for both the category of farmers (Figure 4.11 and Annexure 4.13). The intensity of input use of PNPI per hectare is higher for the small landholders (marginal farmers and small farmers) in relation to large landholders (medium and large farmers).

Figure 4.11: Category of farmers wise expenditure on PNPI by the PMDS+CNF and non-CNF paddy farmers Rabi season

(Rs. /Hectare)

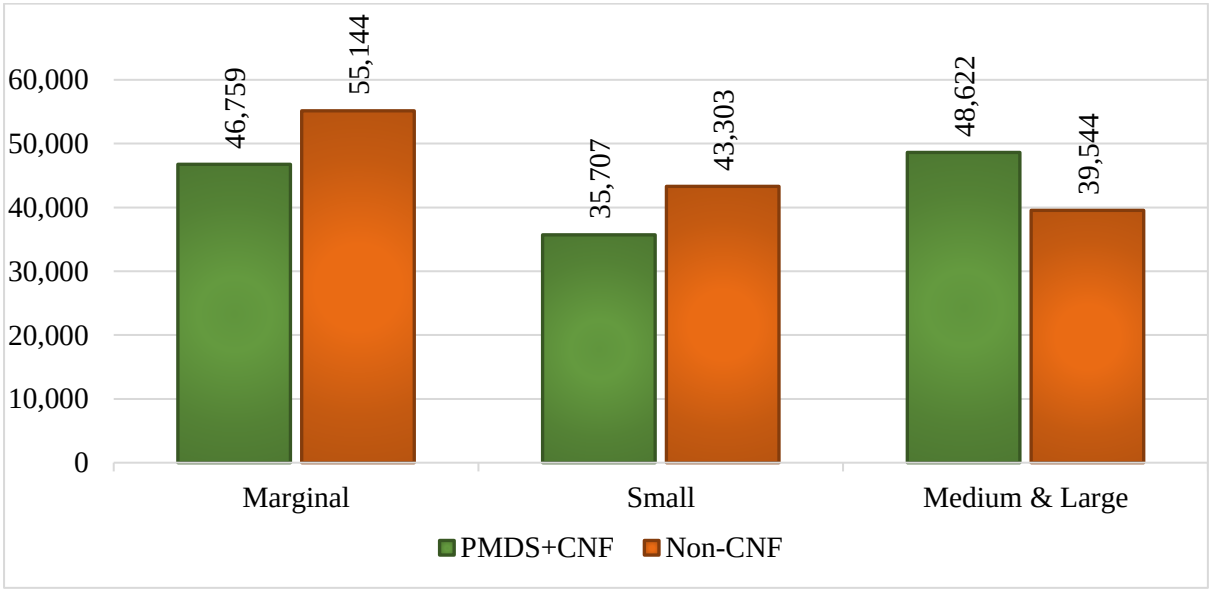


Source: IDSAP Field Survey, 2021

The paid-out costs incurred for growing paddy crop were lower for small landholders of CNF over those of non-CNF, while they were higher for large landholders of CNF over non-CNF The higher paid out costs under CNF over non-CNF for large landholders may be due to higher costs incurred on hired labour in preparing and applying biological inputs on the field. (Figure 4.12 and Annexure Table 4.14) The lower costs for small landholders may be due to use of family labour in preparing and applying the biological inputs on their fields.

Figure 4.12: Category of farmers wise paid-out cost by the PMDS+CNF and non-CNF paddy farmers Rabi season

