Assessing the Impact of APCNF

[Andhra Pradesh Community Managed Natural Farming]

A Comprehensive Approach Using Crop Cutting Experiments

Final Report 2021-22

Submitted To

Rythu Sadhikara Samstha

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Institute for Development Studies Andhra Pradesh

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Project Team

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Acronyms

AH	:	Agriculture Households
AP	:	Andhra Pradesh
APCNF	:	Andhra Pradesh Community Managed Natural Farming
BC	:	Backward Castes
CSs	:	Case Studies
CC	:	Climate Change
CCEs	:	Crop Cutting Experiments
DPMs	:	District Project Managers
DPMU		District Program Management Unit
FYM	:	Farm yard manure
FGDs	:	Focus Group Discussions
FPOs		Farmers Producers Organizations
GR	:	Green Revolution
GCA	:	Gross Cropped Area
GDP	:	Gross Domestic Product
HAT	:	High-altitude and Tribal areas
HDI		Human Development Index
MGNREGS	:	Mahatma Gandhi Rural Employment Guarantee Scheme
NSO	:	National Statistical Office
NPM	:	Non-chemical Pest Management
NGOs	:	Non-Governmental Organizations
OC	:	Open Categories
PDS		Public Distribution Systems
PNPI		Plant Nutrients and Protection Inputs
PMDS	:	Pre-Monsoon Dry Sowing
PRDS	:	Pre-Rabi Dry Sowing
RySS	:	Rhythu Sadhikara Samstha
SC	:	Scheduled Castes
SHG		Self Help Groups
ST	:	Scheduled Tribes
S2S	:	Seed to Seed
SIs	:	Strategic Interviews
TTD		Tirumala Tirupathi Devasthanam
GoAP	:	The Government of Andhra Pradesh
ZBNF	:	Zero Budget Natural Farming

Executive Summary

0.1. Objectives and Methodology

1. This is the final report of the study, covering both Kharif and Rabi seasons of 2021-22. The major objective of the study is to assess the impact of Andhra Pradesh Community Managed Natural Farming (APCNF or CNF) on its economic sustainability, social sustainability and environmental sustainability. The report delineates the contribution of CNF in enhancing the welfare and wellbeing of farmers and people in the state. Specific objectives of this report are:

    i. To estimate and compare the cost of cultivation, cost structure, crop yields, gross and net values of output from crop cultivation under CNF and under chemical-based farming, referred as non-CNF.
    ii. To estimate and compare the crop yields obtained under CNF and non-CNF, independently and also scientifically through crop cutting experiments (CCEs).
    iii. To understand the impact of CNF on the input use, especially, on the use of natural resources and consequent environmental implications.
    iv. To arrive at the impact of CNF on the household income
    v. To guesstimate the actual benefits accruing to the state during the study period and potential benefits to the state due to APCNF
    vi. To comprehend the long-term impact of APCNF through panel study
    vii. To know the impact of CNF on farmers' wellbeing.
    viii. To understand the issues and challenges in adoption of CNF and to offer possible solutions.

2. The study used the "***with and without***" method to assess the impact of CNF. In this method the outcomes of CNF farmers, cultivating a particular crop are compared with the outcomes of the non-CNF farmers cultivating the same crop, but using chemical inputs.
3. In total 1,145 CNF farmers and 737 non-CNF farmers are covered in this report. After surveying all the sample farmers, it was found that 674 CNF farmers and 421 non-CNF farmers have cultivated at least one crop during Rabi 2021-22. At the state level, 59 percent of CNF farmers and 57 percent of non-CNF farmers have cultivated Rabi crops.

4. Further, the study conducted 42 Focus Group Discussions (FGDs), 28 Strategic Interviews (SIs) 70 Case Studies (CAs) of progressive farmers and social enterprises and 70 CAs of horticulture farmers.
5. In this report, the data of Kharif and Rabi are pooled for the cost and returns analysis. The weighted averages of Kharif and Rabi data is used in calculation of average costs, yields and returns of each crop. The areas under each crop in each season are used as the weights. In total 10 crops have 41 plus observations for estimating the cost and returns. The two leftover crops are Green gram and Jowar.
6. Crop Cutting Experiments (CCEs) were conducted scientifically to get independent estimates of crop yields under CNF and non-CNF.
7. The study conducted nearly 1,500 CCEs during 2021-22. However, some of the CCE results could not be used in this report, due to inadequate coverage of a couple of crops and lack of counterfactuals in few other crops in each season. Total number of CCEs used in this report are 1,371. The number includes 872 CNF crops, 499 non-CNF crops. In addition, the study team conducted another 231 CCEs for Panel farmers. Crop wise number of CCEs for CNF crops vary from 11 in Red gram to 400 in Paddy; and the same for non-CNF crops vary from 10 in Tomato to 171 in Paddy.
8. The analysis is carried out mostly at the state level. Wherever possible, results are provided at the agroclimatic zone wise, farm-size category wise, tenurial category wise and social category wise.

0.2. Profile of sample farmers

9. A larger percentage of CNF sample households (HHs) hail from vulnerable communities compared to non-CNF sample HHs. Nearly one-third (31.20%) of CNF sample HHs are SCs and STs compared to 19.52% of non-CNF HHs.
10. Marginal farmers are more among CNF over non-CNF farmers by 10 percentage points.

0.3. Impact of CNF on farming conditions

11. The expenditure on plant nutrient and protection inputs (PNPIs) per hectare is lower under CNF compared to non-CNF across all the crops considered except Ragi crop. CNF farmers saved ₹2,830 in Red gram to ₹26,667 in Chillies, per hectare, in the expenditure on PNPIs (Table 3.1). Only in Ragi, the CNF farmers incurred higher expenditure of ₹696 per hectare on PNPIs. On an average the CNF farmers saved ₹ 8,710 per hectare in the expenditure on PNPIs (Table 7.1).

12. The CNF farmers incurred less paid-out costs in nine out of 10 crops considered in this report; in the range of ₹134 per hectare in case of Bengal gram to ₹29,087 per hectare in respect of Tomato (Table 3.2). The only exception is Red gram, in which the CNF farmers incurred higher paid-out cost of ₹1,744 per hectare. On an average the CNF farmers saved ₹9,389 per hectare in the paid-out costs[1] (Table 7.1).
13. Analysis of the structure of the paid-out costs of CNF and non-CNF crops indicates that CNF not only reduces the cost of cultivation, but also diversifies the input composition.
14. The yields are measured through Crop Cutting Experiments (CCE) to ensure scientific estimates without any bias. The CNF yields are significantly higher than those of non-CNF in five out of ten crops, viz., Bengal gram, Black gram, Maize, Ragi and Tomato. Further, the yields of CNF are on par with those of non-CNF for the remaining five crops viz., Paddy, Groundnut, Cotton, Red gram and Chillis (Table 3.5).
15. The gross value of output is higher under CNF compared to that of non-CNF across all the crops except Chilies (Table 3.7). On an average the CNF farmers obtained higher gross value of crop output of ₹10,501 per hectare (Table 7.1).
16. The net value of CNF output is higher than that of non-CNF in nine out of ten crops included in this report. The CNF farmers have higher net values in the range of 39 percent in Groundnut to over 25 times in Bengal gram (Table 3.8). In Chillies, the net value of CNF output is less than that of non-CNF, the difference is 24 percent. On an average the CNF farmers obtained additional net value of crop output of ₹19,889 (Table 7.1).

0.4. Impact of CNF on farming conditions at disaggregate level

17. The disaggregate analysis, once again confirms the effectiveness of the CNF in making agriculture profitable. By effecting savings in the cost of cultivation (paid-out cost), improving and/ or maintaining the crop yields and fetching higher or same prices for crop output; thus, improving the gross and net values of crops' output, CNF helped the farmers a great deal. The disaggregate analyses reconfirm one of the major findings of the previous studies in the present series- "the resource poor regions and sections too can benefit from CNF".

[1] The paid-out costs include those on (1) seeds, (2) farmyard manure (FAM) including penning, (3) human labour, (4) bullock labour, (5) machine labour, (6) implements and (7) irrigation, along with (8) PNPI. In this study, the monetary values of own and purchased/ hired inputs are included in the paid-out costs of cultivation. But, the value of family labour is not included in the paid-out costs. The paid-out cost used in this study is close to the cost of cultivation concept of 'Cost A' for owner cultivator

18. The analysis also shows that (1) Savings in paid-out cost would be more in input intensive crops. (2) Relatively higher yields can be achieved under CNF in less resource intensive crops. (3) The non-CNF farmers often get negative net value of crop output.

0.5. Impact of CNF on input-use

19. An increase in number of farmers adopting CNF and area put under CNF indicates the beneficial potential of CNF. The number of pure CNF/ S2S (seed to seed) farmers has increased from 33,124 in 2018-19 to 2,59,125 in 2021-22. But the number of partial farmers has stagnated just above 3.5 lakh during last three years (Figure 5.1). The average area devoted by a farmer to CNF has increased from 0.48 hectares in Kharif of 2018-19 to 1.07 hectares in Kharif of 2021-22. During the Rabi seasons also, the average area allocated to CNF has increased from 0.33 hectares in Rabi 2018-19 to 0.63 hectares in Rabi 2021-22, at the state level (Figure 5.2).
20. Another impact of CNF on land use in agriculture is the increase in cropping intensity. CNF is positively impacting on the cropping intensity through PMDS and 365 days green cover strategy. Compared to non-CNF farmers, the PMDS+CNF enabled CNF farmers to cover their cultivated land with crops for longer periods. In total CNF farmers have 27 days more crop cover on their CNF fields compared to the fields of non-CNF farmers during April 2021 to May 2022 (Table 5.1).
21. The total labour days (family labour plus hired labour) per hectare for CNF crops are higher than that of non-CNF crops in seven out of nine crops covered, in the range of 9 to 55 days per hectare. In the case of Cotton and Maize, the total labour use under CNF is less than that of non-CNF by small margin of 7 and 5 days respectively (Table 5.2). Though CNF crops need a greater number of human labour days, most of those labour days have come from family labour only.
22. In Rabi season, a greater number of labour days are used in four crops under CNF; and equal number of days are used in the remaining Black gram for both CNF and non-CNF (Table 5.3).
23. As pointed out in the previous Kharif and Rabi 2021-22 reports, various CNF practices are expected to soften the soil and increase the carbon content in the soil. These changes in turn would increase the water/ rainfall percolation into the soils and increase the water/ moisture holding capacity of the soils. Among CNF farmers, over four-fifths have reported that water-use has decreased, due to CNF in both Kharif and Rabi seasons (Figure 5.5).

With minor exceptions, the trend holds good across almost all agroclimatic zones and all farmer categories.

24. By avoiding completely the agrochemicals, the CNF farmers have been contributing immensely in halting and reversing the multidimensional pollution of the agrochemicals, including the resource degradation. The avoided expenditure on agrochemicals (fertilizers and pesticides), in Kharif 2021-22, varies from ₹1.76 thousand in Ragi to₹43.05 thousand in Chillies (Figure 5.6). In Rabi, the avoided expenditure on agrochemicals varies from ₹8.73 thousand per hectare in Black gram to ₹20.03 thousand per hectare in Paddy and the avoided expenditure on fertilizers varies from ₹1.16 thousand in Black gram to₹13.68 thousand in Paddy respectively (figure 5.7).
25. The reduction in the paid-out cost of cultivation in almost all crops is expected to reduce the working capital requirements for CNF, which in turn, is expected to result in a reduction in the CNF farmers' borrowing for agriculture and other uses. The field data show that incidence of borrowing is considerably less for CNF farmers. While, there are 91 loans for every 100 CNF farmers, the same for non-CNF farmers is 112. The average loan amount for each CNF farmer is ₹71,964, and for each non-CNF farmer is ₹ 1,03,136 (Table 5.6).
26. One of the major interventions under CNF is the introduction of microbes into the soil through biological stimulants. As soil naturally regenerates under CNF, there is no need to apply any chemical inputs. During Kharif, over 90 percent of CNF farmers have used Drava Jeevamrutham, over 89 percent have applied Beejamrutham and 70 percent have applied Ghana Jeevamrutham. Farm yard manure (FYM), which consists of waste from livestock and domestic sectors is applied by 63 percent of farmers (Figure 5.8). During Rabi, 83 percent of CNF farmers have used Dravajeevamrutham, 82 percent applied Beejamrutham, 57 applied Ghanajeevamrutham, and so on (Figure 5.9).
27. CNF has prescribed and introduced many locally prepared pest-specific and disease-specific non-chemical pest management (NPM) methods and inputs known as Kashayams and Asthrams. During Kharif, about 74 percent of CNF farmers have used Pheromone traps to control pests in their fields. Neemasthram is the second most widely used input, used by 61 percent farmers. Agnitasthram and Brahmasthram are used by 36 percent and 32 percent farmers respectively (Figure 5.10). Similar pattern can be observed in Rabi season also (Figure 5.11).
28. Biological stimulants, viz., Beejamrutham, and Ghana and Drava Jeevamrutham not only improve soil quality but also the crop quality. They improve the crops' health and resistance to pests and weather anomalies.

29. Because of CNF, over four-fifths of farmers experienced an improvement in the soil quality in their fields in both Kharif and Rabi seasons (Figure 5.12).
30. About three-fourths to over four-fifths of farmers perceived improvements in different indicators related to crop quality and resilience during both seasons (Figure 5.14).

0.6. Impact of CNF on HH incomes

31. At the state level, the average income of CNF households is ₹2,59,640 compared to ₹2,28,157 of non-CNF household in the agriculture year (AY) 2021-22. CNF households got ₹31,157 higher income than that of non-CNF. That is 14 percent higher income (Table 6.1).
32. CNF is expected to have a positive impact on the structure of CNF households' income. However, structural changes, such as income sources of a household, take time. Even in these early days, the impact of CNF is visible.
33. The disaggregate analysis shows that CNF benefits are reaching most parts of the state, with some minor exceptions and almost all sections of farmers in the state.

0.7. Impact of CNF at the project level

34. Using the crop wise costs and returns data obtained from the field survey; and using the area under each of the 10 sample crops in each season in the state as weights, the expenditure on fertilizers and on agrochemicals, avoided on average are estimated. Similarly, the average and total impact of CNF at the project level and the potential impact at the state level are estimated.
35. At the project level, the farmers saved ₹619.50 crores in the expenditure on PNPI, and ₹667.79 crore in paid-out costs. Further, the project participants got additional gross value of output of ₹746.88 crore in 2021-22. These all resulted in an additional net value of crop output of ₹1,414.64 crore for project participants (Table 7.3).
36. On average, each S2S farmer has avoided use of 5.97 quintals of fertilizers in his/ her S2S plots and 2.98 quintals of fertilizers in his/ her partial plots. Further, each partial farmer has avoided 2.98 quintals of fertilizers use in her/ his partial plots (Figure 7.1).
37. In total, use of 33.79 lakh quintals of fertilizers have been avoided in the state in 2021-22 due to CNF project (Figure 7.3).
38. Each CNF farmer has avoided ₹11.46 thousand expenditure on fertilizers and ₹8.41 thousand expenditure on pesticides in his/ her CNF plots; and ₹9.94 thousand expenditure

on agrochemicals in her/ his partial CNF plots. Similarly, each partial farmer has also avoided ₹9.94 thousand on agrochemicals during the study period (Table 7.4).

39. Total expenditure avoided on agrochemicals is ₹1,124.88 crore in the state, due to APCNF project (Table 7.5). Even after adjusting for a 20 percent error on either side, the expenditure avoided on agrochemicals is in the range of ₹900 crore to ₹1,350 crores. Apart from the financial benefits, avoided use of agrochemicals has larger social (health) and environmental benefits (soil quality improvement and mitigation of climate change).

0.8. Panel study

40. The major objective of the panel study is to assess the transformative potential of CNF. The expected long-term changes are all-round prosperity, including improved human resources development, command over CNF, improved soil quality and fertility, improved local natural resources, etc. However, such changes take time.
41. Though it needs medium to long-term data, of 10-15 years, to show a clear improvement in the lives of panel farmers, the transformative potential of CNF can be seen by comparing the performance of panel farmers vis-à-vis the cross-section CNF farmers, and also that of non-CNF farmers. It may be worth noting that both panel and cross-section farmers would experience similar weather conditions in each year. ***Hence the differences between the farming outcomes of panel and cross-section farmers can be attributed to the transformative potential of CNF.***
42. The time series and cross section (a comparison of panel and cross-section farmers data) analysis clearly demonstrated the long-term potential of CNF. The panel farmers' allocation of area to CNF has been increasing. With a few exceptions, the panel framers' profitability has been increasing. The panel farmers performed better than the cross-section farmers under all farming conditions and other development indicators.
43. The study indicates that some of the problems of CNF farmers may persist over the period, especially the marketing and shortage labour. RySS's successful efforts in bringing in TTD to procure CNF foodgrains has given an impetus to the marketing of CNF output. Such efforts need to be continued.
44. RySS may build on the recent developments with respect to linking MGNREGA with individual farming.
45. A separate questionnaire may be designed for panel study or the questionnaire should be standardized with minimum changes over the years. The sample size may be increased, if possible.

0.9. Impact of CNF on the wellbeing of farmers

46. The wellbeing indicators covered, in this report, are grouped in a three-dimensional framework, viz., (1) Development, (2) Freedom and (3) Dignity. The analysis has been conducted through the integration of quantitative and qualitative data.
47. Over 52 percent of farmers have reported a moderate improvement in the health status of the family members, due to CNF. In addition, 16 percent CNF farmers have testified a considerable improvement in their health status due to CNF (Table 9.1). While 12 percent farmers reported a considerable decline in the health expenditure, another 38 percent have experienced a moderate reduction (Figure 9.2).
48. As the incidence of diseases reduced, due to CNF, children's attendance in the schools has increased. Because of improvements in the financial position, some CNF farmers are able to admit their children in the private/ better schools for 'quality education'. Due to improvement in health and other positive developments, children's learning skills have improved.
49. About 60 percent of CNF farmers confirmed an improvement in their financial position, due to CNF (Figure 9.3).
50. CNF farmers and households got freedom from chemical-based agriculture, which is a health hazard, apart from many other risks. They also got freedom from unhealthy food. They also got freedom from input, credit and in output markets.
51. In all, 98 percent CNF farmers want to continue CNF farming. The same vary between 95 to 99 percent across the agroclimatic zones and farmers categories (Figure 9.4).
52. About 50 percent of CNF farmers have experienced or perceived that CNF has reduced their agriculture related tensions. The same is as high as 87 percent in Godavari zone and 68 percent in Krishna zone. The same is 67 percent for tenant farmers and 53 percent for owner-cum-tenant farmers; and 59 percent for SC and 53 percent for ST farmers (Table 9.4).
53. At the aggregate level, 84 percent of CNF farmers have reported that they are consuming CNF food. The same is 98 percent in Krishna zone and 99 percent in Southern zone. Over 80 to 96 percent farmers of eight farmer categories have been consuming CNF food (Figure 9.6).
54. CNF food is not only healthy, but also tasty. Over 90 percent of CNF farmers, have reported that CNF food is tastier than non-CNF food. Over 90 percent of farmers stated

that CNF food is tasty, in seven out of ten farmer categories. Further, 92 to 98 percent of farmers in four agroclimatic zones have experienced that CNF food is tasty (Figure 9.7).

55. Under CNF, farmers would stop completely the application of fertilizers and pesticides. They would start using their own seeds. All these would reduce, if not eliminate, CNF farmers' dependence on the input markets and related exploitation. All 100 percent CNF farmers experienced a reduction in their dependence on input markets.
56. Because of CNF, 57 percent of farmers, at the state level, experienced a moderate reduction in the requirement of funds for agriculture. In addition, 11 percent of CNF farmers felt a considerable reduction in requirement of funds for cultivation (Figure 9.8).
57. A reduction in the fund's requirement for CNF vis-à-vis non-CNF, would logically lead to a reduction in the borrowings for agriculture. As many as 53 percent of farmers, at the state level, confirmed a moderate decline in borrowings for agriculture, due to CNF, during Kharif 2021-22. Further, 14 percent of CNF farmers reported a considerable reduction in borrowings for agriculture, due to CNF (Figure 9.9).
58. At the state level, 30 percent of CNF farmers witnessed a moderate increase in new output marketing channels such as opportunities to sell in Shandis, exhibitions, door delivery, online; selling directly to friends and relatives, local shops, etc. Further, 4 percent of CNF farmers have seen a considerable increase in new output marketing channels (Figure 9.10).
59. The respect the CNF farmers command, is reflecting the people's (including consumers, relatives and friends and officials in the markets) interest in CNF food and CNF itself, which is environmentally benign. At the state level, 56 percent and 12 percent of CNF farmers experienced and witnessed a moderate and high interest, respectively, in the people, including consumers, relatives and friends and officials, in CNF and CNF food (Figure 9.11).
60. At the state level, 74 per cent of CNF farmers have enjoyed the respect from friends and relatives, during the study period (Figure 9.12). But 50 per cent of farmers said that they got respect in markets or from general public/ consumers, during the study period (Figure 9.13). It indicates an inadequate awareness about CNF food in the general public and consumers.

0.10. Issues, challenges and way forward

61. RySS is an integrated institutional mechanism to promote the APCNF across the state. The program is being implemented with hundreds of functionaries at different levels in each district by the district program management unit (DPMU) under the direction of DPMs.

62. Personal contacts with individual farmers, distribution of pamphlets, exhibition of district specific CNF videos, organization of training and exposure programs, development of demonstration plots, involvement of SHG institutions, NGOs and other resource institutions are major strategies adopted by RySS for the promotion of CNF in the state.
63. Promotion of NPM shops is another important strategy for the expansion of the program.
64. RySS has been encouraging and conducting action research in collaboration with thousands of ICRPs and other functionaries. Needless to say, the learnings are being incorporated into the program design.

0.10.1. SWOT analysis

65. Increase in profitability of cultivation; decrease in funds requirement and borrowing for agriculture; availability of nutrition food; elaborate extension services; improved health outcomes; improved soil and other natural resources and crop quality; etc., are major strengths of CNF.
66. Lack of separate market for CNF output; apprehensions about the crop yields; non-availability of suitable machinery and equipment, like mixers, blenders, drums, etc.; non-availability of suitable machinery for mixed cropping; shortage of raw material for the preparation of CNF inputs/ stimulants; non-availability of Kashayams for urgent use, etc., are major identified weaknesses.
67. Reduction in the use of agrochemicals and irrigation; diversified cropping pattern; higher cropping intensity; availability of chemical free food; and synergistic benefits from crop cultivation coupled with livestock rearing; etc., are major identified opportunities from CNF.
68. Expectation of premium prices for CNF output; slow paced innovations; overdependence on RySS field teams; and lack of integration with other Departments are identified major threats to CNF.

0.10.2. Recommendations

69. RySS may continue the current efforts like involving TTD kind of organizations to procure CNF foodgrains. RySS may also encourage the governments to procure CNF output for the public distribution systems (PDS), Mid-day meal schemes, Anganwadi programs, defence and police forces, etc. RySS may continue and enlarge the activities related to marketing of CNF output, such as linking with Malls, Rythu Bazars, Shandies, Urban

consumers associations, NGOs, NGO promoted Farmers Producers Organizations (FPOs), etc. RySS may undertake an advertisement campaign about the virtues of CNF food. In the advocacy, RySS may focus on higher profitability, environmental benefits, health benefits and not focus on higher prices and yields.

70. RySS may consider involving the Panchayat Raj institutions, which have big stakes in the welfare of the farmers, in implementation of APCNF.
71. The need of hour is a higher-level coordination and collaboration between RySS and the Line Departments. The Line Departments have resources to accelerate the expansion of CNF and benefit the farmers. E.g., the Civil Supplies Department can procure the CNF output. The Animal Husbandry Department can provide livestock and can take care of the livestock health. The Agriculture Department can provide the PMDS seeds under its Green-manure Seeds Distribution Scheme. Research institutions can provide suitable tools, and so on. Priority to CNF should reflect in the Government budgetary allocation and other activities.
72. RySS may continue and increase the efforts to promote NPM shops.
73. RySS may build on current developments and link the MGNREGS with individual farming operations. RySS may encourage and institutionalize the age-old labour exchange (ADALA-BADALA) system and such other systems.

Chapter 1: Context, Objectives and Methodology

1.1. Context

Agricultural development is critical to the food security and livelihood security to majority of the people in the country. To overcome the acute shortage of foodgrains during the 1960s and the 1970s, the Government of India adopted the seed-fertilizers-irrigation technology, known as Green Revolution (GR). Since then, the Central and State Governments have been expending and investing considerably on agricultural development and farmers' welfare.[2] Over the years agricultural sector has transformed totally. India emerged as the largest producer of many agriculture commodities. With just 2.43 of percent world geographical area, India is ranked first in pulses, Onion, and Milk production; second in Wheat, Rice, Groundnut, Sugarcane, Tea, Jute, Tobacco, vegetables, fruits, Potato, and Eggs production; and third in cereal production in the world (Government of India, 2023)[3]. The country also transformed from a hapless importer of the bulk foodgrains to a major exporter of the foodgrains and other agriculture commodities.

However, the agriculture transformation and foodgrains surpluses came at an enormous financial, human, social and environmental costs. Government subsidies favoured the resource intensive crops, well-endowed regions and better off sections. The subsidies also lead to degradation and deterioration of natural resources (see for example Saxena N, 2009). The area under, and, the production of, input[4]-intensive crops like Paddy, Wheat, Cotton, Sugarcane and Chillis have increased at the cost of less input-intensive crops like coarse cereals, pulses, and traditional oilseeds. The Governments' subsidies and price support programs also lead to degradation and deterioration of natural resources- land, water and atmosphere. The agrochemicals (fertilizers and pesticides), which are the principal components under the GR farming, have been adversely affecting the heath of human beings (both producers and consumers), domestic animals, wildlife

[2] This issue was discussed, in detail, in IDSAP, 2023: Assessing the Impact of APCNF, Mimeograph, Institute for Development Studies, Visakhapatnam

[3] Government of India, 2023: Agricultural Statistics at a Glance 2022, Ministry of Agriculture, New Delhi; https://agricoop.nic.in/Documents/CWWGDATA/Agricultural_Statistics_at_a_Glance_2022_0.pdf (Accessed on 25 July 2023)

[4] Especially, water/ irrigation, fertilizers and pesticides

and benevolent microbes in the soil. While the GR strategy is one of the major contributors to climate change (CC), and the farmers and poor became the primary victims of CC.

The costs of cultivation have been continuously increasing and the profitability of cultivation has been declining. The Radhakrishna Commission pointed out that "*Almost all crops considered for the analysis have incurred losses during 1965-2014. Crops such as Sugarcane and Black gram were profitable in most years. The remaining crops, including the principal foodgrain crops, incurred losses. Of these, Jowar, Ragi, Maize and Groundnut suffered losses in greater number of years during this time period."*[5] In recent years, farmers, as a group, experienced a nominal improvement in many development indicators, compared to others such as agriculture labour, and workers in other sectors.[6] The income from cultivation and animal husbandry combined was not adequate to cover actual consumption expenditure of the households self-employed in agriculture (farmers).[7] Suicides of over 300,000 farmers and agriculture labour since the mid-1990s indicate the crises in agriculture, in the country.

The condition of farmers in Andhra Pradesh (AP) is even more pathetic. Farmers in AP, normally, use excess inputs. According to Chand, Ramesh and Pavithra S, (2015) farmers in (combined) AP use excess doses of fertilizers. While all India is deficit in the use of Nitrogen (N) (-3.42%), Phosphorus (P) (-19%) and Potassium (K) (-51%) and total nutrients (NPK) (-17.5%); AP has been using far excess of total fertilizer (44%), 65.55% of excess N, 44.92% of excess P (Table 1.1 and Figure 1.1).

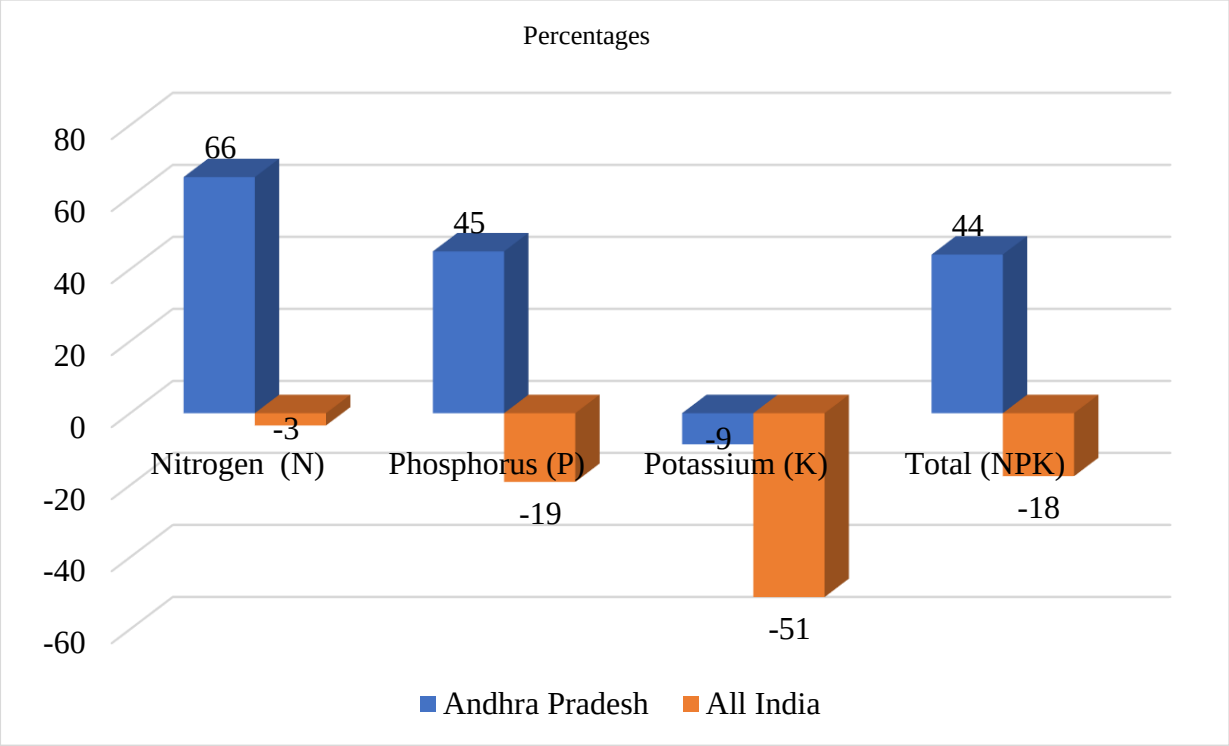
Table 1.1: Normative and actual use of N, P and K, in AP and Inda in Triennium Ending 2011-12 ***(in 1,000 tons)***

Fertilizer	Andhra Pradesh			All India		
	Normative use	**Actual use**	**Percentage difference**	**Normative use**	**Actual use**	**Percentage difference**
Nitrogen (N)	1,138	1,884	65.55	17,030	16,447	-3.42
Phosphorus (P)	679	984	44.92	9,469	7,660	-19.1
Potassium (K)	474	433	-8.65	6,675	3,266	-51.07
Total (NPK)	2,291	3,300	44.04	33,174	27,370	-17.5

Source: Extracted from Chand, Ramesh and Pavithra S, 2015

[5] Radhakrishna R, et al., (2016): *Report of the Commission on Inclusive and Sustainable Agricultural Development of Andhra Pradesh*, Submitted to The Government of Andhra Pradesh, Centre for Economics and Social Studies, Hyderabad.
[6] Ibid.
[7] Ibid.

Figure 1.1: Percentage differences in normative use and actual use of fertilizers in AP and India



Source: Extracted from Chand, Ramesh and Pavithra S, 2015

Another area of concern in AP is higher incidence of debt in rural areas in general and agriculture households in particular. The incidence of indebtedness in rural Andhra Pradesh is very high compared to rural India. Compared to 35 percent households in rural India, 62.8 percent rural households in the state are indebted. The average amount of debt in rural AP is ₹1.27 lakh compared to ₹0.60 lakh in rural India. On the other hand, the average indebted amount per each indebted household in rural AP is ₹2.03 lakh vis-à-vis ₹1.71 lakh in rural India. The average value of debt in rural AP is equal to 9.1 percent of average household assets value. The same in rural India is 3.8 percent. The variations between rural India and rural AP are more pronounced among the cultivators (Table 1.2). Relatively a higher percent of rural households in AP have availed loans from non-Institutional sources also (Table 1.3).

Table 1.2: Occupation category wise assets and liabilities of rural households in AP and India in 2019

Category	Indicator	Units	AP	India
Cultivators	Average Value of Assets	000' ₹	2,384	2,207
	Average amount of Debt	000' ₹	207	74
	Average amount of Debt per indebted household	000' ₹	275	185
	Incidence of Indebtedness	%	75.1	40.3
	Debt-Asset Ratio	%	8.7	3.4
Non-Cultivators	Average Value of Assets	000' ₹	863	785
	Average amount of Debt	000' ₹	83	40
	Average amount of Debt per indebted household	000' ₹	149	144
	Incidence of Indebtedness	%	55.9	28.2
	Debt-Asset Ratio	%	9.6	5.2
All	Average Value of Assets	000' ₹	1,408	1,592
	Average amount of Debt	000' ₹	127	60
	Average amount of Debt per indebted household	000' ₹	203	171
	Incidence of Indebtedness	%	62.8	35.0
	Debt-Asset Ratio	%	9.1	3.8

Source: Government of India, 2021

Table 1.3: Occupation category and credit source wise distribution of rural households in AP and India (in %)

Category	Indicator	AP	India
Cultivators	Institutional only	26.7	21.2
	Non-Institutional only	16.5	10.3
	Both	31.9	8.8
	All	75.1	40.3
Non-Cultivators	Institutional only	19.3	13.5
	Non-Institutional only	18.1	10.0
	Both	18.6	4.7
	All	55.9	28.2
All	Institutional only	21.9	17.8
	Non-Institutional only	17.5	10.2
	Both	23.3	7.0
	All	62.8	35.0

Source: Government of India, 2021

1.1.1. Alternative models of farming

Because of crises in the GR agriculture, which is also known as industrial agriculture and chemical-based agriculture, a number of Non-Governmental Organizations (NGOs), progressive farmers, community leaders and social entrepreneurs have started experimenting with alternative models of farming. The models focused on addressing different challenges of GR agriculture. These include replacement of agrochemicals with biological and organic inputs; a move away from monocropping to mixed cropping and tree-based cropping; experiments to reduce the water requirement in the crop cultivation, e.g., system of roots intensification; shift from independent sectoral development to integrated development; and understanding and application of ecological principles and services. Hundreds of thousands of farmers across the country have been adopting voluntarily these models and practices. Though the number of farmers adopting these models and practices have been increasing, they remained isolated voluntary ventures with very little networking and organization. In this context, AP is the first state, which adopted the ecological farming as the state policy. It is proposed to divert entire crop land and every farmer into natural farming.

The Government of Andhra Pradesh (GoAP) turned to Natural Farming, known as Andhra Pradesh Community Managed Natural Farming (APCNF)[8], as a way of solving the multiple crises in agriculture. The GoAP have established "*Rhythu Sadhikara Samstha*" (RySS) which is an integrated institutional mechanism to promote the APCNF across the state. APCNF is based on Dr Subhash Palekar's spiritual farming model, known as zero budget natural farming (ZBNF), which was developed on the principles of forests growth.[9] However, RySS is contextualizing and improving the original ZBNF (henceforth referred as APCNF) model continuously. Two major improvements incorporated in APCNF in recent times are: (1) To overcome the shortage of Desi cows, RySS is encouraging and facilitating the use of cow-dung and urine of any livestock in the preparation of Beejamrutham, Ghana and Drava Jeevamrutham and Khashayams. (2) To protect the microbes in the soil, especially, during the hot summer months, RySS has incorporated the Pre-Monsoon Dry Sowing (PMDS), a novel method of growing crops, during the offseason/ hot summer months with very little soil moisture. PMDS is briefly described in the Box 1.

[8] The programme was formerly known as Zero Budget Natural Farming (ZBNF)
[9] Dr Palekar observed that forests grow profusely and perpetually, without any external inputs. His experiments and model was to replicate those principles.

Box 1: Pre-Monsoon Dry Sowing

Recently RySS made one of the major breakthroughs in Andhra Pradesh Community Managed Natural Faming (APCNF) in the form of the ***Pre-Monsoon Dry Sowing (PMDS)***, a novel method of growing crops. PMDS enables farmers to raise crops in the dry seasons – before the monsoons. It is a global breakthrough. The exact science is yet to be established. The enhancement of soil biology through APCNF practices with raising of 8 to 15 diverse crops creates some special conditions, which enable seed germination with very little water/ moisture. PMDS is mostly practiced before the advent of monsoon, during summer and also before the beginning of the Rabi season crops. This system believes that land should always be covered with vegetation and farmers should not depend on rainy season alone for growing crops. It contributes to continuous green cover while increasing cropping intensity, agricultural incomes, and soil fertility.

While the benign microbes are introduced into soils through biological stimulants, under CNF, which convert the natural elements available in the soils and atmosphere into plant nutrients; PMDS provides food[10] and shade to the microbes, especially during the hot summer months. Because of these reasons, PMDS became an integral part of CNF.

Source: Extracts from previous reports by IDSAP. The report can be seen at www.idsap.in

Apart from above two major innovations and improvements, RySS has been continuously experimenting and demystifying science behind the natural farming, including several practices of traditional Indian agriculture. The package of APCNF is being constantly improved. The updated universal principles of natural farming are summarized in Box 2 below.

Box 2: Latest RySS's guiding principles for natural farming

UNIVERSAL PRINCIPLES OF NATURAL FARMING

- Soil To Be Covered With Crops 365 Days (Living Root)
- Minimal Disturbance Of Soil
- Bio-stimulants As Necessary Catalysts
- Use Indigenous Seed

[10]It is well known that through photosynthesis, plants convert sunlight, water and carbon dioxide (CO_2) into sugar, called Glucose. Plants store 40 percent of Glucose in above ground biomass and 30 percent in roots and the other 30 percent is exudated into the soil, for feeding vast microbial population. It is interesting to note that there is a direct relation between the diversity on above the ground and below the ground; i.e., diverse crops/ plants in the field contribute to the more diverse life in sub-soils/ below the ground, at different layers.

- Diverse Crops, Trees 15 -20 Crops
- Integrate Animals In To Farming
- Increase Organic Residues On The Soil
- Pest Management Through Botanical Extracts
- No Synthetic Fertilizers, Pesticides, Herbicides

Source: Extracted from https://apcnf.in/ (accessed on 8 August 2023)

Now Government of India and several state governments have adopted natural farming as the state policy. Further, the GoAP decided to cover the entire cropped area and every farmer under natural farming. In this context, independent evaluation studies, like the present study are essential. RySS has awarded this study to Institute for Development Studies Andhra Pradesh (IDSAP or IDS in short), Visakhapatnam.

As the PMDS is integrated in the CNF[11], the present study selected CNF farmers, who have raised PMDS during 2021 and grown the Kharif crop through CNF method, without applying any agrochemicals, i.e., fertilizers and pesticides, at least, in one plot. The study focused on CNF fields/ plots, which were put under PMDS during pre-monsoon period of 2021 and used for raising the Kharif crops through CNF method, without applying any agrochemicals or fertilizers and pesticides.

1.2. Objectives of the study

The current study is a continuation of the Impact studies of APCNF in 2019-20, and 2020-21, undertaken by Institute for Development Studies Andhra Pradesh (IDSAP), Visakhapatnam. As a part of 2021-22, IDSAP prepared and submitted three interim reports, broadly covering pre-monsoon period, Kharif season and Rabi season respectively. This is the final report of 2021-22 study, covering both Kharif and Rabi seasons of 2021-22.

The major objective of the study is to assess the impact of Andhra Pradesh Community Managed Natural Farming (APCNF or CNF) in terms of economic sustainability[12], social sustainability[13]

[11] The words APCNF and CNF are used interchangeably in this report.
[12]Economic sustainability means that APCNF is profitable, i.e., able to generate surpluses after covering the entire cost of cultivation
[13] Social sustainability implies that the poor and vulnerable sections are able to adopt and get benefitted from APCNF.

and environmental sustainability[14] and to delineate its contributions in enhancing the welfare and wellbeing of farmers and people in the state. Specific objectives of this report are:

i. To estimate and compare the cost of cultivation, cost structure, crop yields, gross and net values of output from crop cultivation under CNF and under chemical-based farming, referred as non-CNF in this report and also in all earlier reports.
ii. To estimate and compare the crop yields obtained under CNF and non-CNF, independently and also scientifically through crop cutting experiments (CCEs).
iii. To understand the impact of CNF on the input use, especially, the natural resources used and consequent environmental implications.
iv. To learn the impact of APCNF on the household income
v. To guesstimate the actual benefits accrued to the state during the study period and potential benefits to the state due to APCNF
vi. To comprehend the long-term impact of APCNF through panel study
vii. To know the impact of CNF on farmers' wellbeing.
viii. To understand the issues and challenges in adoption of CNF.

1.3. Methodology

1.3.1. The Basic Approach

This study is a continuation of the previous impact studies conducted in 2018-19[15], 2019-20 and 2020-2021 on APCNF. Earlier studies assessed the effectiveness of APCNF (also known as Seed to seed [S2S] Farming) with the help of field surveys on various aspects. This study covers the same aspects with a fresh random sample of farmers adopting PMDS+CNF (henceforth called CNF farmers in this report) and non-APCNF (also referred as non-CNF) farmers in 2021-22

The study used the "***with and without***" method to assess the impact of CNF. In this method the outcomes of CNF farmers, cultivating a particular crop are compared with the outcomes of the non-CNF farmers cultivating the same crop, but using chemical inputs. Data on costs and returns for the crops considered for the analysis were obtained from the farmers through farmer household

[14] Environmental sustainability implies that APCNF is environmentally benign (non-damaging). That is, the programme is expected to halt and reverse the degradation of the natural resources, especially the soil. It is also expected to make the agriculture resilient to the climate change.
[15] Though 2018-19 study was conducted by the Centre of Economics and Social Studies (CESS), Hyderabad, almost all members of the present team have conducted that study also. All subsequent studies are being conducted by IDSAP with almost same team of professionals.

survey. Crop Cutting Experiments (CCEs) have been conducted to assess the yields of the crops scientifically and independently.

The study is focussed on 12 major crops that are identified based on the cropped area in the state. For these12 crops, costs, yield and returns are analysed. These crops together account for more than 75% of the gross cropped area (GCA) 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) Jowar, (11) Ragi and (12) Tomato. While the first 10 are cultivated on large areas in the state, the last two were selected as the special cases. Given the seasonality the cropping pattern in the state, the survey could not get adequate sample for some crops. Therefore, some of the sample crops were not included in this report. Out of the 12 sample crops, survey could not get adequate number of observations for Green gram and Jowar. Therefore, 10 crops are covered for detailed analyses in this report. These crops are: (1) Paddy, (2) Groundnut, (3) Cotton, (4) Bengal gram, (5) Black gram, (6) Maize, (7) Red gram, (8) Chillis (9) Ragi and (10) Tomato.

In this report, the term 'Community Managed Natural Farming (CNF)' is used interchangeably to mean APCNF as well as PMDS+CNF. Similarly non-APCNF or non-CNF is used interchangeably.

1.3.2. Sample Design

The study was conducted in all the 13 (old) districts of the State of Andhra Pradesh. For the CNF sample, the coverage of the study is the entire area where CNF is practiced while the rest of Andhra Pradesh is covered under non-CNF. All the Gram Panchayats (GPs), where CNF practices are followed, constituted the sample frame for drawing CNF samples. A list of CNF's GPs with number of cultivators, who adopted CNF in PMDS plots (referred as PMDS+CNF), as of April 2021, is provided by RySS. According to the data provided by RySS, the universe for PMDS+CNF consists of 2,816 GPs with 1,72,661 cultivators and 1,27,447 acres. The remaining GPs, where APCNF is yet to begin, form the sample frame for non-CNF sample or control sample. The detailed description of sample selection process was given in the first and second interim reports.[16] The same is summarised below:

[16]IDSAP (2022): *Assessing the Impact of APCNF [Andhra Pradesh Community Managed Natural Farming]: A comprehensive Approach Using Crop Cutting Experiments: First Interim Report of 2021-22: Pre-monsoon Dry Sowing (PMDS)*, Institute for Development Studies Andhra Pradesh (IDSAP), Visakhapatnam.

1. The study proposed a total sample of 169 GPs with 104 GPs for the CNF sample and 65 GPs for non-CNF sample. Given the sample size, it was decided to limit the disaggregate analysis to six agroclimatic zones only.
2. The 104 CNF sample GPs were allocated to each agroclimatic zone in proportion to the number of CNF farmers in that zone.
3. In the case of non-CNF, the total sample size of 65 GPS was allocated to all six zones according to the farmers size obtained in 2020-21 listing.
4. A household listing was conducted in each of sample CNF and non-CNF GPs.
5. From the list PMDS+CNF farmers, crop wise CNF sample was drawn. For each sample crop, the sample size is fixed at a minimum of 50 depending on the availability of cultivators of that crop.
6. After eliminating duplications, 1,186 CNF sample farmers were selected. The number was about 14 percent higher than the planned sample size of 1,040.
7. Non-CNF sample farmers were selected from the list of all farming households in the non-CNF GPs. Same crop wise sample selection process, which was adopted in CNF sample farmers, was adopted in the selection of non-CNF farmers. To get the required minimum number of observations for each of the selected crops, the total non-CNF sample size was also increased by 15 percent over the original plan of 650.

