

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

Pre-Monsoon Dry Sowing Farming in Andhra Pradesh

Submitted To
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Department of Agriculture
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Executive Summary

Context

1. The Government of Andhra Pradesh has introduced Andhra Pradesh Community Managed Natural Farming (APCNF) to make agriculture profitable, environmental and natural resources friendly and climate-resilient. One of the important objectives of APCNF is to keep the soils under green cover for 365 days a year (365DGC), through Pre-Monsoon Dry Sowing (PMDS). PMDS is a system of sowing, tilling and tending the land wherein the farmer grows crops in non-farming season or whenever there is no crop cover on the land. PMDS is based on scientific principles.
2. According to the latest information provided by Rythu Sadhikara Samasta (RySS), PMDS has been taken up by 89,672 farmers in 3,135 Gram Panchayats (GPs) in Andhra Pradesh.
3. The Institute for Development Studies Andhra Pradesh (IDSAP), Visakhapatnam is entrusted the study “**Assessing the Impact of Andhra Pradesh Community Managed Natural Farming: A comprehensive Approach Using Crop Cutting Experiments. This report on PMDS is the first output and is part of this study.** The assessment period is the agricultural year 2020-21.

Objectives

4. The broad objectives of this report are:
 1. To understand the status of adoption of PMDS by farmers in the state;
 2. To assess the adoption of PMDS practices in relations to the protocols suggested by RySS;
 3. To estimate input use, costs, returns and other benefits of PMDS farming in the state;
 4. To identify major challenges faced by farmers in practicing PMDS farming;
 5. To suggest measures to improve the implementation of PMDS farming in the state for its rapid expansion among the farming community.

Approach

5. This study mainly uses primary data to answer objectives of the study. Out of 63,812 total farmers cultivating PMDS in APCNF plot, 1,130 sample households in 107 Gram Panchayats (GPs) have been drawn proportionately across 13 districts of Andhra Pradesh.

6. The data has been analyzed through the use of SPSS software for generating frequency distributions and descriptive statistics. Sample weights have been generated to arrive districts and state level estimates. Further, regression analyses are undertaken to understand the underlying facts and relations.

Adoption of PMDS

7. According to the village listing data, there are 42,877 farming households in 107 sample GPs. Out of these, 18.5 per cent are practicing PMDS in APCNF plots, 4.5 per cent are other PMDS farmers, 32.9 per cent are just practicing APCNF and 44.1 per cent are non-APCNF farmers. That is, a total of 51.4 per cent of farmers are practicing APCNF.
8. The econometric analysis of the household listing data indicates that the chances of adoption of PMDS among APCNF farmers would be high for farmers with larger holdings and own land. Compared to Rayalaseema, the adoption of PMDS among APCNF farmers is high in north and south coastal regions. The number of GPs per district varies from five in Anantapuramu to 16 in Vizianagaram. The district wise number of sample farmers varies from 32 in Anantapuramu to 234 in Vizianagaram.
9. Out of total 1,130 sample farmers, 91 (8%) are land less, 728 (64%) are marginal, 248 (22%) are small and 63 (6%) are medium and large farmers. It shows that PMDS is more popular among the small and marginal and landless farmers.
10. By and large, the profile of the sample farmers reflects the characteristics of households in the project villages, in terms of social groups, age, education, and gender distribution.

RySS protocol vis-à-vis adoption

11. Sustainable PMDS farming requires adoption of practices as per the RySS protocols. The district-wise percentages of cultivators, who adhere the protocol, are the given in table 0.1:

Table 0.1: District wise percentage of farmers adapted RySS protocol while adopting PMDS practice

Sl. No	District	0.5+ acre is under PMDS cultivation	Uses 12+ kg of seed per acre of land	Seeds treated with Beejamrutham	Pelletized the seed	Followed mulching	Used soil layer to protect mulching	Did Fencing	Average number of crops sown in each plot
1	2	3	4	5	6	7	8	9	10
1	Anantapur	91.1	40.1	100.0	2.7	100.0	22.9	40.4	11
2	Chittoor	35.0	74.6	100.0	15.0	100.0	98.8	78.1	10
3	East Godavari	96.7	36.6	96.4	21.8	56.2	25.1	42.3	7
4	Guntur	60.9	39.3	99.1	0.0	98.0	72.5	38.1	13
5	YSR Kadapa	98.2	25.6	98.2	0.0	5.4	1.8	0.0	17
6	Krishna	98.7	58.8	100.0	0.0	91.7	14.2	1.1	13
7	Kurnool	97.7	70.5	95.5	1.8	85.3	28.6	0.0	9
8	PSR Nellore	92.0	29.0	96.4	10.5	94.3	79.0	93.4	10
9	Prakasam	98.2	19.8	99.6	17.7	95.7	23.5	99.0	10
10	Srikakulam	80.9	2.0	96.9	0.0	37.6	0.0	1.6	9
11	Visakhapatnam	45.9	0.0	85.2	1.9	100.0	12.8	30.4	11
12	Vizianagaram	95.7	1.5	96.3	0.7	12.5	11.4	0.0	8
13	West Godavari	100.0	67.9	100.0	0.0	16.8	0.0	0.0	16
	Total	81.3	34.4	95.9	7.5	66.0	30.1	32.7	10