Rs. /Hectare

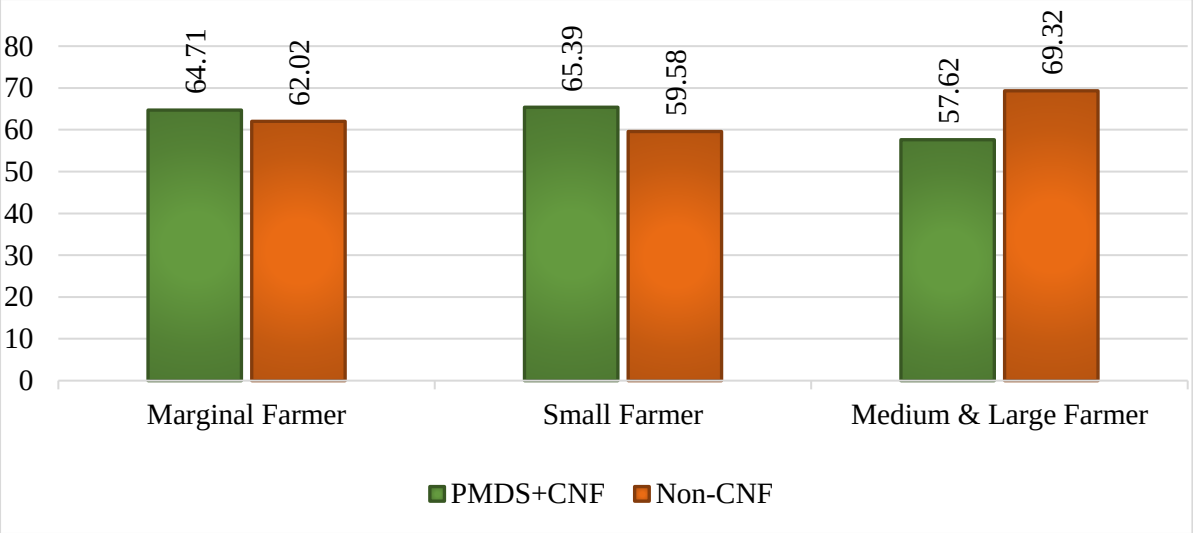


Source: IDSAP Field Survey, 2021

The yield of paddy for the small landholders was higher under CNF over those under non-CNF, while they were lower for large landholders under CNF over non-CNF (Figure 4.13 and Annexure Table 4.15). This implies that the large landholders have not applied quantity of biological inputs required per hectare due to higher dependency on hired labour. This may be the dominant reason for the lower yields by 17 per cent for large landholders under CNF over non-CNF.

Figure 4.13: Category of farmers wise Yields by the PMDS+CNF and non-CNF paddy farmers in Rabi season

Qtil. /Hectare

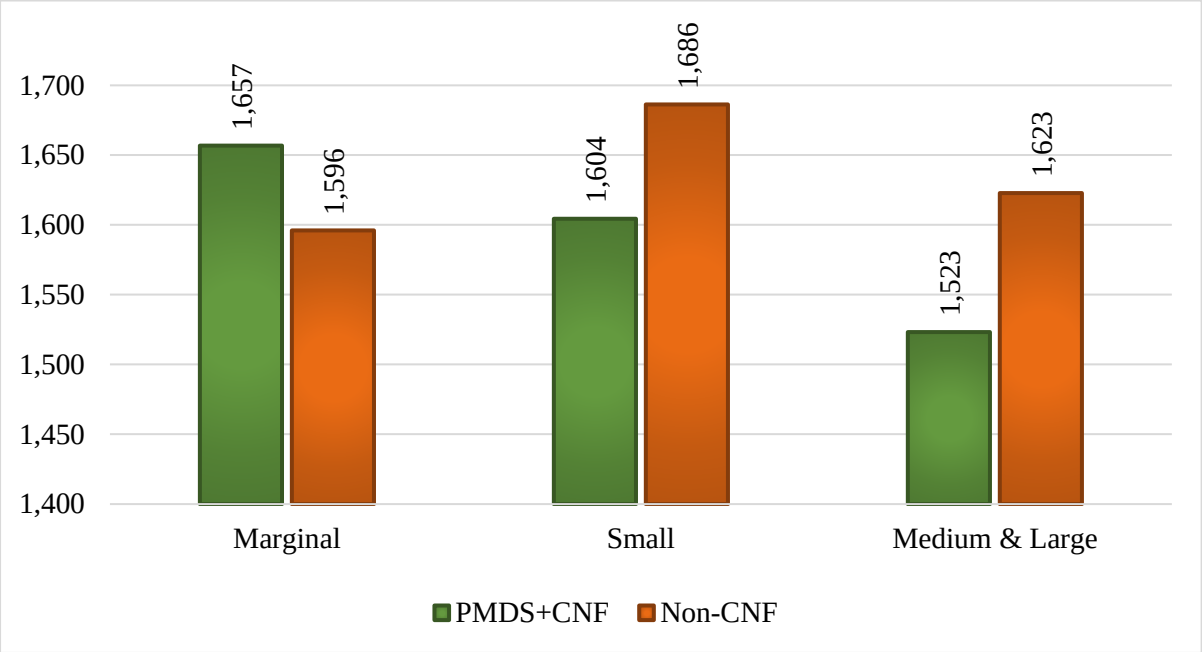


Source: IDSAP Field Survey, 2021

The higher yields per hectare for the small landholders over large landholders have resulted in higher gross values per hectare for the small landholders, given the realised price and value of by-product (Figures 4.14 & 4.15 and Annexure Table 4.16 & 4.17). The gross value of output has become lower under CNF for large landholders by 24 per cent in relation to that of under non-CNF. The net value of output per hectare was higher for small landholders under CNF over non-CNF, while it was lower for large landholders under CNF over non-CNF by 46 per cent (Figure 4.16 and Annexure Table 4.18). Thus, lower paid out costs coupled with higher yields has led to higher net value of output for the small landholders. The size-productivity relationship confirms that small farms are more productive than big farms.