It was planned to collect the qualitative information through three methods, viz. 65 focus group discussions (FGDs), 13 Strategic Interviews (SIs) with the District Project Managers (DPMs), 13 SIs with RySS field staff, 65 case studies (CSs) of progressive and model farmers and (social) entrepreneurs, and a few case studies of horticulture farmers. Except a few SIs with DPMs, data has been collected as planned. To be precise, the study conducted 42 FGDs, 28 SIs, 70 CSs of progressive and model farmers and (social) entrepreneurs, and 70 CSs of horticulture farmers. The information was processed and being developed as an independent document. The major insights, from the qualitative data have been incorporated in this report.

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https://apcnf.in/wp-content/uploads/2022/05/IDS-2021-2022-APCNF-PMDS-Report.pdf or https://www.idsap.in/assets/reports/12%20PMDS%20Report%2021-22.pdf

IDSAP (2022): *Assessing the Impact of APCNF [Andhra Pradesh Community Managed Natural Farming]: A comprehensive Approach Using Crop Cutting Experiments: Second Interim Report of 2021-22: Kharif Season*, Institute for Development Studies Andhra Pradesh (IDSAP), Visakhapatnam.https://apcnf.in/wp-content/uploads/2023/02/Final-APCNF-Kharif-Season-Report-2021-22_17012022.pdf or https://www.idsap.in/assets/reports/13%20APCNF%20Kharif%20Season%20Report%202021%2022%2031%20Dec%202022.pdf

Though it was planned to cover every sample household during the Rabi survey a few sample households could not be contacted due to their migration and a few questionnaires could not be included in the analysis, due to incomplete information. In total 1,145 CNF farmers and 737 non-CNF farmers are covered in this report.[17]After surveying all the sample farmers, it was found that 674 CNF farmers and 421 non-CNF farmers have cultivated at least one crop during Rabi 2021-22. At the state level, 59 percent of CNF farmers and 57 percent of non-CNF farmers have cultivated Rabi crops. However, there are notable variations across agroclimatic zones and farmers categories. Considerably a higher percentage of CNF farmers have cultivated during Rabi in North coastal zone (22 percentage points) and Southern zone (14 percentage points). On the other hand, considerably a higher proportion of non-CNF farmers have cultivated during Rabi 2021-22 in Krishna zone (22 percentage points) and Godavari zone (9 percentage points).

Among the size-classes of farmers, marginal farmers, with Rabi cultivation comprise 56 percent and 57 percent in case of CNF and non-CNF respectively. The corresponding figures for small farmers were 60 and 56; and for other farmers 70 and 59. Among tenurial categories, lesser proportion of CNF tenant farmers (29 percentage points) and CNF owner-cum-tenant farmers (17 percentage points) have cultivated during the Rabi season 2021-22. However, among the owner farmers, who are larger in number among both CNF and non-CNF sample, higher (3 percentage points) CNF farmers have cultivated during the study season. Among social categories, a higher percent of CNF Scheduled Castes (SC) [7 percentage points], Scheduled Tribes (ST) [19 percentage points] and Backward Castes (BC) [9 percentage points] have cultivation during the Rabi 2021-22. However, relatively lesser percentage of CNF Open Categories (OC) farmers (9 percentage points) have cultivated in Rabi season, compared to their counterparts in non-CNF sample (Table 1.4).

[17]Even after some attrition of sample farmers due to variety of reasons, these numbers are higher than originally planned sample size of 1,040 CNF farmers and 650 non-CNF farmers.

Table 1.4: Sample size and Rabi cultivators during 2021-22

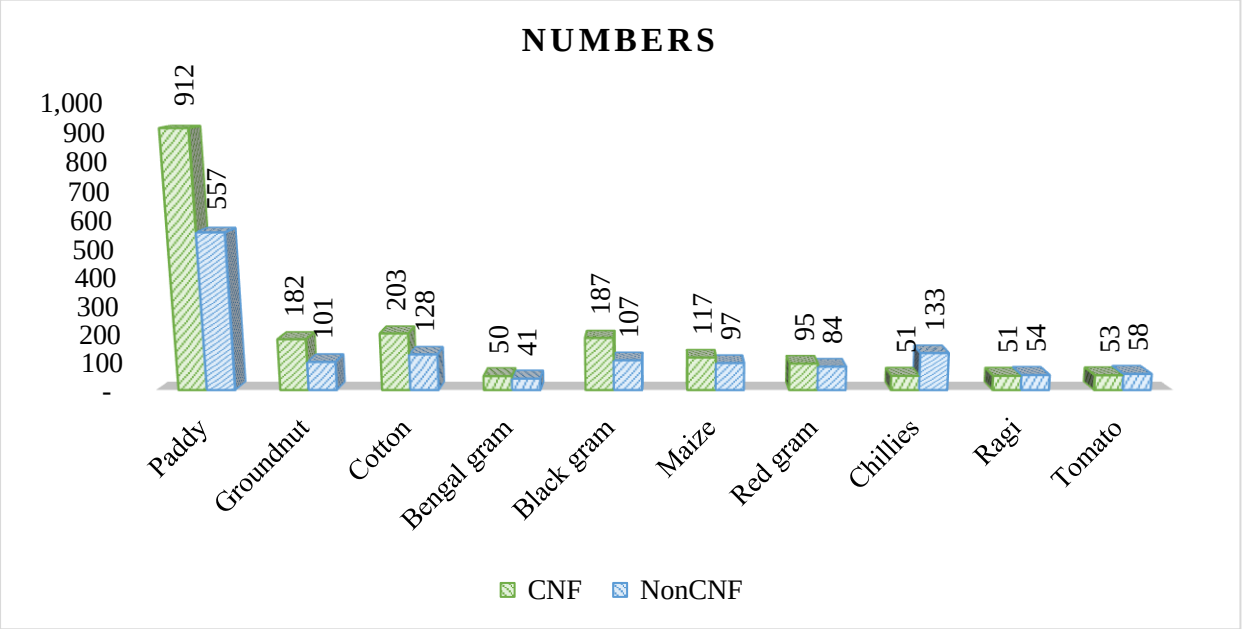
Agroclimatic zones and farmers' categories		Sample size (number)		Farmers cultivated in Rabi (number)		Rabi cultivators as a % of Sample	
		CNF	non-CNF	CNF	non-CNF	CNF	non-CNF
State	AP	1,145	737	674	421	59	57
Agroclimatic zones	HAT	142	72	19	8	13	11
	North coastal	82	41	80	31	98	76
	Godavari	155	50	141	50	91	100
	Krishna	228	159	103	106	45	67
	Southern	281	149	195	82	69	55
	Scarce rainfall	257	266	136	144	53	54
Farm size categories	Marginal	706	376	393	214	56	57
	Small	270	219	162	123	60	56
	Others	169	142	119	84	70	59
Tenurial categories	Tenants	42	28	28	27	67	96
	Owner-tenants	85	26	64	24	75	92
	Owners	1,018	683	582	370	57	54
Social categories	SC	155	61	87	30	56	49
	ST	218	91	82	17	38	19
	BC	476	347	313	198	66	57
	OC	296	238	192	176	65	74

Source: *IDSAP, Field Survey 2021-22*

1.4. Sample observations

In this report, the data of Kharif and Rabi are pooled for the cost and returns analysis. The weighted averages of Kharif and Rabi data is used in calculation of average costs, yields and returns of each crop. The areas under each crop in each season are used as the weights. In total 10 crops have 46 plus observations for estimating the cost and returns. The two leftover crops are Green gram and Jowar. The crops covered, the number of available observations for the estimation of crop wise costs of cultivation, yields, prices and returns are shown in Figure 1.2. It may be noted, as the study focussed on CNF crops grown on the PMDS plots, the number of CNF observations are less than that of non-CNF in a few crops. Not surprisingly, Paddy has the highest number of observations. However, its share is less than half in both CNF and non-CNF crops. The number of sample observations varies from 50 for CNF Bengal gram to 912 for CNF Paddy. In case of non-CNF, the sample observations vary from 41 in Bengal gram to 557 for Paddy (Table 1.5). It may be noted that each crop has a good number of observations to provide robust estimates. This is due to crop wise sample selection strategy that was adopted for this year.

Figure 1.2: Crop wise CNF and non-CNF sample observations for the cost and returns analyses in 2021-22[18]



Source: *IDSAP, Field Survey 2021-22*

Table 1.5: Crop wise CNF and non-CNF sample observations for the cost and returns analyses in (Kharif plus Rabi) 2021-22

Crop	Numbers		Percentage	
	CNF	Non-CNF	CNF	Non-CNF
Paddy	912	557	48	41
Groundnut	182	101	10	7
Cotton	203	128	11	9
Bengal gram	50	41	3	3
Black gram	187	107	10	8
Maize	117	97	6	7
Red gram	95	84	5	6
Chillies	51	133	3	10
Ragi	51	54	3	4
Tomato	53	58	3	4
Total	1,901	1,360	100	100

Source: *IDSAP, Field Survey 2021-22*

1.5. Crop cutting experiments for CNF and non-CNF crops

Crop Cutting Experiments (CCEs) were conducted scientifically to get independent estimates of crop yields under CNF and non-CNF. For each of the selected farmer, a plot where the farmer is

[18] Kharif plus Rabi observations.

growing the sample crop was identified. From this parcel of land, a plot of *size*[19] *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 developed and recommended by Indian Agricultural Statistical Research Institute (IASRI), which is followed by National Statistical Office (NSO) and Directorate of Economics and Statistics (DES) of all states, including Andhra Pradesh, for conducting the CCEs.

The study conducted nearly 1,500 CCEs during 2021-22. However, some of the CCE results could not be used in this report, due to inadequate coverage of a couple of crops and lack of counterfactuals in few other crops in each season. Total number of CCEs used in this report are 1,371. The number includes 872 CNF crops, 499 non-CNF crops. In addition, the study team conducted another 231 CCEs for Panel farmers. This information would be utilized in the panel study chapter. One of the interesting factors about CCEs is that though total number of CCEs is less than expected number, they are mostly confined to 10 crops, which enable the study to provide more reliable estimates to 10 crops in this report. The crop wise number of CCEs conducted during Rabi 2021-22 are shown in the Table 1.6 below. The number of CNF CCEs varies from minimum of 12 for Red gram to maximum of 400 for Paddy. The number of non-CNF CCEs varies from 10 for Groundnut to 171 for Paddy.

Table 1.6: Crop wise and type of farming wise number of CCEs conducted during AY (Kharif + Rabi) 2021-22 (numbers)

Crop	CNF	Non-CNF
Paddy	400	171
Groundnut	108	56
Cotton	29	20
Bengal gram	49	22
Black gram	81	63
Maize	84	66
Red gram	11	15
Chilies	41	64
Ragi	25	12
Tomato	44	10
Total	872	499

Source: *IDSAP Field Survey 2021-22*

[19] Normally, 5 metres by 5 metres, (5^2metres) plots are used for CCEs. However, in few crops 2 metres by 2 metres (Onion) or 10 metres by 10 metres (Red gram) are used.

1.6. Data Collection and Management Process

In all, eleven research tools, were used, and they are: (1) Household listing schedule for the CNF GPs, (2) Household listing schedule for the non-CNF GPs, (3) Village survey schedule for CNF GPs, (4) Village survey schedule for non-CNF GPs (5) PMDS schedule to collect the data from CNF household about PMDS details, (6) Questionnaire for CNF households, (7) Questionnaire for non-CNF households, (8) Checklist for Case Studies, and (9) Checklist for Strategic Interviews, (10) Checklist for Focused Group Discussions, (11) Schedule to record the CCE related details. Further, the Kharif CNF and non-CNF households' schedules were revised for the Rabi survey. The quantitative field-based instruments have in-built checks with appropriate skip patterns over and above the supportive manual with instructions and clarification for all questionnaires. The research tools were finalized through a series of brainstorming consultations. An intensive training and field testing were carried out to train the field investigators and supervisors at Andhra University, Visakhapatnam during last week of September 2021. The field staff was placed continuously in the field in their allotted locations/ districts in order to track the farming and related activities of sample farmers throughout the period, from September 2021 to May 2022. Each sample farmer was visited about six to eight times by the field staff to collect data about farmer household's details and farming operations throughout the survey period.

Senior team members have visited the field and cross-checked the information collected and filled, and participated in data collection processes; conducted SIs with DPMs and a few field staff of RySS; and also participated in the FGDs, by visiting fields, especially of the model farmers and social entrepreneurs, for obtaining information on various farm practices

The field data was digitalized with the help of a technical agency known as "i for Development (i4D) Parishkaar Technologies". Each field staff was given a Tab. The agency developed Apps for the entry of household information and CCE data, apart from the PMDS survey data. Needless to say, the field staff was given comprehensive training about the use of the Tabs and Apps and data entry. The agency provided technical support throughout the year. The agency provided the data to IDSAP in an excel form for checking, midcourse correction and processing. The data was collated and processed using the R programme and Excel software. Descriptive statistics, frequency distributions and cross tabulation are generated at state level, agroclimatic zone[20] wise, farm-size category wise, tenurial category wise and social category wise.

[20] See the details of zones in the Appendix 1 at the end of this chapter

1.7. Structure of the Report

The context, objectives and methodology of the study have been presented in chapter 1. Chapter 2 summarizes profiles of CNF (PMDS+CNF) and non-CNF households, which was discussed in detail in the previous Kharif season report 2021-22.[21] Chapter 3 covers the impact of APCNF on farming conditions. In this chapter the CCE yields used and gross and net value of crop output are estimated on the basis of CCE yields. Chapter 4 covers the impact of APCNF on farming conditions at the disaggregate levels of agroclimatic zones and farmers categories. In this chapter the reported yields are used and gross and net value of crop output are estimated on the basis of reported yields. The impact of CNF on agriculture input use and, on the environment, and natural resources are covered in chapter 5. The impact of CNF on household income are covered in Chapter 6. The actual benefit accrued to the state due to CNF and potential benefits from CNF to the state are analyzed in chapter 7. The data is analyzed in chapter 8. The issues of the farmers wellbeing are covered in chapter 9. The issues and challenges in implementation of APCNF and way forward are coved in chapter 10. Apart from these ten chapters, an Executive Summary of the study is also presented at the beginning of the Report.

[21] See details in IDSAP (2022): *Assessing the Impact of APCNF [Andhra Pradesh Community Managed Natural Farming]: A comprehensive Approach Using Crop Cutting Experiments: Second Interim Report of 2021-22: Kharif Season*, Institute for Development Studies Andhra Pradesh (IDSAP), Visakhapatnam. https://apcnf.in/wp-content/uploads/2023/02/Final-APCNF-Kharif-Season-Report-2021-22_17012022.pdf or https://www.idsap.in/assets/reports/13%20APCNF%20Kharif%20Season%20Report%202021%2022%2031%20Dec%202022.pdf

Appendix 1: List of Agroclimatic zones and their demarcation

Name of the Zone	Districts and Mandals
High-altitude and Tribal areas (HAT) Zone	This zone consists of 37 High altitude and Tribal areas mandals. These include eight Mandals, viz., (1) Hiramandalam, (2) Seethampeta, (3) Kothuru, (4) Bhamini, (5) Meliaputti, (6) Saravakota, (7) Pathapatnam, and (8) Mandasa of erstwhile Srikakulam district; seven mandals, viz., (9) Gummalakshmipuram, (10) Komarada; (11) Kurupam, (12) Makkuva, (13) Pachipenta, (14) Parvathipuram, and (15) Saluru of erstwhile Vizianagaram district; and eleven mandals, viz., (16) Ananthagiri, (17) Arakuvalley, (18) Hukumpeta, (19) Koyyuru, (20) Chintapalle, (21) G. madugula, (22) Gudem Kotha Veedhi, (23) Dumbriguda, (24) Munchingiputtu, (25) Paderu, and (26) Pedabayalu of erstwhile Visakhapatnam district; and eleven mandals, viz., (27) Addatheegala, (28) Chinthuru, (29) Devipatnam, (30) Gangavaram, (31) Kunavaram, (32) Maredumilli, (33) Rajavommangi, (34) Rampachodavaram, (35) V.R. Puram, (36) Y. Ramavaram, and (37) Yetapaka of erstwhile East Godavari district.[22]
North Coastal Zone	All mandals of Srikakulam, Vizianagaram, and Visakhapatnam districts, excluding first 26 mandals (i.e., 1 to 26) of HAT zone, mentioned above.
Godavari Zone	All mandals of East Godavari, excluding last 11 mandals (i.e., 27 to 37) of HAT zone, mentioned above and all mandals of West Godavari district
Krishna Zone	All mandals of Krishna, Guntur and Prakasam districts
Southern Zone	All mandals of Nellore, Chittoor, and Kadapa districts
Scarce Rainfall Zone	All mandals of Kurnool and Anantapur districts

[22] Information was provided by Associate Director of Research (ADR), Chintapalle.

Chapter 2: Profiles of CNF and non-CNF household & farmers

2.1. Introduction

In the Second Interim (Kharif Season) 2021-22 Report, the profiles of CNF and non-CNF households (HHs) and farmers were discussed in detail[23]. The indicators covered in that report are social composition, farm size categories, tenurial status, average area cultivated during Kharif 2021-22, age, education and gender composition of CNF and non-CNF farmers. As the present field survey was conducted with the same set of sample farmers, there would be no difference in the social, economic and demographic profiles of the sample farmers in this survey. Only one potential difference would be the area cultivated during the Rabi season by CNF and non-CNF farmers. In this chapter, apart from summary, the profiles chapter of the Second Interim (Kharif Season) 2021-22 Report, the average area cultivated of CNF farmers vis-à-vis non-CNF farmers is shown.

2.2. Profiles of CNF and non-CNF households and farmers

- A higher percentage of CNF sample households (HHs) hail from vulnerable communities compared to non-CNF sample HHs. Nearly one-third (31.20%) of CNF sample HHs are from SCs and STs compared to 19.52% of non-CNF HHs.
- Marginal farmers are higher in CNF over non-CNF farmers by 10 percentage points.
- In CNF households (HHs), 35 percent are female farmers. The same is 32 percent among the non-CNF HHs.
- The share of young farmers (up to 40 years of age) is higher in CNF sample by 6 percentage points.

2.3. Average operational area

It may be noted that in some regions, farmers may not put their entire area under cultivation during Kharif season. In some other regions, farmers may not cultivate their entire area during Rabi

[23] It may be noted that the study has taken households (HHs)/ family as sample. In each household/ family, there may be more than one cultivator. In this profile chapter the words household/ family and farmers/ cultivators are used separately. In some indicators such as social category and land ownership, operational holding, etc., HHs is used. In case of some indicators such as age, education, gender, etc., individual cultivators', in each HHs, data is used. In all other chapters the words sample HHs and sample farmers are used interchangeably.

season. It implies that the operational area of a farmer may or may not equal to his/ her operational area in Kharif and/ or operational area in Rabi season. During Kharif 2021-22, on an average, CNF farmers have cultivated 1.15 hectares per farmer compared to 1.36 hectares per farmer among non-CNF farmers, i.e., 15 percent smaller average operated area for CNF farmers. But during Rabi, CNF farmers have operational area of 0.97 hectares per farmer vis-à-vis 1.01 hectares per farmer of non-CNF farmers. It shows that the difference of average operated land between CNF and non-CNF farmers is smaller only by 4 percent in Rabi compared to 15 percent similar difference in the Kharif 2021-22. Thus, the relatively lower gap in average operated area in Rabi between CNF and non-CNF farmers indicates the positive impact of CNF on cropping intensity.

Under one of its core strategies of "365 days green cover" on the fields, APCNF is promoting and facilitating a higher cropping intensity. Another factor contributing to a higher cropping intensity under CNF is the reduction in the cost of cultivation. However, in three out of total six agroclimatic zones, the average operational holdings of CNF farmers are larger than that of non-CNF farmers. Similar trend can be seen among farmers categories (Table 2.1).

Table 2.1: Average operational area of CNF and non-CNF farmers across Agroclimatic zones and Farmers' categories during Rabi 2021-22

Agroclimatic zones and farmers' categories		CNF (ha)	non-CNF (ha)	Difference between CNF & non-CNF	
				in ha	in percentage
AP	**AP**	**0.97**	**1.01**	-0.04	**-3.9**
Agroclimatic zones	HAT	0.72	0.49	0.23	47.1
	North coastal	0.96	0.47	0.49	105.2
	Godavari	1.20	1.00	0.20	19.8
	Krishna	0.83	1.08	-0.25	-22.9
	Southern	0.91	0.98	-0.07	-6.7
	Scarce rainfall	1.11	1.20	-0.10	-8.1
Farm size categories	Marginal	0.57	0.49	0.08	16.2
	Small	1.05	1.08	-0.03	-3.1
	Others	2.04	2.28	-0.24	-10.5
Tenurial categories	Tenant	1.34	1.07	0.27	25.0
	Owner-tenant	1.73	1.75	-0.02	-1.1
	Owner	0.87	0.96	-0.09	-9.5
Social categories	SC	0.75	0.64	0.11	16.9
	ST	0.92	0.50	0.42	84.9
	BC	0.91	0.84	0.07	8.4
	OC	1.20	1.38	-0.17	-12.7

Source: *IDSAP, Field Survey 2021-22*

The above is the average cultivated area of the sample farmers during the Rabi season. Usually, the farmers leave a part of their land holding as fallow, during the Rabi season. But the share of fallow lands in the operational holding may not be equal across the state, i.e., across the agroclimatic zones and farmers' categories. The CNF farmers have an average holding of 1.2 hectare and non-CNF farmers have average operational holding of 1.42 hectare. On average, CNF farmers have cultivated 81 percent of their operational holdings during the Rabi season. On the other hand, non-CNF farmers have cultivated 72 percent of their operational holding. That is the CNF farmers have cultivated nine percentage points more area during Rabi 2021-22 compared to non-CNF farmers. Among six agroclimatic zones, in five zones, the CNF farmers have cultivated higher percentage of their operational holdings during the study period. Only exception is the Scarce rainfall zone. Among 10 farmers' categories, in nine categories, the CNF farmers have cultivated a higher percentage of their operational holdings during Rabi 2021-22. Only exception is 'other farmers' which consists of medium and large farmers (Table 2.2). Despite some location and farmers category specific variations, the data clearly shows that CNF has potential for a higher cropping intensity in the state.

Table 2.2: Average Rabi cultivated as a percentage of average operational holding.

Agroclimatic zones and farmers' categories		CNF	non-CNF	Differences in percentage points
AP	**AP**	**81**	**72**	**9**
Agroclimatic zones	HAT	78	30	48
	North coastal	97	79	18
	Godavari	91	89	2
	Krishna	95	84	11
	Southern	78	70	8
	Scarce rainfall	59	67	-8
Farm size categories	Marginal	97	89	8
	Small	77	74	4
	Others	63	72	-9
Tenurial categories	Tenant	88	78	11
	Owner-cum-tenant	91	82	9
	Owner	81	71	10
Social categories	SC	94	84	10
	ST	71	40	31
	BC	79	71	8
	OC	88	77	11

Source: *IDSAP, Field Survey 2021-22*

2.4. Conclusions

Higher presence of SC and ST farmers, marginal farmers, women cultivators and young-age cultivators in CNF compared to non-CNF, indicates the positive inclusive policy of RySS. It also indicates that APCNF is attracting the marginalised sections and youth. Relatively a higher proportion of operated area under Rabi cultivation for CNF farmers demonstrates the APCNF's potential in raising the cropping intensity. The data clearly shows the CNF's potential in enhancing the cropping intensity in the state.

Chapter 3: Impact of CNF on the farming conditions

3.1. Introduction

This chapter is an attempt to assess the impact of CNF on farming conditions in Andhra Pradesh. In this chapter, seven parameters, viz., cost of plant nutrients and protection inputs (PNPI)[24], paid-out costs, paid-out cost structure, yields, prices, gross value of output and net value of output of 10 crops have been considered for conducting analysis. All these parameters are measured per hectare for comparison between CNF and non-CNF.

CNF in Andhra Pradesh should satisfy the requirements of farmer as well as that of agricultural land. This would motivate farmers to adopt APCNF even without any incentives and subsidies from the Government. The examination of cost and returns pattern of selected crops of the state of Andhra Pradesh should provide evidence to the convergence of interest of farmers and agricultural land. In order to examine this further, a comparison has been made between CNF and non-CNF (Chemical based Agriculture) for all the major crops.

The expenditure on PNPI under CNF is considerably lower compared to that of chemical inputs under non-CNF across all the crops considered in the earlier surveys by IDS. This means that the farmers' dependency on the input markets viz., chemical fertilizer and pesticides has declined and also cost of inputs declined for farmers of CNF. On the other hand, the use of biological inoculations under CNF has acted as catalysts to activate the microbiological process below and above land and thereby improved the quality of soil and health of crops. Thus, land requirements as well as of farmers requirements have converged under CNF.

The paid- out cost for growing crops is lower for CNF compared to non-CNF across all crops. This indicates that the investment required to grow crops under CNF are lower over non-CNF and as a result the dependency of CNF farmers on the credit markets has declined relatively. This also revealed that intensive use of inputs has come down under CNF compared to non-CNF. Thus, it is evident that the intensive use of inputs has declined due to CNF. This is evident in the earlier surveys conducted by IDS. The intensive use of inputs for growing crops with

[24] For the sake of comparison, the cost of biological stimulants, viz., Amruthams and Khashayams in CNF and the cost of agrochemicals, viz., fertilizers and pesticides, together referred as plant nutrients and protection inputs (PNPIs)

chemical and pesticides and higher use of water reduces the sustainable use of resources. CNF farmers have used resources optimally which ensures sustainability of resource use. Thus, lower paid out costs under CNF compared to non-CNF benefits both farmer and land.

The earlier surveys of IDS revealed that yields of some the crops of CNF were higher than that of non-CNF; for some other crops yields of CNF were on par with non-CNF; and only in case of one or two crops the yields of CNF were lower than that of non-CNF. This indicates that the interest of farmers as well as the interest of agricultural land have converged. The higher yield of crops and lower paid-out costs have resulted in higher gross and net value of crops under CNF compared to non-CNF. Thus, the interests of farmers as well as of the agricultural land have converged.

All these propositions have been examined using the fresh consolidated data of Kharif and Rabi seasons. The consolidated data has given the opportunity of examination of 10 crops because the number of Crop Cutting experiments has increased of for each crop and of course, number of cost and return observation has also increased for CNF and non-CNF (see Table 1.5 and Table 1.6 in chapter 1). These number of observations are adequate enough to draw reliable conclusions about the impact of CNF on farming conditions in the state.

3.2. Plant Nutrient and protection inputs

The expenditure on plant nutrient and protection inputs (PNPIs) per hectare is lower under CNF compared to non-CNF across all the crops considered except Ragi crop. CNF farmers saved ₹2,830 in Red gram to ₹26,667 in Chillies, per hectare, in the expenditure on PNPIs (Table 3.1). The biological stimulants such as Beejamrutham, Ghana and Dravajeevamrutham; and Kashayams and Asthrams are prepared with local materials such as cow/ animal dung and urine, dairy product and local plants products. The raw materials are very cheap and therefore biological inputs under CNF cost less. Contrary to this, the chemical inputs used under non-CNF cost more. The difference in the expenditure between CNF and non-CNF in this regard in absolute terms is large in input intensive crops such as Cotton and Chillis. In relative terms, even the less input intensive crops such as Red gram, Groundnut, Bengal gram and Black gram have cost less. Thus, the CNF farmers have saved considerable amount of money on PNPI. Consequently, the dependency of farmers on chemical input markets has reduced due to CNF. At the same time, the biological stimulants, applied in the CNF fields, act as catalysts to activate

microbiological process below the land and above the land. Thus, the farmers' interest and land interest coincide, as was evident in the earlier studies.

Table 3.1: Crop wise expenditure on PNPI* under CNF and non-CNF during 2021-22

Crop	₹/ hectare		Difference between CNF & non-CNF	
	CNF	Non-CNF	₹/ hectare	%
Paddy	7,419	16,228	-8,809	-54
Groundnut	5,046	10,193	-5,147	-50
Cotton	5,734	18,107	-12,374	-68
Bengal gram	2,929	9,368	-6,439	-69
Black gram	3,831	10,515	-6,684	-64
Maize	6,988	14,125	-7,137	-51
Red gram	4,306	7,137	-2,830	-40
Chillies	6,812	33,480	-26,667	-80
Ragi	3,610	2,914	696	24
Tomato	8,998	32,081	-23,083	-72

Source: IDSAP, Field Survey 2021-22

3.3. Paid-out costs

The paid-out costs include those on (1) seeds, (2) farmyard manure (FAM) including penning, (3) human labour, (4) bullock labour, (5) machine labour, (6) implements and (7) irrigation, along with (8) PNPI. In this study, the monetary values of own and purchased/ hired inputs are included in the paid-out costs of cultivation. But, the value of family labour is not included in the paid-out costs. The paid-out cost used in this study is close to the cost of cultivation concept of 'Cost A' for owner cultivator[25].

The paid- out costs are invariably lower under CNF compared to non-CNF in almost all sample crops, in all previous studies. In this study also, the paid-out cost under CNF is lower than that of non-CNF in nine out of 10 crops considered for the analysis (Table 3.2). The differences are very large in case of Black gram, Tomato, Chillis, Paddy, Cotton and Maize in absolute as well as in relative(percentage) terms. As noted above, the interests of farmers as well as land have converged due to CNF.

[25] It does not include items like (a) rent paid, (b) estimated rental value of owned land, (c) interest on fixed capital and (d) family human labour

Table 3.2: Crop wise paid-out cost under CNF and non-CNF during 2021-22

Crop	₹/ hectare		Difference between CNF & non-CNF	
	CNF	Non-CNF	₹/hectare	Percentage
Paddy	52,573	64,483	-11,909	-18
Groundnut	53,208	55,691	-2,482	-4
Cotton	52,755	63,467	-10,712	-17
Bengal gram	33,563	33,697	-134	-0
Black gram	26,474	45,910	-19,436	-42
Maize	50,798	59,776	-8,978	-15
Red gram	30,126	28,382	1,744	6
Chillies	93,897	107,647	-13,750	-13
Ragi	42,371	43,487	-1,116	-3
Tomato	71,805	1,00,892	-29,087	-29

Source: IDSAP, Field Survey 2021-22

3.5 Structure of paid-out costs

The structure of inputs used for growing crops has been analyzed. It reflects the production system of the CNF farmers and non-CNF. As mentioned above, the study collected data on eight inputs data. Out of these, four inputs viz., seeds, PNPIs, human labor and machine labour account for the lion's share of the paid-out cost. The other four items, viz., FYM including penning, bullock labour, implements and irrigation, together, account for a smaller proportion in the paid-out costs. These four items are clubbed together and referred as "others". The biological inputs under CNF constitute lower percentage of paid-out costs compared to that of chemical inputs under non-CNF. On the other hand, the share of human labour is higher in paid-out costs under CNF compared to that of under non-CNF across all the crops, except Ragi. At the same time, the share of machine labour in paid-out costs is higher for CNF in some crops and higher for non-CNF of some other crops. In case of other inputs, the share is higher for CNF in majority of crops. (Table 3.3 and Figure 3.1). This trend indicates that CNF not only reduces the cost of cultivation, but also diversifies the input composition. This issue is further analyzed below with absolute expenditure. The cost structure of APCNF can be broadly summarized as labour intensive and cost reducing.

Table 3.3: Crop wise percentage share of major inputs in the paid-out cost under CNF and non-CNF during 2021-22 (in %)

Input	Paddy		Groundnut		Cotton		Bengal gram		Black gram	
	CNF	Non-CNF	CNF	Non-CNF	CNF	Non-CNF	CNF	Non-CNF	CNF	Non-CNF
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
Seed	5	4	29	24	10	7	19	18	13	8
PNPIs	14	25	9	18	11	29	9	28	14	23
Human Labour	40	37	29	22	42	43	28	22	28	22
Machine labour	32	25	20	26	18	16	33	30	34	23
Others	9	8	12	9	20	6	11	1	11	24
Paid-out cost	100	100	100	100	100	100	100	100	100	100

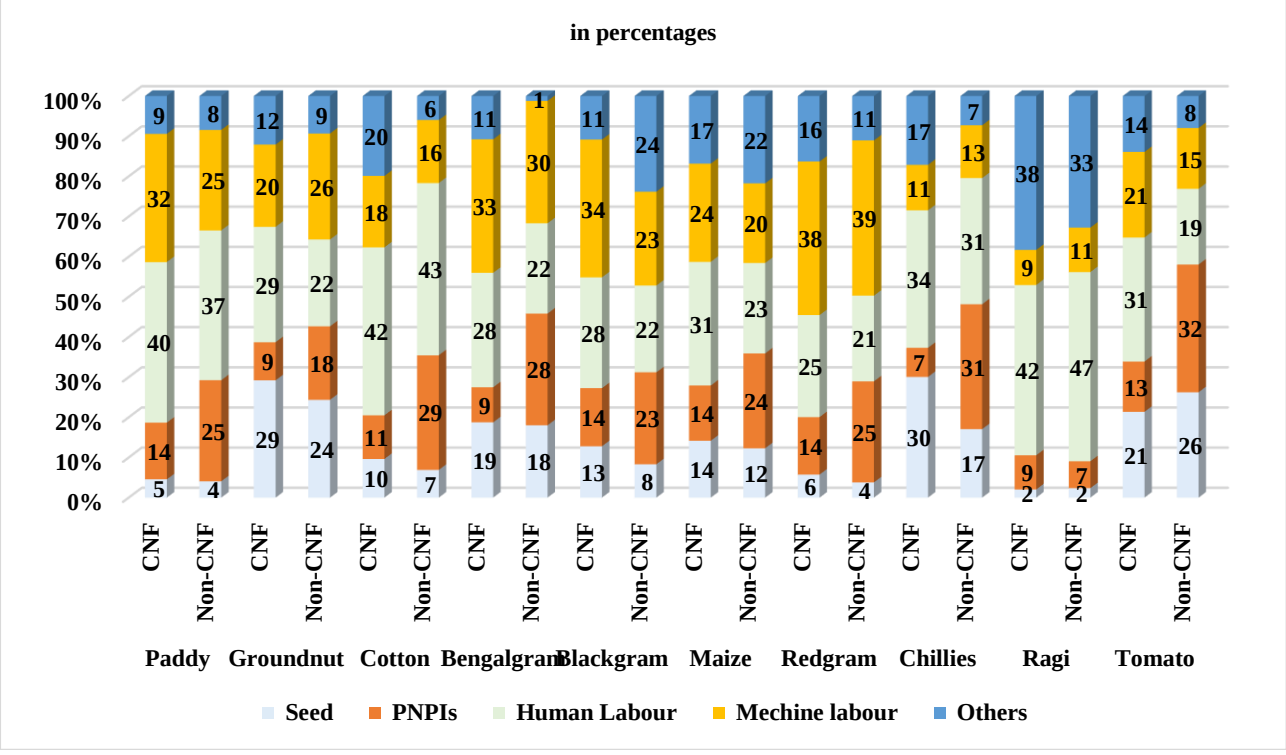
Source: *IDSAP, Field Survey 2021-22*

Table 3.3 continued

Input	Maize		Red gram		Chillies		Ragi		Tomato	
	CNF	Non-CNF	CNF	Non-CNF	CNF	Non-CNF	CNF	Non-CNF	CNF	Non-CNF
1	12	13	14	15	16	17	18	19	20	21
Seed	14	12	6	4	30	17	2	2	21	26
PNPIs	14	24	14	25	7	31	9	7	13	32
Human Labour	31	23	25	21	34	31	42	47	31	19
Machine labour	24	20	38	39	11	13	9	11	21	15
Others	17	22	16	11	17	7	38	33	14	8
Paid-out cost	100	100	100	100	100	100	100	100	100	100

Source: *IDSAP, Field Survey 2021-22*

Figure 3.1: Crop wise percentage share of major inputs in the paid-out cost under CNF and non-CNF during 2021-22



Source: *IDSAP, Field Survey 2021-22*

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The percentages do not give a complete picture about the cost structure. In absolute terms, the seed cost is less for CNF in eight of ten crops considered. As pointed out above the expenditure on PNPIs is less under CNF for nine out of ten crops. Though the share of human labour is higher under CNF compared to non-CNF in eight out of ten crops, in absolute terms, the expenditure on human labour is less under CNF compared to non-CNF in five out of ten crops. Same is the case with machine labour. The expenditure on other inputs is considerably higher under CNF compared to non-CNF in eight out of ten crops. It implies, that CNF is using diversified inputs compared to non-CNF.

Table 3.4: Crop wise expenditure on major inputs under CNF and non-CNF and the percentage variance in 2021-22 (₹/ ha)

Input	Paddy			Groundnut			Cotton			Bengal gram			Black gram		
	CNF	non-CNF	% variance	CNF	non-CNF	% variance	CNF	non-CNF	% variance	CNF	non-CNF	% variance	CNF	non-CNF	% variance
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Seed	2,394	2,619	-9	15,533	13,556	15	5,076	4,385	16	6,293	6,072	4	3,386	3,811	-11
PNPIs	7,419	16,228	-54	5,046	10,193	-50	5,734	18,107	-68	2,929	9,368	-69	3,831	10,515	-64
Human Labour	21,019	24,052	-13	15,286	12,042	27	22,066	27,220	-19	9,565	7,581	26	7,301	9,914	-26
Machine labour	16,790	16,136	4	10,897	14,695	-26	9,383	9,959	-6	11,165	10,264	9	9,088	10,724	-15
Others	4,952	5,448	-9	6,439	5,205	24	10,496	3,795	177	3,612	412	776	2,868	10,945	-74
Paid-out cost	52,573	64,483	-18	53,200	55,691	-4	52,755	63,467	-17	33,563	33,697	-0	26,474	45,910	-42

Table 3.4 Continued.

Input	Maize			Red gram			Chillies			Ragi			Tomato		
	CNF	non-CNF	% variance	CNF	non-CNF	% variance	CNF	non-CNF	% variance	CNF	non-CNF	% variance	CNF	non-CNF	% variance
1	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Seed	7,192	7,345	-2	1,730	1,076	61	28,218	18,351	54	862	1,024	-16	15,333	26,471	-42
PNPIs	6,988	14,125	-51	4,306	7,137	-40	6,812	33,480	-80	3,610	2,914	24	8,998	32,081	-72
Human Labour	15,640	13,454	16	7,657	6,060	26	32,139	33,825	-5	17,961	20,487	-12	22,180	19,029	17
Machine labour	12,426	11,854	5	11,520	10,971	5	10,646	14,148	-25	3,701	4,814	-23	15,302	15,275	0
Others	8,552	12,998	-34	4,912	3,138	57	16,082	7,843	105	16,238	14,248	14	9,993	8,037	24
Paid-out cost	50,798	59,776	-15	30,126	28,382	6	93,897	1,07,647	-13	42,371	43,487	-3	71,805	1,00,892	-29

Source: *IDSAP, Field Survey 2021-22*

3.4. Crop yields

The yields are measured through Crop Cutting Experiments (CCE) to ensure scientific estimates without any bias. The CNF yields are significantly higher than those of non-CNF in five out of ten crops, viz., Bengal gram, Black gram, Maize, Ragi and Tomato. Further, the yields of CNF are on par with those of non-CNF for the remaining five crops viz., Paddy, Groundnut, Cotton, Red gram and Chillis (Table 3.5). The PMDS provided enhancement of soil fertility of land on one hand and benefited the farmer in terms of higher Kharif crop yields, along with additional incomes including regular flow of money and green fodder in summer for the animals.

Table 3.5: Crop wise yields [CCE based] under CNF and non-CNF during 2021-22

Crop	Yield (q/ha)		Difference between CNF & non-CNF		Significance
	CNF	Non-CNF	quintals/ ha	Percentage	
Paddy	50.60	49.24	1.36	2.76	NS
Groundnut	20.72	19.00	1.72	9.06	NS
Cotton	12.28	11.53	0.75	6.51	NS
Bengal gram	19.90	7.24	12.66	174.88	**
Black gram	13.15	10.22	2.93	28.61	**
Maize	52.25	45.15	7.10	15.72	**
Red gram	6.07	4.78	1.29	26.92	NS
Chilies	24.91	26.91	-2.00	-7.44	NS
Ragi	11.63	6.65	4.98	74.96	**
Tomato	186.70	133.45	53.25	39.91	**

** significant at 5% level; NS - Not statistically significant

Source: IDSAP, Field Survey 2021-22

3.5. Prices obtained for CNF and non-CNF crop output

The crop output of CNF is not only chemical free and healthy, but also tasty, as reported by consumers and farmers. Moreover, CNF farmers put in a lot of labour, especially, family labour in growing crops. Therefore, CNF farmers have expectation of expect higher prices for CNF outputs over non-CNF outputs. Crop wise prices obtained by CNF and non-CNF farmers during the study period are given in Table 3.6. Out of 10 crops considered in this report, the price difference between CNF and non-CNF output is negligible in three crops, viz., Paddy, Cotton, and Ragi; around 5 percent in Groundnut and Tomato. However, it may be noted that in both these crops the prices of CNF output are higher than those of non-CNF. In remaining five crops the differences in the prices of CNF and non-CNF are considerable, i.e., more than 7 percent. Out of these five crops, the prices of CNF output are higher than those of non-CNF

in four crops, viz., Bengal gram (9 percent), Black gram (11 percent), Maize (14 percent), and Red gram (7 percent). Apart from local factors (local supply-demand), the preference for CNF output may explain the higher prices obtained in four CNF crops. But in Chilies, the average price of CNF output is less than the price of non-CNF output by 15 percent. As mentioned in the Kharif 2021-22 report "The prices of Chillies fluctuate widely where in, the timing of sale would have larger impact on the prices obtained".

Table 3.6: Crop wise prices obtained for CNF and non-CNF output during 2021-22

Crop	₹/quintal		Difference between CNF & non-CNF	
	CNF	Non-CNF	₹/quintal	%
Paddy	1,723	1,730	-7	-0
Groundnut	5,296	5,089	207	4
Cotton	7,835	7,849	-14	-0
Bengal gram	5,412	4,968	444	9
Black gram	7,023	6,350	673	11
Maize	2,143	1,876	267	14
Red gram	6,722	6,296	426	7
Chillies	14,968	17,681	-2,713	-15
Ragi	3,913	3,903	9	0
Tomato	922	874	48	6

3.6. Gross value of crop output

The gross value of output of any crop is derived by "multiplying the yield (obtained through CCEs) of a crop with price realized by farmer for that crop and adding value of by- product as reported by farmers". The value of output is higher under CNF compared to that of non-CNF across all the crops except Chilies (Table 3.7). In Bengal gram, Block gram, Maize and Tomato, the CNF farmers have achieved higher gross values of output due to higher yields as well as higher prices. The gross value of CNF Groundnut and Red gram output are higher than that of non-CNF due to higher prices realized by farmers, though they have obtained yields on par with that of non-CNF. In case of Chilies the gross value of output under CNF is lower due lower price realization, though these farmers have got yield on par with that of non-CNF farmers. The data indicate that the CNF farmers are also getting benefitted by higher prices for their output in majority of crops, particularly food crops. It shows a growing interest on the part of consumers for chemical free food. The trend may get accelerated further in coming years.

Table 3.7: Crop wise gross value of CNF and non-CNF output during 2021-22

Crop	₹/hectare		Difference between CNF & non-CNF	
	CNF	Non-CNF	₹/hectare	%
Paddy	93,535	91,551	1,984	2
Groundnut	118,646	102,768	15,878	15
Cotton	96,436	90,617	5,819	6
Bengal gram	107,818	36,523	71,295	195
Black gram	93,609	65,438	28,172	43
Maize	114,066	86,217	27,849	32
Red gram	41,836	30,476	11,360	37
Chillies	372,912	475,947	-103,035	-22
Ragi	45,648	26,673	18,974	71
Tomato	1,72,137	1,16,635	55,502	48

Source: IDSAP, Field Survey 2021-22

3.7. Net value of crop output

Net value of output is obtained through subtraction of the paid-out cost from gross value of output. As seen above the gross values of crop output are higher for CNF farmers than those of non-CNF farmers across all the crops, except Chillies. Further, the paid-out cost of CNF farmers is lower than that of non-CNF farmers across all crops except Red gram. This indicates that reduction in paid-out cost increases the net value of crops. Thus, yield, prices, and paid-out costs determine the net value of output of crop. The savings in paid-out costs act as buffer to withstand lower yield and lower prices. Further, higher prices for CNF output can act as buffer to possible lower yields.