Note: the percentages are to the respective totals. Figures under column 3 to 9 are percentages of famers to respective totals; and column 10 is in actual numbers

Sources: IDSAP Field Survey 2020

12. Almost all farmers have adhered to the recommendations related to application of Beejamrutham. Mulching, is followed by 66%, and about half of them have applied soil-layer on the mulch to protect it from blowing away. Over one-third of sample farmers have adhered to the suggested seed rate of 12 plus kgs per acre. Less than one-third have put in the fencing around their plots. Only 7.5 per cent farmers have pelletized the seeds, which is a mandatory protocol recommendation.
13. The reasons for lesser proportion of farmers adopting some of recommended protocols, such as Palletisation of seeds, number of crop varieties grown in a plot, putting soil layers on the mulch, etc., need to be probed.

Costs and benefits

14. On an average, total cost of cultivation in PMDS plot is Rs. 11,939/- per hectare in the state as a whole. Major cost items are mulching material, biological inputs, labour and seeds.

15. On average, each farmer has invested Rs. 3,941 on PMDS. The per farmer expenditure on PMDS varies from Rs. 3,026 for landless category to Rs. 5,212 for medium and large farmers. The same varies from Rs. 1,434 in Visakhapatnam to Rs. 9,191 in Anantapur.
16. Gross revenue generated from crops grown in PMDS plots is Rs. 7,840/- per hectare which is lower than the per hectare average cost incurred by all sample cultivators in the state.
17. Over 70 per cent sample farmers who did not harvest crops at all for economic returns have incurred a net loss of Rs. 11,419 per hectare. Over 21 per cent of farmers have completely harvested the PMDS crops, have gained net returns of Rs. 32,283 per hectare. About 9 per cent of farmers have partially harvested their PMDS crops and obtained net returns of Rs. 12,734 per hectare.
18. To know the relation between crop output and resources used by PMDS farmers who have completely harvested their crops, Cobb-Douglas Production function is estimated. PMDS farmers have experienced the increasing-returns to scale of 2.75. That is, an additional investment of 1 per cent on PMDS would yield more than 2.75 per cent increase in output. Among the individual variables, total cost, rainfall, fencing, pelletizing the seed, and tenancy status have positive and significant relation with output. Mulching, though positive, is not significant. On the other hand, the soil-layer on the mulching has negative relation, though not significant.
19. To know the resource use efficiency (technical efficiency) at household level, Stochastic Frontier-production function has been estimated. The distribution of households as per efficiency levels indicates no pattern in number of households falling in each of efficiency level intervals. Higher percentage of small and marginal farmers are found to be efficient than land less and medium and large farmers. Farmers, who have given more importance to non-monetary benefits, are found to be more efficient. Probably, they might have invested less on PMDS. The farmers, who have provided mulching proved to be less efficient. Perhaps, the soil layer on mulching might have nullified the potential benefits from the mulching. Fencing may not be cost-effective, although beneficial. There is no difference of household efficiency with respect to palletisation. The farmers who have provided soil layer on mulching appeared to be less efficient. There is no big difference between owner and owner-cum-tenant farmers. Among six districts, which got positive gross returns, farmers in Vizianagaram are most efficient followed by YSR Kadapa and Chittoor.
20. The benefits cited by the farmers for taking up PMDS are: to keep soil under shade to protect the microorganisms in the soil (66 per cent), conserve soil moisture (51 per cent),

capture atmospheric moisture (45 per cent), fodder for the cattle (40 per cent), increased soil quality and productivity (38 per cent), etc. About 99.6 per cent of farmers have incorporated complete crop or crop residuals in the same or other plots.

Challenges

21. The major challenges faced by the farmers in PMDS farming are: menace from grazing animals, shortage of labour, shortage of protective water sources and shortage of mulching material.