Figure 4.14: Farm category wise price realised by the PMDS+CNF and non-CNF Paddy farmers during Rabi season

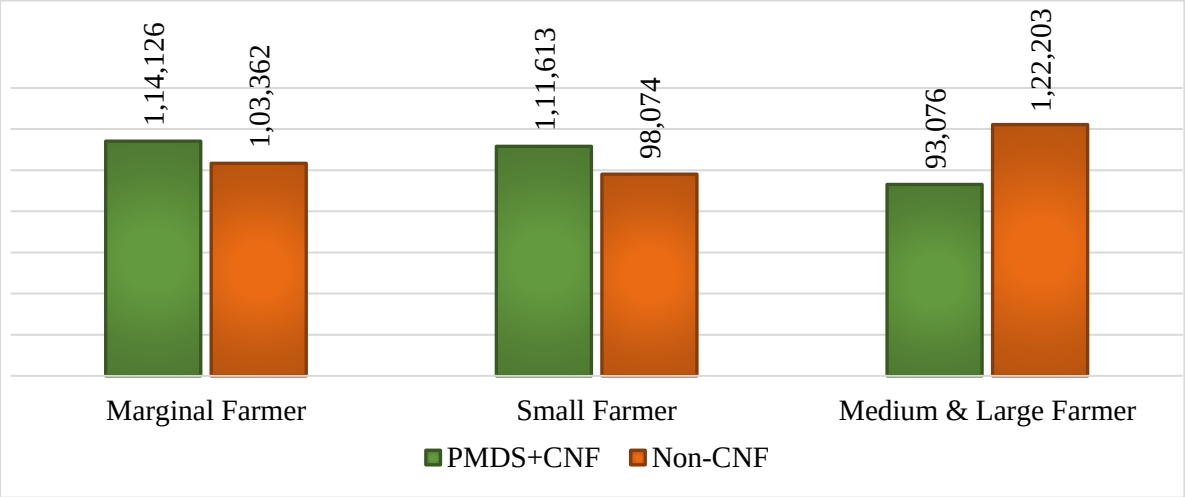
Rs. /Qtil



Source: IDSAP Field Survey, 2021

Figure 4.15: Category of farmers wise gross value of output by the PMDS+CNF and non-CNF paddy farmers in Rabi season