The net value of CNF output is higher than that of non-CNF in nine out of ten crops included in this report. The only exception is Chillies, which is largely the result of the difference in the realized prices by CNF and non-CNF farmers, which in turn depended on the timing of the harvesting and sale. The CNF farmers have higher net values in the range of 39 percent in Groundnut to 2,527 percent in Bengal gram (Table 3.8). In Chillies, the net value of CNF output is less than that of non-CNF, the difference is 24 percent. The data indicates that CNF could be an effective method for sizable increase in the farmers income. The results, further, indicate that CNF can increase the farmers income without the fertilizers subsidy and many other such incentives and support. However, a small incentive (premium) in the minimum support price (MSP) and proactive procurement of CNF output for the public distribution system (PDS), schools' mid-day meal program, Anganwadi program and other such programs may enthuse and attract the farmers into the natural farming.

Table 3.8: Crop wise net value of CNF and non-CNF output during 2021-22

Crop	₹/hectare		Difference between CNF & non-CNF	
	CNF	Non-CNF	₹/hectare	%
Paddy	40,962	27,069	13,893	51
Groundnut	65,438	47,077	18,361	39
Cotton	43,681	27,150	16,531	61
Bengal gram	74,255	2,826	71,428	2,527
Black gram	67,135	19,528	47,607	244
Maize	63,268	26,442	36,827	139
Red gram	11,710	2,094	9,616	459
Chillies	279,015	368,300	-89,286	-24
Ragi	3,277	-16,814	20,090	
Tomato	1,00,332	15,743	84,589	537

Source: IDSAP, Field Survey 2021-22

3.8. Conclusion

The analysis in this chapter clearly indicates that CNF is improving the farming conditions considerably compared to non-CNF. The cost of cultivation (paid-out cost) is considerably low under CNF due to replacement of agrochemicals with biological stimulants. At the same time, the yields remained same (differences are not statistically significant) or larger under CNF. Further, the CNF outputs are fetching relatively higher prices for majority of crops. It indicates a positive interest for CNF output is developing among the consumers. As a result, the gross and net value of CNF output is higher than that of non-CNF output in all crops, with one exception. The data indicates that CNF could be an effective method for doubling the farmers income. The results, further, indicate that CNF can double the farmers income without the fertilizers subsidy and many other such incentives and support. However, a small incentive (premium) in the minimum support price (MSP) and proactive procurement of CNF output for the public distribution system (PDS), schools' mid-day meal program, Anganwadi program and other such programs may enthuse and attract the farmers into the natural farming.

Chapter 4: Impact of CNF on the farming conditions at disaggregate level

4.1. Introduction

The previous chapter clearly shows the efficacy of CNF in improving the farming conditions in the state. With few exceptions, CNF has led to a reduction in the cost of cultivation (paid-out cost), in attaining the equal or higher crop yields, higher or equal prices for crop output, higher gross and net values of output in almost all crops covered in the report. In this chapter the impact of CNF is analyzed for agroclimatic zones and for different categories of farmers. The major indicators, viz., paid-out cost, crop yields and net value crop output are analyzed in this chapter. As mentioned in chapter 1, the study has conducted a smaller number of CCEs compared to planned. This comes in the way of disaggregated analysis. Therefore, the yields reported by both CNF and non-CNF farmers, (henceforth referred as 'reported yields'), are used in this chapter. As mentioned in chapter one, there are a good number of crop wise observations in the household data for estimating the cost and returns. The number of CNF and non-CNF observations and reported yields at the state level are given crop-wise in Table 4.1. ***It may be noted the yields given in Table 4.1 are different from the yield data given in the previous chapter. The previous chapter was based on the CCE yields. This chapter is based on the reported yields. The state level yields and net values of crop output of this chapter are different from that of previous chapter.***

Table 4.1: Crop wise sample observations and reported yields in AP in 2021-22[26]

Crop	Sample observations (number)		Reported yields (quintals/ hectare)		Difference between CNF & non-CNF yields	
	CNF	non-CNF	CNF	non-CNF	quintals/ hectare	percentage
Paddy	912	557	55.65	52.29	3.36	6.4
Groundnut	182	101	16.76	9.45	7.31	77.4
Cotton	203	128	11.27	13.93	-2.66	-19.1
Bengal gram	50	41	17.91	11.85	6.06	51.1
Black gram	187	107	10.97	9.52	1.45	15.2
Maize	117	97	65.58	49.07	16.51	33.6
Red gram	95	84	7.87	6.82	1.05	15.4
Chillies	51	133	23.21	16.93	6.28	37.1
Ragi	51	54	27.81	20.69	7.12	34.4
Tomato	53	58	235.58	212.20	23.38	11.0

Source: IDSAP, Field Survey 2021-22

[26] The sample observations are pooled data of Kharif and Rabi samples. The yields and other indicators analysed in this chapter are the weighted average values Kharif and Rabi results. The area under each crop in each season are used as weights.

The main purpose of this chapter is to see if all the geographical regions and sections in the state, particularly the poorer regions and small and marginal farmers getting benefited by, the CNF program. Given the smaller number of crop wise sample observations, the analysis in this chapter is limited to only six crops, viz., Paddy, Groundnut, Cotton, Black gram, Maize and Red gram. Further, in each crop, the zone and farmer categories with minimum 10 observations for both CNF and non-CNF are included in the disaggregated analysis.

4.2. Paddy

Paddy is the principal crop and is cultivated in all agroclimatic zones and by all farmer categories. As mentioned above the paid-out costs, yields, and net value of output of Paddy under CNF and non-CNF are analyzed in this section.

4.2.1. Paid-out cost of Paddy

Agroclimatic zone wise and farmer category wise paid-out cost of Paddy cultivation under CNF and non-CNF conditions and their differences are given in Table 4.2. The paid-out cost in Paddy cultivation is less in CNF compared to non-CNF in five out of six zones. The difference varies From 4 percent in Krishna zone to 27 percent in Godavari zone. Only in Southern zone the paid-out cost CNF Paddy is higher by 4 percent. It is interesting to know that the savings in paid-out costs are higher in the northern part of the state, including the HAT zone. In the southern part of state, the Scarce rainfall zone has relatively a higher savings of seven percent, compared to other two zones in that part. It shows that the poorer regions are also getting benefited from CNF. Among all 10 farmer categories analyzed here, nine categories got savings in paid-out cost of Paddy cultivation due to CNF. Among the three farm size categories, the marginal farmers got highest savings of 25 percent in paid-out cost of Paddy cultivation due to CNF, followed by small farmers (13 percent) and other farmers, including medium and large farmers (11 percent). Similarly, among tenurial categories, the tenant farmers and owner-cum-tenant farmers got higher savings of 27 percent and 28 percent respectively compared to 17 percent by owner farmers. However, among the social categories, the backward castes (BC) and other castes (OC) have relatively a higher savings in the paid-out cost due to CNF. Here also, the scheduled tribes (ST) are not far behind in benefitting from CNF. Only the scheduled castes (SC) have incurred higher paid-out costs in CNF Paddy cultivation. This needs further investigation.

Table 4.2: Agroclimatic zone wise and farmers categories wise paid-out cost of Paddy cultivation under CNF and non-CNF and their differences in 2021-22

Agroclimatic zones & farmers' categories		₹/ hectare		Difference between CNF & non-CNF	
		CNF	non-CNF	₹/ hectare	Percentage
State	AP	52,573	64,483	-11,909	-18
Agroclimatic zones	HAT	42,270	52,039	-9,769	-19
	North coastal	54,753	74,739	-19,986	-27
	Godavari	48,841	78,779	-29,939	-38
	Krishna	73,692	76,443	-2,752	-4
	Southern	56,289	53,922	2,366	4
	Scarce rainfall	50,958	55,031	-4,073	-7
Farm size categories	Marginal	55,811	74,205	-18,394	-25
	Small	48,817	56,192	-7,376	-13
	Others	48,422	54,145	-5,723	-11
Tenurial categories	Tenants	46,866	64,290	-17,424	-27
	Owner-cum-tenants	55,920	78,105	-22,184	-28
	Owners	52,806	63,886	-11,080	-17
Social categories	SC	76,329	67,182	9,148	14
	ST	45,045	51,839	-6,794	-13
	BC	52,387	69,181	-16,793	-24
	OC	52,552	63,672	-11,119	-17

Source: IDSAP, Field Survey 2021-22

4.2.2. Paddy yields

Table 4.3 gives details on Paddy yields by zone and categories of farmers for CNF and non-CNF categories for the year 2021-22. Among six zones, the CNF yields are substantially higher compared to non-CNF yields, in three zones in the south. The differences vary from 11 percent in Krishna zone to 39 percent in Southern zone. On the other hand, the differences are marginal, if not negligible, in three north zones. It may be noted that the three south zones have less savings in the paid-out cost, but substantial yield gains in CNF Paddy. On the other hand, three north zones have considerable savings in paid-out costs, but no yield gains. Among farm size categories, small farmers among the farm size categories; and tenant farmers among tenurial categories have highest yield gains due to CNF. On the other hand, the BC and OC categories got higher yield gains compared to other two social categories.

Table 4.3: Agroclimatic zone wise and farmers categories wise Paddy yields under CNF and non-CNF and their differences in 2021-22

Agroclimatic zones & farmers' categories		Quintals/ hectare		Difference between CNF & non-CNF	
		CNF	non-CNF	Quintals/ hectare	Percentage
State	AP	55.65	52.29	3.36	6
Agroclimatic zones	HAT	51.12	50.74	0.38	1
	North coastal	55.29	55.44	-0.15	-0
	Godavari	63.01	66.55	-3.54	-5
	Krishna	60.95	54.68	6.27	11
	Southern	48.03	34.58	13.45	39
	Scarce rainfall	60.26	47.51	12.75	27
Farm size categories	Marginal	56.39	54.95	1.44	3
	Small	54.60	48.45	6.15	13
	Others	54.61	50.97	3.64	7
Tenurial categories	Tenants	64.74	56.21	8.53	15
	Owner-cum-tenants	53.91	57.58	-3.67	-6
	Owners	55.13	51.44	3.69	7
Social categories	SC	55.84	53.65	2.19	4
	ST	51.81	51.30	0.51	1
	BC	56.98	52.18	4.80	9
	OC	56.29	52.33	3.96	8

Source: IDSAP, Field Survey 2021-22

4.2.3. Net value of Paddy output

Agroclimatic zone wise and farmers categories wise net value of Paddy output under CNF and non-CNF and their differences, in 2021-22, are presented Table 4.4. Each of six zones have higher net value of CNF Paddy output over non-CNF output. The differences vary from 31 percent in Krishna zone to 83 percent in Scarce rainfall zone. It is noteworthy that relatively poorer zones, i.e., the Scarce rainfall zone (83 percent) and HAT zone (62 percent) have higher net value of Paddy output, because of CNF. Similarly, marginal farmers (65 percent) and small farmers (60 percent) and tenant farmers (72 percent) have higher net value of CNF Paddy output vis-à-vis others in their respective categories. Among the social categories, BCs (80 percent) and STs (61 percent) have the highest improvement in their net value of Paddy output due to CNF.

Table 4.4: Agroclimatic zone wise and farmers categories wise net value of Paddy output under CNF and non-CNF and their differences in 2021-22

Agroclimatic zones & farmers' categories		₹/ hectare		Difference between CNF & non-CNF	
		CNF	non-CNF	₹/ hectare	Percentage
State	AP	49,668	32,347	17,321	54
Agroclimatic zones	HAT	45,555	28,146	17,409	62
	North coastal	52,393	30,750	21,643	70
	Godavari	80,580	46,426	34,154	74
	Krishna	44,014	33,507	10,507	31
	Southern	28,421	21,205	7,216	34
	Scarce rainfall	42,414	23,217	19,198	83
Farm size categories	Marginal	47,705	28,943	18,761	65
	Small	52,482	32,820	19,662	60
	Others	50,534	37,636	12,898	34
Tenurial categories	Tenants	74,368	43,138	31,230	72
	Owner-cum-tenants	53,130	34,722	18,409	53
	Owners	46,851	30,554	16,296	53
Social categories	SC	25,905	36,074	-10,168	-28
	ST	46,853	29,125	17,728	61
	BC	53,959	30,013	23,946	80
	OC	50,880	34,708	16,172	47

Source: IDSAP, Field Survey 2021-22

4.3. Groundnut

Groundnut is predominantly cultivated in the Southern and Scarce rainfall zone. None of the tenant farmers and very few owner-cum-tenant farmers have cultivated the crop. Similarly, very few ST farmers and SC non-CNF farmers cultivated the crop. There are enough sample observations to analyze the Groundnut data among the two agroclimatic zones and by size of farm.

4.3.1. Paid-out cost of Groundnut

Agroclimatic zones wise and farm size category wise paid-out cost of Groundnut during the study period is given in Table 4.5. Normally, Groundnut is cultivated with less chemical inputs. Therefore, there is less scope to reduce the paid-out cost, especially, the expenditure on PNPIs. Seed cost is one of the major cost items, which is almost equal among CNF and non-CNF farmers. Further, human labour is another principal cost item in Groundnut. Higher doses of human labour are usually used in CNF for the preparation of biological stimulants other related

activities. As a result of all these, there is little (4 percent) savings in the paid-out cost of Groundnut. But the CNF farmers of Southern zone incurred ₹14,394 (32 percent) higher paid-out cost compared to the non-CNF farmers in that zone. On the other hand, the CNF farmers in Scarce rainfall zone have saved ₹10,214 (17 percent) in the paid-out cost of Groundnut. While the marginal CNF farmers incurred a 3 percent higher paid-out cost, CNF small and other farmers have 7 percent and 6 percent savings respectively in the paid-out cost of Groundnut.

Table 4.5: Agroclimatic zones wise and farm size category wise paid-out cost of Groundnut under CNF and non-CNF and differences in 2021-22

Agroclimatic zones & farmers' categories		₹/ hectare		Difference between CNF & non-CNF	
		CNF	non-CNF	₹/ hectare	Percentage
State	AP*	53,200	55,691	-2,490	-4
Zones	Southern	58,734	44,339	14,394	32
	Scarce rainfall	49,772	59,986	-10,214	-17
Farm size categories	Marginal	58,265	56,819	1,446	3
	Small	51,971	55,966	-3,995	-7
	Others	47,142	50,356	-3,214	-6

* AP data include the data of leftover zones and farmers categories also

Source: IDSAP, Field Survey 2021-22

4.3.2. Groundnut yields

As pointed out in almost all earlier reports, there is a good scope for getting higher yields under CNF in the less input intensive crops like pulses, millets and traditional oilseeds. Though there is little savings in the paid-out costs, the yields of CNF Groundnut are substantially higher than that of non-CNF (Table 4.6). The CNF farmers in Southern zone, who incurred 32 percent higher paid-out cost, reaped 310 percent higher yields compared to non-CNF farmers in the zone. It may be noted that CNF, by increasing the soil quality, contributes to crop resistance to weather anomalies. This could be one of the reasons for such huge variations in the CNF and non-CNF yields in the Southern zone. On the other hand, the CNF farmers of Scarce rainfall zone, who have a saving of over ₹10,000 per hectare in the paid-out cost got 22 percent higher yields compared to non-CNF yields in that zone. The CNF marginal farmers, who incurred ₹1,446 (3 percent) higher paid-out cost, obtained 8.23 quintals (92 percent) higher yields compared to their counterparts in non-CNF. The results are clearly demonstrated that resource poor regions (Scarce rainfall zone) and marginal farmers too can get benefitted by CNF.

Table 4.6: Agroclimatic zones wise and farm size category wise Groundnut yields under CNF and non-CNF and their differences in 2021-22

Agroclimatic zones & farmers' categories		Quintal/ hectare		Difference between CNF & non-CNF	
		CNF	non-CNF	Quintal/ hectare	Percentage
State	AP*	16.76	9.45	7.31	77
Zones	Southern	17.27	4.21	13.06	310
	Scarce rainfall	14.01	11.46	2.55	22
Farm size categories	Marginal	17.13	8.90	8.23	92
	Small	15.33	9.65	5.68	59
	Others	17.12	12.44	4.68	38

* AP data include the data of leftover zones and farmers categories also

Source: IDSAP, Field Survey 2021-22

4.3.3. Net value of Groundnut output

The net value of non-CNF Groundnut output, largely, reflect the present condition of agriculture in the state and also in the country. The net value of non-CNF output is negative at the state level, and in Southern zone; and for marginal and small farmers. The net values of CNF output are not only positive at disaggregated level, but also substantially higher than that of non-CNF. It is as high as 784 percent in Scarce rainfall zone and 273 percent for other farmers (Table 4.7). The same is the case with other disaggregated units of analysis. The results once again prove that the poorer regions and sections too can get benefitted from CNF.

Table 4.7: Agroclimatic zones wise and farm size category wise Groundnut yields under CNF and non-CNF and their differences in 2021-22

Agroclimatic zones & farmers' categories		₹/ hectare		Difference between CNF & non-CNF	
		CNF	non-CNF	₹/ hectare	Percentage
State	AP *	44,452	-1,522	45,974	
Agroclimatic zones	Southern	43,917	-19,103	63,020	
	Scarce rainfall	43,429	4,911	38,519	784
Farm size categories	Marginal	37,970	-5,763	43,733	
	Small	29,049	-59	29,109	
	Others	66,549	17,858	48,692	273

* AP data include the data of leftover zones and farmers categories also

Source: IDSAP, Field Survey 2021-22

4.4. Cotton

In case of Cotton also the data permits the disaggregate analysis for two zones, viz., Krishna and Scarce rainfall zones and for three farm size categories. There are no tenant farmers, very few owner-cum-tenant farmers and no counterfactuals for SC and ST farmers in the Cotton cultivation.

4.4.1. Paid-out cost of Cotton

Agroclimatic zones & farm size categories paid-out cost of Cotton under CNF and non-CNF and differences are presented in Table 4.8. Cotton is one of the input intensive crops. Hence, the scope for savings in the paid-out cost is higher for CNF farmers. At the state level, CNF farmers are able to save 17 percent in the paid-out cost. It is more than ₹10,000 per hectare. Krishna zone and marginal farmers, who, normally, invest a larger sum on cultivation, are able to save ₹14,934 (24 percent) and ₹18,094 (25 percent) respectively in their paid-out cost, due to CNF.

Table 4.8: Agroclimatic zones & farm size categories paid-out cost of Cotton under CNF and non-CNF and differences in 2021-22

Agroclimatic zones & farm size categories		₹/ hectare		Difference between CNF & non-CNF	
		CNF	non-CNF	₹/ hectare	Percentage
State	AP*	52,755	63,467	-10,712	-17
Zones	Krishna	46,750	61,683	-14,934	-24
	Scarce rainfall	55,737	68,744	-13,008	-19
Farm size categories	Marginal	53,784	71,878	-18,094	-25
	Small	51,749	62,782	-11,033	-18
	Others	45,863	56,121	-10,258	-18

* AP data include the data of leftover zones and farmers categories also

Source: IDSAP, Field Survey 2021-22

4.4.2. Cotton yields

CNF Cotton yields are lower than non-CNF yields at the state level and also at every disaggregated level. In Krishna zone, the CNF yields are 46 percent lower than the non-CNF yields. However, the CNF farmers in Scarce rainfall zone suffered relative less loss in yields. While CNF marginal farmers got 19 percent lower yields, the small farmers got almost equal yields compared to their counterparts in non-CNF.

Table 4.9: Agroclimatic zones & farm size categories wise Cotton yields under CNF and non-CNF and differences in 2021-22

Agroclimatic zones & farmers' categories		Quintals/ hectare		Difference between CNF & non-CNF	
		CNF	non-CNF	Quintals / hectare	Percentage
State	AP*	11.27	13.93	-2.66	-19
Zones	Krishna	8.32	15.44	-7.12	-46
	Scarce rainfall	11.32	12.22	-0.90	-7
Farm size categories	Marginal	10.33	12.72	-2.39	-19
	Small	14.34	14.38	-0.04	-0
	Others	13.86	14.72	-0.86	-6

* AP data include the data of leftover zones and farmers categories also

Source: IDSAP, Field Survey 2021-22

4.4.3. Net value of Cotton output

Though the CNF farmers got lower Cotton yields compared to their non-CNF counterparts at the state level and all five disaggregate levels of analysis, they got substantially higher net value of Cotton output in Scarce rainfall zone, for small and other farmers, due to considerable savings they made in the paid-out costs. (Table 4.10). These results indicate that savings in the paid-out costs can act as buffer and reduce the losses, in unfavorable years.

Table 4.10: Agroclimatic zones & farm size categories wise net value of Cotton output under CNF and non-CNF and differences in 2021-22

Agroclimatic zones & farmers' categories		₹/ hectare		Difference between CNF & non-CNF	
		CNF	non-CNF	₹/ hectare	Percentage
State	AP*	35,734	45,962	-10,228	-22
Zones	Krishna	14,321	83,882	-69,561	-83
	Scarce rainfall	28,277	9,550	18,727	196
Farm size categories	Marginal	22,966	52,265	-29,298	-56
	Small	70,421	42,155	28,266	67
	Others	96,777	46,035	50,742	110

* AP data include the data of leftover zones and farmers categories also

Source: IDSAP, Field Survey 2021-22

4.5. Black gram

Adequate number of samples for disaggregate comparative analysis are available from North coastal, Krishna and Southern zones and farm size categories.

4.5.1. Paid-out costs of Black gram

Black gram is one of the low input intensive crops. Hence, there is little scope to obtain savings in the paid-out cost under CNF. However, some regions and a few farm categories raised the crop with higher doses of farm inputs. In such cases, there is a scope to obtain a sizable savings in the paid-out cost under CNF. At the state level, the paid-out cost of non-CNF Black gram is ₹33,697 per hectare. As a result, the CNF farmers are able to save only ₹134 per hectare in the paid-out cost (Table 4.11). However, the non-CNF farmers in Southern zone incurred paid-out cost of ₹71,011 per hectare in Black gram. It turned out to be 49 percent saving to CNF farmers in that zone (Table 4.11). Same is the case of marginal farmers. Here also the CNF farmers in relatively resource poor Southern zone and CNF marginal farmers have reaped larger benefits from CNF.

Table 4.11: Agroclimatic zones & farm size categories wise paid-out cost of Black gram under CNF and non-CNF and differences in 2021-22

Agroclimatic zones & farmers' categories		₹/ hectare		Difference between CNF & non-CNF	
		CNF	non-CNF	₹/ hectare	Percentage
State	AP*	33,563	33,697	-134	-0
Zones	North coastal	13,133	16,029	-2,896	-18
	Krishna	27,320	38,349	-11,029	-29
	Southern	36,430	71,011	-34,581	-49
Farm size categories	Marginal	23,702	55,725	-32,023	-57
	Small	26,292	42,751	-16,459	-38
	Others	38,841	35,164	3,677	10

* AP data include the data of leftover zones and farmers categories also

Source: IDSAP, Field Survey 2021-22

4.5.2. Black gram yields

It was pointed out many times in the previous reports that the scope for enhancing yields is higher under CNF, in less input intensive crops like pulses, millets/ coarse grains, and traditional oilseeds. Here also, the CNF yields are higher than non-CNF at the state level by 15 percent and in two out of three zones and two out of three farm size categories covered in this section by bigger margins (Table 4.12).

Table 4.12: Agroclimatic zones & farm size categories wise Black gram yields under CNF and non-CNF and differences in 2021-22

Agroclimatic zones & farmers' categories		Quintals/ hectare		Difference between CNF & non-CNF	
		CNF	non-CNF	Quintals/ hectare	Percentage
State	AP*	10.97	9.52	1.45	15
	North coastal	5.60	7.13	-1.53	-21
	Krishna	16.08	13.81	2.27	16
	Southern	11.78	4.29	7.49	175
Farm size categories	Marginal	10.54	11.05	-0.51	-5
	Small	10.68	8.06	2.62	33
	Others	12.82	9.08	3.74	41

* AP data include the data of leftover zones and farmers categories also

Source: IDSAP, Field Survey 2021-22

4.5.3. Net value of Black gram output

Agroclimatic zones & farm size categories wise net value of Black gram output under CNF and non-CNF and differences are presented in Table 4.13. The non-CNF farmers in Southern zone got negative net value of Black gram output, i.e., they incurred loss in Black gram cultivation. At the state level, the CNF farmers obtained 244 percent higher net value over non-CNF farmers. Except in North coastal zone, the CNF farmers got higher net value in all zones and farmers' categories considered in this section. The CNF farmers in Southern zone got over ₹1.10 lakh higher net value per hectare compared to non-CNF.

Table 4.13: Agroclimatic zones & farm size categories wise net value of Black gram output under CNF and non-CNF and differences in 2021-22

Agroclimatic zones & farmers' categories		₹/ hectare		Difference between CNF & non-CNF	
		CNF	non-CNF	₹/ hectare	Percentage
State	AP*	51,824	15,052	36,772	244
Zones	North coastal	26,387	34,291	-7,904	-23
	Krishna	83,621	50,670	32,951	65
	Southern	61,991	-48,083	1,10,073	
Farm size categories	Marginal	58,626	16,676	41,950	252
	Small	40,155	7,461	32,694	438
	Others	43,363	21,858	21,505	98

* AP data include the data of leftover zones and farmers categories also

Source: IDSAP, Field Survey 2021-22

4.6. Maize

The study got adequate number of CNF and non-CNF Maize samples from Krishna and Scarce rainfall zones. Also adequate samples are available for all three farm size categories covered in this report.

4.6.1. Paid-out cost of Maize

Maize is normally cultivated in the input intensive method in the state, especially in the zones like Godavari and Krishna and by marginal and small farmers. Hence, there is good scope to reduce the paid-out costs under CNF. The savings in the paid-out cost of Maize under CNF is 15 percent at the state level, 57 percent in Krishna zone and 34 percent for marginal farmers (Table 4.14).

Table 4.14: Agroclimatic zones & farm size categories wise paid-out cost of Maize under CNF and non-CNF and differences in 2021-22

Agroclimatic zones & farmers' categories		₹/ hectare		Difference between CNF & non-CNF	
		CNF	non-CNF	₹/ hectare	Percentage
State	AP*	50,798	59,776	-8,978	-15
	Krishna	43,611	1,01,964	-58,352	-57
	Scarce rainfall	53,342	55,075	-1,734	-3
Farm size categories	Marginal	50,235	76,415	-26,180	-34
	Small	54,177	56,048	-1,871	-3
	Others	49,994	54,687	-4,693	-9

* AP data include the data of leftover zones and farmers categories also

Source: IDSAP, Field Survey 2021-22

4.6.2. Maize yields

It is perplexing to note that while the CNF farmers at the state level have higher yields of 33 percent over non-CNF farmers, they have lower yields in both zones covered in this section. The reason is that the state figures include the data of all other zones, which are not individually covered in this section. It is interesting to see while, marginal and small CNF farmers have 39 percent and 49 percent higher yields respectively over their counterpart non-CNF farmers, other farmers got only 12 percent higher yields over the non-CNF other farmers (Table 4.15). These results, once again, show that resource poor farmers too can get benefitted from CNF.

Table 4.15: Agroclimatic zones & farm size category wise Maize yields under CNF and non-CNF and differences in 2021-22

Agroclimatic zones & farmers' categories		Quintals/ hectare		Difference between CNF & non-CNF	
		CNF	non-CNF	Quintals/ hectare	Percentage
State	AP*	65.58	49.07	16.51	34
	Krishna	55.24	57.03	-1.79	-3
	Scarce rainfall	43.47	48.19	-4.72	-10
Farm size categories	Marginal	66.47	47.75	18.72	39
	Small	69.53	46.55	22.98	49
	Others	58.76	52.30	6.46	12

* AP data include the data of leftover zones and farmers categories also

Source: IDSAP, Field Survey 2021-22

4.6.3. Net value of Maize output

Even though CNF yields of Maize in Krishna zone are less than that of non-CNF, the net value of CNF output is over three times higher than that of non-CNF. Substantial reduction in the

paid-out cost of CNF Maize is the reason. Higher yields and reduction in paid-out costs under CNF together contributed to very high net value of output over that of non-CNF across all farm size categories and also at the state level (Table 4.16).

Table 4.16: Agroclimatic zones & farm size categories wise net value of Maize output under CNF and non-CNF and differences in 2021-22

Agroclimatic zones & farmers' categories		₹/ hectare		Difference between CNF & non-CNF	
		CNF	non-CNF	₹/ hectare	Percentage
State	AP*	91,844	33,796	58,049	172
Zones	Krishna	73,040	17,892	55,149	308
	Scarce rainfall	27,114	36,148	-9,034	-25
Farm size categories	Marginal	93,179	15,295	77,884	509
	Small	97,584	32,210	65,374	203
	Others	79,564	45,136	34,429	76

* AP data include the data of leftover zones and farmers categories also

Source: IDSAP, Field Survey 2021-22

4.7. Red gram

In Red gram, sizable sample observations are available from Krishn and Scarce rainfall zones. In other zones, they are thinly spread. However, enough number of samples are available across all three farm size categories to make companions.

4.7.1. Paid-out cost of Red gram

Red gram is, usually, cultivated with a fewer inputs/ investment in the state. Hence, there is little scope for savings in paid-out cost under CNF. In fact, the field data indicate that the paid-out cost under CNF is slightly higher than that of non-CNF by ₹1,744 (6 percent) per hectare. The same is true in both Krishna (5 percent) and Scarce rainfall (13 percent) zones. However, the marginal and small CNF farmers have obtained savings of 14 percent and 9 percent respectively in the paid-out cost of Red gram over non-CNF farmers. But CNF other farmers have incurred 27 percent higher paid-out cost over non-CNF farmers (Table 4.17).

Table 4.17: Farm size category wise paid-out cost of Red gram under CNF and non-CNF and differences in 2021-22

Agroclimatic zones & farmers' categories		₹/ hectare		Difference between CNF & non-CNF	
		CNF	non-CNF	₹/ hectare	Percentage
State	AP	30,126	28,382	1,744	6
Zones	Krishna	27,000	25,631	1,369	5
	Scarce rainfall	33,301	29,583	3,718	13
Farm size categories	Marginal	33,087	38,331	-5,244	-14
	Small	26,897	29,564	-2,667	-9
	Others	30,787	24,267	6,520	27

* AP data include the data of leftover zones and farmers categories also

Source: IDSAP, Field Survey 2021-22

4.7.2. Yields of Red gram

As mentioned above, Red gram is cultivated with relatively fewer inputs (agrochemicals) under non-CNF. As pointed out elsewhere in this report and also in almost all previous reports, the scope for yield enhancement is high, under CNF, in such crops. Agroclimatic zones and farm size categories wise Red gram yields are presented in Table 4.18. The CNF farmers got 15 percent higher yields compared to non-CNF farmers at the state level. But the CNF farmers got 11 percent lower yields in Krishna zone; however, the CNF farmers got nearly 7 times higher yields in Scarce rainfall zone. The Scarce rainfall zone yields indicate the CNF crops' potential to withstand the adverse weather conditions. The small and other CNF farmers obtained 16 percent and 32 percent higher yields respectively. But non-CNF marginal farmers got 9 percent higher yields compared to their counterparts in CNF (Table 4.18).

Table 4.18: Farm size categories wise yields of Red gram under CNF and non-CNF and differences in 2021-22

Agroclimatic zones & farmers' categories		Quintal/ hectare		Difference between CNF & non-CNF	
		CNF	non-CNF	Quintal/ hectare	Percentage
State	AP	7.87	6.82	1.05	15
Zones	Krishna	5.67	6.37	-0.83	-11
	Scarce rainfall	8.45	1.08	7.37	682
Farm size categories	Marginal	8.87	9.70	-0.83	-9
	Small	5.73	4.92	0.81	16
	Others	9.25	7.01	2.24	32

* AP data include the data of leftover zones and farmers categories also

Source: IDSAP, Field Survey 2021-22

4.7.3. Net value of Red gram output

The disaggregate analysis, in this chapter, once again confirms the effectiveness of the CNF in making agriculture profitable. With 15 percent gain in the yield, the CNF farmers obtained 60 percent higher net value of Red gram output over non-CNF farmers. Further, the small and other CNF farmers obtained 125 percent and 121 percent higher net value of output respectively with 16 percent and 32 percent higher yields respectively over non-CNF farmers. On the other hand, CNF marginal farmers attained 17 percent higher net value per hectare, though they got 9 percent less yields compared to non-CNF marginal farmers. Apart from savings in paid-out cost, most of the CNF farmers, particularly marginal and other farmers, have obtained higher prices.

Table 4.19: Farm size categories wise net value of Red gram output under CNF and non-CNF and differences in 2021-22

Agroclimatic zones & farmers' categories		₹/ hectare		Difference between CNF & non-CNF	
		CNF	non-CNF	₹/ hectare	Percentage
State	AP	23,812	14,923	8,889	60
Zones	Krishna	12,430	16,325	-3,895	-24
	Scarce rainfall	14,389	-23,678	38,067	
Farm size categories	Marginal	22,869	19,629	3,240	17
	Small	8,710	3,874	4,836	125
	Others	43,901	19,905	23,996	121

* AP data include the data of leftover zones and farmers categories also

Source: IDSAP, Field Survey 2021-22

4.8. Conclusion

The disaggregate analysis, in this chapter, once again confirms the effectiveness of the CNF in making agriculture profitable. Both the CCE yields based results in the previous chapter and reported yields-based results in this chapter confirm the positive impact of CNF in improving the farming conditions. By effecting savings in the cost of cultivation (paid-out cost), improving and/ or maintaining the crop yields and fetching higher or same prices for crop output; thus, improving the gross and net values of crops' output, CNF helped the farmers a great deal. The disaggregate analyses reconfirm one of the major findings of the previous studies in the present series- "***the resource poor regions and sections too can benefit from CNF***". The study also shows that (1) Savings in paid-out cost would be more in input intensive crops. (2) Relatively higher yields can be achieved under CNF in less resource intensive crops. (3) The non-CNF farmers often get negative net value of crop output. In this chapter also such outcomes are observed. (4) A K Sen's well-known hypothesis- "inverse relationship between the farm size and productivity" is valid. In some instances, the marginal farmers made higher investments and obtained higher yields compared to small and other farmers.

The data over the years, broadly, indicate that while the reduction in the paid-out cost has been the major benefit of CNF. Its contribution to enhance yield and in securing higher prices for the yield is none too small.

Chapter 5: Impact of CNF on input-use and environmental sustainability of agriculture

5.1. Introduction

As mentioned in the previous reports, APCNF has brought about a paradigm shift in agriculture, and contributed to a social, economic and environmental sustainability. Social sustainability has been analysed, through an examination of marginalized and vulnerable social and economic groups, in CNF in the chapter 2 of the Kharif 2021-22 report (IDSAP, 2022)[27] and Rabi 2021-22 reports (IDSAP, 2023). The same is summarized in the chapter 2 of this report. Economic analysis has been covered in Chapters 3 and 4 of this report to reflect on economic sustainability of APCNF. The impact of CNF on input use and consequent environmental changes have been discussed in detail in Kharif (IDSAP, 2022) and Rabi (IDSAP, 2023) in detail. In this chapter, the major findings of those two reports with respect to the impact of CNF on input use and environmental sustainability are summarised. The inputs/ resources covered in this chapter are land, labour, water, chemical inputs, investment, credit and biological stimulants and practices. This chapter also discusses the changes in the quality of natural resources, especially land and crops.

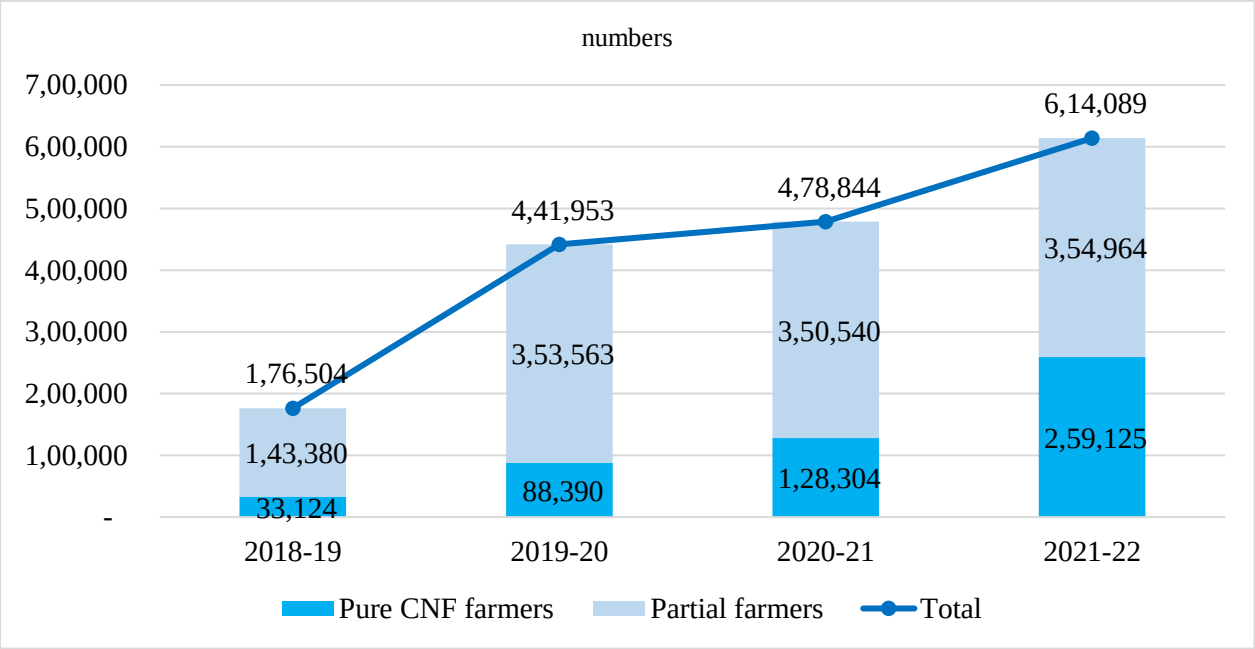
5.2. Land-use and Environmental sustainability

Expansion of area under CNF is a reliable indicator about the positive impact of CNF and its sustainability. Area under CNF would expand, if more and more farmers take up CNF, which is referred as "**expansion of the programme**"; and if the existing CNF farmers allocate more area towards CNF, it is referred as "**intensification of the programme**". It is encouraging to note that the area under CNF is expanding in recent years because of both expansion and intensification of CNF. As per the data provided by RySS, the number of APCNF project participant farmers has been increasing at rapid pace. As of now, RySS is recording the CNF project participants under two categories, viz., (1) Pure CNF farmers or seed to seed (S2S) farmers, who cultivate crops with only CNF inputs and practices, without applying any chemical inputs, at least on a part of their operational holdings (at least one plot); and (2) Partial CNF farmers, who apply both biological and chemical inputs in their fields. The number of farmers adopting CNF as the pure CNF/ S2S farmers and partial CNF farmers together, has

[27]See details in IDSAP (2022): *Assessing the Impact of APCNF [Andhra Pradesh Community Managed Natural Farming]: A comprehensive Approach Using Crop Cutting Experiments: Second Interim Report of 2021-22: Kharif Season*, Institute for Development Studies Andhra Pradesh (IDSAP), Visakhapatnam. https://apcnf.in/wp-content/uploads/2023/02/Final-APCNF-Kharif-Season-Report-2021-22_17012022.pdf or https://www.idsap.in/assets/reports/13%20APCNF%20Kharif%20Season%20Report%202021%2022%2031%20Dec%202022.pdf

reached 6.14 lakh in 2021-22 The number of total participants has increased 3.46 times during last four years; from 1.77 lakh farmers in 2018-19 to 6.14 lakh farmers in 2021-22. It is interesting to note that the number of pure CNF/ S2S farmers are increasing at a rapid pace during the last four years; i.e., 7.82 times, from 33,124 in 2018-19 to 2,59,125 in 2021-22. But the number of partial farmers has stagnated just above 3.5 lakh during last three years (Figure 5.1).

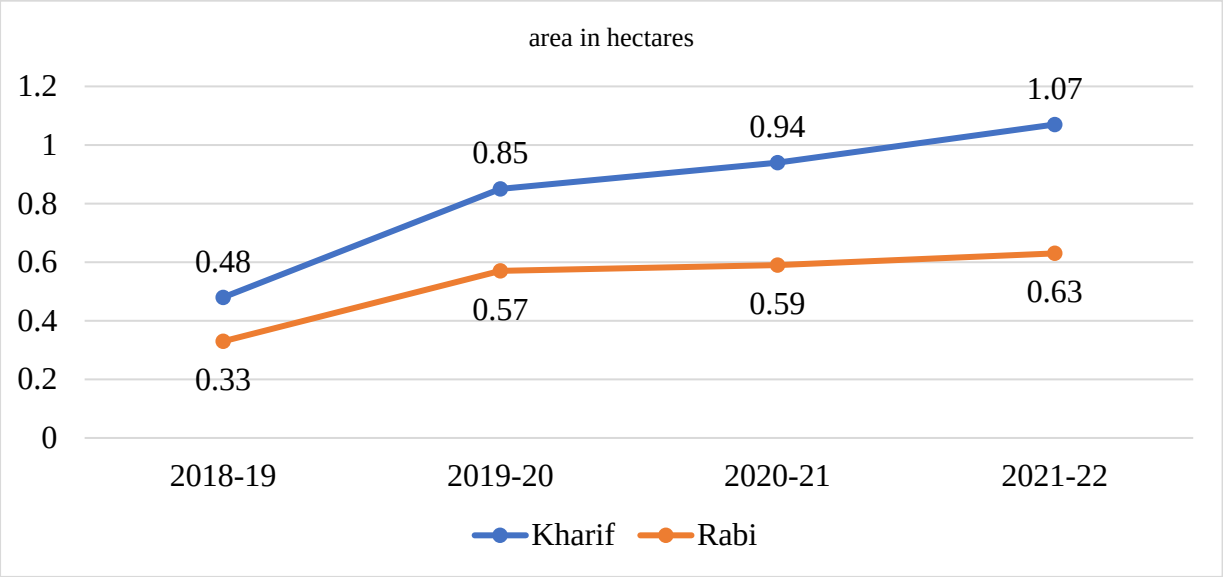
Figure 5.1: Number of participating farmers in CNF project during last four years



Source: RySS

The data from previous surveys also indicate that the area under CNF is growing season by season and year by year. For example, as per the data collected in 2021-22, the area allocated for CNF has been increased during the last four Kharif and Rabi seasons, that is, during 2018-19 and 2021-22. The average area per farmer under CNF has increased from 0.48 hectares in Kharif of 2018-19 to 1.07 hectares in Kharif of 2021-22. During the Rabi seasons also, the average area allocated to CNF has increased from 0.33 hectares in Rabi 2018-19 to 0.63 hectares in Rabi 2021-22, at the state level (Figure 5.2).

Figure 5.2: Average area allocated to CNF, by CNF farmers during Kharif and Rabi season of 2018-19 to 2021-22



Note: The Kharif data include a small portion of PMDS area also. For the sake of similarity with the data given in Kharif Report (IDSAP, 2022), it is retained as it was in Kharif report.
Source: IDSAP, Field Survey 2021-22

The focus group discussions with farmers and case studies of farmers across the sample villages have also endorsed this trend, especially in recent years. The land use pattern in terms of diversified crops grown is another indicator to assess the environmental sustainability. Focus group discussions with farmers have indicated that a shift from monocropping to multi cropping has been taking place slowly due to CNF. The qualitative data also indicate that farmers have started growing mixed crops, inter crops, border crops, and bund crops. They are growing fruits, vegetables and flowers, which provide, apart from economic benefits, ecological services also.

Another impact of CNF on land use in agriculture is the increase in cropping intensity. CNF is positively impacting the cropping intensity through PMDS and 365 days green cover strategy. Compared to non-CNF farmers, the PMDS+CNF enabled CNF farmers to cover their cultivated land with crops for longer periods. As per the Kharif survey, the CNF fields have 187 days crop cover compared to 152 days crop cover on non-CNF field, i.e., 35 (23 percent) days more crop cover (IDSAP, 2022).[28] Crop coverage for longer periods implies taking more than one crop on the same piece of land. This has multiple benefits: Firstly, the availability of more biomass consisting of green manure, fodder, foodgrains, vegetables and leafy vegetables. Secondly, the soil would be protected from the sunlight and heat, thus preserving the soil

[28] Ibid.

moisture and microbes in the soil. Thirdly, plants prepare their own food through photosynthesis and exudate a part of it into the soil, which nourish the microbes in the soil. Additionally, the longer crop cover means that the microbes would be nourished for longer periods of time. However, there is no difference between CNF fields of CNF farmers and non-CNF fields of non-CNF farmers with respect to crop cover over their fields during Rabi 2021-22. The difference in number of days of crop cover over CNF and non-CNF fields is just one day (0.4 percent). Almost similar (marginal differences) trends can be observed across all agroclimatic zones and farmer categories (IDSAP, 2023). This shows that there is less scope to take Pre-Rabi Dry Sowing (PRDS) between Kharif and Rabi crops. In total CNF farmers have 27 days more crop cover on their CNF fields compared to non-CNF fields of non-CNF farmers during April 2021 to May 2022 (Table 5.1).