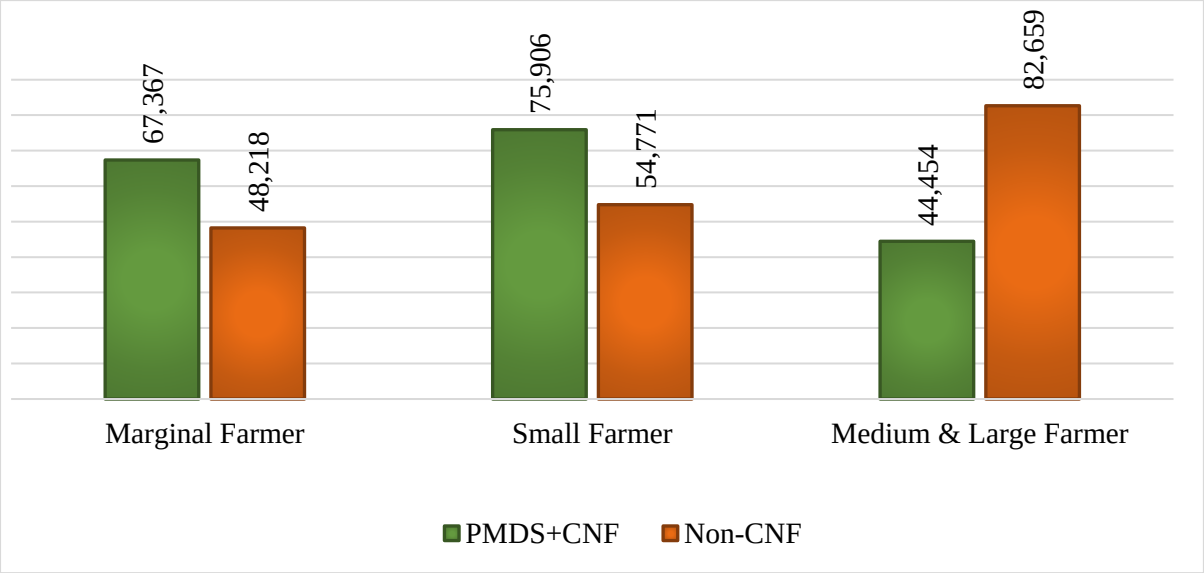
Rs. /Hectare



Source: IDSAP Field Survey, 2021

Figure 4.16: Category of farmers wise net value of output by the PMDS+CNF and non-CNF paddy farmers in Rabi season

Rs. /Hectare



Source: IDSAP Field Survey, 2021

4.5 Conclusions

The analysis has divulged many critical impact dimensions of CNF. The intensive use of land is higher for both small as well as large landholders under CNF over that of non-CNF.

Labour is another dimension of resources that has been analysed in this chapter. The analysis has revealed that the labour use, more so the family labour use, is intensive under CNF over non-CNF for the small as well as large landholders. But the large landholders have encountered the constraint on the availability of hired labour specially to prepare biological input and application of the same on their fields. They have achieved lower yield of paddy due to lower application of biological inputs because of labour scarcity problem under CNF. The readymade biological inputs should be made available through Village Organisations (Vos), the federations of Women Self-Help groups, by providing support for the backward and forward linkages for producing biological inputs. This may enable farmers to overcome the problem of labour scarcity. Hence there is scope for utilising services of women intensively in producing biological inputs of CNF.

The paid-out costs per hectare is found to be lower under CNF over non-CNF for the small landholders, while it was reverse for the large landholders. This clearly indicates the lower requirement of working capital for growing crop under CNF. The required working capital for

agricultural operations and household needs are met from relatively cheap credit sources. Hence, it is evident that the CNF demands lower intensive use of capital.

The adoption of CNF practices has implications for reduction in the cost of inputs because biological inputs are made out of locally available lower cost raw materials. The increased adoption of CNF practices over time is indication to the reduction in the paid-out costs for growing crops. It is evident from the analysis that yield response to biological inputs is higher than that to chemical inputs of non-CNF. The higher response to biological inputs of CNF under controlled irrigation have fetched higher gross and net value of crop output for the small landholders compared to large landholders.

Thus, it is evident from the analysis that practice of CNF led to higher intensive use of land and labour, less intensive use of water capital funds, cost reduction in growing crops, yield enhancement of crops, and inclusiveness of small landholder of the farming community

Annexure to Chapter 4

Annexure Table 4.1: Category of farmers wise cultivated area under CNF in Rabi season, on average.

(In acres)

Category of farmers	2017-18	2018-19	2019-20	2020-21
Marginal	0.33	0.54	0.77	0.88
Small	0.54	0.79	1.11	1.40
Medium & Large	0.72	1.09	1.35	2.35

Source: IDSAP Field Survey, 2021

Annexure Table 4.2: CNF cultivated area as a % of total cultivated area in Rabi season for small and large landholders

Category of farmers	2017-18	2018-19	2019-20	2020-21
Marginal	33.87	52.87	67.24	71.76
Small	24.80	34.12	44.66	57.24
Medium & Large	19.28	29.08	41.26	53.16

Source: IDSAP Field Survey, 2021

Annexure Table 4.3: Area cultivated in Rabi season as a % of area cultivated in Kharif season for small and large landholders

Farm Category of farmers	PMDS+CNF	Non-CNF
Marginal	65.14	80.70
Small	60.62	61.64
Medium & Large	80.83	41.41

Source: IDSAP Field Survey, 2021

Annexure Table 4.4: Category of farmers wise Cropping Intensity among the PMDS + CNF and Non-CNF farmers

(In Percentage)

Category of farmers	PMDS+CNF	Non-CNF
Marginal	208	181
Small	183	162
Medium & Large	200	141

Source: IDSAP Field Survey, 2021

Annexure Table 4.5: Category of farmers wise average labour use by the paddy farmers (No./hectare)