Table 5.1: Agroclimatic zones and farmer category wise crop cover over CNF fields of CNF farmers and non-CNF of non-CNF farmers during April 2021 to May 2022

Agroclimatic Zones & Categories of farmers		Days		Difference between CNF & non-CNF	
		CNF	non-CNF	Days	Percentages
State	AP	211	184	27	12.94
Agroclimatic zones	HAT	299	214	85	28.52
	North coastal	278	236	42	15.20
	Godavari	143	128	15	10.47
	Krishna	142	188	-46	-32.08
	Southern	234	173	60	25.88
	Scarce rainfall	215	182	32	15.05
Farm size category	Marginal	206	183	24	11.49
	Small	226	184	42	18.43
	Others	204	186	18	8.86
Tenurial status	Tenants	172	180	-8	-4.61
	Owner cum tenants	183	188	-4	-2.39
	Owners	217	184	33	15.17
Social category	SC	207	165	42	20.26
	ST	244	197	47	19.44
	BC	213	177	36	17.07
	OC	188	193	-4	-2.31

Source: *IDSAP, Field Survey 2021-22.*

5.3. Labour-use and Environmental sustainability

The earlier studies conducted by IDSAP on impact of APCNF has brought out clearly three insights regarding labour use across all the crops: (1) The labour days used per hectare by and large is higher across all the crops for CNF compared to non-CNF; this means that CNF is labour intensive. (2) The hired labour use is also higher for CNF compared to non-CNF for majority of the crops; this means that CNF provides more employment to wage employment seekers. (3) The own labour (family labour) is also higher in almost all crops for CNF over non-CNF; this shows that the engagement of the family labour with CNF is more.

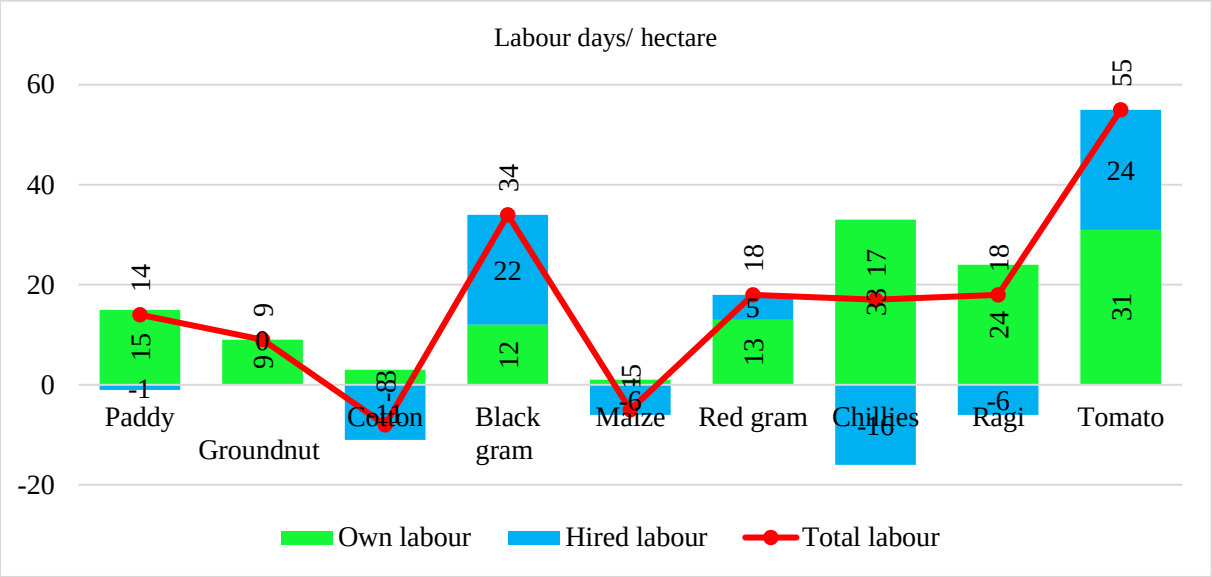
The trends are found to be true in the case of most crops considered for the analysis in Kharif season. The total labour days (family labour plus hired labour) per hectare for CNF crops are higher than that of non-CNF crops in seven out of nine crops covered, in the range of 9 to 55 days per hectare. In the case of Cotton and Maize, the total labour use under CNF is less than that of non-CNF by small margin of 7 and 5 days respectively (Table 5.2). Though CNF crops need a greater number of human labour days, most of those labour days have come from family labour only. The use of family labour has been high in CNF vis-à-vis non-CNF in all nine crops covered, in the range of 1 day in Maize to 33 days in Chillies. In five out of nine crops, the hired labour under CNF is less than that of non-CNF. In one crop – Cotton, there is difference between CNF and non-CNF in the number of hired labour days employed (Table 5.2 and Figure 5.3). The results indicate that most of the additional demand in crop cultivation under CNF would accrue to own labour.

Table 5.2: Crop wise own, hired and total labour used under CNF and non-CNF during Kharif 2021-22

	Own labour (Days/ ha)		Hired labour (Days/ ha)		Total labour (Days/ ha)		Difference between CNF & non-CNF (Days/ ha)		
Crops	CNF	non-CNF	CNF	non-CNF	CNF	non-CNF	Own labour	Hired labour	Total labour
Paddy	76	61	57	58	133	119	15	-1	14
Groundnut	33	24	40	40	73	64	9	0	9
Cotton	42	39	71	82	113	121	3	-11	-8
Black gram	31	19	37	15	68	34	12	22	34
Maize	34	33	38	44	72	77	1	-6	-5
Red gram	26	13	19	14	45	27	13	5	18
Chillies	95	62	109	125	204	187	33	-16	17
Ragi	149	125	68	74	217	199	24	-6	18
Tomato	86	55	111	87	197	142	31	24	55

Source: IDSAP, Field Survey 2021-22

Figure 5.3: Difference in the use of own, hired and total labour in crop cultivation under CNF and non-CNF during Kharif 2021-22



Source: IDSAP, Field Survey 2021-22

The results, of the Rabi survey of 2021-22, also endorse the trends observed in the earlier reports; and also mentioned above. A greater number of own labour days are used in CNF crops vis-à-vis non-CNF in four out of five crops covered here, in the range of 4 days per ha in Groundnut to 14 days per ha in Paddy. Only in Maize, use of own labour is less under CNF by 7 days per hectare. In case of hired labour, a greater number of labour days are used under CNF in three out of five crops, in the range of 5 days per hectare in Groundnut to 22 days per hectare in Maize. On the other hand, a lesser number of hired labour days are used under CNF, in remaining two crops, in the range of 4 days per hectare in Bengal gram to 7 days in Black gram. In total, a greater number of labour days are used in four crops under CNF; and equal number of days are used in the remaining Black gram for both CNF and non-CNF (Table 5.3 and Figure 5.4). The major reasons for higher labour requirement are preparation of biological inputs and stimulants and crop diversity- taking mixed crops, inter crops, bund crops and border crops. Even more important reason is that CNF is knowledge intensive, in which farmers have to be vigilant and responsive to the developments in the fields. All these indicate the CNF's employment generation potential. At least it can reduce the disguised[29] unemployment in agriculture and increase the labour productivity in the sector.

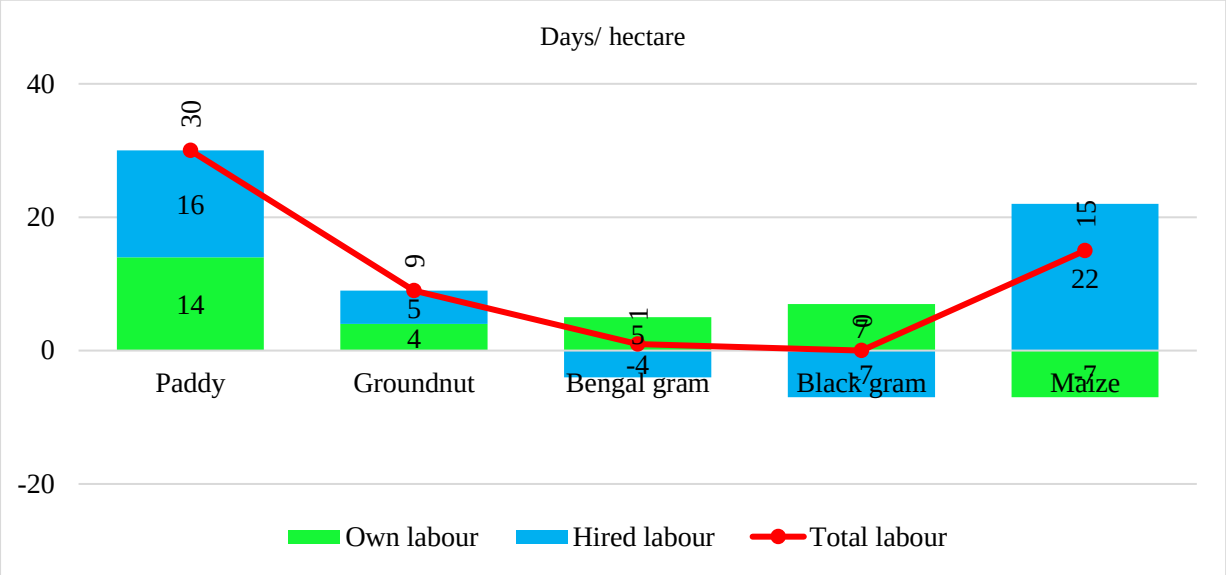
[29]In economics text books, the term disguised unemployment is used to the workers with zero marginal productivity, in agriculture and unorganized sector. It implies their presence or absence does not impact the total production. Because of higher labour requirement in CNF with specific skills, the disguised unemployed can contribute positively to the total production, i.e., shift occurs.

Table 5.3: Crop wise own, hired and total labour used under CNF and non-CNF during Rabi 2021-22

Crops	Own labour (Days/ ha)		Hired labour (Days/ ha)		Total labour (Days/ ha)		Difference between CNF & non-CNF		
	CNF	non-CNF	CNF	non-CNF	CNF	non-CNF	Own labour	Hired labour	Total labour
Paddy	58	44	54	38	112	82	14	16	30
Groundnut	48	44	46	41	94	85	4	5	9
Bengal gram	17	12	19	23	36	35	5	-4	1
Black gram	52	45	26	33	78	78	7	-7	0
Maize	47	54	60	38	107	92	-7	22	15

Source: *IDSAP, Field Survey 2021-22*

Figure 5.4: Difference in the use of own, hired and total labour in crop cultivation under CNF and non-CNF during Rabi 2021-22



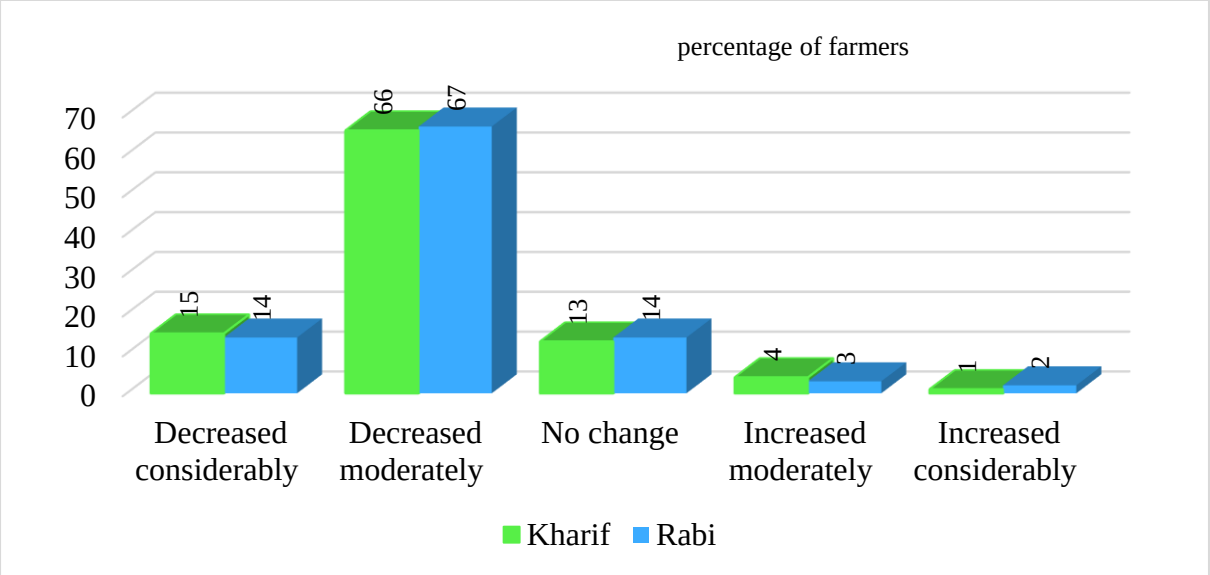
Source: IDSAP, Field Survey 2021-22

5.4. Water-use and Environmental sustainability

As pointed out in the previous Kharif and Rabi 2021-22 reports, various CNF practices are expected to soften the soil and increase the carbon content in the soil. These changes in turn would increase the water/ rainfall percolation into the soils and increase the water/ moisture holding capacity of the soils. To know the field reality, the CNF farmers were asked about their experiences with respect to changes in water consumption in crop cultivation after the introduction of CNF. Their responses have been recorded in the five-point scale, during both Kharif and Rabi 2021-22 survey. The data is presented in Figure 5.5. Among CNF farmers, over four-fifths have reported that water-use has decreased, due to CNF in both Kharif and Rabi seasons. With minor exceptions, the trend holds good across almost all agroclimatic zones and all farmer categories (IDSAP, 2022 and 2023). The focus group discussions with the

farmers and the case studies of farmers across the sample villages have also endorsed this. These farmers have also reported that the moisture in the soil has increased and groundwater levels also increased in some of the sample villages.

Figure 5.5: CNF farmers response about the impact of CNF on water requirement in crop cultivation during Kharif and Rabi seasons of 2021-22

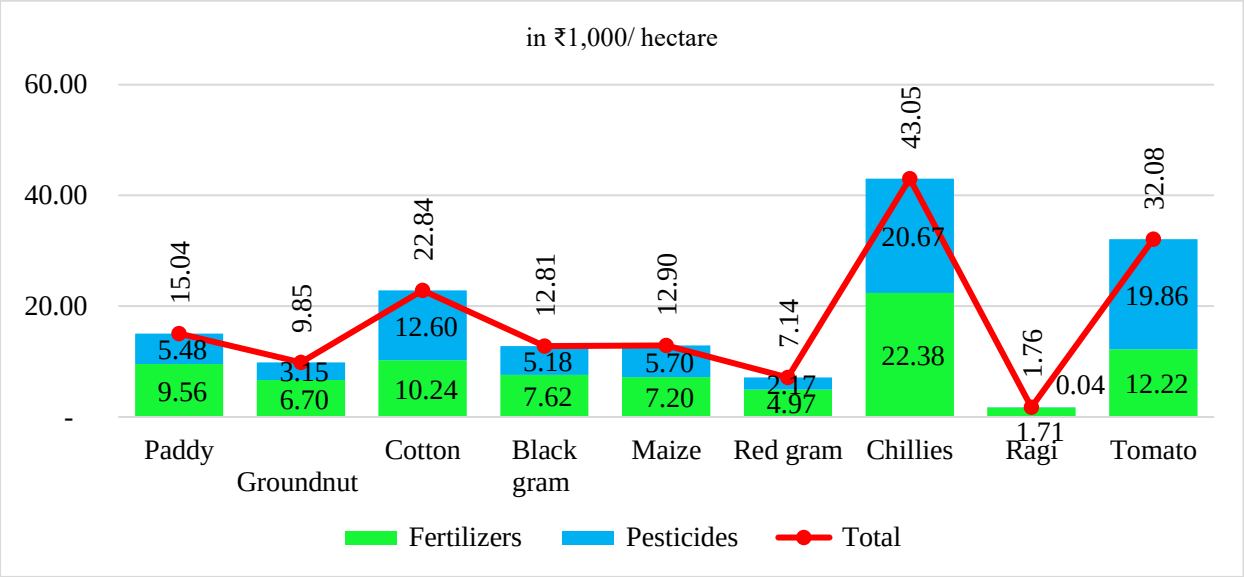


Source: *IDSAP, Field Survey 2021-22.*

5.5. Avoidance of agrochemicals and environmental effect

One of the most dreaded effects of modern agriculture is the pollution effects of agrochemicals, i.e., fertilizers and pesticides. These chemicals pollute the soils, water bodies, and atmosphere. These chemicals have killed the microbes in the soil and made the soil dead (without any life in it) under non-CNF. The polluted water bodies and atmosphere have health hazards to the human and other living beings. Even the agrochemical residues in agriculture output, particularly the food, have bigger health risk to the human and other living beings. By avoiding completely these agrochemicals, the CNF farmers have been contributing immensely in halting and reversing the multidimensional pollution of the agrochemicals, including the resource degradations. Crop wise avoided expenditure on agrochemicals, by CNF farmers in Kharif and Rabi seasons are shown in Figure 5.6 and 5.7 respectively. The avoided expenditure on agrochemicals, in Kharif 2021-22 varies from ₹1.76 thousand per hectare in Ragi to ₹43.05 thousand per hectare in Chillies. The avoided expenditure on fertilizers, in Kharif 2021-22, varies from ₹1.71 thousand in Ragi to₹22.38 thousand in Chillies. In Rabi, the avoided expenditure on agrochemicals varies from ₹8.73 thousand per hectare in Black gram to ₹20.03 thousand per hectare in Paddy and the avoided expenditure on fertilizers varies from ₹1.16 to ₹13.68 thousand, i.e., ₹1.16 thousand in Black gram to₹13.68 thousand in Paddy respectively.

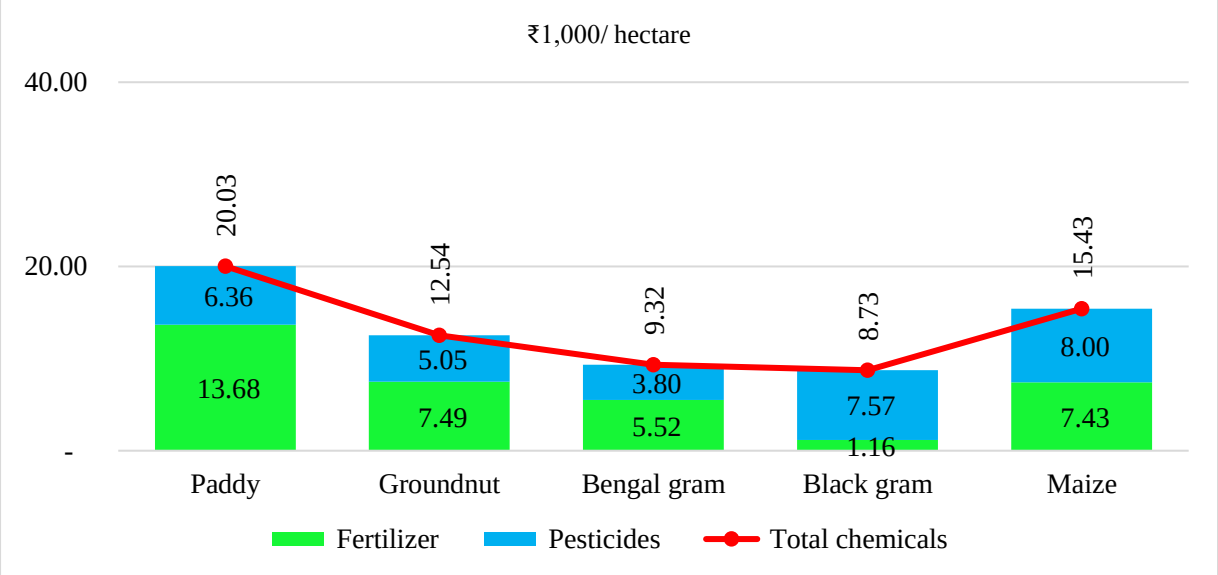
Figure 5.6: Crop wise avoided expenditure on agrochemicals* by CNF farmers during Kharif 2021-22



***This is actual expenditure incurred on agrochemicals by non-CNF farmers. Hence, this is considered as the expenditure avoided on agrochemicals, by CNF farmers*

Source: *IDSAP, Field Survey 2021-22.*

Figure 5.7: Crop wise avoided expenditure on agrochemicals* by CNF farmers during Rabi 2021-22



***This is actual expenditure incurred on agrochemicals by non-CNF farmers. Hence, this is considered as the expenditure avoided on agrochemicals, by CNF farmers*

Source: *IDSAP, Field Survey 2021-22.*

Crop wise fertilizers avoided by CNF farmers in Kharif and Rabi seasons are given in Table 5.4 and 5.5 respectively. In Kharif, the avoided fertilizers vary from 1.52 quintal per hectare in Ragi to 11.53 quintal per hectare in Chillies. The same in Rabi vary from 0.66 quintal per

hectare in Black gram[30] to 7.08 quintal per hectare in Paddy. Various studies have indicated that Government of India's fertilizer subsidy is equal to actual expenditure of the farmers on fertilizers.[31] That is, if a farmer spends ₹100 on fertilizers, the GoI would spend ₹100 on subsidy. By avoiding the use of fertilizers, the CNF farmers are saving the fertilizer subsidy of the GoI.

Table 5.4: Crop wise avoided fertilizers* by CNF farmers during Kharif 2021-22
(quintal/ hectare)

Crop	Urea	DAP	NPK	Ammonia Sulphate	Other fertilizers	Total fertilizers
Paddy	1.79	1.40	0.69	0.14	1.12	5.15
Groundnut	0.65	1.03	0.76	0.01	0.54	2.99
Cotton	1.75	1.43	0.66	0.01	1.46	5.30
Black gram	1.10	5.69	0.03	0.00	1.24	8.07
Maize	1.56	1.02	0.73	0.00	0.38	3.68
Red gram	0.40	1.58	0.05	0.00	1.28	3.31
Chillies	2.70	3.65	1.51	0.01	3.65	11.53
Ragi	1.30	0.17	0.04	0.00	0.00	1.51
Tomato	1.28	1.51	1.31	0.00	2.39	6.50

**This is actual expenditure incurred on agrochemicals by non-CNF farmers. Hence, this is considered as the expenditure avoided on agrochemicals, by CNF farmers*
Source: *IDSAP, Field Survey 2021-22.*

Table 5.5: Crop wise avoided fertilizers* by CNF farmers during Rabi 2021-22 (quintal/ hectare)

Crop	Urea	DAP	NPK	Ammonia Sulphate	Other fertilizers	Total fertilizers
Paddy	2.33	2.00	1.20	0.22	1.32	7.08
Groundnut	0.49	0.96	0.85	0.00	0.74	3.04
Bengal gram	1.00	1.31	0.09	0.00	0.09	2.49
Black gram	0.03	0.48	0.02	0.03	0.10	0.66
Maize	1.55	1.08	0.80	0.00	0.68	4.11

**This is actual expenditure incurred on agrochemicals by non-CNF farmers. Hence, this is considered as the expenditure avoided on agrochemicals, by CNF farmers*
Source: *IDSAP, Field Survey 2021-22.*

[30] It may be noted that Black gram is, normally, cultivated on Paddy fields of Kharif season, during Rabi season with very little/ no plant nutrients under non-CNF. However, the crop is cultivated in Kharif, under non-CNF, as any other crop with normal agrochemicals. However, the crop is cultivated sparsely during Kharif.
[31] See for example Harish Damodaran (2020): "Explained: How fertiliser subsidy works", *The Indian Express*, October 20, 2020 https://indianexpress.com/article/explained/how-fertiliser-subsidy-works-6793395/

Such reduction in the use of fertilizers and pesticides, is not only environmentally beneficial to the society, consumers and farmers, but also financially beneficial to the farmers. Farmers dependence on agrochemicals suppliers reduce considerably. Their dependence on agriculture credit also reduces considerably. This issue is discussed briefly in the next section.

5.6. Impact of CNF on agriculture investment and credit

A noteworthy reduction in the paid-out cost of cultivation in almost all crops is expected to reduce the working capital requirements for CNF, which in turn, is expected to result in a reduction in the CNF farmers' borrowing for agriculture and other uses. The field data show that incidence of borrowing is considerably less for CNF farmers. While, there are 91 loans per every 100 CNF farmers, the same for non-CNF farmers is 112. The average loan amount for each CNF farmer is ₹71,964, and for each non-CNF farmer is ₹ 1,03,136 (Table 5.6), i.e., each non-CNF farmer has 30 percent higher loan amount vis-à-vis a CNF farmer. A considerably lower loan outstanding indicates a noteworthy reduction in the indebtedness for CNF farmers. More details can be seen in IDSAP, (2022).

Table 5.6: Status of borrowing by CNF and non-CNF farmers as on date of survey

Indicator	CNF	Non-CNF
Total sample farmers	1,186	748
Number of loans	1,075	837
Number of loans per 100 farmers	91	112
Total loan amount (₹)	8,53,49,102	7,71,45,416
Average loan amount per farmer (₹)	71,964	1,03,136
Average loan outstanding per farmer (₹)	36,606	52,335

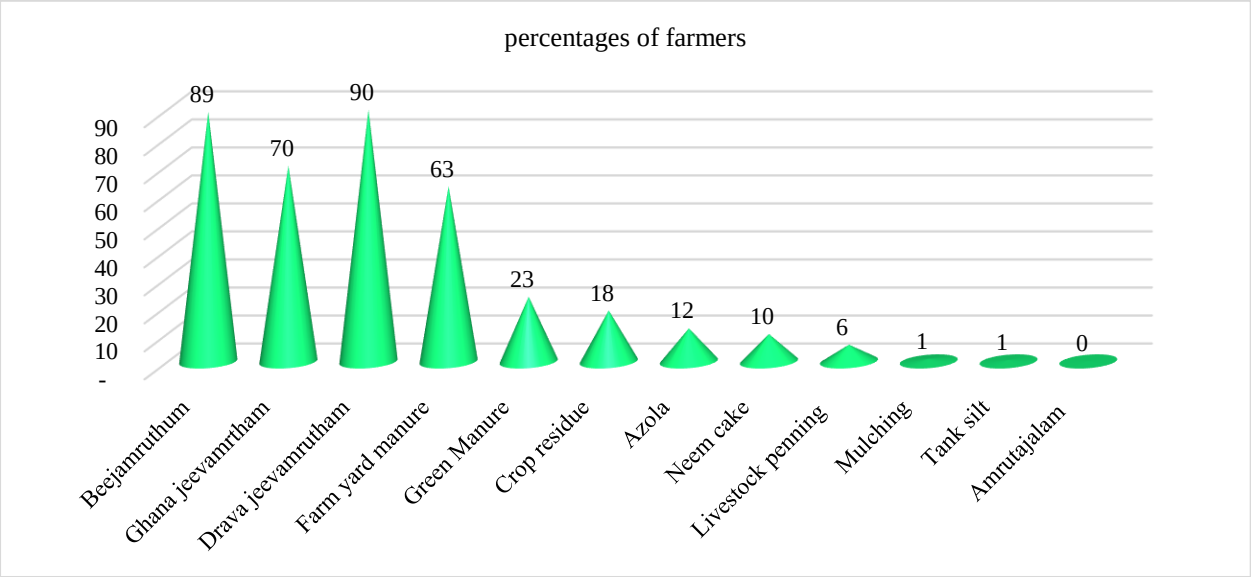
Source: IDSAP, Field Survey 2021-22

5.7. Adoption and application of CNF inputs and practices

As mentioned in the Chapter 1, one of the major interventions under CNF is the introduction of microbes into the soil through biological stimulants. As soil naturally regenerates under CNF, there is no need to apply any chemical inputs. In this section, the rate of adoption and application of different biological stimulants and natural inputs is discussed. During Kharif, over 90 percent of CNF farmers have used Drava Jeevamrutham, over 89 percent have applied Beejamrutham and 70 percent have applied Ghana Jeevamrutham. Farm yard manure (FYM), which consists of waste from livestock and domestic sectors is applied by 63 percent of farmers. Green manure and crop residue are used by 23 percent and 18 percent farmers respectively.

Other natural inputs used by CNF farmers include Azola, Neem cake, Livestock penning, Mulching, Tank silt, etc. (Figure 5.8).

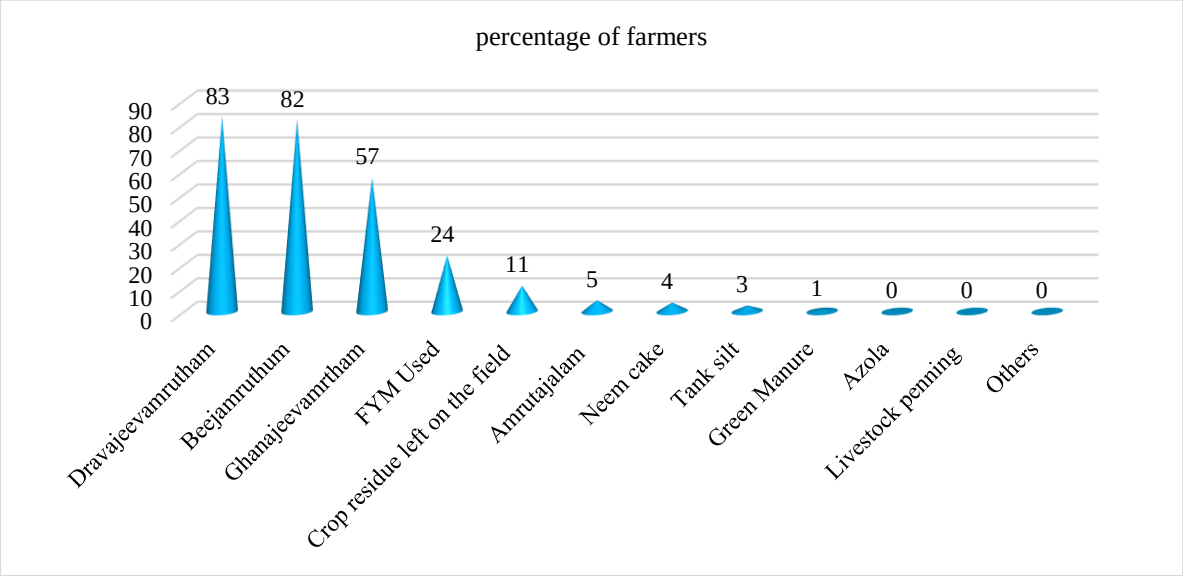
Figure 5.8: Percentage of CNF farmers applied different biological stimulates and natural inputs for the plant growth and improvement during Kharif 2021-22



Source: IDSAP, Field Survey 2021-22

During Rabi, 83 percent of CNF farmers have used Dravajeevamrutham, 82 percent applied Beejamrutham, 57 applied Ghanajeevamrutham, and so on (Figure 5.9).

Figure 5.9: Percentage of CNF farmers applied different biological stimulates and natural inputs for the plant growth and improvement during Rabi 2021-22

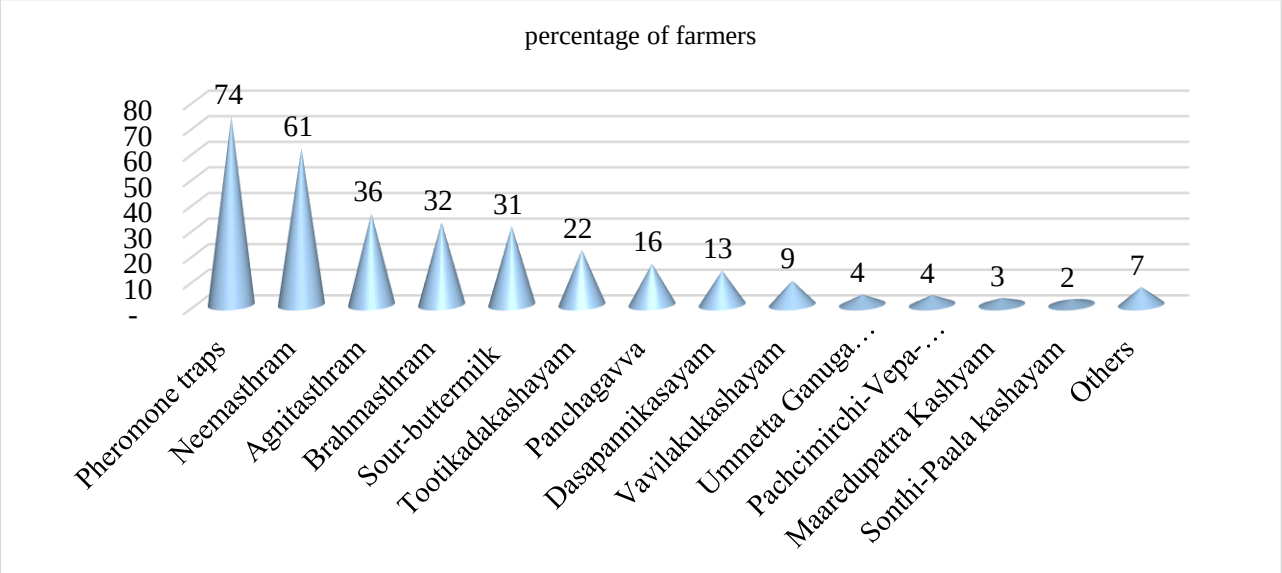


Source: IDSAP, Field Survey 2021-22

Biological stimulants, viz., Beejamrutham, and Ghana and Drava Jeevamrutham not only improve soil quality but also the crop quality. They improve the crops' health and resistance to pests. Further, CNF has prescribed and introduced many locally prepared pest-specific and

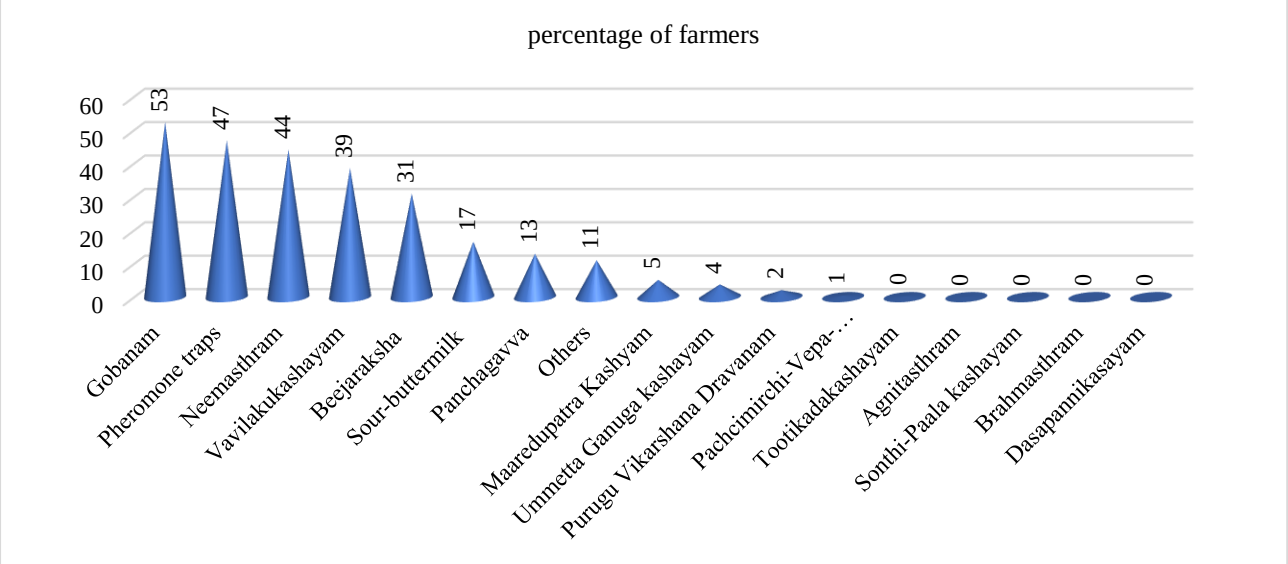
disease-specific non-chemical pest management (NPM) methods and inputs known as Kashayams and Asthrams. During Kharif, about 74 percent of CNF farmers have used Pheromone traps to control pests in their fields. Neemasthram is the second most widely used input, used by 61 percent farmers. Agnitasthram and Brahmasthram are used by 36 percent and 32 percent farmers respectively. Five different Kashayams are also used: Tootokada Kashayam is applied by the maximum at 22 percent CNF farmers, while Sonti-paala Kashayam is being adopted the least by the at 2 percent of CNF farmers (Figure 5.10). Percentage of farmers, who applied different NPM methods and biological inputs for the pests and deceases control during Rabi 2021-22 is given in Figure 5.11.

Figure 5.10: Percentage of CNF farmers applied different NPM methods and biological inputs for the pests and deceases control during Kharif 2021-22



Source: IDSAP, Field Survey 2021-22

Figure 5.11: Percentage of CNF farmers applied different NPM methods and biological inputs for the pests and deceases control during Rabi 2021-22

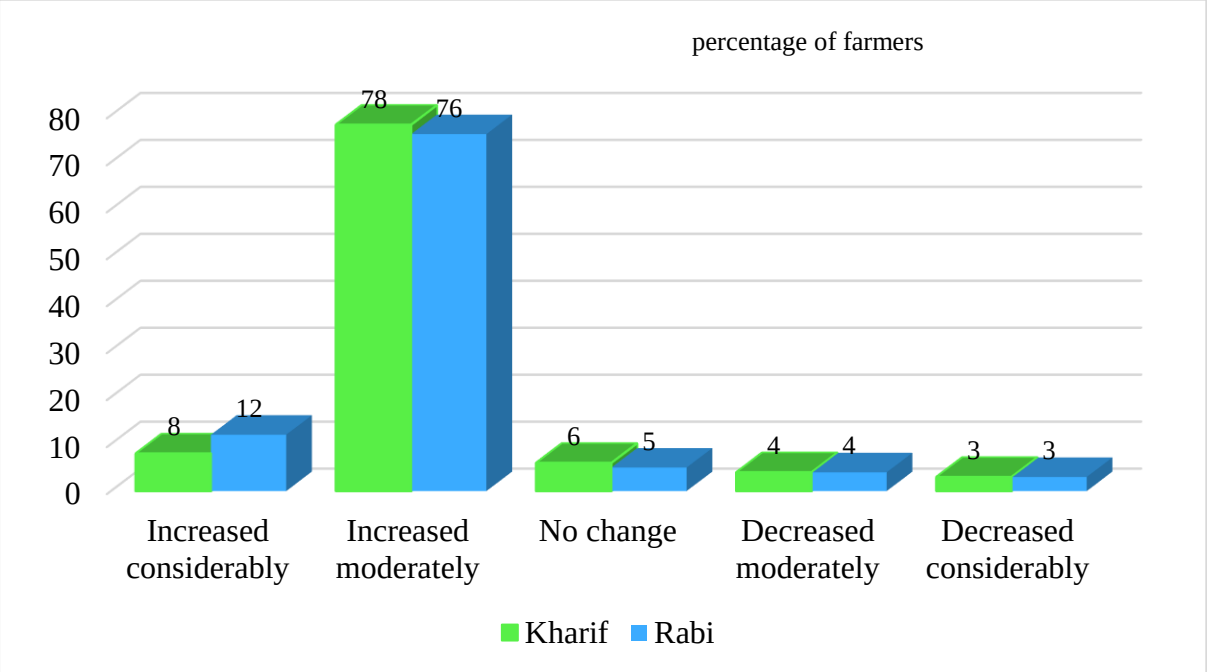


Source: IDSAP, Field Survey 2021-22

5.8. Outcomes of environmental sustainability

The study has been enquiring into the CNF farmers' experiences and perceptions about improvement in the soil quality, crop quality and related issues, due to CNF in both seasons. Farmers in both seasons of study period have given identical response. Over four-fifths of farmers experienced an improvement in the soil quality in their fields (Figure 5.12). The disaggregate details are given in IDSAP, (2023).

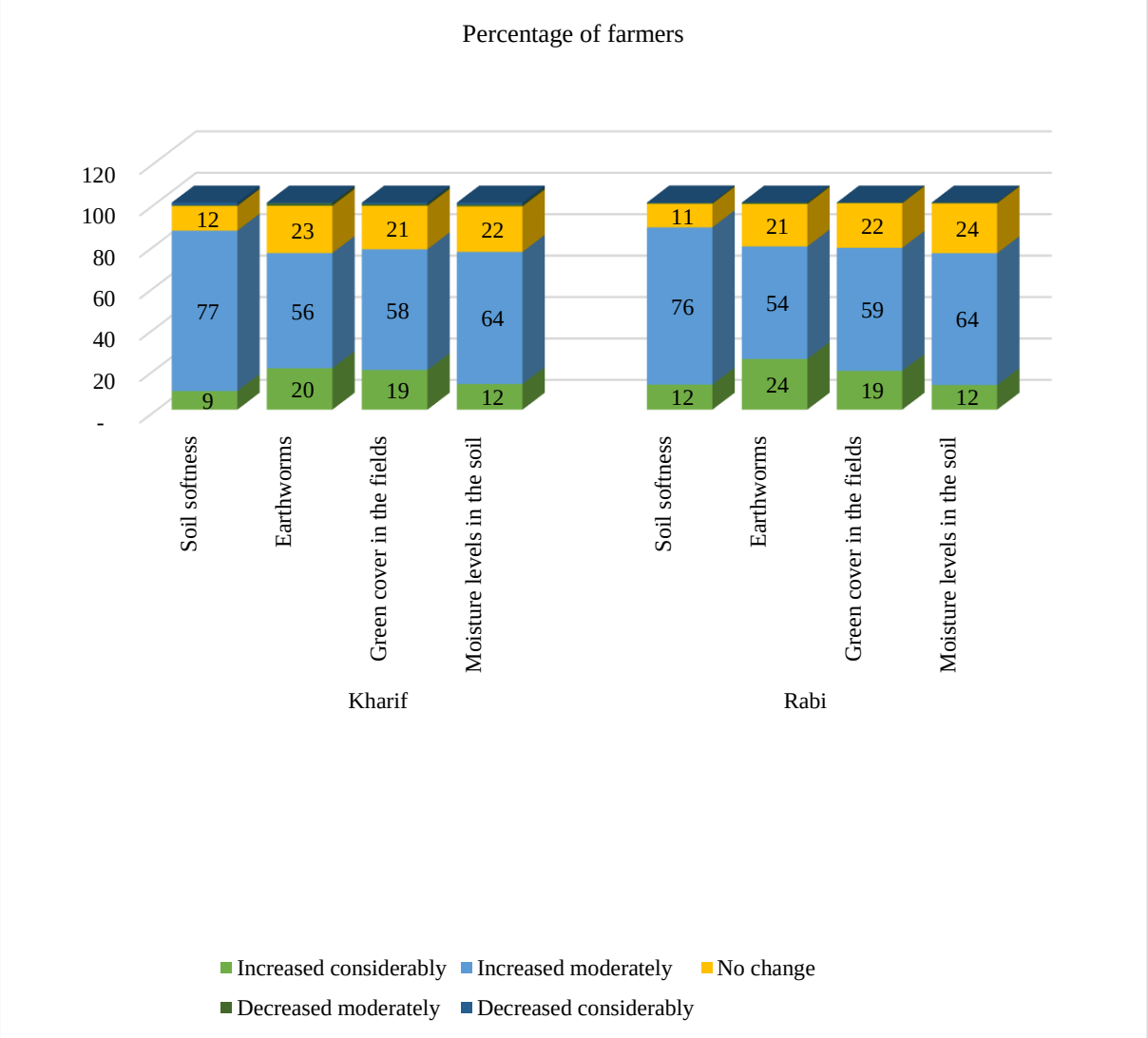
Figure 5.12: CNF farmers response about the improvement in the soil quality during Kharif and Rabi 2021-22



Source: *IDSAP, Field Survey 2021-22.*

From the past surveys, four indicators, viz., (1) soil softness, (2) presence of earthworms in the soil, (3) green cover in the fields and (4) moisture levels in the soil, have been identified to reflect the soil quality. CNF farmers' responses about each of these four indicators, during Kharif and Rabi 2021-22 surveys, are presented in Figure 5.13. Over four-fifth of CNF farmers have reported that soil softness increased moderately or considerably. Similarly, nearly four-fifths of farmers have reported an increase in earthworms and green cover respectively in their fields. Over three-fourths have informed an increased soil moisture levels (moisture hold capacity of the soil) in their fields. Needless to say, the list of indicators is not comprehensive.