Category of farmers	PMDS+CNF			Non-CNF		
	Family Labour Days	Casual Labour Days	Total Labour days	Family Labour Days	Casual Labour Days	Total Labour days
Marginal	64.35	43.41	107.76	39.01	41.88	80.89
Small	40.27	34.90	75.17	28.79	32.86	61.65
Medium & Large	82.05	63.89	145.94	26.89	25.44	52.33

Source: IDSAP Field Survey, 2021

Annexure Table 4.6: Category of farmers wise and source wise percentage of PMDS+CNF and non-CNF farmers mobilised funds for agriculture and non-Agriculture purposes

(In Percentage)

Source of funds	Marginal		Small		Medium & Large	
	PMDS+CNF	Non-CNF	PMDS+CNF	Non-CNF	PMDS+CNF	Non-CNF
Own Savings	97.9	96.4	98.5	97.1	98.2	100.0
Rythu Bharosa	36.6	41.4	25.4	23.2	25.2	40.1
Banks	5.0	11.7	14.2	6.1	33.9	3.5
Friends and Relatives	22.3	23.8	28.2	38.6	46.2	39.6
Traders	3.4	11.0	4.3	7.0	5.5	7.2
Others	5.7	0.4	1.5	2.6	2.0	0.0

Source: IDSAP Field Survey, 2021

Annexure Table 4.7: Category of farmers wise and source wise share of funds mobilised t for agriculture and non-agriculture purposes

(InPercentage s)

Source	Marginal		Small		Medium & Large	
	PMDS+CNF	Non-CNF	PMDS+CNF	Non-CNF	PMDS+CNF	Non-CNF
Own Savings	65.90	66.03	61.97	64.84	40.63	62.40
Rythu Bharosa	5.86	6.03	2.02	2.28	1.03	3.10
Banks	3.72	10.34	18.64	7.77	33.79	2.64
Friends and Relatives	18.99	13.12	15.17	22.05	23.25	27.43
Traders	2.09	4.33	1.92	1.96	1.16	4.43
Others	3.44	0.16	0.28	1.09	0.15	0.00

Source: IDSAP Field Survey, 2021

Annexure Table 4.8: Percentage of PMDS + CNF and non-CNF Farmers growing mixed crop during Rabi Season for small and large landholders

Percentage

Category of farmers	Growing mixed crop	
	PMDS+CNF	Non-CNF
Marginal	7.5	0.1
Small	8.4	2.4
Medium & Large	2.0	0.0

Source: IDSAP Field Survey, 2021

Annexure Table 4.9: Area under mixed crop as a percentage of cultivated area in Rabi season for small and large landholders

Percentage

category of farmers	PMDS+CNF	Non-CNF
Marginal	1.3	0.1
Small	1.7	1.0
Medium & Large	0.1	0.7

Source: IDSAP Field Survey, 2021

Annexure Table 4.10: Category of farmers wise average number of CNF practices adopted by PMDS+CNF farmers during 2017-21 period

Category of farmers	2017-18	2018-19	2019-20	2020-21
Marginal	2.15	3.42	4.15	4.29
Small	1.96	2.83	3.54	4.04
Medium & Large	2.10	3.30	3.61	4.29

Source: IDSAP Field Survey, 2021

Annexure Table 4.11: Category of farmers wise and agroclimatic zone wise and irrigation status wise total area under cultivation in Rabi Season

Category of farmers	PMDS+CNF			Non-CNF		
	Cultivated Area in hectare	% of Cultivated area		Cultivated Area in hectare	% of Cultivated area	
		Unirrigated	Irrigated		Unirrigated	Irrigated
Marginal	151.52	17.50	82.50	184.05	23.21	76.79
Small	81.58	12.08	87.92	131.63	20.17	79.83
Medium & Large	19.47	7.28	92.72	66.37	31.71	68.29

Source: IDSAP Field Survey, 2021

Annexure Table 4.12: Farm category wise and agroclimatic zone wise and irrigation status wise total area under cultivation in Rabi season

Farm category	PMDS+CNF						Non-CNF					
	Cultivated Area in hectare	Percentage of net cultivated area					Cultivated Area in hectare	Percentage of net cultivated area				
		Rainfed	Canal	Tank	Borewell	Others		Rainfed	Canal	Tank	Borewell	Others
Marginal	151.52	17.99	24.57	9.56	43.71	4.17	184.05	23.38	39.46	4.98	24.43	7.74
Small	81.58	12.08	12.35	5.26	66.44	3.87	131.63	20.63	15.88	4.16	52.20	7.13
Medium & Large	19.47	7.28	19.75	0.00	55.51	17.46	66.37	31.71	17.62	11.70	38.36	0.61