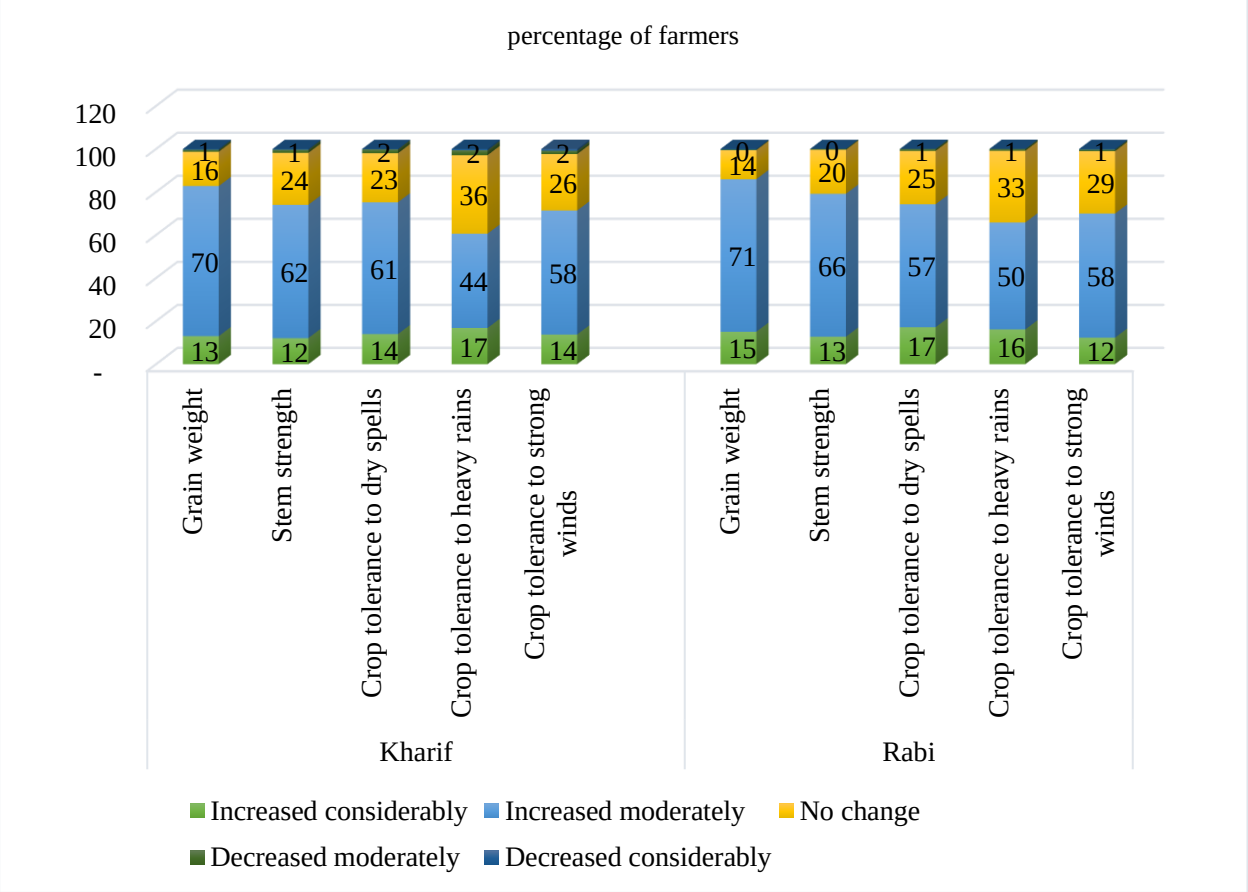
Figure 5.13: CNF farmers' response with respect to changes in soil quality related indicators during Kharif and Rabi 2021-22



Source: *IDSAP, Field Survey 2021-22.*

Similarly, crop quality has been assessed through grain weight, stem's strength, crop tolerance to dry spells, crop tolerance to heavy rains and crop tolerance to strong winds. These data have been collected through farmer's household survey during Kharif and Rabi surveys. The results are presented in Figure 5.14. About three-fourths to over four-fifths farmers perceived improvements in different indicators related to crop quality and resilience during both seasons (Figure 5.14). More details can be seen in IDSAP (2023).

Figure 5.14: CNF farmers' responses with respect to crop quality improvement indicators during Kharif and Rabi 2021-22



Source: *IDSAP, Field Survey 2021-22.*

5.9. Conclusions

The above analysis indicates that resources are efficiently used by the CNF farmers. This is a pointer to the environmental sustainability. By avoiding the use of fertilizers and pesticides completely, the CNF has the potential to halt and reverse the degradation of the natural resources and deterioration of the environment in the state and country. The environmental sustainability has resulted in the improvement of soil health and crop health. The totality of the analysis is a pointer to the contribution of CNF to the environmental sustainability.

Chapter 6: Impact of CNF on Household Incomes

6.1. Introduction

It is known fact that income from crop cultivation is one of many sources of agriculture household incomes. The agriculture households (AH) get the income from wages, salaries, self-employment, rental income from agriculture machinery, bullocks, implements, land, houses, buildings, remittances, transfers from government, etc. Chapters 3 and 4 indicated clearly that the CNF farmers have derived larger crop income compared to non-CNF farmers. Apart from providing higher income, APCNF is expected to have a positive impact on the structure/ sources of income. However, such shifts take time. In the previous studies also, it was observed that there was slight shift in the composition of CNF households' income from wage labour to livestock. The chapter covers the following issues.

1. Household income of CNF and non-CNF during the agriculture year 2021-22
2. Composition of households' income CNF and non-CNF farmers, in terms of number of households reporting and the amount.
3. Impact of CNF on household income across agroclimatic zones and farmer categories.

In this chapter the household income is estimated based on reported yields. One of the reasons for using the reported yields is the data availability for each household and each crop. Further, apart from yields of 12 sample crops considered in this report, reported yields of all other crops have been used. Same method is used for both CNF and non-CNF farmers.

6.2. Annual households' income in AY2021-22

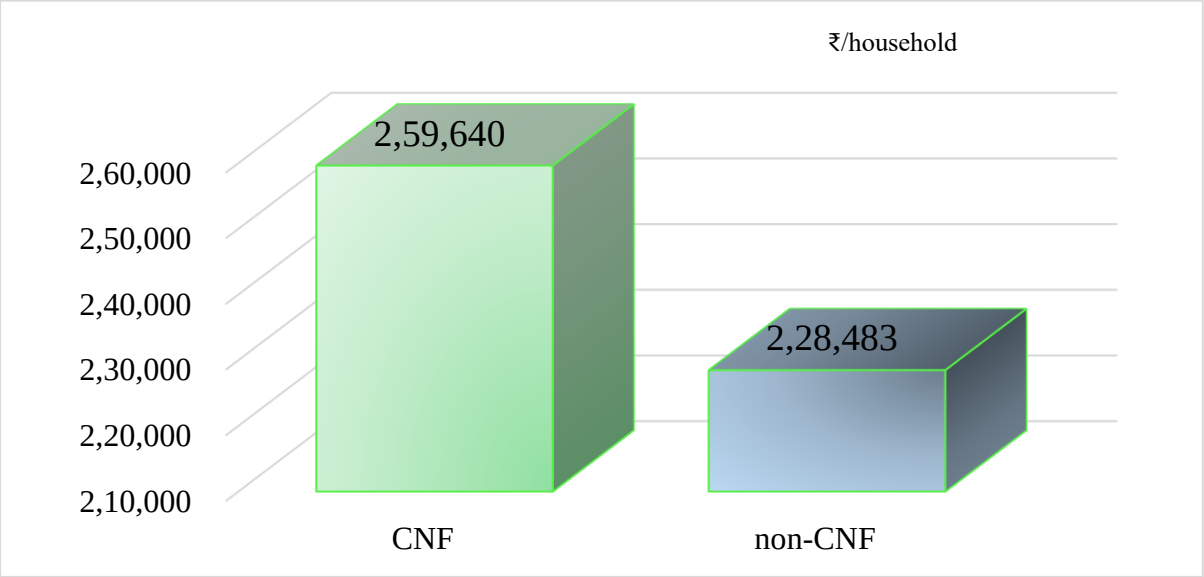
At the state level, the average income of CNF households is ₹2,59,640 compared to ₹2,28,157 of non-CNF household in the agriculture year (AY) 2021-22. CNF households got ₹31,157 higher income than that of non-CNF. That is 14 percent higher income (Table 6.1 and Figure 6.1). Compared to higher net values of CNF crops over non-CNF crops (chapter 3), the difference between CNF and non-CNF households' incomes looks modest. The obvious reason is that crop income is just one of the many sources of AH's incomes.

Table 6.1: Households' income of CNF and non-CNF households in AY 2021-22

Year	₹/ household		Difference between CNF & non-CNF	
	CNF	non-CNF	in ₹	percentage
2021-22	2,59,640	2,28,483	31,157	14

Source: IDSAP, Field Survey 2021-22

Figure 6.1: Average annual income of CNF and non-CNF households, in AP, in AY 2021-22



Source: IDSAP, Field Survey 2021-22

6.3. Composition of household income

As mentioned above, CNF is expected to have a positive impact on the structure of CNF households' income. The study has collected data about different sources of households' incomes and amount derived from each source, in 2021-22. The major sources of income included in the survey are: major crops, consisting of 12 sample crops[32], other crops[33] wages, salary income, self-employment/ business, livestock, rental income from agriculture machinery, implements, land, house, buildings, commercial space, etc., remittances, cash assistance received from the government, and others. Percentage of farmers reporting different sources of income. during the study period, are presented in Table 6.2. As the CNF and non-CNF samples were drawn from the list of farmers, who are cultivating 12 sample crops during the study period, 100 percent of CNF and non-CNF farmers reported income from cultivation of major crops (12 sample crops). As government is giving cash assistances/ transfers, generously, 94 percent of CNF farmers and 91 percent of non-CNF farmers reported government cash assistance as one of the sources of their income during the study period. Rental income is reported by 76 percent of CNF farmers and 82 percent of non-CNF farmers. As expected, a higher percentage (75%) of CNF farmers reported income from livestock vis-à-vis 72 percent of non-CNF households. On the other hand, a higher (73%) percent of CNF

[32] In case of CNF farmers, the sample12 crops cultivated under CNF are considered as major crops. If CNF farmers cultivated the same 12 crops under non-CNF method or any other method, are considered as other crops. In case of non-CNF farmers, the sample crops cultivated under non-CNF method or chemical based method are considered as major crops. If those crops are cultivated under natural farming or organic farming or any other such method, are considered as other crops.
[33] Ibid

farmers got their income from wage employment. One of the possible reasons for these counter-intuitive result could be the higher share of SCs and STs, who are mostly dependent on wage employment, in CNF sample. Most interesting observation in the Table 6.2 is that as many as 66 percent of CNF farmers reported that they get income from other crops. The same is 17 percent for non-CNF (Table 6.2). This reflects crop diversity and more diversified income, which is desirable in these days. However, one caveat in this rosy scenario is that CNF farmers might have cultivated same 12 sample (major) crops under non-CNF method also. Even after accounting for such practice, the huge gap (49 percentage points) between CNF and non-CNF farmers, who are getting income from other crops, suggest that CNF farmers have more diversity in their cropping pattern. It may be noted that APCNF advocates and facilitates diversified cropping pattern among the project participants. It may also be noted, if a farmer cultivates same crop under two different methods, say CNF and non-CNF methods, they can be treated as two different crops. In this way, CNF farmers have more diversified cropping and incomes pattern.

Table 6.2: Percentage of CNF and non-CNF farmers' responses about different sources their households' income (%)

Source of income	CNF	non-CNF
Major crops	100	100
Cash assistance from Govt.	94	91
Livestock	75	72
Rental income from agri. Machinery, implements, etc.	74	78
Wage income	73	69
Other Crops	66	17
Salary	14	14
Self-employment/ Business	6	8
Others	7	11
Total income	100	100

Source: IDSAP, Field Survey 2021-22

Actual amount of income derived from each source of income gives additional insights. Normally, the PMDS+CNF plot sizes under major crops by CNF farmers are less in size, compared to non-CNF farmers. Still income form major crops are higher for CNF farmers over non-CNF farmers by 14 percent. Further, CNF farmers have obtained two times higher income over non-CNF farmers from other crops. As mentioned above, other crops contribute not only to higher incomes, but also give more stability to the household income. In addition, the CNF farmers attained 26 percent higher income from livestock. This indicates a growing synergy between crop production and livestock rearing, under CNF. It may be noted that under CNF,

the household get higher value for cattle dung and urine also. Another noteworthy point is that the CNF farmers have a higher rental income, mostly rent from the agriculture machinery. One possible reason is that under CNF there is little need for ploughing, spraying, etc. They have less peak time demand for many agriculture operations. Hence, they might be leasing out those machinery and equipment. As mentioned in the biggening of this chapter, that structural changes take more time. However, the data in Table 6.3 indicate that CNF farmers are not only getting higher income, but also getting income from more quality sources such as agriculture, livestock, instead of wages and self-employment/ business.[34]

Table 6.3: Sources wise income obtained by CNF and non-CNF households and their differences in AY 2021-22

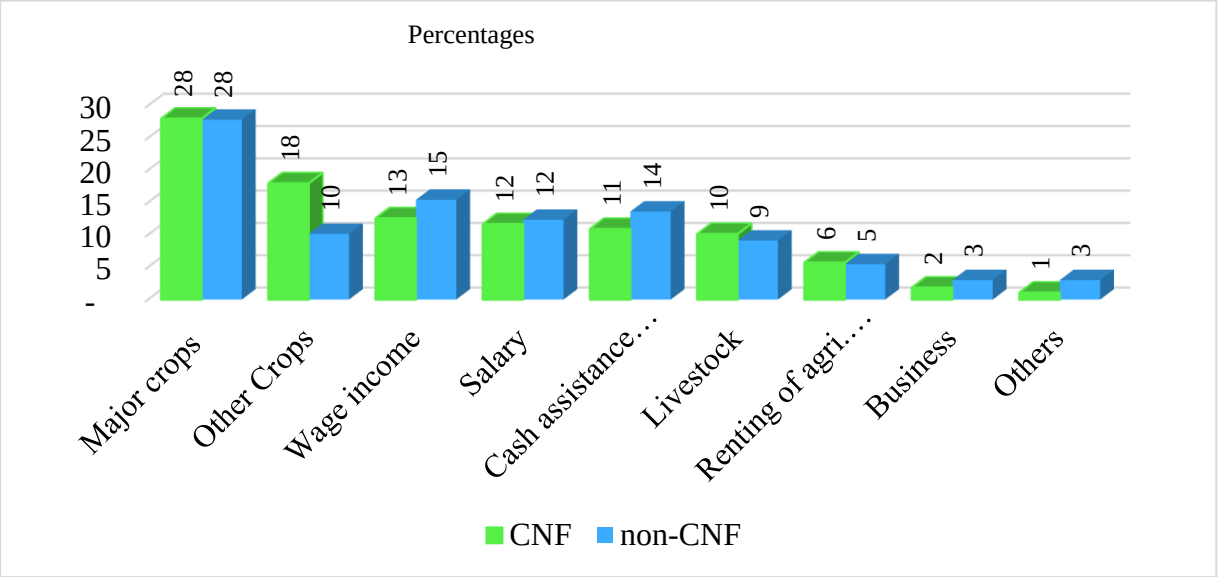
Sources	₹/ household		Difference between CNF & non-CNF	
	CNF	non-CNF	₹	Percentages
Other Crops	46,729	23,212	23,517	101
Livestock	26,369	20,849	5,520	26
Rental income from agri. machinery, implements, etc.	14,861	12,493	2,368	19
Major crops	72,693	63,584	9,109	14
Salary	30,318	28,208	2,110	7
Wage income	32,670	35,275	-2,604	-7
Cash assistance from Govt.	28,388	31,109	-2,721	-9
Self-employment/ Business	4,818	6,880	-2,063	-30
Others	2,793	6,873	-4,080	-59
Total income	2,59,640	2,28,483	31,157	14

Source: IDSAP, Field Survey 2021-22

Percentage share of each source of income in total income of CNF and non-CNF households are given in Figure 6.2. Though CNF farmers have relatively less area under the major crops vis-à-vis non-CNF, both sets of households have derived same percentage of income from major crops. While CNF farmers got 46 percent of their income from crop cultivation (major and other crops), non-CNF got 38 percent only. Further, the CNF farmers got 56 percent of their income from agriculture and livestock. The same is 47 percent for non-CNF. This indicates that CNF can enhance the share of agriculture in the gross domestic product (GDP).

[34] Self-employment could be a remunerative vocation or desperate venture due to the pull or push factors.

Figure 6.2: Share of households' income from different sources for CNF and non-CNF farmers in AY 2021-22



Source: IDSAP, Field Survey 2021-22

6.4. Impact of CNF on households' income at disaggregate levels

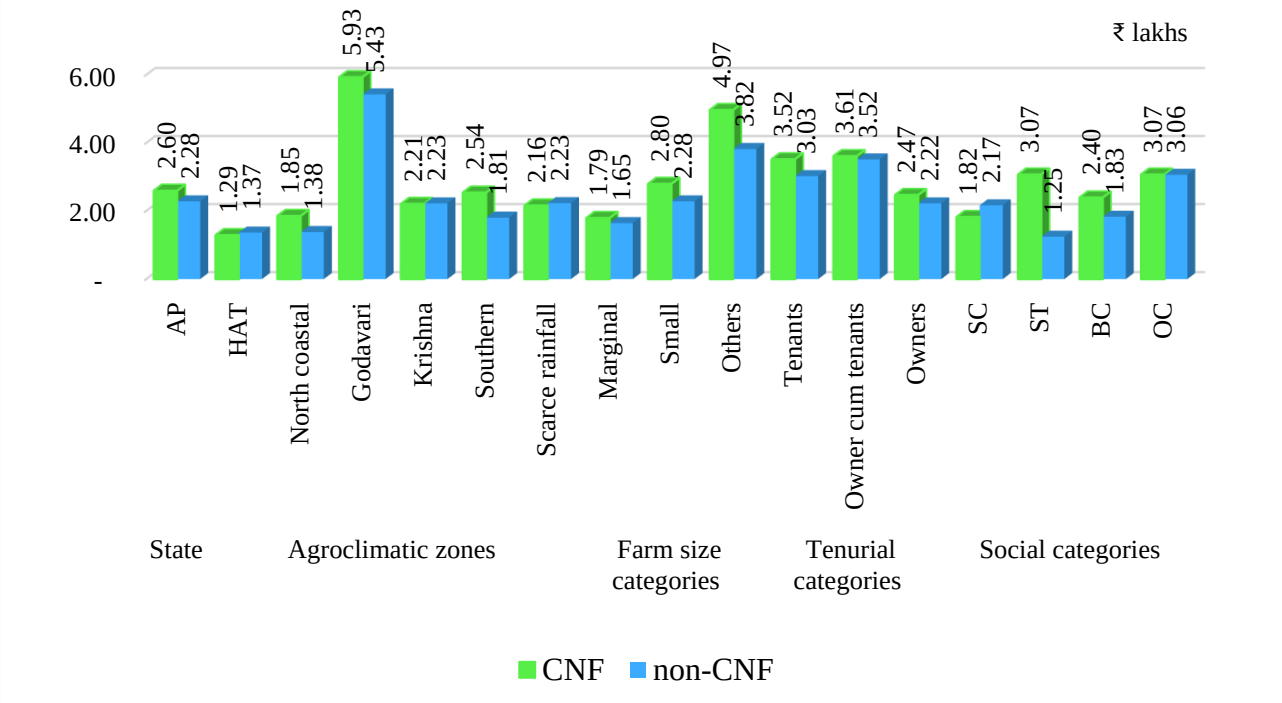
The households' incomes of CNF and non-CNF farmers and their differences across agroclimatic zones, farm size categories, tenurial categories and social categories are given in Table 6.4 and Figure 6.3. Out of six agroclimatic zones, the CNF farmers have considerably higher households' income in three zones, viz., North coastal, Godavari and Southern zones, in the range of 9 percent in Godavari to 41 percent Southern zone. In absolute terms, the differences vary from ₹47,339 in North coastal to 73,589 in Southern zone. On the other hand, the non-CNF farmers have marginally higher incomes over CNC farmers in three zones, viz., HAT zone (6 percent), Krishna zone (1 percent) and Scarce rainfall zone (3 percent). Among 10 farmer categories considered here, the CNF farmers obtained higher income in nine categories. Among the farm size categories, CNF 'other farmers', consisting of medium and large farmers, got highest income benefit of ₹1,14,533 (30 percent) over that of non-CNF, followed by CNF small farmers (23 percent) and CNF marginal farmers (9 percent). Among the tenurial categories, CNF tenant farmers got highest income benefit of ₹49,493 (16 percent) followed by CNF owner farmers (11 percent) and CNF owner-cum-tenant farmers (3 percent). Among social categories CNF ST farmers obtained highest income benefit of ₹1,82,686 (147 percent) over their non-CNF counterparts, followed by CNF BC farmers (31 percent). But only CNF SC farmers got lower household income compared to non-CNF SC farmers.

Table 6.4: Agroclimatic zones & farmers categories wise households' incomes of CNF and non-CNF farmers and their difference in AY 2021-22

Agroclimatic zones & farmers categories		₹/ household		Difference between CNF & non-CNF	
		CNF	non-CNF	in ₹	percentages
State	AP	2,59,640	2,28,483	31,157	14
Agroclimatic zones	HAT	1,29,083	1,36,681	-7,598	-6
	North coastal	1,85,469	1,38,130	47,339	34
	Godavari	5,93,360	5,42,669	50,691	9
	Krishna	2,20,904	2,22,515	-1,611	-1
	Southern	2,54,137	1,80,548	73,589	41
	Scarce rainfall	2,16,165	2,22,958	-6,793	-3
Farm size categories	Marginal	1,79,441	1,64,570	14,871	9
	Small	2,79,756	2,28,303	51,453	23
	Others	4,96,768	3,82,235	1,14,533	30
Tenurial categories	Tenants	3,52,113	3,02,620	49,493	16
	Owner-cum-tenants	3,61,240	3,51,515	9,725	3
	Owners	2,47,079	2,22,413	24,666	11
Social categories	SC	1,82,457	2,16,805	-34,348	-16
	ST	3,07,237	1,24,551	1,82,686	147
	BC	2,39,598	1,83,160	56,438	31
	OC	3,07,077	3,06,397	680	0

Source: IDSAP, Field Survey 2021-22

Figure 6.3: Agroclimatic zones & farmers categories wise households' incomes of CNF and non-CNF farmers in AY 2021-22



Source: IDSAP, Field Survey 2021-22

6.5. Conclusions

The survey results in this chapter clearly indicate that CNF's potential in enhancing the household income, by effecting a shift in the composition of household income and bringing in a synergy between crop cultivation and livestock rearing. The disaggregate analysis shows that CNF benefits are reaching most parts of the state, with some minor exceptions and almost all sections of farmers in the state. As mentioned above, structural changes, such as income sources of a household, take time. Even in these early days, the impact of CNF is visible.

Chapter 7: Actual and potential impact of APCNF on agriculture in the state

7.1. Introduction

The crop wise impact of CNF on farming conditions is analysed in chapter 3. The impact of CNF on individual households is discussed in chapter 6. The impact of CNF on crop production in the state is deliberated in this chapter. The impact is analysed at two levels, that is, the actual impact of APCNF at the project level and the potential impact of APCNF, if the entire cropped area were put under CNF. This chapter has been included in the previous two consolidated/ final reports of 2019-20 and 2020-21. The scope and methodology of this chapter has been evolving. Apart from covering the major farming indicators, such as paid-out costs, yields, gross value of crop output and net value of crop output, the actual use of fertilizers is covered in this chapter. Before discussing the results, the steps followed and assumptions made in the estimation of the benefits from CNF, are summarised below.

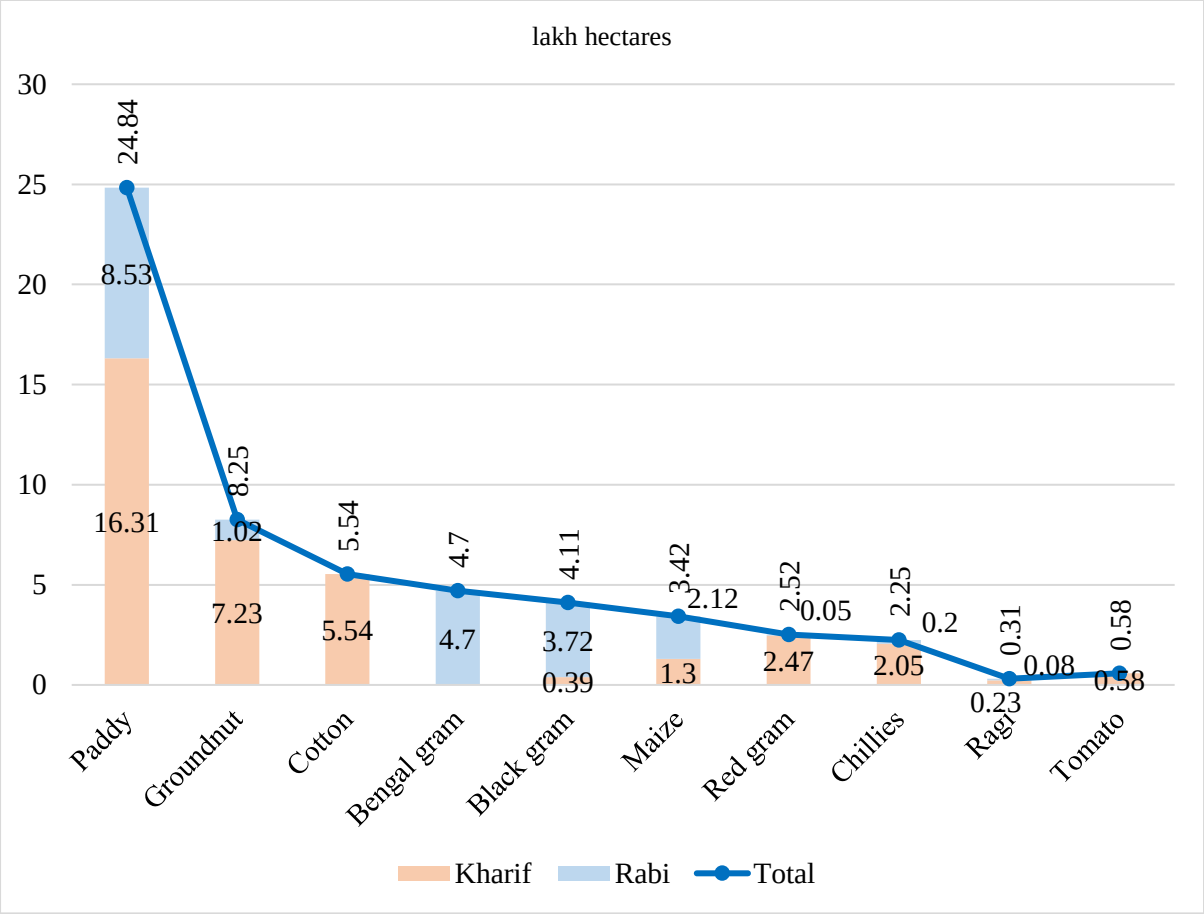
1. Using the crop wise costs and returns data obtained from the field survey (see chapter 3) and using the area under each of the 10 sample crops in each season in the state (see Figure 7.1) as weights, the expenditure on fertilizers and on agrochemicals, avoided on average are estimated.
2. As the area cultivated by CNF farmers, particularly the partial farmers are not available, the estimates are made based on per farmer values and total number of participating farmers.
3. As each S2S farmer cultivated 1.26 hectare, under S2S, in both seasons together, per hectare values are extrapolated to 1.26 to get per S2S farmer beneficiary values.
4. It is assumed that benefits derived by the partial farmers in their partial CNF plots is equal to 50 percent of the benefits derived by S2S farmer in his/ her S2S plots.
5. Further, it is assumed that S2S farmers also cultivate a part of their holdings under CNF partial method. Hence, it is assumed that they too derived benefits in their partial CNF plots, equal to 50 percent of the benefits derived in his/ her S2S plots.
6. Per farmer values are blown up by total number of S2S and partial farmers to get total beneficiary values.

7.2. Average CNF impact per hectare

In chapter 3, the impact of CNF on farming conditions is analysed for 10 crops individually. From that data, the weighted average values of these 10 crops, per hectare, are estimated, using the area under each of these 10 crops, in the state, as the weights. Same (uniform) cropping

pattern is used as weights for both CNF and non-CNF crops. The area under each of the 10 crops covered in this report are shown in Figure 7.1. It varies from 0.31 lakh hectare under Ragi to 24.84 lakh hectares under Paddy.

Figure 7.1: Area under each of 10 sample crops in Kharif and Rabi seasons in the state in 2021-22



Source: DES, (2023): Season and Crop Report 2021-22, Andhra Pradesh, Governemnt of Andhra Pradesh

Using the area under each of 10 crops as the weights, the per hectare average savings, due to the adoption of CNF instead of non-CNF, in the expenditure on PNPI, paid-out costs, and increase in gross and net values of crop output are calculated and presented in Table 7.1. On an average the CNF farmers spent ₹6,079 per hectare on PNPI. They saved ₹8,710 (59 percent) per hectare on PNPI, by avoiding non-CNF. In total, CNF farmers saved ₹9,389 (16 percent) per hectare in the paid-out cost. On an average, CNF farmers obtained ₹10,501 (11 percent) higher gross value of output per hectare and ₹19,889 (50 percent) higher net value of output per hectare. These 10 crops together cover 76.43 percent of gross cropped area (GCA) in the state. Hence the average values of these 10 crops can be assumed as the average values of all crops in the state.

Table 7.1: Average expenditure on PNPIs, paid-cost, gross and net value of output under CNF and non-CNF and differences in the state in AY 2021-22

Farming Indicator	₹/ hectare		Difference between CNF & non-CNF	
	CNF	non-CNF	₹/ hectare	percentage
1	*2*	*3*	*4*	*5*
PNPIs	6,079	14,789	-8,710	-59
Paid-cost	49,883	59,272	-9,389	-16
Gross value of crop output	1,09,281	98,780	10,501	11
Net value of crop output	59,398	39,509	19,889	50

Source: IDSAP, Field Survey 2021-22

7.3. Project level impact

As per recent data provided by RySS, over 10 percent of farmers, in the state, are adopting APCNF either completely, known as seed-to-seed farmers (S2S) or pure CNF process[35][36]; or partially, known as partial or mix of both CNF inputs/ stimulants and agrochemicals[37]. As mentioned above the methodology in the estimation of the impact of APCNF at the project level is evolving. In the 20019-20 report, the project level estimation was based on the area cultivated by the CNF farmers under S2S method only. It missed the impact of the project on the partial areas. There is no data about the size of the area cultivated under partial farming, i.e., mixed use of CNF inputs/ stimulants and agrochemicals. Further, a sizable area under APCNF is being put under variety of crop mixes. Therefore, the estimate in 2020-21 was made on the basis of number of project participants. ***It was assumed that partial farmers get benefits from CNF partial plots, equal to 50 percent of benefits derived by S2S farmers in S2S plots***. It may be noted that the partial farmers might have applied less than 50 percent of CNF inputs/ stimulants and practices, but they might have cultivated larger areas under partial farming.[38] ***It implies that the assumption that partial farmers get benefits from CNF, equal to 50 percent of benefits derived by S2S farmers in S2S plots, is a plausible assumption***.

As mentioned in chapter 5, there are 6.14 lakh farmers registered with RySS, including 2.59 lakh S2S/ pure CNF farmers and 3.55 lakh partial farmers. The chapter also indicates that the

[35] S2S farmers are the farmers, who cultivate crops with only CNF inputs/ stimulants and practices without applying any agrochemicals including fertilizers, pesticides and weedicides, at least in plot of his/ her operational holding.
[36] The words S2S, pure CNF or CNF and PMDS+CNF are used interchangeably in this chapter and also in this report.
[37] Partial farmers are the farmers, who apply both CNF inputs/ stimulants and practices and also agrochemicals on a same plot.
[38] Such trends are observed by the study team during the field visits.

CNF farmers have put on average 1.07 hectares under CNF during the Kharif season. As mentioned in that chapter, it includes a small portion of the area under PMDS but not S2S. After deducting that area, the area put under CNF in Kharif season is 0.88 hectare. Further out of 1,145 CNF farmers, 674 have cultivated during Rabi season. On average they have cultivated 0.64 hectares under CNF. It turns out to be an average area of 0.38 hectares, under CNF, for 1,145 sample farmers. In total the CNF farmers have cultivated 1.26 hectares under CNF during both seasons in 2021-22. The benefits estimated per hectare from the CNF, in the previous section, have been inflated to 1.26 hectare to get per S2S farmer wise benefit from the CNF in S2S plots in 2021-22. Further, it is assumed 50 percent benefits of S2S, are obtained by the partial farmers. In addition, S2S farmers, usually cultivate at least some of his/ her other plots under partial cultivation, i.e., they too must be getting benefitted from CNF. It can be assumed that S2S farmers are getting 50 percent of benefits estimated in S2S plots, from their partial plots. As discussed above, additional benefits accrued to per hectare and per S2S farmer in S2S plots and partial plots and per partial farmers have been estimated and shown in Table 7.2. Each S2S farmers has saved ₹11,830 in paid-out costs and obtained ₹25,060 additional net value of output in his/ her S2S plots. Further, he/ she obtained ₹5,915 savings in paid-out costs and ₹12,530 additional net value of output from his/ her partial plots. In addition, each partial farmer gained ₹5,915 savings in paid-out costs and ₹12,530 additional net value of output in his/ her partial plots.

Table 7.2: Additional benefits accrued due to CNF to per hectare, per S2S and per partial farmer in 2021-22

Indicator	Per S2S farmer			Per partial farmers
	₹/ hectare in S2S plots	₹/ farmer in S2S plots	₹/ farmer in partial plots	₹/ farmer in partial plots
1	2*	3**	4***	5***
PNPIs	-8,710	-10,974	-5,487	-5,487
Paid-cost	-9,389	-11,830	-5,915	-5,915
Gross value of output	10,501	13,231	6,615	6,615
Net value of output	19,889	25,060	12,530	12,530

** From Column 4 of Table 7.1; ** Column 2X1.26; *** 50% of column 3*
Source: IDSAP, Field Survey 2021-22

Based on the per farmer estimates, as shown in the Table 7.2, the project level benefits are estimated and presented in Table 7.3. The table shows the benefits derived by 2.59 lakh S2S farmers in both S2S plots and partial plots; and 3.55 lakh partial farmers in their partial plots. The S2S farmers have saved ₹305.21 crores in their paid-out costs and got ₹646.55 crores additional net value of output from their S2S plots. Further, they saved ₹152.60 crore in the

paid-out cots and attained ₹323.27 crore additional net value of output in their partial CNF plots. Furthermore, 3.55 lakh partial farmers have saved ₹209.98 crore in paid-out costs and gained ₹444.81 crore in their partial plots. In total, all 6.14 lakh project participants have saved ₹667.79 crore in paid-out costs and gained ₹1,414.64 crore additional net value of output in 2021-22, due to APCNF project. With the assumption that there could be a 20 percent error on either side of estimates, the project would have resulted in an additional net value of crop output in the range of ₹1,130 to ₹1,700 crore in 2021-22.

Table 7.3: Major additional benefits derived by CNF S2S and partial farmers during 2021-22

Indicator	For 2.59 lakh S2S farmer		For 3.55 lakh partial farmers	Total benefits all farmers
	Crore ₹ in S2S plots	Crore ₹ in partial plots	Crore ₹ in partial plots	Crore ₹ for all participants
PNPIs	-283.14	-141.57	-194.79	-619.50
Paid-cost	-305.21	-152.60	-209.98	-667.79
Gross value of output	341.36	170.68	234.85	746.88
Net value of output	646.55	323.27	444.81	1,414.64

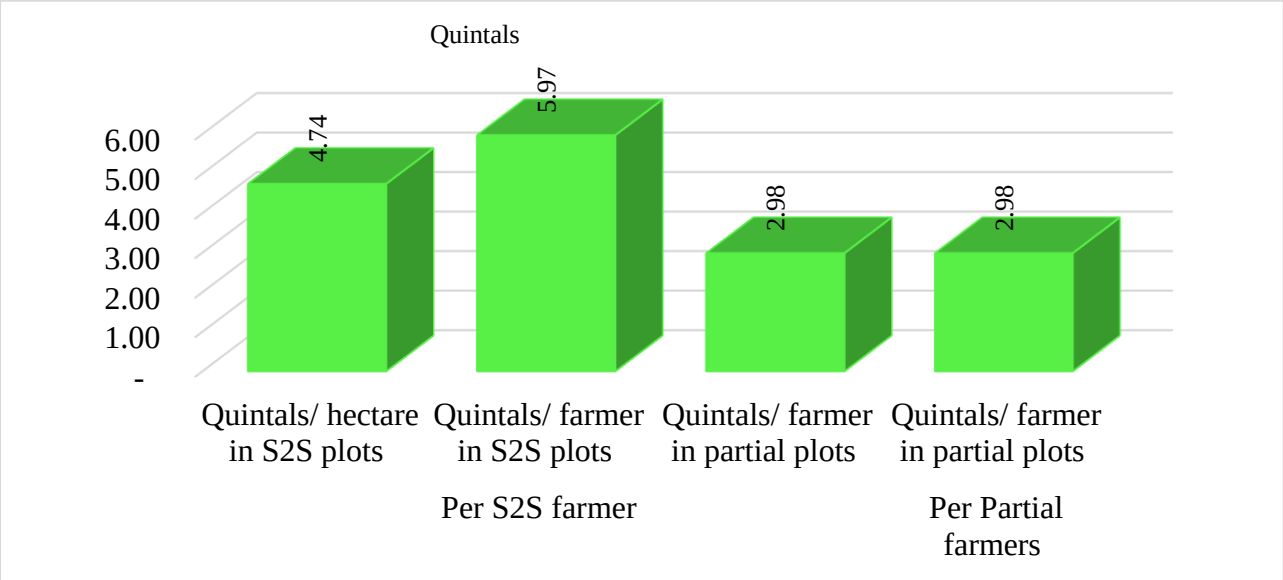
Source: IDSAP, Field Survey 2021-22

7.3.1. Impact of CNF on the use of agrochemicals

One of the major objectives of CNF is to eliminate completely the use of agrochemicals, i.e., fertilizers, pesticides and weedicides. Using the same methodology used in the previous section, quantities of fertilizers avoided and the expenditure on fertilizers and agrochemicals avoided by each of S2S and partial farmer have been estimated.

Using the above methodology per farmer benefits and total benefits are estimated and presented in Figure 7.2nand in Figure 7.3. On average, each S2S farmer has avoided use of 5.97 quintals of fertilizers in his/ her S2S plots and 2.98 quintals of fertilizers in his/ her partial plots. Further, each partial farmer has avoided 2.98 quintals of fertilizers use in her/ his partial plots

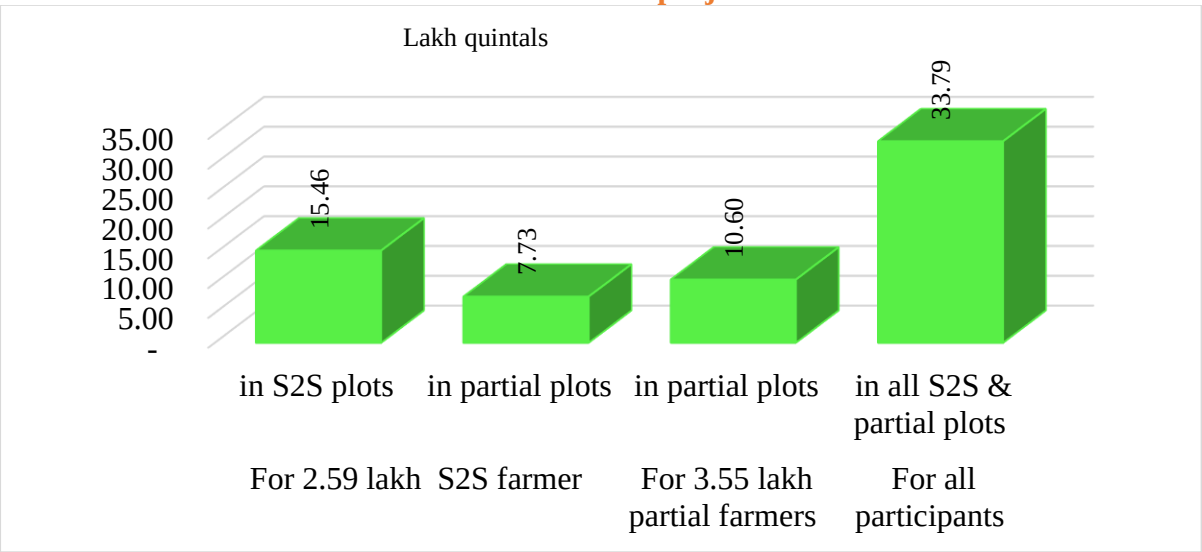
Figure 7.2: Avoided fertilizers quantity use[39] by each of S2S & partial CNF farmers in 2021-22 in the state due to APCNF project



Source: IDSAP, Field Survey 2021-22

In total, S2S farmers avoided 15.46 lakh quintals of fertilizers on their CNF plots and 7.73 lakh quintals on their partial CNF plots. Further, the partial farmers have avoided 10.60 lakh quintals on their partial CNF plots. In total, use of 33.79 lakh quintals of fertilizers have been avoided in the state in 2021-22 due to CNF project (Figure 7.3). Even after adjusting for a 20% error in the estimates on either side, a minimum of 31 to maximum of 37 lakh quintals of fertilizers have been saved in the state during the study period due to APCNF project.

Figure 7.3: Avoided[40] fertilizers quantity uses by all CNF farmers in 2021-22 in the state due to APCNF project



Source: IDSAP, Field Survey 2021-22

[39] The data is related to fertilizers used by the control/ non-CNF farmers during the study period. These are assumed to be avoided by the CNF farmers.
[40] The data is related to fertilizers used by the control/ non-CNF farmers during the study period. These are assumed to be avoided by the CNF farmers.

The expenditure avoided by each CNF farmers in her/ his CNF plots and partial CNF plots; and partial CNF farmers in his/ her partial CNF plots is presented in Table 7.4. Each CNF farmer has avoided ₹11.46 thousand expenditure on fertilizers and ₹8.41 thousand expenditure on pesticides in his/ her CNF plots; and ₹9.94 thousand expenditure on agrochemicals in her/ his partial CNF plots. Similarly, each partial farmer has also avoided ₹9.94 thousand on agrochemicals during the study period (Table 7.4).

Table 7.4: Avoided expenditure on agrochemicals use[41] by each of S2S & partial CNF farmers in 2021-22 in the state due to APCNF project

Agrochemicals	per S2S farmer			Per Partial farmers
	1,000 ₹/hectare in S2S plots	1,000 ₹/ farmer in S2S plots	1,000 ₹/ farmer in partial plots	1,000 ₹/ farmer in partial plots
Fertilizers	9.10	11.46	5.73	5.73
Pesticides	6.67	8.41	4.20	4.20
Total	15.77	19.87	9.94	9.94

Source: IDSAP, Field Survey 2021-22

In total, S2S farmers have avoided ₹514.74 crore expenditure on agrochemicals in their CNF plots and ₹257.37 crores in their partial CNF plots during the study period. In addition, the partial farmers have avoided ₹352.77 crore expenditure on agrochemicals. Total avoided expenditure on agrochemicals is ₹1,124.88 crore in the state, due to APCNF project (Table 7.5). Even after adjusting for a 20 percent error on either side, the avoided expenditure on agrochemicals is in the range of ₹900 crore to ₹1,350 crores. Apart from the financial benefits, avoided use of agrochemicals has larger social (health) and environmental benefits (soil quality improvement and mitigation of climate change).

Table 7.5: Avoided expenditure on agrochemicals use[42] by all CNF farmers in 2021-22 in the state due to APCNF project

Agrochemicals	For 2.59 lakh S2S farmer		For 3.55 lakh partial farmers	Crore ₹ for all participants in all plots
	Crore ₹ in S2S plots	Crore ₹ in partial plots	Crore ₹ in partial plots	
Fertilizers	296.93	148.47	203.50	648.89
Pesticides	217.81	108.90	149.27	475.99
Total	514.74	257.37	352.77	1,124.88

Source: IDSAP, Field Survey 2021-22

[41] The data is related to agrochemicals used by the control/ non-CNF farmers during the study period. These are assumed to be avoided by the CNF farmers.
[42] The data is related to fertilizers used by the control/ non-CNF farmers during the study period. These are assumed to be avoided by the CNF farmers.

7.4. Potential benefits of APCNF

The potential benefits from APCNF are estimated, as the benefits would accrue to the state, if the entire cropped area in the state is put under CNF. Unlike the project level estimates, as discussed in the previous section, estimation of potential benefits is simple and straightforward. But this is just an academic exercise. The average benefits per hectare derived and presented in the Table 7.1 are blown up with entire GCA of 73.28 lakh hectares in the state in 2021-22. It may be noted that the average benefits given in Table 7.1 are weighted averages of 10 sample crops, covered in this report. The area under each crop in the state are used as the weights. These 10 crops together cover 77.13 percent of GCA in the state in 2021-22. With simple and realistic assumption that average values of 77 percent of GCA, would hold good for 100 percent of GCA, the potential benefits are estimated and given in Table 7.6. If the entire GCA is put under CNF, the state would have saved ₹6,382 crore (59 percent) in PNPI, ₹6,880.04 crore (16 percent) in paid-out costs; and would have attained ₹7,694.89 crore (11 percent) additional gross value of crop output and ₹14,574 crore (50 percent) higher net value of crop output. It is worth noting that contribution of gross value of crop output, in the incremental net value of crop output, is higher than that of the savings obtained in paid-out cost. This is the first time such phenomenon is observed.[43] It implies that there is a positive impact of CNF on crop yields and output prices. It may be also due to rising cost of cultivation or cost of biological stimulants/ inputs, under CNF. While former is a cause for elation, later needs a careful strategy to keep down the costs.

Table 7.6: Potential benefits from APCNF in the state, if the entire GCA is put under CNF in 2021-22

Indicator	Crore ₹/ hectare		Difference between CNF & non-CNF	
	CNF	non-CNF	Crore ₹/hectare	percentage
PNPIs	4,455.02	10,837.56	-6,382.53	-59
Paid-cost	36,554.34	43,434.38	-6,880.04	-16
Gross value of output	80,080.92	72,386.02	7,694.89	11
Net value of output	43,526.58	28,952.01	14,574.56	50

Source: IDSAP, Field Survey 2021-22

7.4.1. Potential impact of CNF on crop output

The impact of CNF on crop output is analysed here. If the entire GCA is put under APCNF, the change in the output of 10 sample crops, covered in this report, in 2021-22 are shown in Table 7.7. Out of 10 crops covered, in nine crops, the CNF outputs have been higher than that

[43] In the previous reports, savings in the paid-out costs were major benefits in CNF

of non-CNF. The differences, in absolute terms, in those nine crops, vary form 0.15 lakh tons in Ragi to 5.95 lakh tons in Bengal gram. It seems that Bengal gram under non-CNF was affected by some abnormal factors. It reflects the CNF crops' ability to withstand certain abnormal conditions. In relative (percentage) terms, the differences vary from 3 percent in Paddy to 175 percent in Bengal gram. In six out of nine crops, with higher CNF output, the differences would be higher than 15 percent; they include 16 percent in Maize, 27 percent in Red gram, 29 percent in Black gram, 40 percent in Tomato, 75 percent in Ragi and 175 percent Bengal gram. Only in Chillies, the output would have declined by 7 percent. The data indicate that output would have been increased in 90 percent of remaining crops, which are not covered in this report, if the entire GCA is put under CNF.

Table 7.7: Potential impact of APCNF on crop output, if the entire GCA is put under CNF during AY 2021-22

Crop	Area under the crop (lakh ha)	Yield (quintals/ hectare) [CCE yields]		Output (lakh tons)		Difference between CNF & non-CNF	
		CNF	non-CNF	CNF	non-CNF	lakh tons	percentage
Paddy	24.84	50.6	49.24	125.69	122.31	3.38	3
Groundnut	8.25	20.72	19	17.09	15.68	1.42	9
Cotton	5.54	12.28	11.53	6.80	6.39	0.42	7
Bengal gram	4.7	19.9	7.24	9.35	3.40	5.95	175
Black gram	4.11	13.15	10.22	5.40	4.20	1.20	29
Maize	3.42	52.25	45.15	17.87	15.44	2.43	16
Red gram	2.52	6.07	4.78	1.53	1.20	0.33	27
Chillies	2.25	24.91	26.91	5.60	6.05	-0.45	-7
Ragi	0.31	11.63	6.65	0.36	0.21	0.15	75
Tomato	0.58	186.7	133.45	10.83	7.74	3.09	40

Source: IDSAP, Field Survey 2021-22

7.4.2. Potential impact of CNF on the use of agrochemicals

If the entire GCA is put under CNF, the state would have avoided the use of 34.72 lakh tons of fertilizers in 2021-22. In the same year, the state would have avoided ₹11,558.57 crore expenditure on agrochemicals, including ₹6,667.63 crores on fertilizers and ₹4,890.94 crores on pesticides (Table 7.8). As mentioned above that avoided use of agrochemicals has larger social (health) and environmental benefits (soil quality improvement and mitigation of climate change).

Table 7.8: Potential impact of CNF on use of agrochemicals in the state in 2021-22

Indicator	Units	Total avoided quantities and expenditure
Quantity of Fertilizers	Lakh tons	34.72
Expenditure on fertilizers	Crore ₹	6,667.63
Expenditure on pesticides	Crore ₹	4,890.94
Expenditure on agrochemicals	Crore ₹	11,558.57

Source: IDSAP, Field Survey 2021-22

7.5. Conclusions

Despite challenges in estimating the actual and potential benefits from APCNF, the project level benefits are real and reasonably accurate. About ₹1,414.64 crore additional net value of crop output is the annual feature. A 50 percent higher net value of crop output indicates that CNF could be one of most cost-effective methods for improving the condition of the farmers in the state and also in the country. It is interesting to note that improvement in the crop yields coupled with higher price realization are emerging as the major contributory factors in the incremental net value of crop output. It implies that the demand for chemical free food and other output is on rise and it is also fetching higher prices for CNF farmers. Avoided use of agrochemicals have larger health and environmental benefits, along with the economic benefits. Larger potential benefits from CNF may encourage non-CNF farmers to shift to CNF in the state and also in the country. The results may also encourage the policy makers in the state and country to replicate the program on a mission mode.

Chapter 8: Panel study

8.1. Introduction

One of the unique features of this study is that it has been surveying a small number of panel farmers since 2018-19. The number of panel farmers was fixed at 260 from 26 GPs, at the rate of 10 farmers per GP and two GPs from each of 13 erstwhile districts 2019-20. Further, another130 farmers from another set of 26 GPs at the rate of five farmers per GP and two GPs from each of pre-reorganized 13 districts have been included to the panel list in 2020-21. In all 390 panel farmers from 52 GPs from all over the state have been selected. The major objective of the panel study is to assess the transformative potential of CNF. It implies that the study wishes to learn the long-term impact of CNF on the lives of the project participants/ CNF farmers, beyond the short-term impacts, such as change in cost of cultivation, yields, profitability, etc. The expected long-term changes are all-round prosperity, including improved human resources development, command over CNF, improved soil quality and fertility, improved local natural resources, etc. However, such changes take time.

It is well known fact that Indian agriculture is a gamble with vagaries of monsoon. Apart from annual fluctuations in the weather and climate change related fluctuations, agriculture investment and returns fluctuate widely, from year to year, due to changes in farmers expectations (influence of previous years yields, prices and returns), availability of funds with the farmers, credit availability, government transfers, availability of farm inputs, output prices, etc. Given the wider annual volatilities in Indian and state agriculture, a smooth trend in improvement in the conditions of CNF panel farmers is not probable, especially, in a short span of four years. Further, during the last four years, agriculture is affected by Covid 19 in two years. In addition, direct cash transfers are emerging as major sources of cash in the hands of the farmers. Though it needs medium to long-term data, of 10-15 years, to show a clear improvement in the lives of panel farmers, the transformative potential of CNF can be seen by comparing the performance of panel farmers vis-à-vis the cross-section CNF farmers, and also that of non-CNF farmers.[44] It may be worth noting that both panel and cross-section farmers would experience similar weather conditions in each year. ***The differences between the***

[44] It may be noted that data in this report and also in all previous reports clearly shown that CNF farmers are far better off, compared to non-CNF farmers in in all farming conditions related indicators, in almost all crops. Hence the comparison is limited to CNF panel farmers and CNF cross-section farmers during last four years.

farming outcomes of panel and cross-section farmers can be attributed to the transformative potential of CNF.

In this chapter, the following four parameters are analysed.

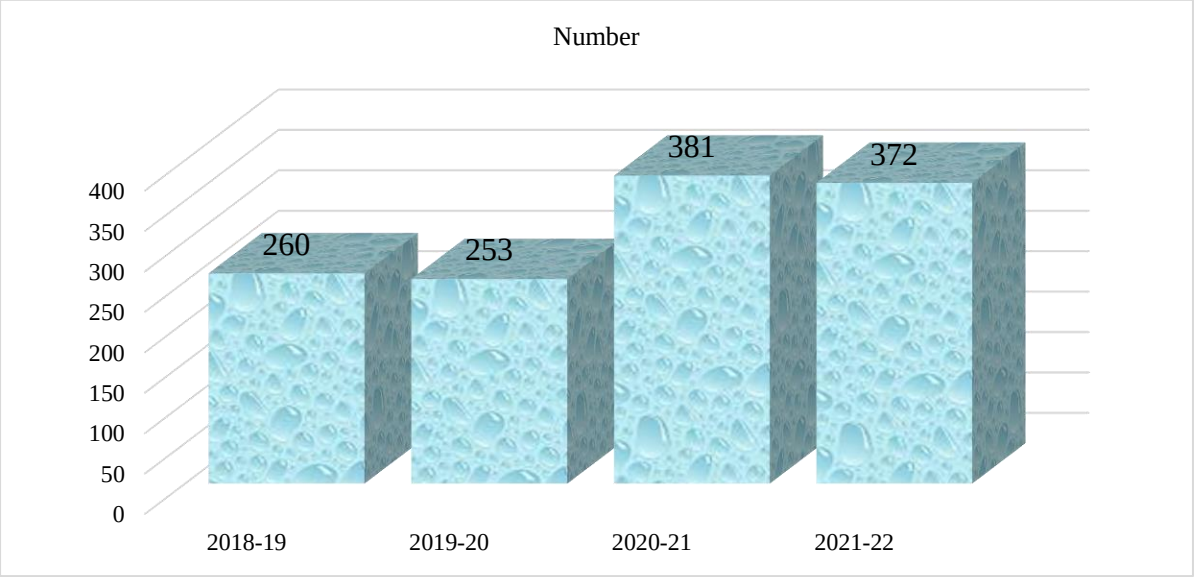
1. Trends in the area allocated to CNF by the panel farmers and cross-section farmers over the years.
2. The differences between panel and cross-section farmers in farming practices.
3. Household incomes of panel and cross-section farmers in 2021-22.
4. Coping strategies adopted by panel and cross-section farmers over the years.

Before discussing the results and data, some clarity about the data is in order. As the sample selection process changed over the years, only partial data has been collected from the panel farmers. In the first year, separate sample was selected for Kharif and Rabi season from different GPs. In the second year, Rabi data was collected from a subset of sample, who cultivated any crop during Rabi. Given these limitations, most of the analysis in this chapter is limited to Kharif data only. However, Rabi data is also used in the household income estimations.

8.2. Attrition of farmers and trends in land cultivation

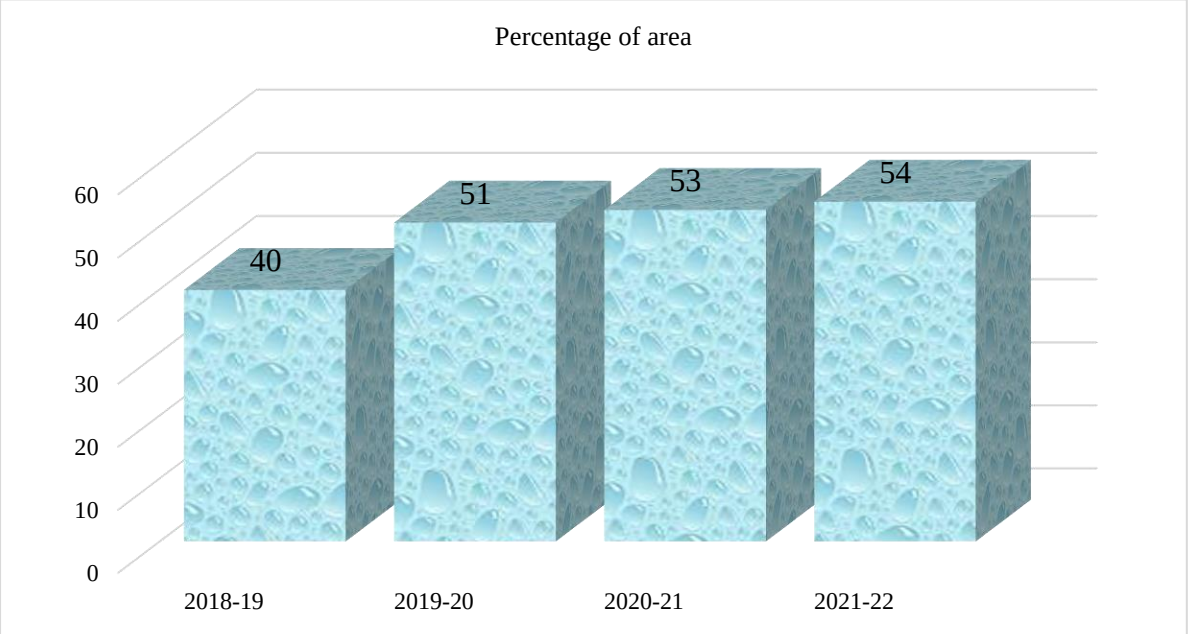
One of the challenges in any panel studies is attrition of sample individuals and/ or families. Tracing of sample respondents, year after year, is a big challenge. But attrition is relatively less challenging issue in case of cultivators. As mentioned above initially the panel size was fixed at 260 and subsequently raised to 390. The number of sample farmers surveyed during the last four years were shown in the Figure 8.1. In the second year, 7 farmers were missing, in the third year, 9 farmers could not be traced and in the fourth year, 18 farmers could not be contacted. The reasons for these attritions include- (1) death of farmers and dropping out of cultivation by the families, discontinuation of agriculture by families due to termination of lease agreements or any other reason, and migration of families out of their villages.

Figure 8.1: Number of panel farmers survey during last four years (2018-19 to 2021-22)



Increase in the area allocated to CNF in absolute terms and relative terms, i.e., as a percentage of operated area, is an important indicator for beneficial potential of CNF. The percentage of area allocated to CNF during last four Kharif seasons, since 2018-19, by the panel farmers is given in Figure 8.2. The allocated area as percentage of operated area has increased from 39.89 percent in 2018-19 to 53.87 percent in 2021-22. Though the rate of increase slowed down during last three years, there is positive increase in each year.

Figure 8.2: Percentage of operational area allocated to CNF by panel farmers



Source: IDSAP, Field Survey 2021-22

8.3. Impact of CNF on farming conditions over the years

Reasonable number of observations of panel farmers are available for three crops, viz., Paddy, Groundnut and Red gram. The impact CNF on paid-out costs, yields and net value of crop output of these three crops during last four Kharif seasons are analysed.

8.3.1. Trends in area allocated to select crops

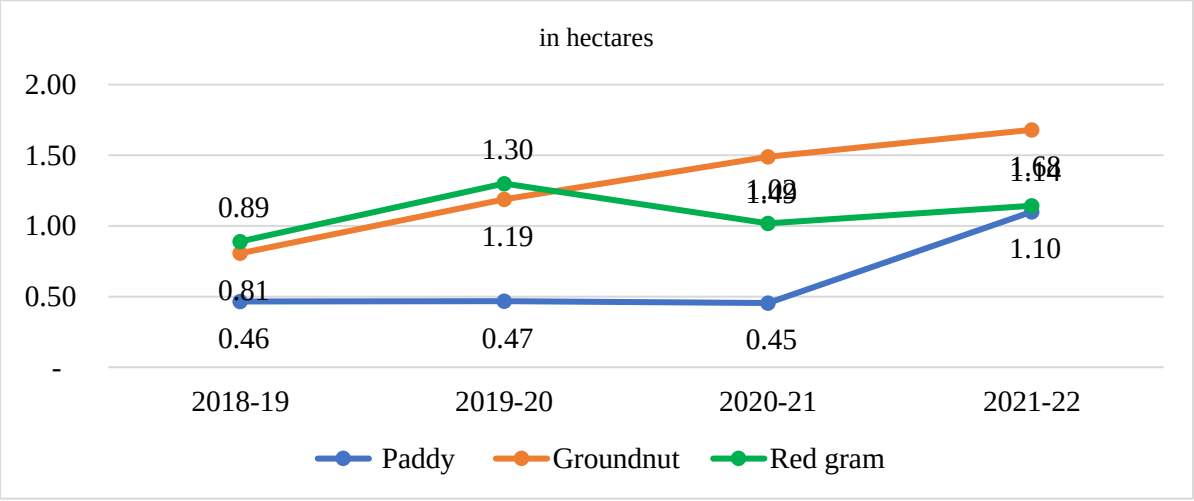
As mentioned above and different parts of this report that increase in area allocated to CNF, in general, or to crop would indicate that CNF is proving to be beneficial to the participants. Trends in number of farmers growing, and area allocated to, three select crops are shown in Tables 8.1. In case of Paddy and Groundnut, which has a good number of samples, show an increasing trend in average area allocated over the years. Even in case of Red gram, area allocation shows an increasing trend with an outlier in 2019-20 (Table 8.1 and Figure 8.3).

Table 8.1: Trends in number of panel farmers growing, and area allocation to, select three crops during last four Kharif seasons

Crop	Indicator	2018-19	2019-20	2020-21	2021-22
Paddy	No. of farmers	103	175	343	305
	Total area (ha)	47.86	81.76	155.91	335.50
	Average area (ha)	0.46	0.47	0.45	1.10
Groundnut	No. of farmers	21	34	22	31
	Total area (ha)	16.93	40.39	32.74	52.08
	Average area (ha)	0.81	1.19	1.49	1.68
Red gram	No. of farmers	14	11	10	7
	Total area (ha)	12.46	14.30	10.17	8.00
	Average area (ha)	0.89	1.30	1.02	1.14

Source: IDSAP, Field Survey 2021-22

Figure 8.3: Average area allocated to three crops during last four Kharif seasons*

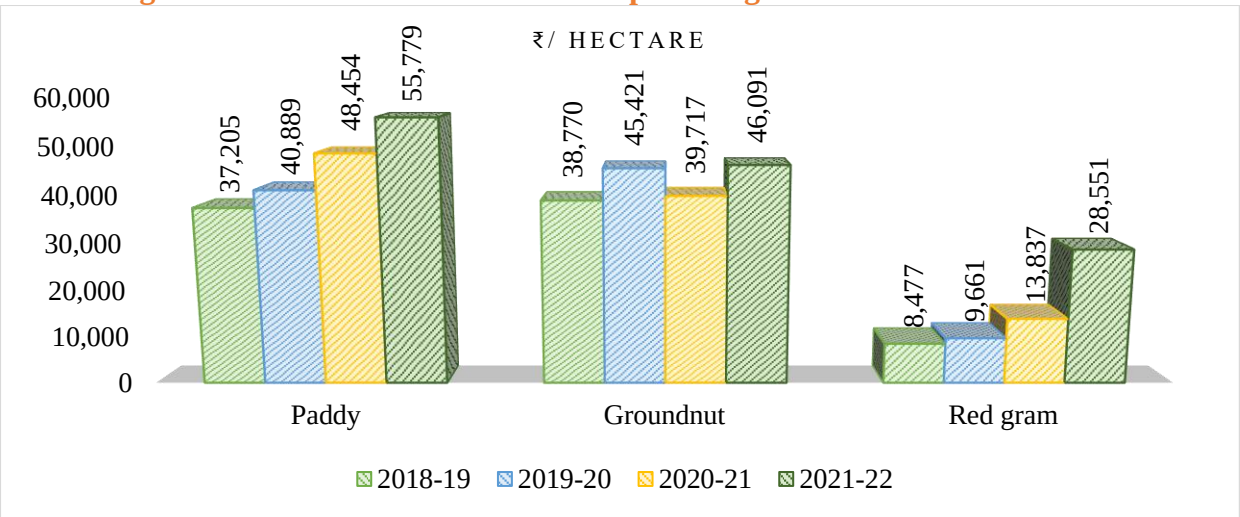


* Figures are related to the reporting farmers only;
Source: IDSAP, Field Survey 2021-22

8.3.2. Trends in paid-out costs

As CNF matures and soil quality improves and cropping intensity increases, the cost on certain agricultural operations such as ploughing and weeding may reduce. Even the need for incorporation of certain biological stimulants for plant growth may reduce. On the other hand, the expenditure on crop harvesting may increase due to higher and diversified yields. The paid-out costs of three crops during last four Kharif seasons are given in Figure 8.4. As CNF is in the initial stage, there is no clear trend in the paid-out costs of three crops considered here, especially, in case of Groundnut. However, there is an increasing trend in the paid-out cost of Paddy and Red gram. Further, it may be noted that farming investment fluctuate widely due to various reasons. It may take time to see the impact of CNF on the paid-out costs.

Figure 8.4: Paid-out costs of select crops during last four Kharif seasons

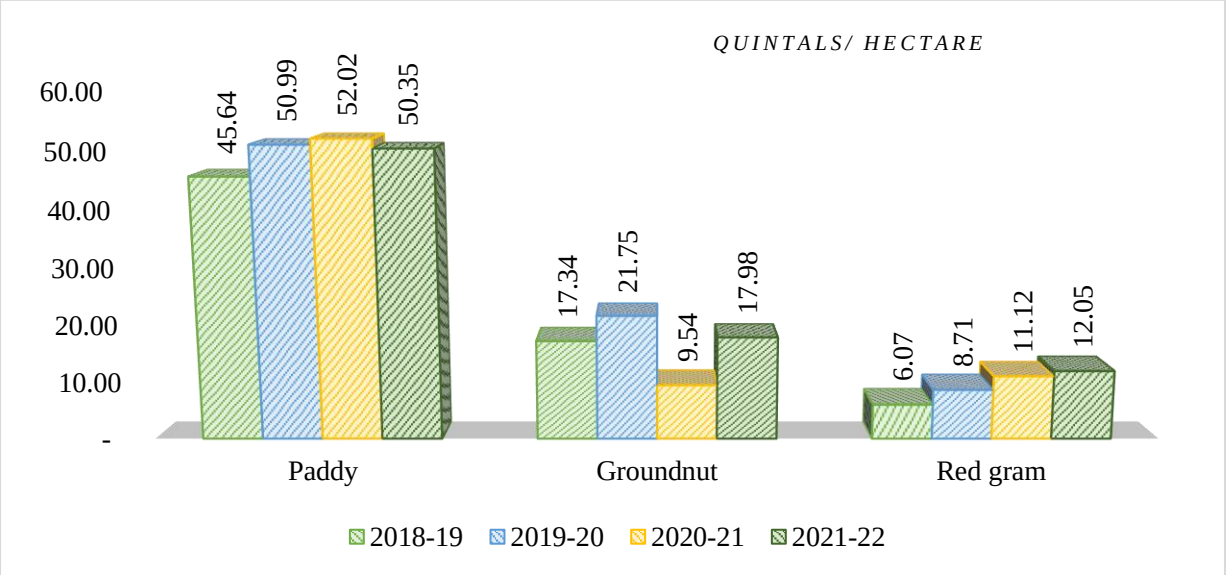


Source: IDSAP, Field Survey 2021-22

8.3.3. Trends in crop yields

The yields of three crops during last four Kharif seasons are given in Figure 8.5. The yields of Red gram show a smooth increase. As mentioned, in the previous reports, the scope for yield increase is high in less input intensive crops like pulses. Red gram proved to be a good example. However, these are early years, more time is needed to get confirmation. In case of Paddy also, the yields have increased in the second and third years, but registered a decline in the fourth year. As mentioned above, CNF may need time to increase and stabilize the yields. In case of Groundnut, the yields fluctuated widely. Similar yearly fluctuations were also observed in case of Groundnut yields of CNF Cross section farmers. Yields of Groundnut, which is grown mostly on degraded lands and under rainfed conditions, usually fluctuate. However, it was observed that PMDS not only has a positive impact in increasing the yields, but also in reducing the fluctuations in the crop yields.

Figure 8.5: Yields of three select crops of panel farmers during last four Kharif seasons

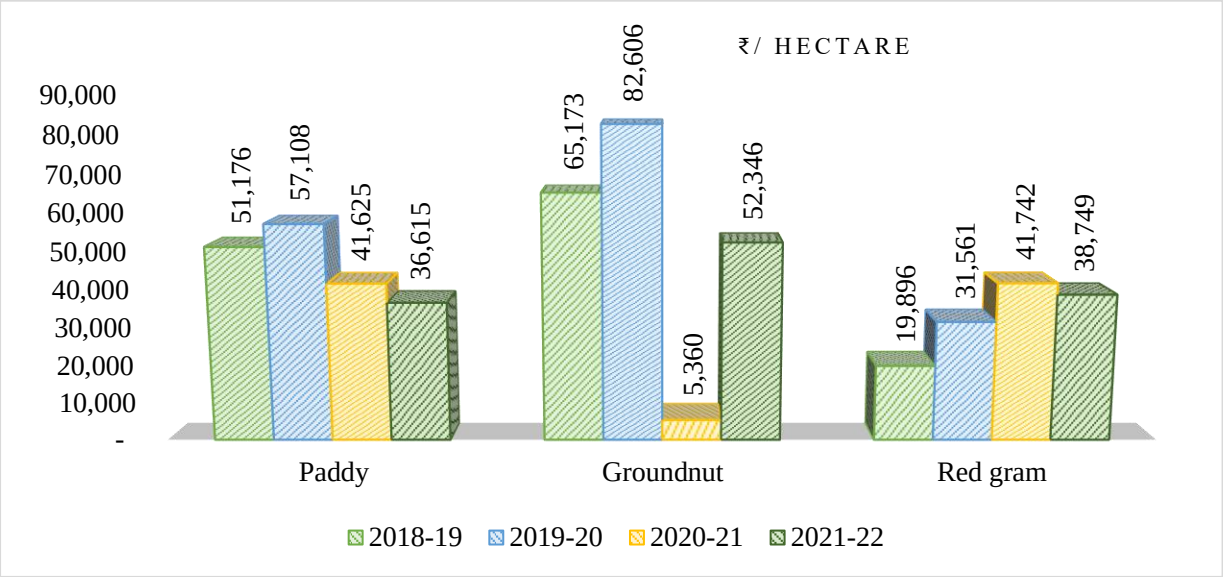


Source: IDSAP, Field Survey 2021-22

8.3.4. Net values of crop output

Crop wise net values of output during last four Kharif seasons are given in Figure 8.6. As net value of crop output depends on paid-out cost, crop yields and prices, it fluctuates widely. The net value of Red gram output has shown some volatility due to high paid-out cost in 2021-22. Similarly, the net values of Paddy crop were lower in 2020-21 and 2021-22 due to relatively higher paid-out costs in those years. Groundnut has shown highest fluctuations because of fluctuations in the paid-out costs and yields. Despite large annual fluctuations, the net value of output remained positive in each crop in each year. In contrast, the net values of non-CNF crops often turn negative. In most of previous reports, such a phenomenon was found in at least in one or two crops. For example, in this report itself, the Ragi under non-CNF has given negative net value; see Table 3.8.

Figure 8.6: Crop wise net values of output of panel farmers during last four Kharif seasons



Source: IDSAP, Field Survey 2021-22

8.4. A comparison of the farming outcomes of CNF panel and CNF cross-section farmers

As mentioned in the beginning of this chapter, agriculture yields, and the costs of cultivation fluctuate widely from year to year due to a variety of reasons, including weather conditions, output marketing conditions, input marketing conditions, credit marketing conditions, farmers expectations, cash flows, etc. One can expect that all these conditions would remain same for all farmers in any particular year or season. With this simple assumption a comparison is made between the farming outcomes of CNF panel farmers and CNF cross-section farmers in each year (season) to know the transformative potential of CNF over the years.

It is important to note that the cross-section CNF samples were selected from PMDS+CNF[45] farmers during last two years, i.e., 2020-21 and 2021-22. While 100 percent of cross-section farmers taken up PMDS, about 75 percent of panel farmers are engaged in PMDS, in each of these years. As mentioned in the previous reports, PMDS has positive impact on crop yields. This implies that the cross-section farmers have certain advantage over panel farmers during last two years. As PMDS is getting integrated into CNF, the percentage of panel farmers adopting PMDS may reach 100 percent in coming years.

[45] Farmers who have grown the PMDS during March – June on a plot and grew Kharif crop on CNF method on the same plot.

8.4.1. Paddy

The cost and returns from Paddy cultivation for panel and cross-section farmers during last four Kharif seasons are presented in Table 8.2. The paid-out costs of panel farmers are slightly higher than that of cross-section farmers in each year. The differences vary from 0.4 percent in 2019-20 to 5.1 percent in 2020-21. One of the possible reasons for lower paid-out cost of cross-section farmers could be splitting of some costs, such as land preparation between PMDS and Kharif crops.[46] The Paddy yields of panel farmers are marginally higher during the first two years, but notably lower during last two years. As mentioned above PMDS could be a plausible reason. The net values of Paddy have reflected the trends observed in the yields. PMDS could be the influencing factor during last two seasons.

Table 8.2: Costs and returns from Paddy cultivation for panel and cross-section farmers during last four Kharif seasons

Indicator	Year	units/ hectare		Difference between panel and cross-section	
		Panel	Cross-section	units/ hectare	Percentage
Paid-out costs [₹/ hectare]	2018-19	37,205	36,009	1,196	3.3
	2019-20	40,889	40,734	155	0.4
	2020-21	48,454	46,125	2,329	5.1
	2021-22	55,779	54,173	1,606	3.0
Yields [Quintals/ hectare]	2018-19	45.64	45.22	0.42	0.9
	2019-20	50.99	50.87	0.12	0.2
	2020-21	52.02	53.95	-1.93	-3.6
	2021-22	50.35	54.23	-3.88	-7.2
Net values [₹/hectare]	2018-19	51,176	45,262	5,914	13.1
	2019-20	57,108	51,426	5,682	11.0
	2020-21	41,625	53,168	-11,543	-21.7
	2021-22	36,615	45,439	-8,824	-19.4

Source: IDSAP, Field Survey 2021-22

8.4.2. Groundnut

Costs and returns from Groundnut cultivation for panel and cross-section farmers during last four Kharif seasons are given in Table 8.3. The paid-out costs of panel farmers are less than that of cross-section farmers during last three Kharif seasons. The Groundnut yields of panel farmers are higher than that of cross-section farmers during three out of four years covered in this chapter. But in 2020-21, the yields of panel farmers were less than half of the yields of the cross-section farmers. During that season, the state received 26 percent excess rainfall. In fact, the Rayalaseema regions, in which Groundnut is cultivated extensively, received 66 percent

[46] This phenomenon was recorded in previous reports also.

excess rainfall. The Groundnut crop of cross-sections farmers might have been protected by the PMDS. In that season, the Groundnut yields of CNF cross-section farmers were higher than that of non-CNF by 13 percent (IDSAP, 2021). Similarly, the net values of Groundnut output have mirrored the trends in yields. The net value of output of panel farmers are higher than that of cross-section farmers in three years and less in 2020-21.

Table 8.3: Costs and returns from Groundnut cultivation for panel and cross-section farmers during last four Kharif seasons

Indicator	Year	units/ hectare		Difference between panel and cross-section	
		Panel	Cross-section	units/ hectare	Percentage
Paid-out costs [₹/ hectare]	2018-19	38,770	29,219	9,551	32.7
	2019-20	45,421	47,047	-1,626	-3.5
	2020-21	39,717	46,540	-6,823	-14.7
	2021-22	46,091	50,933	-4,842	-9.5
Yields [Quintals/ hectare]	2018-19	17.34	13.34	4.00	30.0
	2019-20	21.75	16.53	5.22	31.6
	2020-21	9.54	22.12	-12.58	-56.8
	2021-22	17.98	13.44	4.54	33.8
Net values [₹/ hectare]	2018-19	65,173	35,819	29,354	82.0
	2019-20	82,606	51,190	31,416	61.4
	2020-21	5,360	49,899	-44,539	-89.3
	2021-22	52,346	20,596	31,750	154.2

Source: IDSAP, Field Survey 2021-22

8.4.3. Red gram

Costs and returns from Red gram cultivation for panel and cross-section farmers during last four Kharif seasons are presented in Table 8.4. There is no data for cross section farmers in 2018-19 for the three seasons. The paid-out costs of panel farmers are less than that of cross-section farmers in two out of three years of comparison. In the third year, the difference was quite small. The Red gram yields of panel farmers are higher than that of cross-section farmers in all three years, in the range of 34.6 percent to 54.3 percent. Similarly, the net value of output of panel farmers are higher than that of cross-section farmers, in the range of 62.1 percent to 75.4 percent.

Table 8.4: Costs and returns from Red gram cultivation for panel and cross-section farmers during last four Kharif seasons

Indicator	Year	units/ hectare		Difference between panel and cross-section	
		Panel	Cross-section	units/ hectare	%
Paid-out costs [₹/ hectare]	2018-19	8,477			
	2019-20	9,661	18,164	-8,503	-46.8
	2020-21	13,837	13,305	532	4.0
	2021-22	28,551	31,490	-2,939	-9.3
Yields [Quintals/ hectare]	2018-19	6.07			
	2019-20	8.71	6.47	2.24	34.6
	2020-21	11.12	7.42	3.70	49.8
	2021-22	12.05	7.81	4.24	54.3
Net values [₹/hectare]	2018-19	19,896			
	2019-20	31,561	19,466	12,095	62.1
	2020-21	41,742	23,795	17,947	75.4
	2021-22	38,749	22,673	16,076	70.9

Source: IDSAP, Field Survey 2021-22

The analysis of the three crops demonstrates the transformative potential of CNF. Though the cross-section farmers have some advantage of PMDS, the panel farmers outperformed them.[47] The above three crops analysis provides limited evidence about the potential of the CNF. To get additional and more comprehensive evidence, the household incomes of panel and cross-sections farmers are compared below.

8.5. Household income of panel and cross section farmers

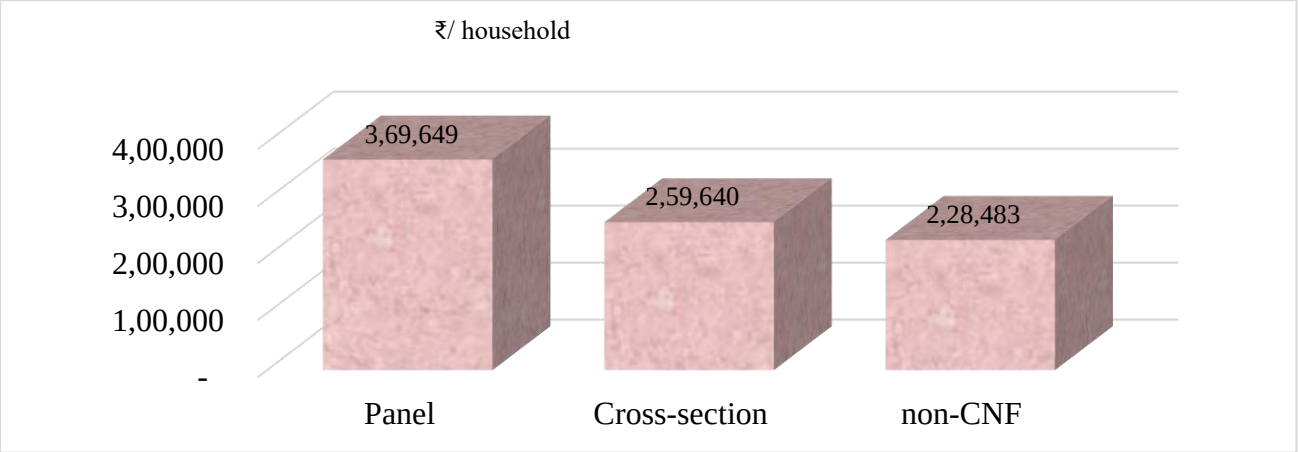
As mentioned above there are some issues about data in the first two years to prepare the household income. The state experienced a heavy and excess rains in 2020-21, which had affected different sections and regions differently. Hence, the household incomes of 2021-22 is only compared in this section.

As can be seen in chapter 6, that CNF (cross-section) HHs have higher income and positive improvement in the structure of the household income vis-à-vis non-CNF HHs. Hence, the comparison, in this section, is mostly limited to the HHs incomes of panel and cross-section farmers only. At the state level, the panel farmers have ₹3.70 lakh HHs' income in 2021-22. It is 42 percent (₹1.1 lakh) higher than the CNF cross-section HHs annual income (Figure 8.7 and Table 8.5). The possible reasons for such higher income include- (a) higher operated area,

[47] However, it may be noted that about three-fourths of panel farmers have also grown PMDS during last two years.

(b) higher cropping intensity, (c) more diversified cropping pattern, (d) cultivation of high value crops including horticulture crops, (e) better the soil quality and higher productivity, (f) integration of livestock farming with crop cultivation, (g) higher prices for CNF crop output, and so on. Compared to 1.04 hectares of cross-section farmers, the panel farmers have operated area of 1.37 hectares in 2021-22. Apart from higher operated area, all other above cited reasons for higher HHs' income are inferred reasons. As one persists with CNF, his/ her soil quality is expected to increase, the farmer get recognition as the supplier of CNF output, in the locality. As can be seen in Table 8.5, the panel farmers have obtained 60 percent higher income from livestock farming, compared to cross-section farmers. They have also obtained 47 percent higher income from other crops. It may indicate a greater crop diversity among the panel farmers. The panel farmers got more than double income from hiring out of farm machinery, implements and equipment. They might include some CNF related equipment.

Figure 8.7: Average income of panel and cross-section HHs in 2021-22



Source: IDSAP, Field Survey 2021-22

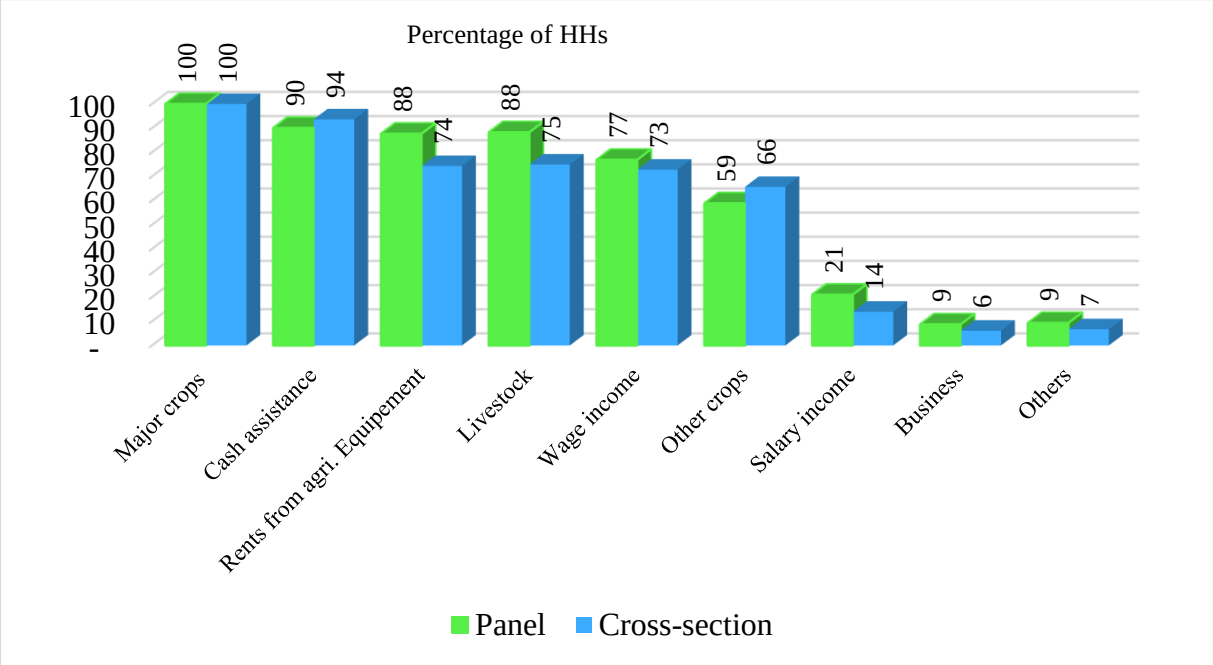
Table 8.5: Average income of panel and cross-section HHs from difference sources in 2021-22

Source of income	₹/ HHs		Difference between panel & cross-section	
	Panel	Cross-section	₹/ HHs	Percentage
Major crops	1,03,248	72,693	30,555	42
Cash assistance from Govt.	32,153	28,388	3,765	13
Rents from agri. equipment	31,615	14,861	16,754	113
Livestock	42,318	26,369	15,949	60
Wage income	41,838	32,670	9,168	28
Other Crops	68,750	46,729	22,021	47
Salary	32,835	30,318	2,517	8
Self-employment/ Business	6,433	4,818	1,616	34
Others	10,458	2,793	7,665	274
Total income	3,69,649	2,59,640	1,10,009	42

Source: IDSAP, Field Survey 2021-22

Source wise percentage of HHs and percentage of income obtained by panel and cross-sections HHs in 2021-22, are shown in Figure 8.8 and 8.9. The data indicate the transformative potential of CNF over the years. Panel farmers not only got higher HH income but also experienced a positive improvement in the structure of their income sources.

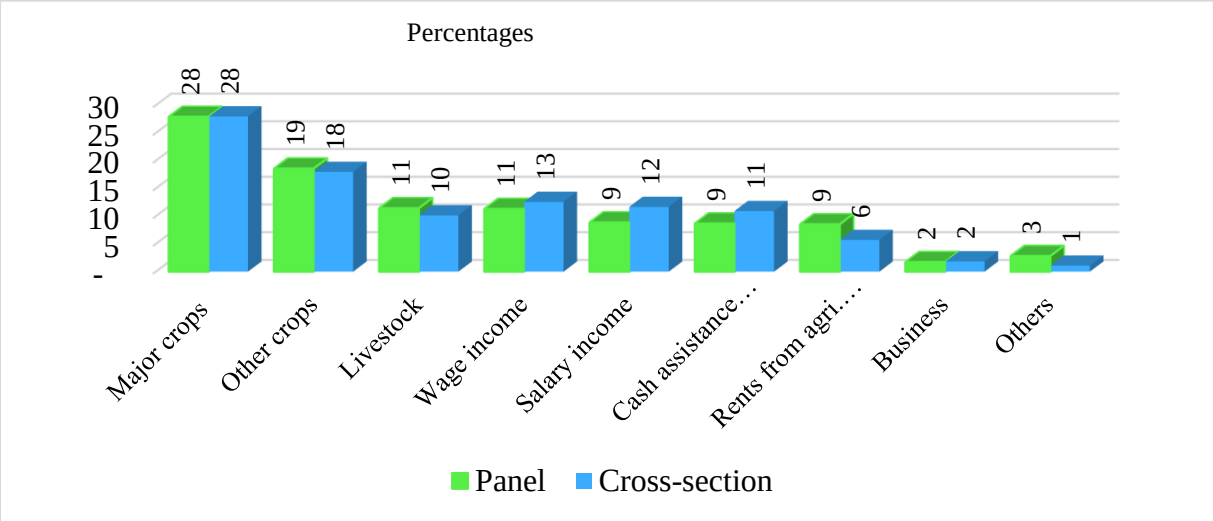
Figure 8.8: Percentage of panel and cross-section HHs obtained income from different sources in 2021-22



Source: IDSAP, Field Survey 2021-22

Compared to cross-section, the panel HHs got one percentage point higher income from other crops, livestock, three percentage points higher income from renting out of agriculture machinery, implements and equipment and two percentage points higher income from other sources. At the same time, they get two percentage points less income from wage and salary employment (Figure 8.9).

Figure 8.9: Source wise percentage of income obtained by panel and cross-sections HHs in 2021-22



Source: IDSAP, Field Survey 2021-22

8.6. Other improvements due to CNF

In this section, the impact of CNF on input use, soil and crop quality and wellbeing of farmers are discussed. In this section also the analysis is restricted to the comparison between panel and cross-section HHs' data.[48] This analysis would overcome the challenges associated with larger inter-year fluctuations in farming conditions and also inflation. In this section issues related to households' debt, wellbeing soil and crop quality improvement are discussed.

8.6.1. Household debt

One of the major benefits expected instantly from CNF is a reduction in the cost of cultivation. The same has been established by all the earlier reports. It was also established that due to a considerable reduction in the cost of cultivation, the CNF farmers have lower indebtedness vis-à-vis non-CNF farmers, in terms of number of loans and average loan amounts, in general and for agriculture purpose, in particular. Compared to the cross-section HHs, the panel HHs have even lower indebtedness. The panel HHs have 81 loans per every 100 HHs; the same is 91 for 100 in case of cross-section HHs. The average loan amounts are ₹61,290 and ₹71,964 for panel and cross-section HHs respectively (Table 8.6). The prevalence of borrowing and average borrowed amounts, for agriculture, are also less for the panel farmers vis-à-vis cross-section farmers. These results once again give a clue about the long-term potential of CNF.

[48] Changes in the questionnaire, which is primarily meant for cross section study of "with and without" method, posed certain challenges. Further, the time series analysis has another set of challenges associated with inflation. These issues are taking much more time. The team is still working on these issues. The team is hopeful to provide more comprehensive analysis of panel data in the next final report.