Note: Other irrigation sources include lift irrigation, other well, stream, and purchasing water.
Source: IDSAP Field Survey, 2021

Annexure Table 4.13: Farm category wise expenditure on PNPI by the PMDS+CNF and non-CNF paddy farmers Rabi season

(Rs. /Hectare)

Farm category	PMDS+CNF	Non-CNF	Difference in Rs.	Difference in %
1	2	3	4 = (2-3)	5 = (4/3*100)
Marginal	5,189	12,695	-7,506	-59.13
Small	3,801	9,383	-5,582	-59.49
Medium & Large	2,895	8,170	-5,275	-64.57

Source: IDSAP Field Survey, 2021

Annexure Table 4.14: Farm category wise paid-out cost by the PMDS+CNF and non-CNF paddy farmers Rabi season

(Rs. /Hectare)

Farm size	PMDS+CNF	Non-CNF	Difference in Rs.	Difference in %
1	2	3	4 = (2-3)	5 = (4/3*100)
Marginal	46,759	55,144	-8,384	-15.20
Small	35,707	43,303	-7,597	-17.54
Medium & Large	48,622	39,544	9,078	22.96

Source: IDSAP Field Survey, 2021

Annexure Table 4.15: Farm category wise Yield rate by the PMDS+CNF and non-CNF paddy farmers Rabi season

(Qtil. /Hectare)

Farm size	PMDS+CNF	Non-CNF	Difference in Rs.	Difference in %
1	2	3	4 = (2-3)	5 = (4/3*100)
Marginal Farmer	64.71	62.02	2.69	4.34
Small Farmer	65.39	59.58	5.81	9.76
Medium & Large Farmer	57.62	69.32	-11.70	-16.87

Source: IDSAP Field Survey, 2021

Annexure Table 4.16: Farm category wise price realised by the Paddy PMDS+CNF and non-CNF Farmers during Rabi season

Rs. /Qtil

	PMDS+CNF	Non-CNF	Difference in Rs.	Difference in %
1	2	3	4 = (2-3)	5 = (4/3*100)
Marginal	1657	1596	61	3.81
Small	1604	1686	-82	-4.86
Medium & Large	1523	1623	-100	-6.14

Source: IDSAP Field Survey, 2021

Annexure Table 4.17: Farm category wise Gross value of output by the PMDS+CNF and non-CNF paddy farmers Rabi season

(Rs. /Hectare)

Farm size	PMDS+CNF	Non-CNF	Difference in Rs.	Difference in %
1	2	3	4 = (2-3)	5 = (4/3*100)
Marginal Farmer	1,14,126	1,03,362	10,764	10.41
Small Farmer	1,11,613	98,074	13,539	13.81
Medium & Large Farmer	93,076	1,22,203	-29,127	-23.84

Source: IDSAP Field Survey, 2021

Annexure Table 4.18: Farm category wise Net Value of output by the PMDS+CNF and non-CNF paddy farmers in Rabi season

(Rs. /Hectare)

Farm size	PMDS+CNF	Non-CNF	Difference in Rs.	Difference in %
1	2	3	4 = (2-3)	5 = (4/3*100)
Marginal Farmer	67,367	48,218	19,149	39.71
Small Farmer	75,906	54,771	21,135	38.59
Medium & Large Farmer	44,454	82,659	-38,205	-46.22

Source: IDSAP Field Survey, 2021

Chapter 5
Summary, Conclusions and Policy Implications

5.1 Introduction

The basic premise of this Rabi study of 2020-21 is to assess the impact of Pre-Monsoon Dry Sowing (PMDS)+Community managed Natural Farming (CNF) on farming and farmers of Andhra Pradesh. PMDS is a part of CNF. The impact of PMDS+CNF is assessed through the comparison of PMDS+CNF farmers with non-CNF farmers regarding different impact parameters. The study examines the pattern of utilisation of factors of production such as land, labour, water, and capital (funds mobilised for meeting the expenditure on agricultural operations and household needs) of PMDS+CNF farmers compared to non-CNF farmers for growing crops. It also assesses the adoption of CNF practices by the farmers of CNF. The study covers the impact of the pattern of utilisation of factors of production and adoption of CNF practices on costs and returns of major crops of CNF and non-CNF to assess the impact of PMDS+CNF on farming. This analysis has been conducted at state level as well as agroclimatic zones and category of farmers' level. Finally, the policy implication emanating from the analysis are identified and policy suggestion are provided.