Table 8.6: Indebtedness among panel and cross-section HHs in 2021-22

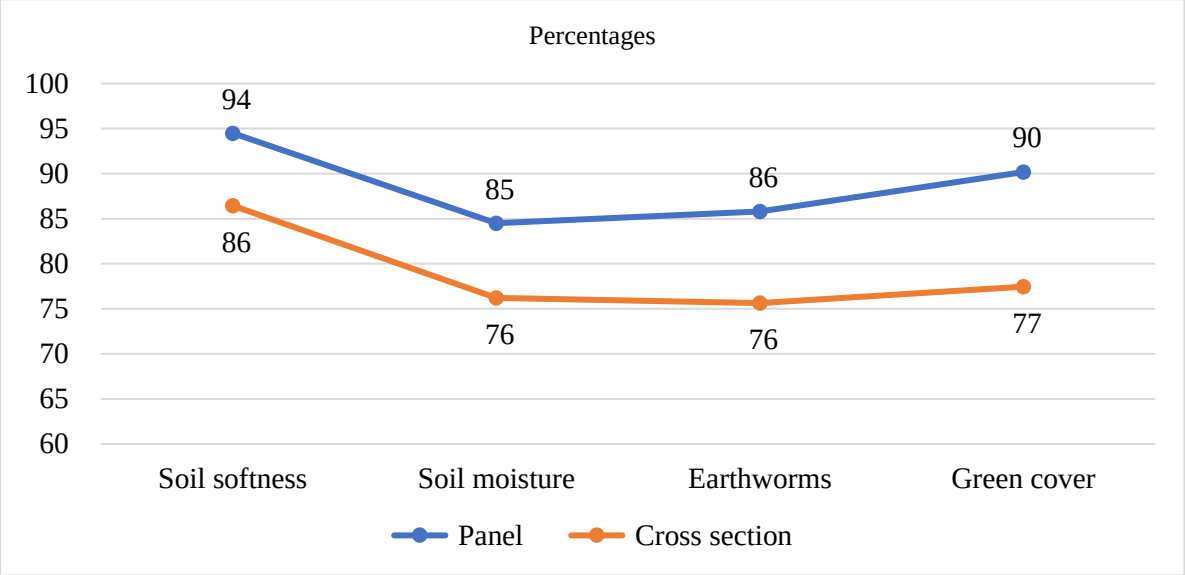
Indicator	Panel	Cross-section
Sample size	372	1,186
Number of loans	301	1075
Number of loans per 100 sample HHs	81	91
Average loan amount per sample HHs	61,290	71,964
Number of agricultural loans	243	895
Number of agricultural loans per 100 sample HHs	65	75
Average agriculture loan amount per sample HHs	49,731	58,946
Number of non-agriculture loans	58	180
Number of non-agricultural loans per 100 sample HHs	16	15
Average non-agriculture loan amount per sample HHs	11,559	13,018

Source: IDSAP, Field Survey 2021-22

8.6.2. Improvement in soil and crop quality

Under CNF, the soil quality and productivity are expected to increase. The same has been recorded in all previous reports. Still, compared to cross-section famers, a greater percentage of panel farmers have experienced an improvement in each of four soil quality related indicators, viz., soil softness (8 percentage points), soil moisture levels (9 percentage points), increased presence of earthworms in the soils (10 percentage points) and increased green cover in the fields (13 percentage points) [Figure 8.10 and Table 8.7]. Relatively a greater percentage of panel farmers have experienced a considerable improvement in each of these indicators (Table 8.7). These results, once again, confirm the long-term benefits of CNF.

Figure 8.10: Percentage of panel and cross-section farmers confirming improvement in soil quality related indicators in 2021-22



Source: IDSAP, Field Survey 2021-22

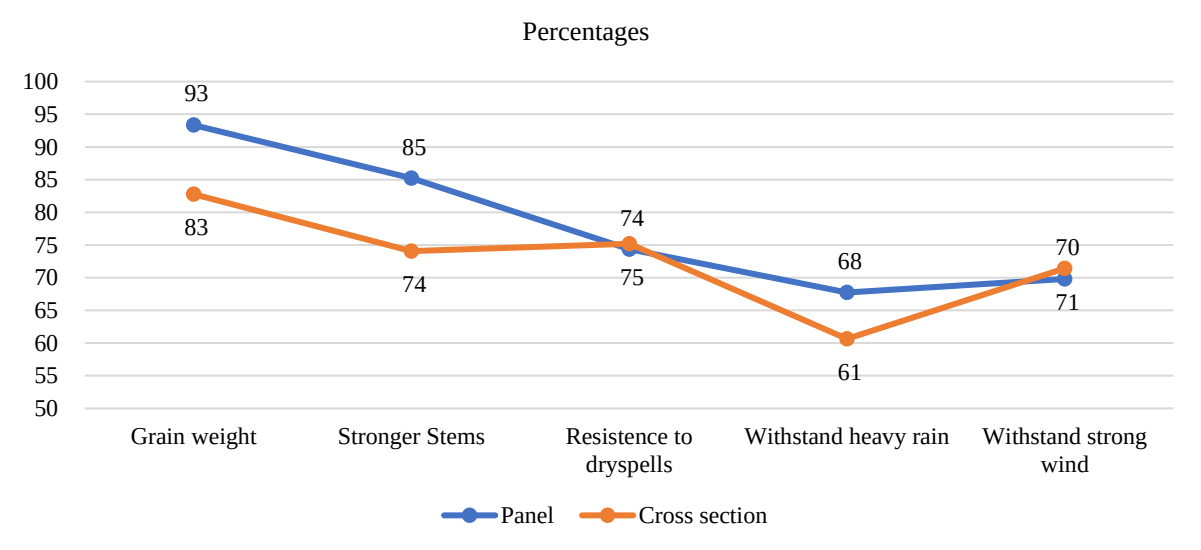
Table 8.7: Percentage of panel and cross-section farmers confirming improvement in soil quality related indicators in 2021-22

Indicator	Increased considerably		Increased moderately		Both types of increases	
	Panel	Cross-section	Panel	Cross-section	Panel	Cross-section
Soil softness	14	9	81	77	94	86
Soil moisture	13	12	71	64	85	76
Earthworms	29	20	57	56	86	76
Green cover	23	19	67	58	90	77

Source: IDSAP, Field Survey 2021-22

In all previous surveys, the CNF farmers, perceived that CNF has positive impact on crop quality also. Often cited crop quality indicators are heavy grains, strong stems, crops' tolerance to prolonged dry spells, heavy rains, strong winds, and floods.[49] A greater percentages of panel farmers compared to cross-section farmers, experienced improvement of grain weight (10 percentage points), strong stems (11 percentage points) and crop tolerance to heavy rains (7 percentage points). However, no such difference is observed in other two indicators (Figure 8.11).

Figure 8.11: Percentage of panel and cross-section farmers confirming improvement in crop quality related indicators in 2021-22



Source: IDSAP, Field Survey 2021-22

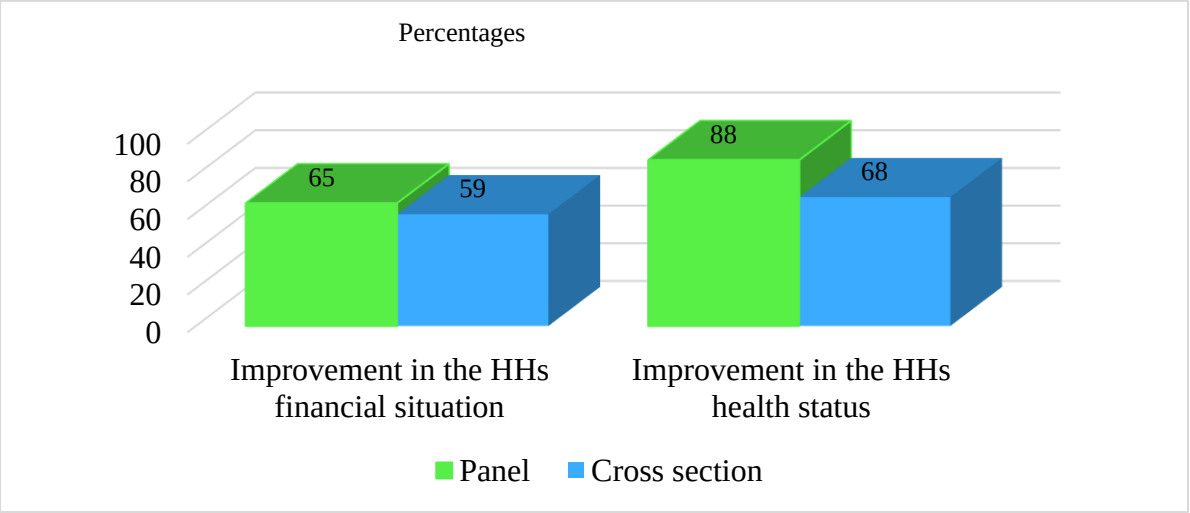
8.6.3. Farmers wellbeing

CNF farmers have been reporting, in most of the previous surveys, improvement in various indicators related to farmers wellbeing. The indicators include HHs' financial condition, farming related stress, HHs health status, HHs health expenditure, consumption of CNF food,

[49] One of the frequently cited reasons for CNF crops higher tolerance to weather anomalies is deep rooting of the crops, which is the result of the softening of the soils.

respect in the output market, dependency on input markets, etc. Over 60 to 90 percent of CNF farmers have been reporting an improvement in these indicators. In this section, the experiences of CNF panel and cross-section farmers in 2021-22, with respect to a couple of indicators, are discussed as an illustration. Compared to cross-section farmers, a greater number of panel farmers reported an improvement in HHs financial situation (6 percentage points) and HHs health status (20 percentage points) [Figure 8.12]. A greater percentage of panel farmers reported a considerable improvement in these two indicators (Table 8.8).

Figure 8.12: Percentage of panel and cross-section farmers reported improvement in HHs financial conditions and health status in 2021-22



Source: IDSAP, Field Survey 2021-22

Table 8.8: Percentage of panel and cross-section farmers reported improvement in HHs financial conditions and health status in 2021-22

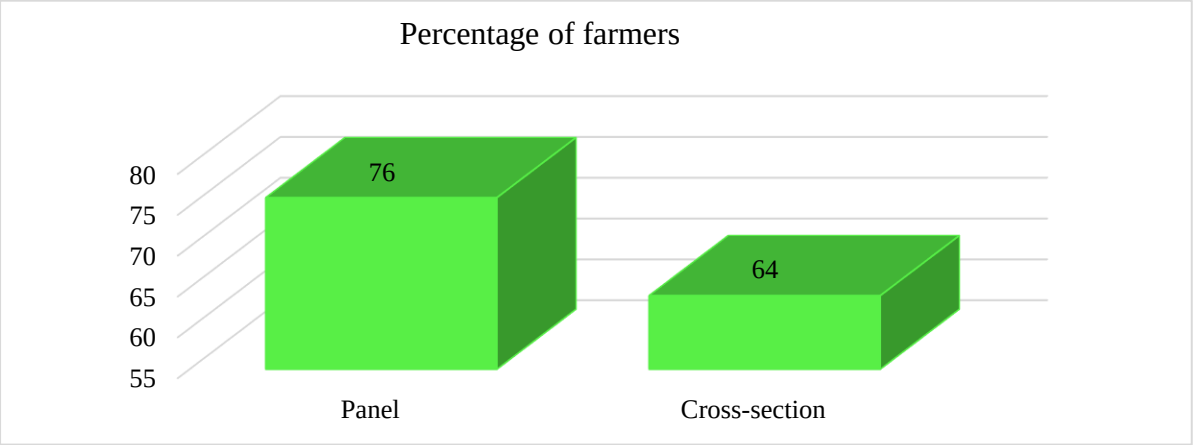
Indicator	Improved considerably		Improved moderately		Improved-total	
	Panel	Cross-section	Panel	Cross-section	Panel	Cross-section
Improvement in the HHs financial situation	9	6	57	53	65	59
Improvement in the HHs health status	21	16	68	52	88	68

Source: IDSAP, Field Survey 2021-22

8.7. Issues and challenges

Compared to cross-section CNF farmers, a greater percentage of panel farmers experienced one or the other problem in adoption of CNF; the difference is 12 percentage points (Figure 8.13). This implies, that the problems in adoption of CNF are long-term problems. They cannot be wished away or treated as temporary.

Figure 8.13: Percentage of panel and cross-section farmers reported one or the other problem in adoption of CNF in Kharif 2021-22



Source: IDSAP, Field Survey 2021-22

The responses of panel and cross-section farmers about the problems faced in the adoption of CNF are presented in Table 8.9. The pattern of farmers responses suggest that the farmers can overcome certain problems on their own in the long period. But in other problems, they may need external support. Shortage of labour, especially, family labour is an issue beyond the control of the farmers. Shortage of labour, in labour abundant economy like rural AP looks odd. It implies that wages and earnings even CNF are not attractive enough to attract the labour, including the family labour. However, the data in chapter 6 indicate that CNF is leading a positive transformation in the household occupation structure. RySS may also think about building on the recent developments with respect to linking Mahatma Gandhi Rural Employment Guarantee Scheme (MGNREGS) with individual farming works. Marketing is another issue beyond the control of the households. Marketing of CNF output, per se is not a special issue. The issue is that CNF farmers want higher price. Not getting a premium price for the CNF output is the issue. Since the present survey in 2021-22, RySS facilitate the purchase of CNF foodgrains by Tirumala Tirupathi Devasthanam (TTD). This has given a big boost in the marketing of CNF output. In recent survey of 2022-23, it was noted that CNF output is getting higher prices.

On the other hand, the data in Table 8.9 indicate that in the long-run, the CNF farmers can solve certain problems such as shortage of livestock for dung and urine, shortage of knowhow for the preparation of biological stimulants/ inputs, shortage of raw material for the preparation of biological stimulants/ inputs, and others, on their own.

Table 8.9: Responses of panel and cross-section farmers about different problems in adoption of CNF in 2021-22

Challenge	Panel	Cross-section	% points difference
Scarcity of Labour	62	61	1
Scarcity of family labour	64	61	3
Realized prices for APCNF output are less than the expected prices	84	79	5
Scarcity of livestock for dung and urine	45	47	-1
Lack of adequate knowledge about APCNF	63	67	-4
Scarcity of raw materials to make biological inputs	70	80	-10
Others	33	44	-10

Source: IDSAP, Field Survey 2021-22

8.8. Conclusion

The time series and cross section (a comparison of panel and cross-section farmers data) analysis clearly demonstrated the long-term potential of CNF. The panel farmers' allocation of area to CNF has been increasing. With a few fluctuations and exceptions, the panel framers' profitability has been increasing. The panel farmers performed better than the cross-section farmers on all farming conditions and other development indicators. The study indicates that some of the problems of CNF farmers may persist over the period, especially the marketing and shortage labour. RySS's successful efforts in bringing in TTD to procure CNF foodgrains has given an impetus to the marketing of CNF output. Such efforts need to be continued.

RySS may build on the recent developments with respect to linking MGNREGA with individual farming. However, given the year-to-year fluctuating nature of agriculture, the panel study should be continued for 15-20 years to know the full and accurate impact of APCNF. A separate questionnaire may be designed for panel study or the questionnaire should be standardized with minimum changes over the years. The sample size may be increased, if possible.

Chapter 9: Wellbeing of CNF farmers

9.1. Introduction

In all previous reports, it was pointed out that the chemical-based agriculture has adversely affected the farmers' wellbeing in the country in general, in the state in particular. Further, the environmental consequences of the chemical-based farming are well known. In chapter 2 to chapter 4, the issues of social, economic and environmental sustainability of CNF have been discussed. The analyses in those three chapters have established that CNF has positive contributions in each of the three dimensions of sustainable development. In this chapter, the impact of CNF on the wellbeing of farmers is deliberated. It is well known that wellbeing is a multidimensional phenomenon.[50] A full analysis of wellbeing is beyond the scope of this study. Therefore, only some indicators relevant for this study are analyzed in this chapter. For easy understanding and illustration, the wellbeing indicators covered, in this chapter, are grouped in a three-dimension framework, viz., (1) Development, (2) Freedom and (3) Dignity. Primary data collected through CNF farmer household survey and the qualitative data collected through focused group discussions and case studies of farmers, across the sample villages, have been used in this chapter. The analysis has been conducted through the integration of quantitative and qualitative data.

9.2. Development

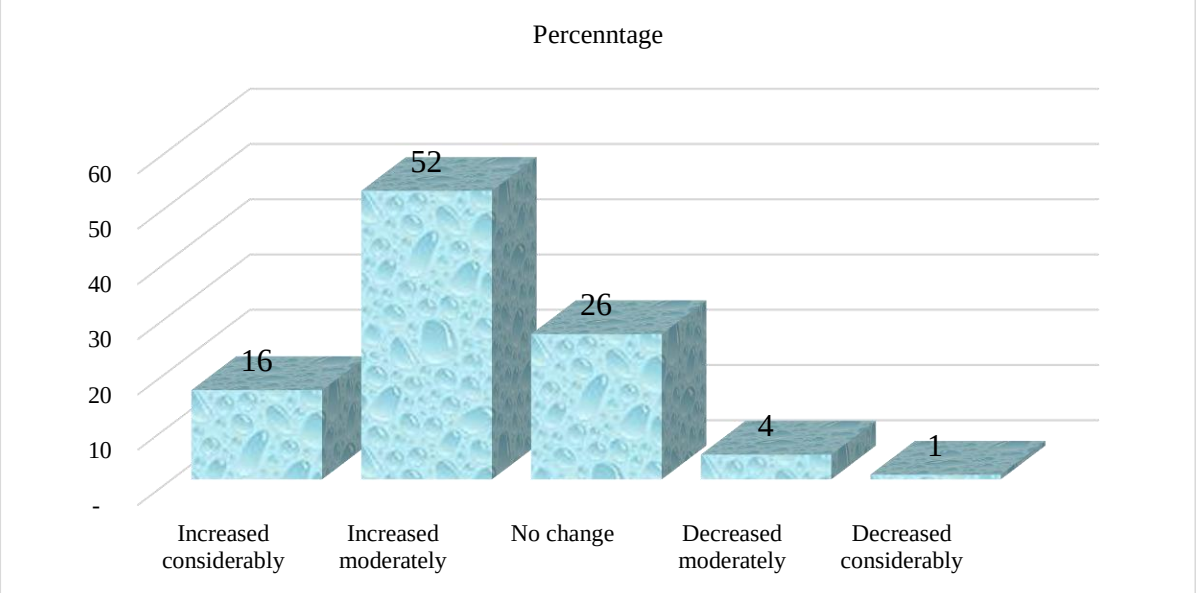
This dimension is similar to the human development index (HDI), which is a composite index of health, education and standard of living. In this section, the data and information available with respect to CNF households' health, education and economic improvements are discussed.

[50] Wellbeing is a broad subject. "Compendium of OECD Well-being Indicators" by OECD [https://www.oecd.org/sdd/47917288.pdf] has given two sets of wellbeing indicators, viz., (I) Quality of life consists of (1) Health status, (2) Work and life balance, (3) Education and skills, (4) Social connections, (5) Civic Engagement and Governance, (6) Environmental Quality, (7) Personal Security, and (8) Subjective well-being; (II) Material Living Conditions consists of (1) Income and wealth, (2) Jobs and earnings, and (3) Housing. Further, the Report pointed out that Sustainability of Well-Being Over Time requires preserving different types of capital viz., (1) Natural capital, (2) Economic capital, (3) Human capital, and (4) Social capital. APCNF can have a positive impact on many of the above listed indicators.

9.2.1. Health

Information about two health indicators, viz., (1) Impact of CNF on the health status of CNF farmers households; and (2) Impact of CNF on the household health expenditure, was collected in the household survey during Kharif 2021-22. As farmers and family members had reduced, if not stopped, the application of agrochemicals, particularly the pesticides, their illness rate might have come down. Further, their consumption of CNF food, which is chemical free, might have improved their health condition. Farmers' responses about the health status of the family members have been enquired in the survey. Health status implies the incidence of sickness among the family members, i.e., the number of sick person days[51], a family experienced in a year. The changes, if any, in the incidence of sickness in the family, due to CNF, are enquired and summarized in Figure 9.1 and Table 9.1. Over 52 percent of farmers have reported a moderate improvement in the health status of the family members, due to CNF. In addition, 16 percent CNF farmers have testified a considerable improvement in their health status due to CNF. Among agroclimatic zones, 92 percent in Krishna zone and 95 percent farmers in Godavari zone have reported either moderate or considerable improvement in health status of their family members (Table 9.1).

Figure 9.1: CNF farmers responses about impact of CNF on family members health status during Kharif 2021-22



Source: *IDSAP, Field Survey 2021-22.*

[51]That include the number of persons fell sick in a year and the number of days a family member fell sick in a year.

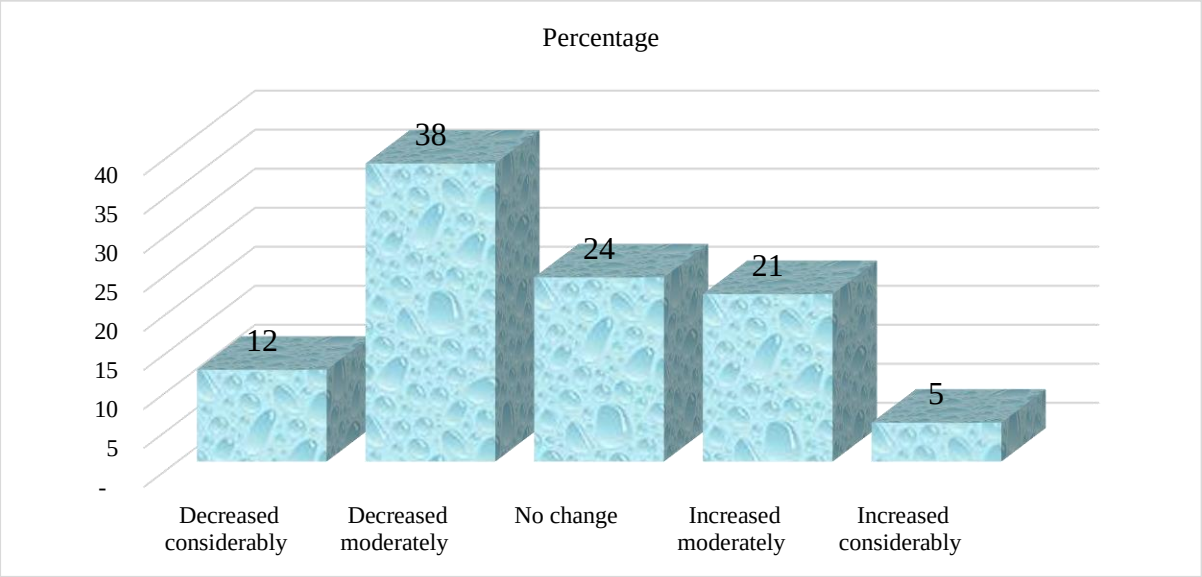
Table 9.1: Agroclimatic zones and farmers' categories wise CNF farmers response about changes in the health status of their families due to CNF, in Kharif 2021-22 (%)

Agroclimatic zones & farmers' categories	Increased considerably	Increased moderately	No change	Decreased moderately	Decreased considerably
Agroclimatic zones					
HAT	19	40	40	-	1
North coastal	9	51	36	4	-
Godavari	22	73	3	1	1
Krishna	43	48	6	2	-
Southern	11	52	30	5	2
Scarce rainfall	1	51	39	9	-
AP	16	52	26	4	1
Farm size categories					
Marginal	21	47	26	5	1
Small	11	58	26	4	1
Others	7	64	26	3	1
All	16	52	26	4	1
Tenurial categories					
Tenants	12	76	10	-	2
Owner-tenants	13	61	19	6	1
Owners	17	50	28	5	1
All	16	52	26	4	1
Social categories					
SC	19	47	30	3	1
ST	17	49	32	1	1
BC	13	54	27	5	1
OC	20	54	19	6	1
All	16	52	26	4	1

Source: *IDSAP, Field Survey 2021-22.*

These days, the health concerns are on the rise. Because of evolving of new diseases, viruses, increasing pollutions, etc., the incidence of illness and expenditure on health-care are on the rise. Because of inflation and other reasons, the expenditure on health care, in general, is increasing year after year. However, majority of CNF farmers reported a reduction in the out-of-pocket expenditure on health care. While 12 percent farmers reported a considerable decline in the health expenditure, another 38 percent have experienced a moderate reduction (Figure 9.2). Among six agroclimatic zones, 46 percent and 48 percent farmers in Godavari zone reported a decrease in health expenditure considerably and moderately, respectively. Among different farmer categories, higher percentage of tenant and owner-cum-tenant farmers have reported a decrease in health expenditure. Similarly, the ST farmers, among social categories have reported highest decline in the health expenditure (Table 9.2).

Figure 9.2: CNF farmers response about the changes in their health expenditures after CNF, during Kharif 2021-22



Source: IDSAP, Field Survey 2021-22

Table 9.2: Agroclimatic zones and farmer categories wise CNF farmers response about the changes in their health expenditures after CNF, during Kharif 2021-22 (in %)

Agroclimatic zones & farmers' categories	Decreased considerably	Decreased moderately	No change	Increased moderately	Increased considerably
Agroclimatic zones					
HAT	12	30	46	12	-
North coastal	27	35	21	16	-
Godavari	46	48	5	1	-
Krishna	9	42	27	9	13
Southern	3	36	28	22	11
Scarce rainfall	-	37	18	45	0
AP	12	38	24	21	5
Farm size categories					
Marginal	10	43	24	17	6
Small	15	33	26	22	5
Others	13	30	18	35	3
All	12	38	24	21	5
Tenurial categories					
Tenants	24	45	18	10	4
Owner cum tenants	24	36	18	21	1
Owners	10	38	24	22	5
All	12	38	24	21	5
Social categories					
SC	6	44	22	19	10
ST	28	32	32	8	-
BC	8	39	23	26	4
OC	11	38	20	24	7
All	12	38	24	21	5

Source: *IDSAP, Field Survey 2021-22.*

9.2.2. Education

In the international human development index, education is an important dimension, and it consists of two indicators. But there were no questions about education in the household questionnaire, to assess the impact of CNF on children's education. However, the impact of CNF on education has come out prominently in the FGDs. Some of those points are given below.

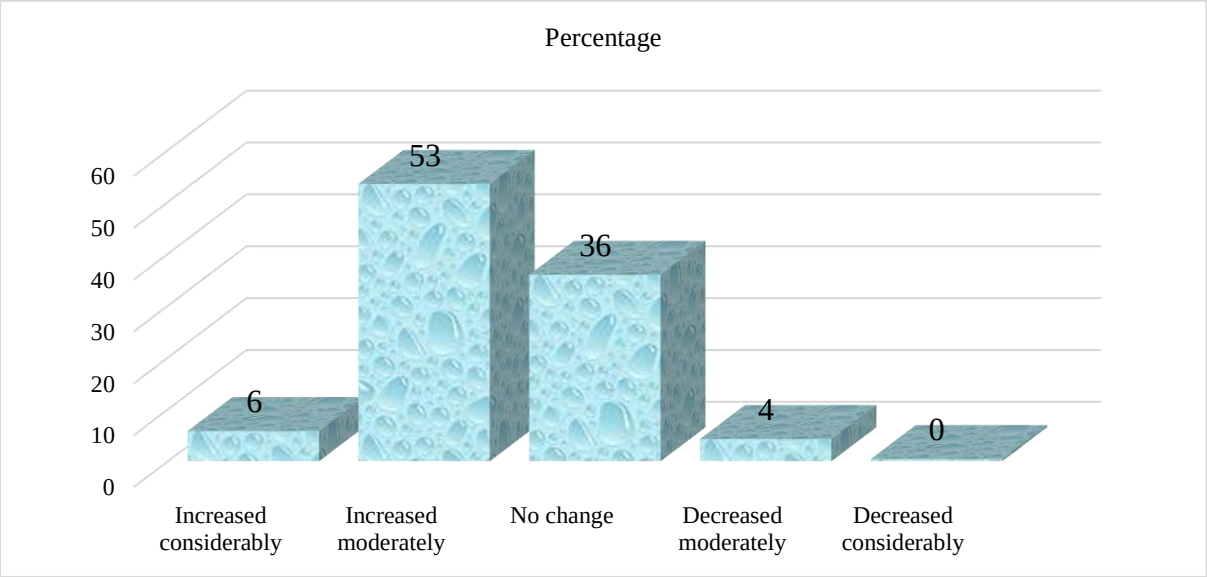
a. As the incidence of diseases reduced, due to CNF, children's attendance in the schools has increased.[52]
b. As the tensions related to chemical-based agriculture reduced, due to CNF, families are able to focus on children's education.
c. Because of improvements in the financial position, some CNF farmers are able to admit their children in the private schools for 'quality education'.
d. Due to improvement in health and other positive developments, children's learning skills have improved.

9.2.3. Financial conditions

Living standard represented by the per-capita income, is the third dimension in the international human development index. In all previous surveys and also in the present survey, it was established, that CNF gives higher net value of output than non-CNF, in almost all crops. In the previous two consolidated/ final reports, it was seen that the household incomes of the CNF farmers are higher than that of non-CNF. The same holds true this year also (see chapter 6). Further, the study has been eliciting the CNF farmers' own perception about their economic conditions. In all previous surveys, the farmers have perceived an improvement in the financial conditions. In the present survey also, about 60 percent of CNF farmers confirmed an improvement in their financial position, due to CNF (Figure 9.3). In Krishna zone, over 76 percent of farmers have reported a moderate increase in their financial situation and another 14 percent have reported a considerable increase in their financial condition. A higher proportion of farmers in Southern zone reported an increase in their financial conditions, due to CNF. Among the farm size categories, a higher percentage of other farmers reported an increase in their financial position. Similarly, a higher proportion of owner-tenant and owner farmers among the tenurial categories and OC and SC farmers among social categories reported an increase in their financial conditions (Table 9.3).

[52]Even if the school going child is healthy, he/ she may not go to school, if he has to take care of other sick person in the family or no healthy person is available in the family to send him/ her to the school.

Figure 9.3: CNF farmers response about the changes in their financial position during Kharif 2021-22



Source: IDSAP, Field Survey 2021-22

Table 9.3: Agroclimatic zones and farmers categories wise CNF farmers response about the changes in their financial position during Kharif 2021-22 (in %)

Agroclimatic zones & farmers categories	Increased considerably	Increased moderately	No change	Decreased moderately	Decreased considerably
Agroclimatic zones					
HAT	1	56	42	-	1
North coastal	-	39	60	1	-
Godavari	14	42	44	-	1
Krishna	14	76	7	2	0
Southern	6	53	36	5	1
Scarce rainfall	0	48	42	10	-
AP	6	53	36	4	0
Farm size categories					
Marginal	6	52	36	5	0
Small	7	50	40	3	0
Others	5	63	29	3	1
All	6	53	36	4	0
Tenurial categories					
Tenants	4	53	43	-	-
Owner-tenants	7	52	36	3	2
Owners	6	54	36	5	0
All	6	53	36	4	0
Social categories					
SC	10	50	38	2	-
ST	7	54	37	0	1
BC	5	50	39	6	0
OC	4	63	27	6	0
All	6	53	36	4	0

Source: *IDSAP, Field Survey 2021-22.*

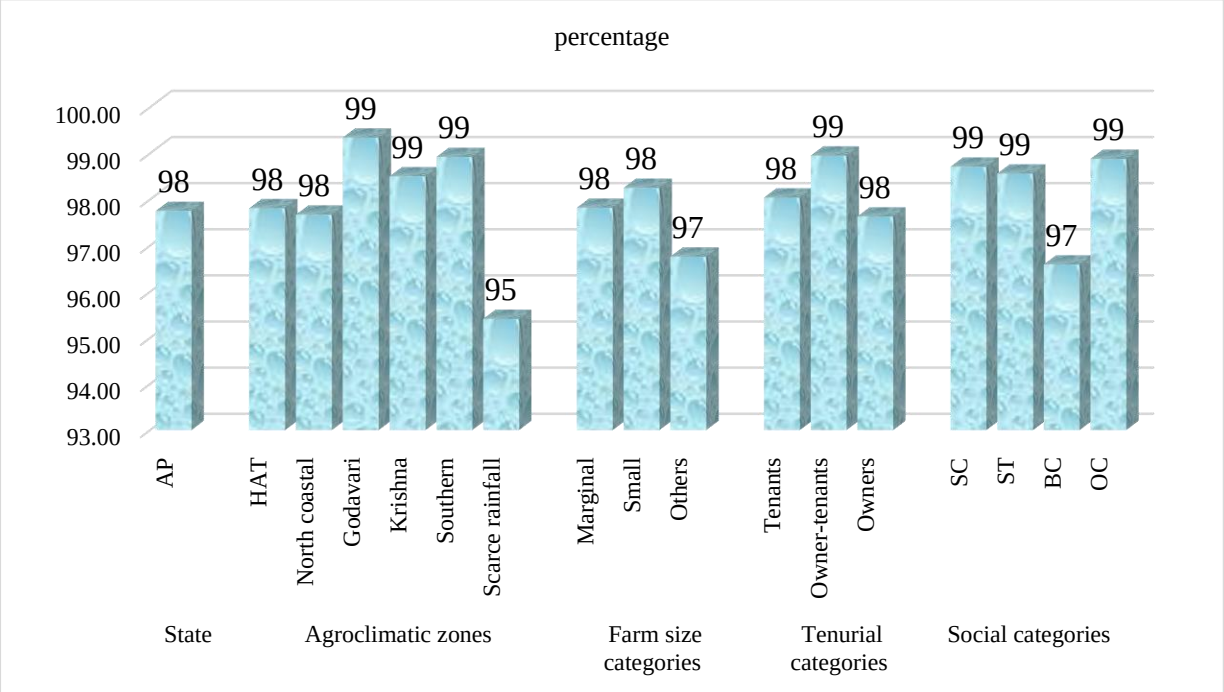
9.3. Freedom

The CNF has given or is giving the freedom to the participating farmers, in a number of ways. CNF farmers and households got freedom from chemical-based agriculture, which is a health hazard, apart from many other risks. They also got freedom from unhealthy food. They also got freedom from input, credit and output markets. These issues are discussed, briefly, in this section.

9.3.1. Freedom from chemical-based agriculture

In the previous Rabi 2021-22 report, it was shown that farmers are becoming relatively, if not absolutely, poorer year after year. Two decades back, the NSSO in "The Situation Assessment of …… India" reported that more than 40 percent of farmers would like to quit agriculture if alternative opportunities were available. Since then, farmers are leaving cultivation. The youth are opting even for low paid jobs, instead of continuing in agriculture. The survey results revealed that 98 percent of CNF farmers want to continue CNF farming. The same vary between 95 to 99 percent across all the agroclimatic zones and farmers categories (Figure 9.4).

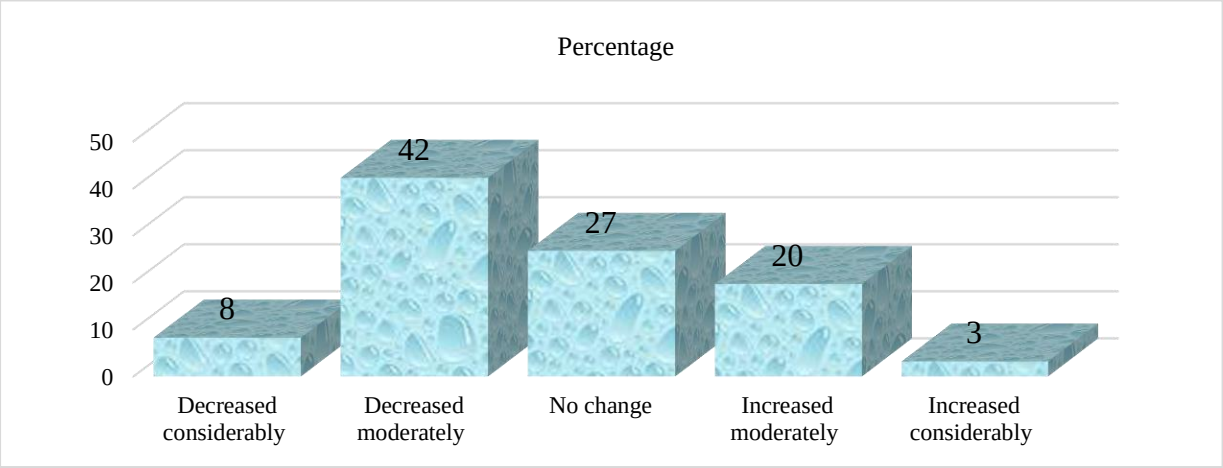
Figure 9.4: Agroclimatic zone and farmer categories wise percentage of CNF farmers want to continue the CNF farming during Kharif 2021-22



Source: *IDSAP, Field Survey 2021-22.*

The farmers like CNF not just for environmental reasons, but for economic and personal reasons. Apart from health hazards, chemical-based farming involves larger investments and mobilization of large funds, from various sources, often with adverse, if not exploitative, terms and conditions. All these lead to personal and domestic tensions. About 50 percent of CNF farmers have experienced or perceived that CNF has reduced their agriculture related tensions (Figure 9.5). The same is as high as 87 percent in Godavari zone and 68 percent in Krishna zone. The same is 67 percent for tenant farmers and 53 percent for owner-cum-tenant farmers, among tenurial categories (Table 9.4).

Figure 9.5: CNF farmers response about changes in farming related stress after CNF during Kharif 2021-22



Source: *IDSAP, Field Survey 2021-22.*

Table 9.4: Agroclimatic zones and farmers categories wise CNF farmers response about changes in farming related stress after CNF, during Kharif 2021-22 (in %)

Agroclimatic Zones & farmers categories	Decreased considerably	Decreased moderately	No change	Increased moderately	Increased considerably
Agroclimatic zones					
HAT	4	30	56	10	-
North coastal	4	15	68	13	-
Godavari	18	69	13	-	-
Krishna	26	42	17	12	4
Southern	2	30	40	19	10
Scarce rainfall	0	54	4	42	1
AP	8	42	27	20	3
Farm size categories					
Marginal	8	47	25	16	4
Small	8	38	30	21	3

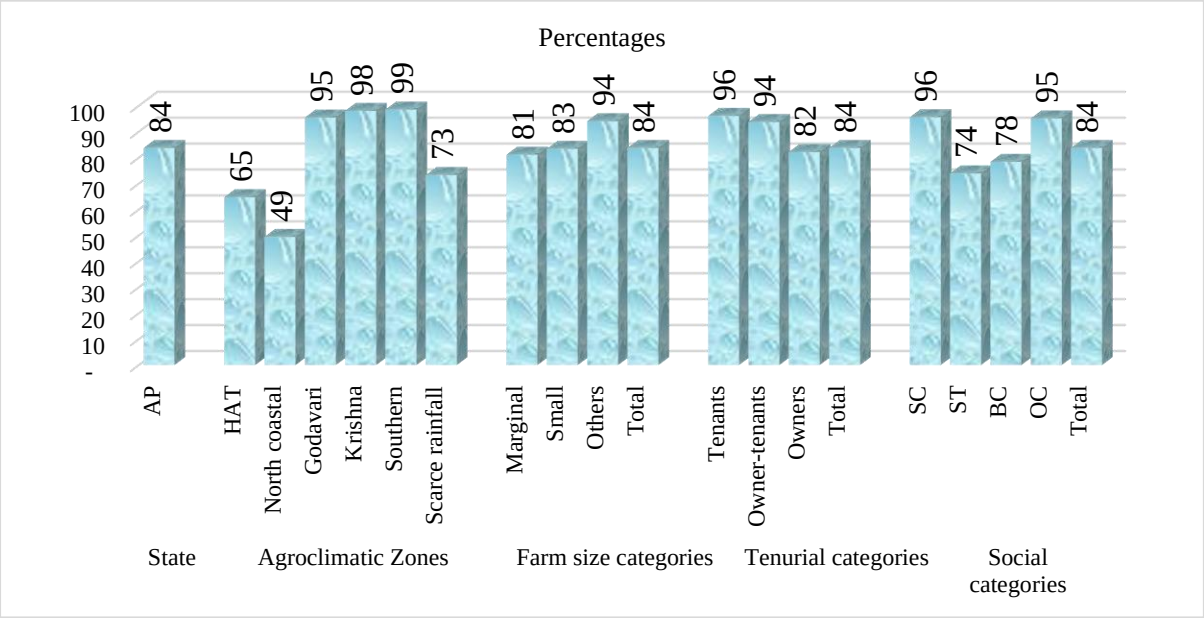
Agroclimatic Zones & farmers categories	Decreased considerably	Decreased moderately	No change	Increased moderately	Increased considerably
Others	11	30	28	30	1
All	8	42	27	20	3
Tenurial categories					
Tenants	14	53	20	12	2
Owner-tenants	16	37	28	15	4
Owners	7	42	27	21	3
All	8	42	27	20	3
Social categories					
SC	7	52	17	20	5
ST	11	42	39	8	-
BC	5	42	26	24	4
OC	13	38	25	21	3
All	8	42	27	20	3

Source: *IDSAP, Field Survey 2021-22.*

9.3.2. Freedom from toxic food

Another chemical-based agriculture related factor, which has been affecting adversely the farmers and their families, is the contaminated food with fertilizers and pesticides' residues. Nowadays, the health hazards of food, produced in chemical-based farming, are well known. But the consumers, including farmers, have no choice but to consume the toxic food. CNF has provided them a choice, in the form of chemical free food, which is cultivated under CNF. At the aggregate level, 84 percent of CNF farmers have reported that they are consuming CNF food. The same is 98 percent in Krishna zone and 99 percent in Southern zone. Over 80 to 96 percent farmers of eight farmer categories have been consuming CNF food. But only 49 and 65 percent farmers of North coastal and HAT zones, respectively, are consuming CNF food. Similarly, relatively fewer number of ST (74 percent) and BC (78 percent) farmers reported to be consuming the CNF food (Figure 9.6). A couple of possible reasons, for relatively smaller number of farmers consuming CNF food, in these two zones and two social categories could be: (1) they might not be raising food crops or foodgrains of their choice, and (2) they might be selling CNF output at higher prices and consuming non-CNF food.

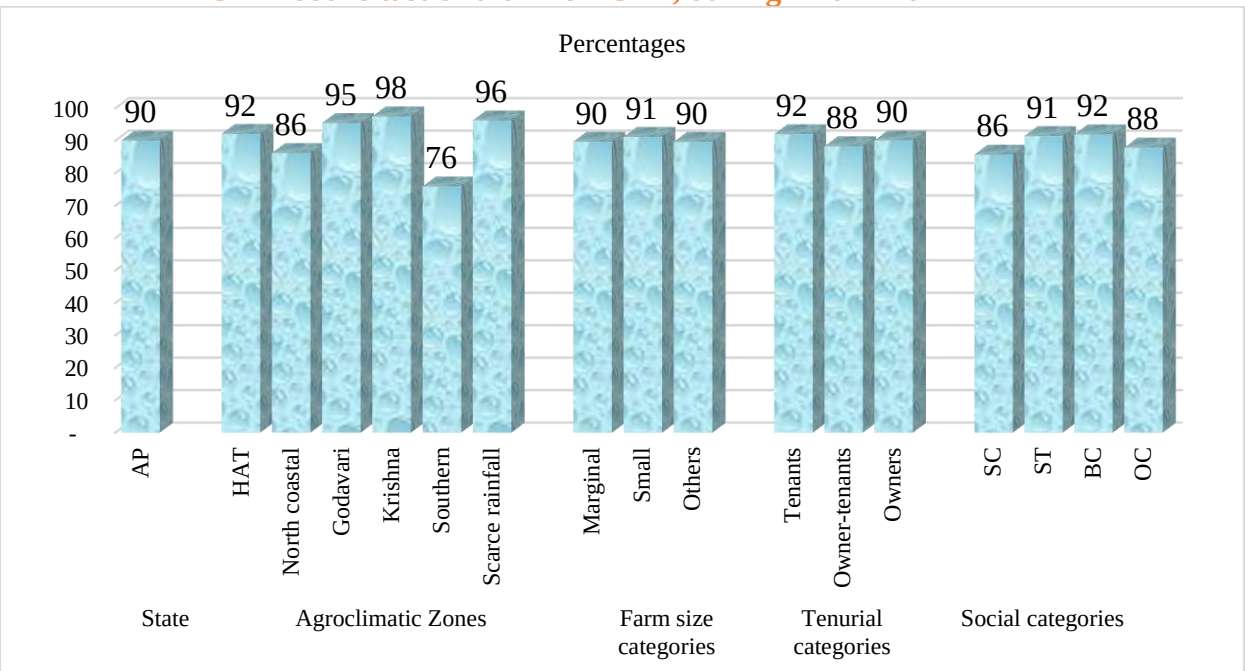
Figure 9.6: Agroclimatic zones and farmers categories wise percentage of farmers consuming CNF food, during Kharif 2021-22



Source: *IDSAP, Field Survey 2021-22.*

CNF food is not only healthy, but also tasty. Over 90 percent of CNF farmers, have reported that CNF food is tastier than non-CNF food. Over 90 percent of farmer stated that CNF food is tasty, in seven out of ten farmer categories. Further, 92 to 98 percent of farmers in four agroclimatic zones have experienced that CNF food is tasty. However, this percentage is less than 90 in remaining three farmer categories and two zones (Figure 9.7).