5.2 Methodology

This study is conducted in all the 13 districts of Andhra Pradesh. It adopted a stratified, multi-stage sampling scheme with Gram Panchayats (GPs) as first stage units and cultivators (households) as second stage units. A total of 1140 total farmer households of PMDS+CNF were surveyed in Kharif season. The survey in Rabi Season has revealed that as high as 800 farmers of 1140 PMDS+CNF farmers covered in Kharif season, around 73 per cent of farmers, have grown Rabi crops. It is noteworthy that less than one percent of farmers have grown pre-Rabi crop among the total farmers. Further, around 10 per cent of farmers have raised crops both in Pre-Rabi and Rabi seasons. Furthermore, around 63 per cent of farmers have grown Rabi crop without Pre-Rabi crops on PMDS+CNF plots of the Kharif Season. All the farmers who have grown crops in Rabi have been considered, these households constitute around 73 per cent of 1140 CNF households. On the other hand, 78 per cent of 646 non-CNF farmers grow crops in Rabi season. These percentages vary across zones and category of farmers.

There are 10 crops, in Rabi season, for which CCEs were conducted to estimate yields under PMDS+CNF and non-CNF plots for assessing the impact of CNF on yields. The crops include Cotton, Chilies, Jowar, Bengal Gram, Horse Gram, Paddy, Groundnut, Black Gram, Maize and Green Gram. The last five crops, viz., Paddy, Groundnut, Black Gram, Maize and Green Gram are considered for the impact analysis on costs and returns of crops in Rabi season because they have adequate sample size to estimate costs and returns. Among the five crops considered, the pulse crops (Black Gram and Green Gram) are mostly grown under unirrigated conditions compared to other crops by both the PMDS+CNF and the non-CNF farmers. The Rabi impact study is based on the cross-section survey of the agricultural year,2020-21.

5.3 Summary of Major Findings

5.3.1 Pattern of utilisation of Land, Labour, Water and Capital Funds

- PMDS+CNF farmers both small and large compared to non-CNF farmers have utilised their cultivated land more intensively in the state, across all the agroclimatic zones.
- The intensive use of hired labour as well as family labour is pronounced among the PMDS+CNF farmers over non-CNF farmers across all the crops in the state, in paddy across all the agroclimatic zones and for the small and large landholders
- Large landholders depend relatively more on controlled irrigation sources like borewells, while small landholders relatively more on canal irrigation among the both the PMDS+CNF and non-CNF farmers.
- The dependency of CNF farmers on the traders/money lenders was less in the state across all the zones and for both the small and large landholders

5.3.2 Pattern of adoption of CNF practices

- The number of practices adopted has been on the increase by the PMDS+CNF farmers during the four agricultural years, 2017-21 among the CNF farmers. This was pronounced after the spread of PMDS, during the last two years, compared to the first two years.
- The practice of mixed cropping was higher among the CNF farmers over non-CNF farmers in the state, across zones and both for the small and large landholders' category.

5.3.3 Costs and returns of crops

- The expenditure on PNPI and the overall paid-out costs per hectare were lower for all the five crops considered in Rabi season under PMDS+CNF plots over non-CNF plots in the state. This is true across all the agroclimatic zones in case of paddy. However, both the small and large landholders have higher paid out cost under PMDS+CNF over non-CNF plots in case of paddy. This is due to higher use of hired labour by small as well as large landholders.
- The yields of the crops are either higher or the same under PMDS+CNF over those of non-CNF. This is true across all the agroclimatic zones, except Godavari Zone. Further, small landholders have obtained higher yield compared to large landholders for PMDS+CNF over non-CNF.
- The gross value of crop output per hectare is invariably higher under PMDS+CNF compared to non-CNF across all the crops considered for the analysis. The yield responses to inputs have contributed to the higher gross value of output in case of pulses-black gram and green gram, while yield and prices together have contributed to higher gross value of output in case of cereals-paddy and maize and oil seeds-groundnut. All the agroclimatic zones except Godavari Zone have higher gross value of output under PMDS+CNF compared to non-CNF. Small landholders, compared to large landholders, have obtained higher gross value of output.
- The net value of output of crops grown under PMDS+CNF is invariably higher than that grown under non-CNF across all five crops considered for the analysis. This indicates that lower paid-out costs have contributed consistently for the higher net value of output under PMDS+CNF over non-CNF. Thus, it is evident that the lower paid-out costs in case of all crops; higher yields and realized prices in case of paddy and maize and groundnut; and yields in case of pulse crops- black gram and green gram have contributed to the higher net value of crop outputs under PMDS+CNF over non-CNF. The net value of paddy is higher for PMDS+CNF over non-CNF across all agroclimatic zones, except Godavari Zone. This is due to lower paid out cost as well as higher yields. Similarly, it is higher for the small landholders compared to large landholders. This is also due to low paid out cost and higher yields of the small landholders over large landholders.