Figure 9.7: Agroclimatic zones and farmers categories wise percentage of farmers stated CNF food is tastier than non-CNF, during Kharif 2021-22



Source: *IDSAP, Field Survey 2021-22.*

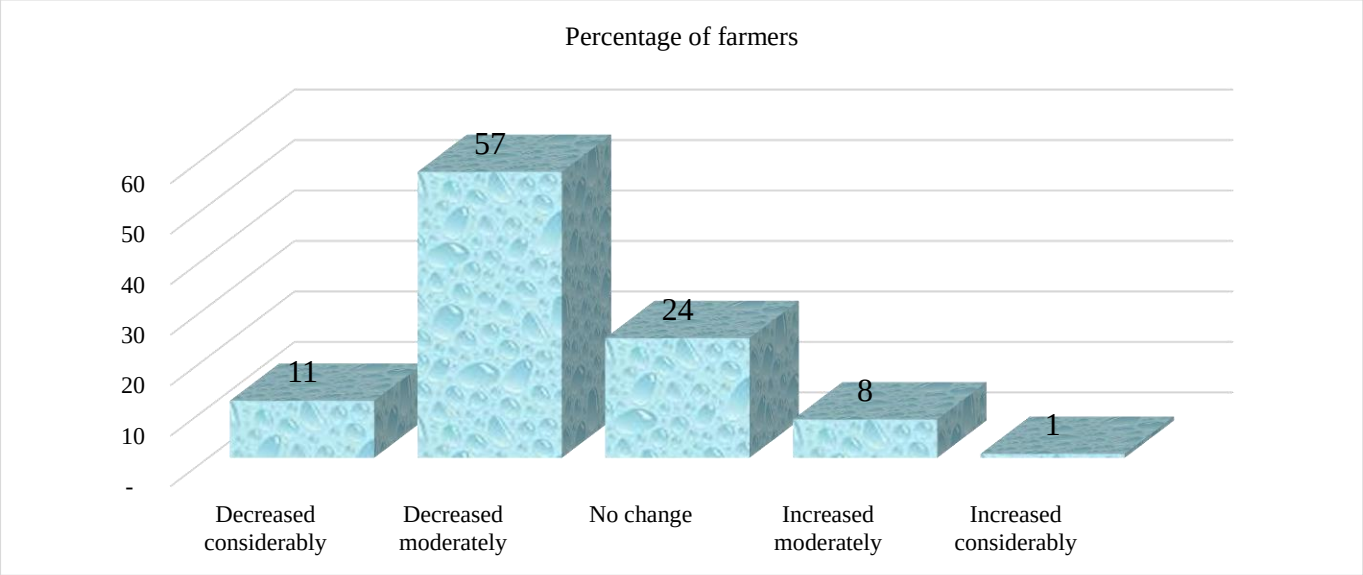
9.3.3. Freedom from exploitation in the input and output markets

As shown in the chapter 3 and 5, under the chemical-based farming, farmers spend a lot of money on fertilizers, pesticides and seeds. These inputs are often costly; which compel farmers to mobilize funds from different sources, including from the input suppliers, under unfavorable terms and conditions, on continuous basis. Having to buy spurious inputs is another common problem faced by farmers in chemical-based farming. Under CNF, farmers would stop completely the application of fertilizers and pesticides. They would start using their own seeds. All these would reduce, if not eliminate, CNF farmers' dependency on the input markets and related exploitation. As CNF sample is drawn from the list S2S farmers, who stopped completely the use of agrochemicals, at least in a part of their operated holding, 100 percent of farmers in each zone and category reported a reduction in their dependence on input markets.

9.3.4. Freedom from the credit markets

In all previous studies, and also in the present study, it is established that the cost of cultivation is low under CNF vis-à-vis non-CNF (chemical-based farming). Because of CNF, 57 percent of farmers, at the state level, experienced a moderate reduction in the fund's requirement for agriculture. In addition, 11 percent of CNF farmers felt a considerable reduction in funds requirement for cultivation (Figure 9.8). As many as 41 percent of CNF farmers in Godavari zone and 13 percent in Krishna zone stated a considerable decline in funds requirement for CNF cultivation. About 24 percent each of tenant farmers and owner-cum-tenant farmers also indicated a considerable decline in funds requirements for agriculture (Table 9.5).

Figure 9.8: CNF farmers response about the impact of CNF on funds requirement for agriculture working capital, in Kharif 2021-22



Source: *IDSAP, Field Survey 2021-22.*

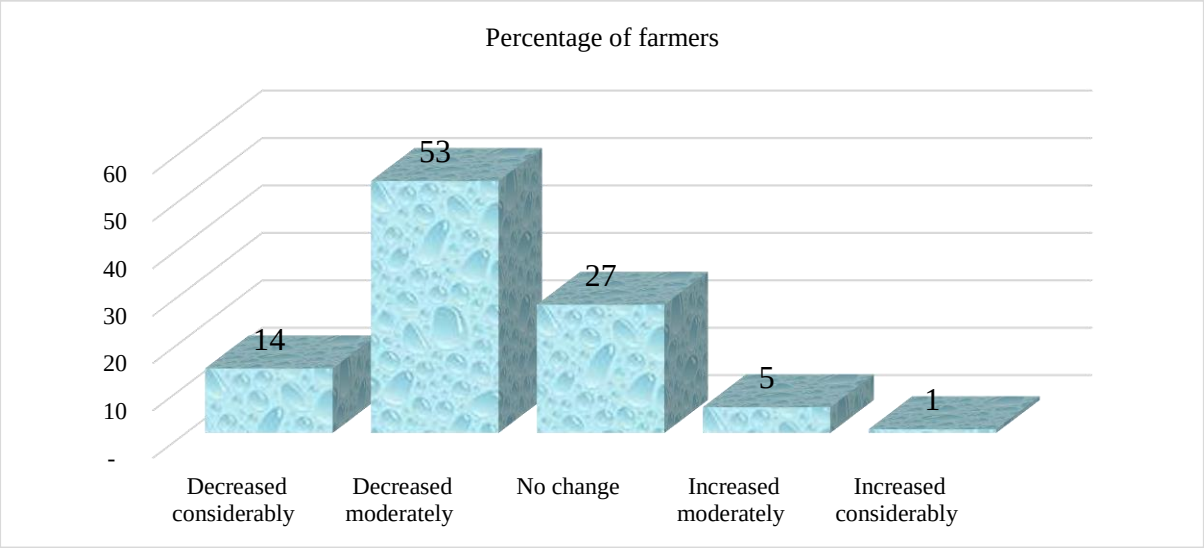
Table 9.5: Agroclimatic zones and farmers' categories wise CNF farmers response about impact of CNF on funds requirement for agriculture in Kharif (in %)

Agroclimatic Zones & farmer categories	Decreased considerably	Decreased moderately	No change	Increased moderately	Increased considerably
Agroclimatic zones					
HAT	5	11	79	5	-
North coastal	9	25	59	7	-
Godavari	41	51	7	1	-
Krishna	13	69	2	11	5
Southern	10	47	27	16	-
Scarce rainfall	-	90	8	2	-
AP	11	57	24	8	1
Farm size categories					
Marginal	11	58	23	8	1
Small	12	51	28	8	1
Others	12	61	21	6	1
All	11	57	24	8	1
Tenurial categories					
Tenants	24	64	4	8	-
Owner-tenants	24	51	16	9	1
Owners	10	57	25	7	1
All	11	57	24	8	1
Social categories					
SC	5	63	14	15	3
ST	23	19	55	3	-
BC	8	66	19	7	1
OC	12	65	15	8	0
All	11	57	24	8	1

Source: *IDSAP, Field Survey 2021-22.*

A reduction in the fund's requirement for CNF vis-à-vis non-CNF, would logically lead to a reduction in the borrowings for agriculture. As many as 53 percent of farmers, at the state level, confirmed a moderate decline in borrowings for agriculture, due to CNF, during Kharif 2021-22. Further, 14 percent of CNF farmers reported a considerable reduction in borrowings for agriculture, due to CNF (Figure 9.9). As many as 93 percent of CNF farmers in Scarce rainfall zone and 72 percent of farmers in Godavari zone perceived a moderate decline in borrowings for agriculture due to CNF. Further, 48 percent and 14 percent of farmers in Krishna and Godavari zones, respectively, said a considerable reduction in the borrowings for agriculture, because of CNF (Table 9.6).

Figure 9.9: CNF farmers response about the impact of CNF on borrowings for agriculture, during Kharif 2021-22



Source: *IDSAP, Field Survey 2021-22*

Table 9.6: Agroclimatic zones and farmers' categories wise CNF farmers responses about the impact of CNF on borrowings for agriculture, during Kharif 2021-22 (in %)

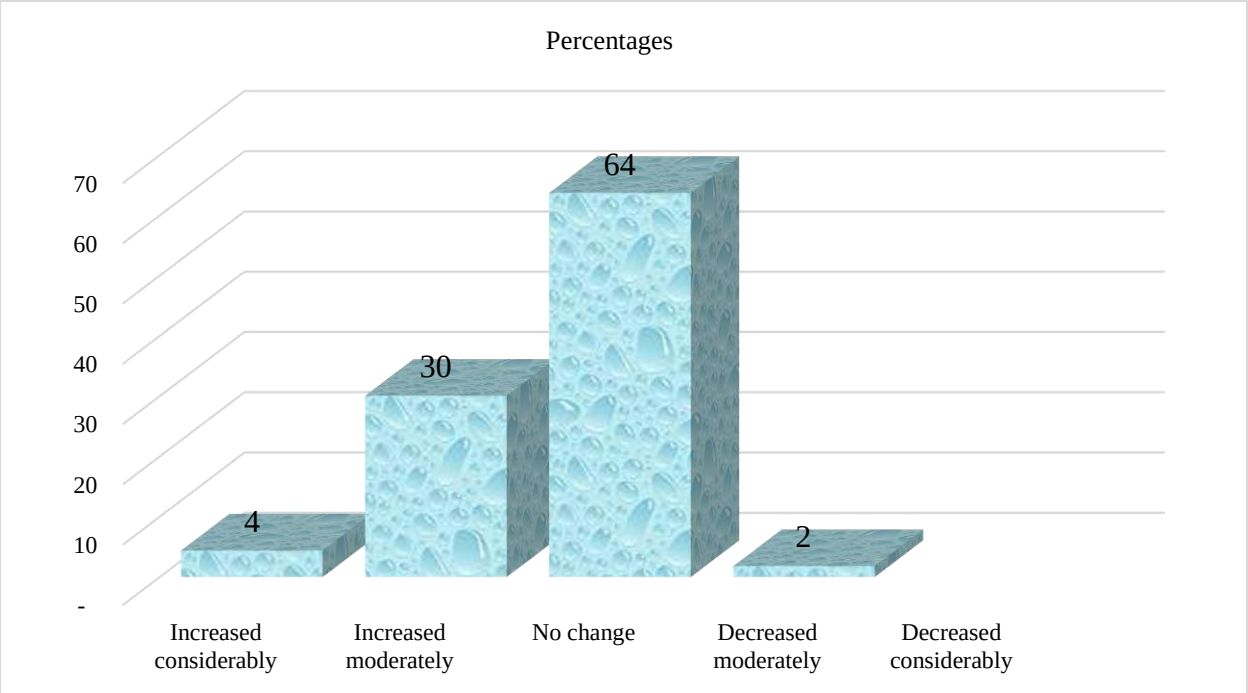
Agroclimatic zones & farmers' categories	Decreased considerably	Decreased moderately	No change	Increased moderately	Increased considerably
Agroclimatic zones					
HAT	3	9	86	3	-
North coastal	11	25	57	6	-
Godavari	14	72	14	-	-
Krishna	48	31	18	2	1
Southern	10	45	25	18	3
Scarce rainfall	-	93	6	1	-
AP	14	53	27	5	1
Farm size categories					
Marginal	15	51	28	5	1
Small	11	53	28	7	1
Others	12	63	20	5	-
All	14	53	27	5	1
Tenurial categories					
Tenants	12	74	6	8	-
Owner-tenants	12	63	20	4	-
Owners	14	51	29	5	1
All	14	53	27	5	1
Social categories					
SC	10	55	25	8	2
ST	9	26	63	2	-
BC	12	61	20	6	1
OC	23	58	14	5	1
All	14	53	27	5	1

Source: *IDSAP, Field Survey 2021-22*

9.3.5. Relief in agriculture output marketing

Agriculture output marketing is one of the big challenges, in general, in India and also in the state. Various studies on the subject indicate that farmers get mostly a raw deal in the output marketing. The literature also indicates that almost all existing marketing channels are exploitative. Fortunately, CNF farmers, albeit in small number, are getting new opportunities and new marketing channels to market their output. At the state level, 30 percent of CNF farmers witnessed a moderate increase in new output marketing channels such as opportunities to sell in ***Shandis***, exhibitions, door delivery, online; selling directly to friends and relatives, local shops, etc. Further, 4 percent of CNF farmers have seen a considerable increase in new output marketing channels (Figure 9.10). In three out of six agroclimatic zones, viz., Godavari, Krishna and Southern, have experienced an emergence of more new marketing channels. On the other hand, the farmers of Scarce rainfall zone did not see the advent of any new output marketing channels and relatively a smaller percentage of CNF farmers in HAT and North coastal zones see the new marketing channels (Table 9.7).

Figure 9.10: CNF farmers responses with respects to changes in market channels for APCNF output



Source: *IDSAP, Field Survey 2021-22.*

Table 9.7: Agroclimatic zones and farmer categories wise CNF farmers responses with respect to changes in market channels for APCNF output, during Kharif 2021-22 (in %)

Agroclimatic Zones & farmers categories	Increased considerably	Increased moderately	No change	Decreased moderately	Decreased considerably
Agroclimatic zones					
HAT	-	27	73	-	
North coastal	-	27	73	-	
Godavari	16	37	47	-	
Krishna	7	70	23	-	
Southern	5	33	55	8	
Scarce rainfall	-	1	99	-	
AP	4	30	64	2	
Farm size categories					
Marginal	5	33	61	2	
Small	5	28	65	2	
Others	2	23	73	2	
All	4	30	64	2	
Tenurial categories					
Tenants	4	26	66	4	
Owner-tenants	10	23	64	3	
Owners	4	31	64	2	
All	4	30	64	2	
Social categories					
SC	8	29	58	5	
ST	8	33	59	-	
BC	2	25	72	1	
OC	6	37	55	2	
All	4	30	64	2	

Source: *IDSAP, Field Survey 2021-22.*

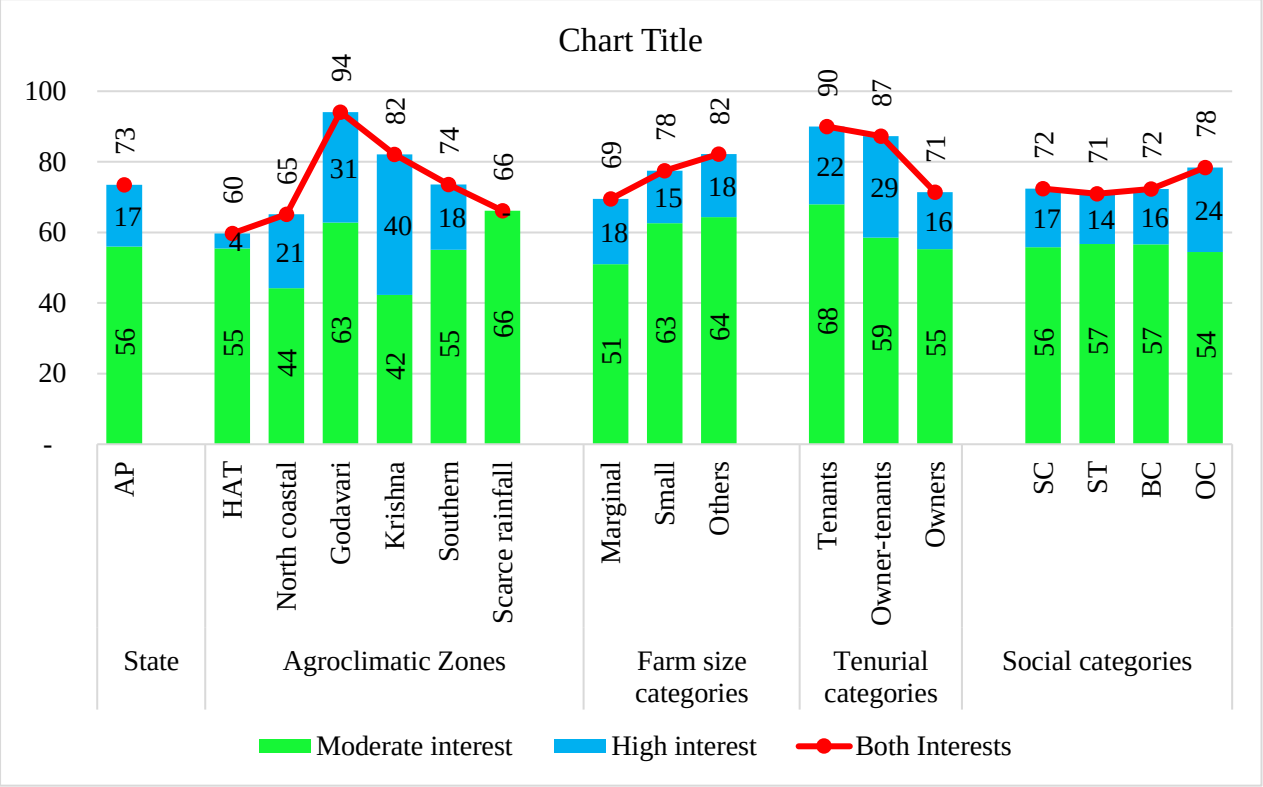
9.4. Impact of CNF on farmers' dignity

Farmers dignity is defined, here, as the respect they get, as CNF farmers, from relatives and friends, and in the market. Apart from responses in the household survey, the CNF farmers in FGDs have revealed that they are getting respect and priority in the market yards, Rythu Bazars, and other marking places in unloading their output, allocation of slots, shops, display places, storing places, etc. The respect the CNF farmers command, reflects the people's (including consumers, relatives and friends and officials in the markets) interest in CNF food and CNF itself, which is environmentally benign.

At the state level, 56 percent and 12 percent of CNF farmers experienced and witnessed a moderate and high interest, respectively, in the people, including consumers, relatives and

friends and officials, in CNF and CNF food. The percentage of farmers, who felt an interest in CNF varies widely, from 60 percent in HAT zone to 94 percent in Godavari zone, across the agroclimatic zones. Such variations are relatively less across the farm size categories, tenurial categories and social categories (Figure 9.11).

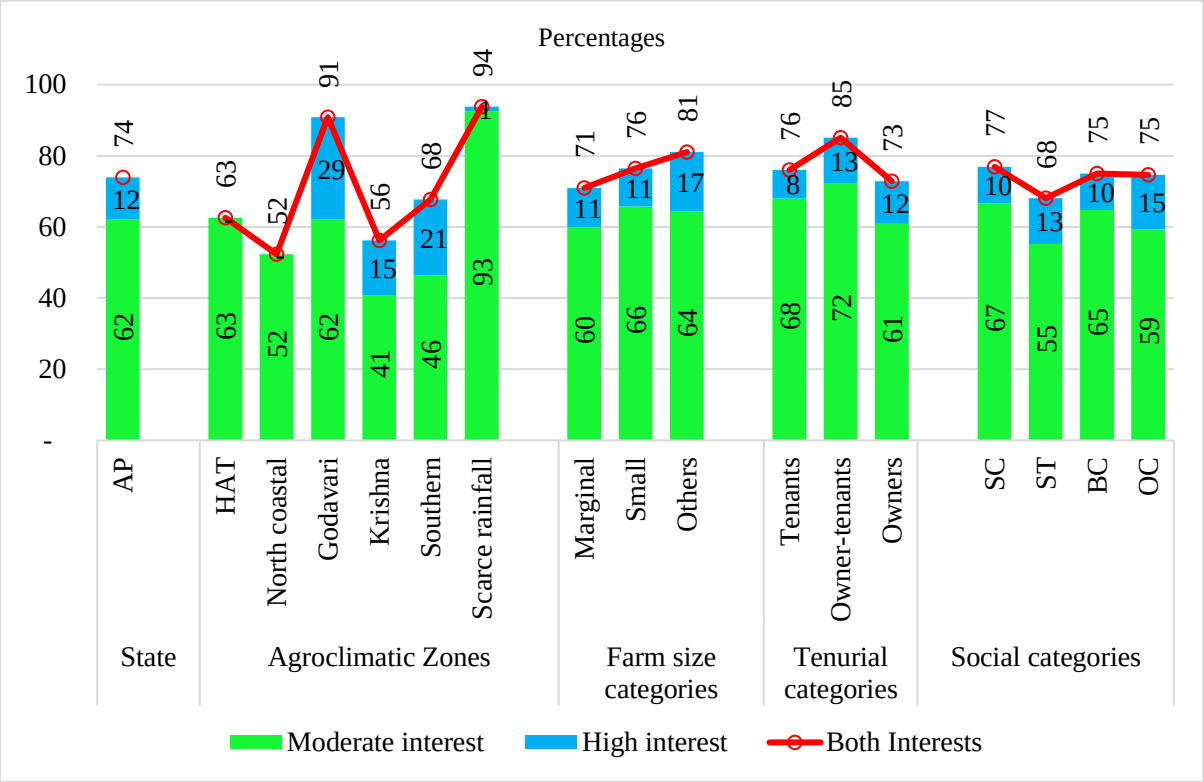
Figure 9.11: Agroclimatic zones and farmer category wise CNF farmers responses about people's interest for APCNF, during Kharif 2021-22



Source: *IDSAP, Field Survey 2021-22.*

As per the information obtained in FGDs, the relatives and friends of CNF farmers are purchasing/ getting CNF food in large numbers/ larger quantities from CNF farmers. As mentioned above, this kind of interest in CNF food, obviously, turns into the respect for the CNF farmers. At the state level, 74 per cent of CNF farmers have enjoyed the respect from friends and relatives, during the study period. The same varies from 52 percent in North coastal zone to 94 percent in Scarce rainfall zone (Figure 9.12). Such variations are relatively less among the farm-size categories, tenurial categories and social categories. It may be noted that most of disaggregated results are similar for HAT zone and tribal farmers. The reasons are obvious, i.e., coterminous existence of HAT zone and tribal farmers.

Figure 9.12: Agroclimatic zones and farmer category wise CNF farmers responses about respect they get from friends and relatives, during Kharif 2021-22

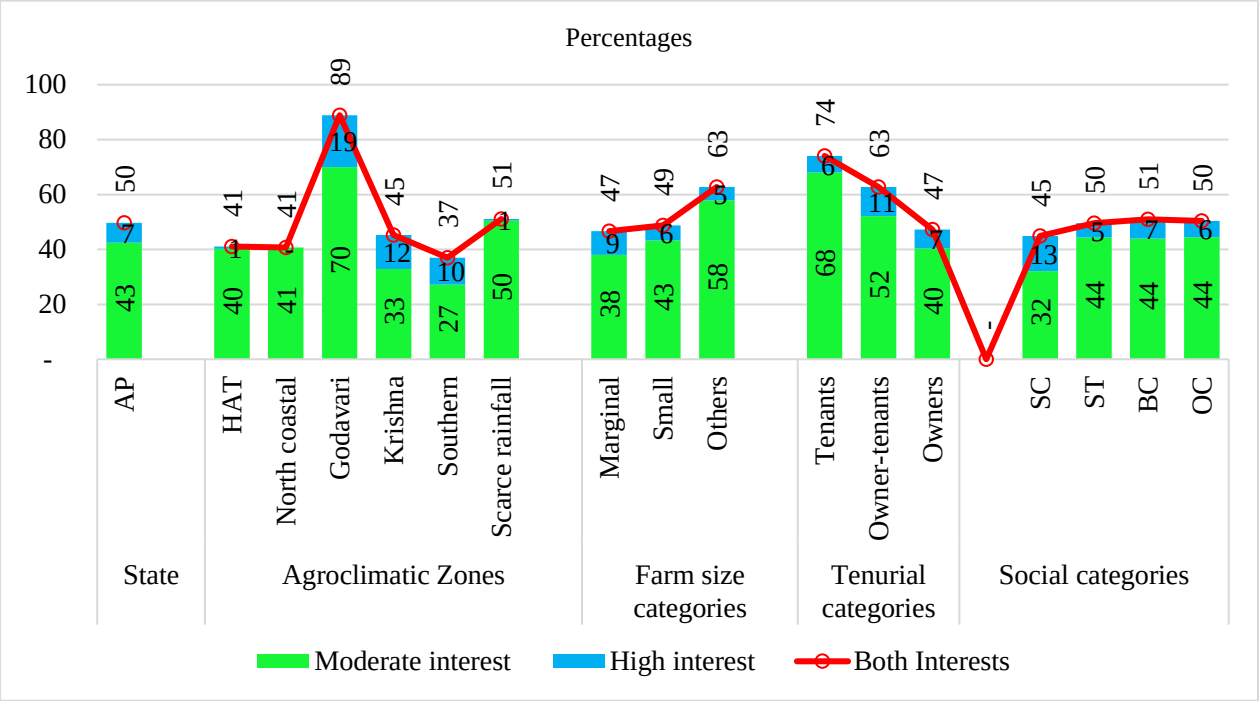


Source: *IDSAP, Field Survey 2021-22.*

Compared to 74 percent of CNF farmers, who command respect of their friends and relatives as in Figure 9.12, only 50 per cent of farmers said that they got respect in markets or from general public/ consumers, during the study period (Figure 9.13). The same varies widely from 37 percent in Southern zone to 89 percent in Godavari zone. Such variations are relatively less across different farmer categories.

The FGDs revealed that CNF output, especially the fruits and vegetables, including the leafy vegetables, have longer shelf life. Despite being chemical free and having longer shelf life, CNF output get less recognition in markets and a smaller number of CNF farmers get respect in the market. It indicates an inadequate awareness about CNF food in the general public and consumers.

Figure 9.13: Agroclimatic zones and farmer category wise CNF farmers responses about the respect they get in output markets in Kharif 2021-22



Source: IDSAP, Field Survey 2021-22

9.5. Conclusions

The detailed analysis in this chapter clearly indicates that CNF has substantial positive impact on the farmers' wellbeing. This is the need of hour. Apart from improving household income, it is positively impacting the health and education of the CNF households. CNF is freeing farmers from many compulsions and dependencies. CNF farmers are also getting new marketing channels, albeit few, for their output. Most of the farmers are commanding respect and recognition due to CNF.

Chapter 10: Implementation of APCNF: Issues, challenges and way forward

10.1. Introduction

The ultimate objective of RySS is to bring all the farmers and all the gross cropped area in the state under CNF. There has been improvement over the period in the number of farmers, who have devoted their entire gross cropped area to CNF or increasing area under CNF. There is also concern as to why all farmers are not fully bringing in their land under CNF and why all farmers in villages are not adopting CNF. CNF has to be implemented in the presence of chemical agriculture, that is supported by subsidies, incentives and other benefits. CNF has to maintain balance between interest of farmers and land. In this background, this chapter covers the issues related to the implementation of CNF project; strengths, weaknesses, opportunities and threats (SWOT) of the program (implantation); and issues and challenges encountered by farmers while adopting CNF; and way forward.

Apart from the information obtained from the HH schedule, the study conducted a wealth of information through strategic interviews (Sis) with the District Project Managers (DPMs), Mandal, Cluster and GPs level functionaries, focus group discussions (FGDs) with CNF farmers and other stakeholders in the GPs, and case studies of progressive farmers, social entrepreneurs, supportive institutions, etc. All these information have been used in this chapter. Further, the expertise and experience of the present research team are also leveraged in this chapter.

10.2. SWOT of APCNF

In this section the program implementation strategies are summarized. The SWOT analysis of the program is presented.

10.2.1. Implementation strategies

RySS is an integrated institutional mechanism to promote the APCNF across the state. The program is being implemented with hundreds of functionaries at different levels in each district by the district program management unit (DPMU) under the direction of DPMs. Broadly the following strategies are deployed in the implementation of the program.

1. Utilize the services of SHG institutions at every stage of the program implementation
2. RySS field staff visits each house and interacts with HH and get the HH enrolled in the program.
3. Distribute pamphlets to educate the HHs about CNF.
4. Exhibit district specific CNF videos in the villages.
5. Organize the training programs for the farmers in CNF
6. Arrange exposure visits for the farmers
7. Develop model farming plots for demonstration purpose in each village through internal community resource persons (ICRPs).
8. Other field functionaries like Community resource persons (CRPs), cluster assistant/ activists (Cas), master trainers (MTs), Mandal Anchors (MA), etc., provide hand holding support throughout the season/ year. They also provide other support related to raw material supply, input supply, input preparation, marketing of output, networking with others, etc.
9. RySS arranges loans from local SHG institutions and other support for setting up of NPM shops, by the enterprising farmers and other individuals.
10. RySS has been encouraging and conducting action research in collaboration with thousands of ICRPs and other functionaries. Needless to say, the learnings are being incorporated into the program design.
11. Initially 100s of cows were distributed to CNF farmers, with the support of TTD, who agreed to take good care of those animals. In some districts, the stray/ abandoned cattle, which were wondering in the urban streets were caught and distributed to CNF farmers, who agreed to take care of those animals, with the support of the urban local bodies.
12. RySS has been supporting the farmers in marketing of CNF output, through variety of means such as Shandies, Rythu Bazars, Retail shops, Online marketing, networking with malls, NGOs, urban consumer bodies, etc. Recent agreement with TTD is one important milestone, in marketing of CNF output.

10.2.2. SWOT analysis

The qualitative data collected, is summarized in the SWOT frame. The insights from the HH data and present research teams learnings are also utilized in this analysis. See Box 3 below.

Box 3: SWOT analysis of APCNF program

Strengths
1. *Less cost of cultivation and higher profitability* 2. *Increasing number of participating farmers and area under CNF* 3. *PMDS has been increasing the soil quality and productivity* 4. *Increase in crop diversity and intensity.* 5. *Availability of inexpensive biological inputs/ stimulants, which are prepared locally with locally available raw materials, in the local non-pesticide management (NPM) shops.*[53] 6. *Availability of extensive extension and handholding support throughout the year.* 7. *Availability of model plots and farmers in each village for extension and exposures.* 8. *Elevated carbon levels in, and, softness and porosity of, soils lead to higher percolations of rainwater and rising of groundwater table.* 9. *Elevated soil moisture led to reduction in irrigation requirements. It in turn led to a reduction in the electricity consumption in agriculture.* 10. *Softness and porosity of soil enable the crop/ plants' roots to penetrate deeper into the soil. This, in turn, increase the crops' resistance to dry-spells, heavy and untimely rains and strong winds.* 11. *Reduction in agricultural working capital requirements reduced borrowing by farmers, especially from informal and exploitative sources.* 12. *Reduction in agricultural working capital requirements, enable the farmers to cultivate more area, including the hitherto fallow lands.* 13. *Reduction, in agricultural working capital requirements, is encouraging different kinds of tenancies also*[54]*. In some places the owners are resuming the cultivation, at least on a part of land, due to CNF.* 14. *CNF crops have high nutritional values and improved the immune systems of consumers. In turn, it resulted in the improved health outcomes of family members and enhanced children's educational outcomes.* 15. *Reduction in the local pollution of natural resources- soil, water bodies and atmosphere.*
Weaknesses
1. *No separate marketing facility for the CNF crop output.* 2. *Apprehensions about the yields. Many, especially, the tenant farmers feel that CNF may give low yields, even after making full investment and paying the land rent; then they may incur losses.*

[53] These are facilitated by RySS through handholding and credit facility form SHG institutions

[54] One farm of tenancy, in which the land owner bears all, but the labour, costs of cultivation and the tenant bear the labour cost. In return the tenant is given a pre-determined share in the output. This kind of tenancy may not be considered as tenancy. In this way, the incidence of tenancy gets under reported.

3. *Non-availability of suitable machinery and equipment, like mixers, blenders, drums, etc., for the preparation machinery and even no separate sprayers for cultivation.*
4. *Shortage/ non-availability of suitable machinery for different agriculture operations in the mixed crops and different crops introduced under CNF and PMDS.*
5. *Shortage of raw materials, including livestock dung, urine, plant products like leaves, fruits/ seeds, etc., for the preparation of biological inputs/ stimulants.*
6. *Inadequate knowledge about inputs preparation of biological inputs/ stimulants and practices.*
7. *Preparations of CNF inputs/ stimulants are lengthy and tedious processes; and family labour intensive.*
8. *Storage of APANF inputs is difficult after preparation. At times, they are not available for the urgent usage.*
9. *CNF is labour intensive, in general, and family labour intensive, in particular.*

Opportunities

1. *Reduction in water requirements for crop cultivation. This may reduce governments' expenditures on building and operating the irrigation infrastructure. This may also reduce water disputes between the states. This may also reduce governments' power subsidy bill*
2. *Avoidance of fertilizers and pesticides use may reduce governments' fertilizers subsidy bill; and reduce the pollution of natural resources and release of greenhouse gases (GHGs).*
3. *Continuous and intensive crop cover over the fields may seize the carbon from the atmosphere and reduces GHGs levels in the atmosphere.*
4. *Consumption of chemical free CNF food may improve the health status of people.*
5. *Can reap the synergistic benefits from crop cultivation coupled with livestock rearing.*

Threats

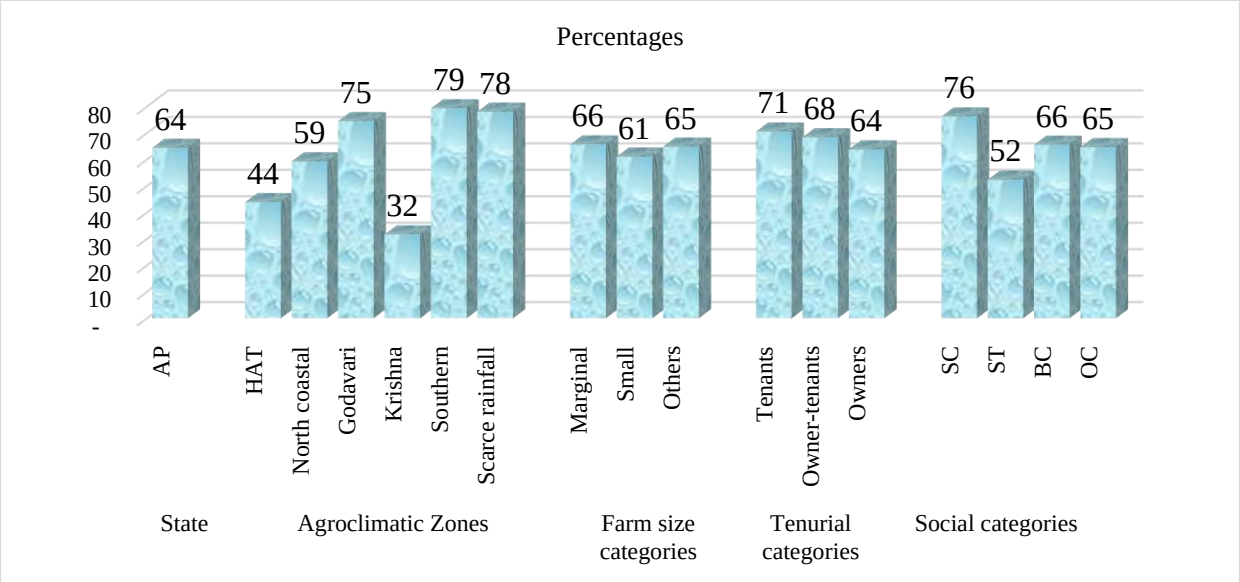
1. *Expectation of premium prices for CNF output by the farmers. Though the CNF is more profitable compared to non-CNF, the farmers are expecting premium prices. They like to have higher "minimum support prices (MSPs)" for CNF output, separate government procurement channel and certification to sell their products in the market.*
2. *No innovative techniques are found in APCNF. In the fast-paced evolution of agricultural technologies, CNF appears to be a slow paced, if not a static, strategy. For example, some recently released Chilly varieties are giving very high yields.*
3. *Overdependence on RySS field teams. Compared to the Government extension services, RySS has provided very elaborate extension services, including the demonstration/ model plots. But the challenges are temporary vacancies in the field teams and higher expectations by the farmers. CNF farmers, often, over depend on RySS field teams. Instead of going out and getting required information and inputs, they expect the field teams to visit them and supply the necessary inputs, including seeds.*
4. *Lack of integration with other Departments. Though the Government's objective is to cover the entire area under CNF, still the majority of budgetary allocation is for*

non-CNF and the official machinery is working for non-CNF. Even the agriculture research is focusing on non-CNF. The Rythu Barossa Kendras (RBKs) are supporting mostly non-CNF.

10.3. Farmers facing one problem or the other in adopting CNF

At the state level, 764 farmers or 64 percent of CNF sample farmers have reported one or the other problem in adopting CNF (Figure 10.1). Farmers, facing problems are more in Southern, Scarce rainfall and Godavari zones. Marginal farmers, landless tenant farmers and SCs constitute large proportions among those facing problems.

Figure 10.1: Percentage of CNF farmers reporting any problem in adoption of the CNF during Kharif 2021-22



Source: IDSAP, Field Survey 2021-22

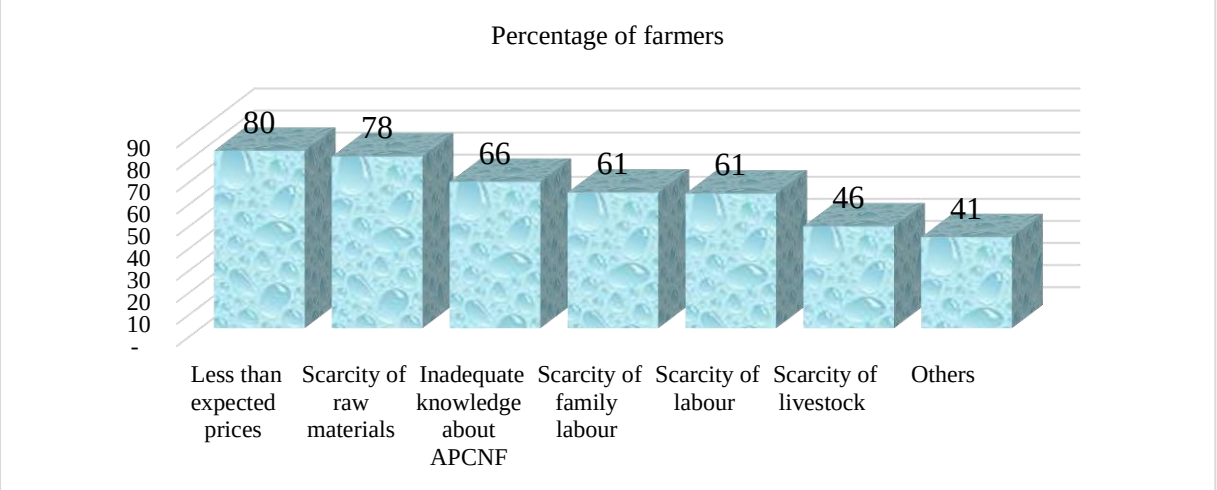
10.3.1. Major challenges identified by farmers in adopting CNF

As mentioned above, expectation of higher prices for CNF output is major challenge in the adoption of CNF[55]. The major problems identified by farmers were realised less than the expected prices (80 percent of farmers); scarcity of raw material to make biological inputs (78 percent of farmers); lack of adequate knowledge about APCNF (66 percent); scarcity of family labour (61 percent) and scarcity of hired labour (61 percent). Scarcity of livestock for dung and urine is reported by relatively less percentage of farmers. This was one of the major problems reported by most of the farmers in the earlier surveys. Recently RySS advised the farmers to

[55] The major objectives of APCNF are to reduce the cost of cultivation, improve the profitability, improve the quality of the soil and other natural resources and make available the chemical free food. But popular expectations are higher yields and higher prices for CNF output. These issues may be focussed in the awareness programs

use dung and urine of any cattle, instead of only Desi cow. This recommendation has reduced the intensity of problem considerably.

Figure 10.2: Farmers response to major identified problems in adoption of CNF, during Kharif 2021-22



Source: IDSAP, Field Survey 2021-22

10.4. Extension services

Lack of adequate knowledge about APCNF is one of the fundamental constraints for adopting CNF. This has implication in encouraging of farmers to adopt CNF. There is a need to provide extension services to encourage and educate the farmers.

About 96 percent of farmers reported that they got extension support from the master farmer, who is also known as ICRP. Apart from ICRPs, RySS field team is second most important source of extension services. Fellow farmers are the third most popular source of advice, availed by 53 percent of farmers. Relatively less percentage of farmers accessed extension services from SHG institutional leaders and members (31 percent), formal training by RySS (26 percent), exposers (14 percent), NGOs (18 percent), electronic media (24 percent), newspapers and magazines (19 percent), booklets (19 percent) and others (10 percent). On an average the respondent farmers have 10 interactions with ICRPs and 6 interactions with each of RySS field staff and fellow farmers (Table 10.1). The farmers have above average satisfaction with their interactions with first five sources of extension services and average satisfaction with next five sources cited in the Table 10.1. However, they have highest satisfaction from their interactions with ‘others’ sources of interaction. The other sources mostly consist of visits of RySS higher officials and other visitors. The type of training includes: the formal training by RySS, exposure visits organized by RySS, Booklets given by RySS are the basic training mode. Involvement of NGOs and booklets given by others and all

other private sources including the print and digital media also form part of extension services. By any standard, the extension services provided by RySS are exceptional, at least in quantitative terms. Despite this strong extension system, it is surprising as to why 66 percent of farmers reported that lack of adequate knowledge as not enabling them to adopt CNF practices. This calls for further examination of extension system in detail. Normally, the government agencies operate in a patron-client mode. Given the target-oriented strategies, the field functionaries focus on numbers rather than on quality.[56] Apart from target orientation, the government agencies do not, usually, promote the ownership stakes among the primary stakeholders. Further, there are many vacancies in the field positions, especially the ICRPs. These may be the reasons for less than desirable learning outcomes.

Table 10.1: Details of the extension services received by CNF farmers during Kharif 2021-22

Source of advice/ extension services	Number of farmers responded	Percentage of farmers responded	Average Number of interactions	Satisfaction level**
Fellow farmers	634	53	6	4
Master farmer/ ICRP	1,137	96	10	4
RySS staff -CRP, CA, MA, etc.	1,074	91	6	4
SHG/ VO members/ leaders	373	31	3	4
Formal training by RySS	304	26	4	4
Exposure visits	170	14	1	3
NGO	218	18	3	3
Electronic media TV/ Videos	288	24	3	3
Newspapers and magazines	187	16	1	3
Booklets given by RySS and others	225	19	1	3
Others	113	10	1	5

** 5=highly satisfied; 4=; more satisfied 3=satisfied; 2=less satisfied; and 1= no use
Source: IDSAP, Field Survey 2021-22

10.5. Issues and recommendations

The major issues identified in the study and possible solutions and recommendations are given in Box 4 below.

[56] This is cited one of DPMs in the strategic interviews. His words are – "*farmers need to be influenced gradually i.e., step by step process by demonstration method. Mere fixing the abnormal targets may not serve the purpose and it may lead to submit reports which are far from truth*."

Box 4: Major identified issues and corresponding recommendations

S No	Issues	Recommendation
1	Expectation of higher prices for CNF. Want certification of CNF output. Identity cards for CNF farmers. Premium MSP. Exclusive procurement by the Government.	May continue the current efforts like involving TTD kind of organizations to procure. RySS may also encourage the governments to procure CNF output for the public distribution systems (PDS), Mid-day meal schemes, Anganwadi programs, defence and police forces use, etc. RySS may continue and enlarge the activities related to marketing of CNF output, such as linking with Malls, Rythu Bazars, Shandies, Urban consumers associations, NGOs, NGO promoted Farmers Producers Organizations (FPOs), etc. RySS may undertake an advertisement campaign about the virtues of CNF food. In the advocacy, RySS may focus on higher profitability, environmental benefits, health benefits. Not focus on higher prices and yields.
2	Target orientation. Vacancies in the field teams, heavy workload on the field staff, internet connections in the remote areas, small/ basic phones, not suitable for filling and uploading a big and complicated reports.	Observation of RySS activities, in recent days, suggest that RySS is already moving from target orientation to model building. RySS may consider involving the Panchayat Raj institutions, which have big stakes in the welfare of the farmers, in implementation of APCNF.
3	Integration with the line Departments. DPMs in SIs said that the line Departments are not interfering in their work.	What is needed is a higher-level coordination and collaboration. The line Departments have resources to accelerate the expansion of CNF and benefit the farmers. E.g., the Civil Supplies Department can procure the CNF output. The Animal Husbandry Department can provide livestock and can take care of the livestock health. The Agriculture Department can provide the PMDS seeds under its Green-manure Seeds Distribution Scheme. Research institutions can provide suitable tools, and so on. Priority to CNF

S No	Issues	Recommendation
		should reflect in the Government budgetary allocation and other activities.[57]
4	Preparations of CNF inputs/ stimulants are lengthy and tedious processes; and family labour intensive. Storage of CNF inputs is an issue. CNF inputs are not readily available for urgent use.	RySS may continue and increase the efforts to promote NPM shops.
5	Labour shortage	RySS may build on current developments to link the MGNREGS with private agriculture fields' works. RySS may encourage and institutionalize the age-old labour exchange (ADALA-BADALA) system.

[57] In many FGDs, the participants said that a ban on agrochemical use may be imposed.

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