5.4 Conclusions

- The analysis has brought out to the fore that the net value of output per hectare has been determined by the paid-out costs, yield and realised prices of crops.
- The intensive use of land and labour; less intensive use of water for irrigation and capital funds for meeting expenditure on agricultural operation including marketing; and more adoption of CNF practices including PMDS have contributed to reduction in the paid-out costs and enhancement in yield of crops in the ultimate analysis of costs and returns of crops.
- Thus, higher volume of outputs has been achieved by CNF farmers at lower costs of production. This is in contrast to the chemical-based agriculture.
- For all the crops considered for the analysis and in all the agroclimatic zones, and small landholder (marginal and small farmers) in caparison with large landholders (medium and large farmers) have obtained higher yields of output of crops at lower costs under CNF
- The intensive use of land throughout the agricultural year, improvement in yields of crops and more net and gross value of output of CNF can contribute more to agricultural growth under CNF over chemical-based agriculture.
- The reduced cost of production and enhanced yields of crops under CNF can protect the income to the farmers in the situation of falling prices of crop outputs. Thus, CNF has enabled farmers to withstand the risk of falling prices of crop outputs in the output markets.

Thus, it is evident from the analysis that practice of CNF led to higher intensive use of land and labour, less intensive use of water, less intensive use of capital funds, cost reduction in growing crops, yield enhancement of crops, and inclusiveness of scarce rainfall areas and small landholder of the farming community.

5.5 Policy suggestions

The analysis has also highlighted challenges to be addressed. They are as follows:

1. The expansion of cultivated area under PMDS, especially in rainfall dependent zones, more so in scarce rain fall zones to enhance land use intensity for obtaining potential benefits of PMDS+CNF is a concern that need to be addressed. The existing women

Self-Help Groups and their federation need to be leveraged. The kitchen garden can be an intervention and act as entry point through PMDS for women groups. It can result in the motivation of women in each household. The women in turn can motivate their men to go for PMDS Practice in their field. The RySS also can go-in for the Model development of Plot(s) at the village level on the common lands through Internal Community Resource Persons (ICRPs) to demonstrate the practices of CNF including PMDS. This enables farmers to get motivated by the real demonstration of CNF practices including PMDS.

2. The increase in the cost of production especially in case of paddy crop due to increase in the use of hired labour by small landholders needs to be addressed because this results in reduced net value of output. Hence, yield enhancement and achievement of higher prices in output markets enable CNF farmers to address this challenge. More specifically, the adoption of all the practices of CNF especially PMDS to enhance yield of crops and reduction of cost simultaneously appears useful. Output market support through public procurement by the government to start with and promotion of FPOs along with natural farming certification may enable the smallholders to effectively meet this challenge.
3. The lower use of biological inputs due to higher wages of labour for preparation and application of biological inputs needs policy attention. This is pronounced in case of farmer households having family labour shortage. This ultimately results in lower yields of crops and net value of output. Hence, biological inputs should be made available through NPM shops managed by women Self-Help Groups and their federations, wherever possible. Also, physical structures like small tanks to store and apply these biological inputs to the fields through pipelines by gravity flow may be encouraged under Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) and Andhra Pradesh Minor Irrigation Project (APMIP) for small as well as large landholders. Decentralised technology dissemination. provides solution to the labour scarcity issue in the preparation and application of biological inputs to fields of farmers. These practices are observed in the field survey of IDSAP.

Reference

IDSAP (2021): Assessing the Impact of Andhra Pradesh Community Managed Natural Farming: A comprehensive Approach Using Crop Cutting Experiments: Second Interim Report (Kharif 2020-21), Mimeograph, Institute for Development Studies Andhra Pradesh, Visakhapatnam.