Recommendations

22. As the PMDS farming has a large potential role in resolving the problem of global warming, the major threat to the planet, the PMDS farmers' contributions, need to be recognized and rewarded. It will give a big boost to the PMDS in the state, and also in the country.
23. About 74 per cent of net sown area (NSA) in state is used for single season only. Through PMDS, the cropping intensity could be increased from present 1.26 to more than 2.00.
24. Based on the experience of the farmers, who have harvested their crops, the PMDS model may be tweaked.
25. As this is a novel and very useful, the model needs to be more popularized through media and all possible methods.
26. Before analysing the field issues, the conceptual issues may be reviewed. For example, almost all the recommended protocols are uniform to the entire state. These rates and practices may be reviewed. Diverse factors such geographical conditions, soil types, local rainfall, local germination rates, composition of crops, inclusion of main crop, etc., may be considered while recommending protocols.
27. One of the important protocols, viz. providing soil layer on the mulch needs to be reviewed. It is possible that soil may absorb the morning dew and allow it to evaporate during the day time, leaving no moisture to percolate down. The regression analysis also indicated that soil layer has negative relation with crop returns.
28. Protective water sources are widely felt need. As in case of multi-layer models, RySS may collaborate with MGNREGS to provide farm ponds to the farmers. The ponds should be designed in such way to hold the water throughout the year. The ponds may get filled during un-timely/ off season rains, which has become a regular phenomenon these days.

29. Shortage of mulching material is a widely felt constraint. As a lot of biomass is available in different areas, a coordination is required to link the shortage areas with the surplus areas.
30. Grazing animals is one of the serious challenges to the PMDS plots. Live fencing may take time to establish. Building up of strong temporary fencing may be expensive. Social control of grazing may be a good option, under which, the livestock may be guarded collectively or PMDS plots may be protected collectively.

Chapter 1

Context, Objectives and Methodology

1.1 Context

The Government of Andhra Pradesh has introduced Andhra Pradesh Community Managed Natural Farming (APCNF)¹ as an alternative to chemical based agriculture. It is a paradigm shift in agricultural development aiming at making agriculture economically viable, agrarian livelihoods profitable and climate-resilient. It also aims to reduce cost of cultivation, enhance yields, increase farm incomes, reduce risks and protect agriculture sector from uncertainties of climate change by promoting the adoption of an agroecology framework. According to the latest information provided by RySS, about 7,15,349 acres of land of 6,40,833 farmers spread over in all the 13 districts is covered under this APCNF.

One of the important objectives of APCNF is to keep the soil under green cover round the year through Pre-Monsoon Dry Sowing (PMDS). Walter Jehne in his lecture in NITI Aayog in 2019 mentioned that “*PMDS through ZBNF in Andhra Pradesh is a Global breakthrough ... India’s unique contribution to the World*”. PMDS is a system of sowing, tilling and tending the land wherein the farmer grows crops in non-farming seasons or whenever there is no crop cover on the land. This can be practiced before the advent of monsoon, during summer, after Kharif and before beginning of Rabi season.

The major scientific principles behind the PMDS are:

- a. There is an abundant water vapour or micro-water-lets in the atmosphere, equal to 10 times of water flowing in all rivers and groundwater sources.
- b. There is a complex biodiversity, including microorganism under the soil surface.
- c. There is a high positive correlation between diversity on the soil surface and sub-surface. These microbes, not only need protection from agri-chemicals, but also from heat, pounding rain and wind.
- d. The microbes under the soil would convert the carbon, exuded by the plant roots, into humus and enrich the soils and prevent the release of the sub-surface carbon into the atmosphere.

¹ The farming was earlier named as Zero-Budget Natural Farming (ZBNF).

It has been confirmed that water vapor is the most important greenhouse gas in the atmosphere. There is a need to limit the concentrations and retentions of water micro-droplets in the air which is the main basis for adoption of PMDS. PMDS harnesses the water vapor from air that gets settled in the form of early morning dew. The dew supplies the required moisture to the soil. This is facilitated by the mulch material spread across the field. It uses this water vapor to provide moisture to the soil, sufficient for plants to grow. Hence, it reduces water consumption, especially groundwater consumptions and, thereby, reduces diesel motor pump cost for bailing groundwater.

It is also argued that focus should not be a just on economics of the crops and should also be on protection of soil health. Soil needs protection from heat, pounding rain, and wind. It also requires increased diversity in soil microorganisms, beneficial insects and other species. Covering soil for 365 days with plant diversity is also critical to protect soil health and to balance climate change. PMDS can facilitate all these functions.

According to latest information provided by Rythu Sadhikara Samstha (RySS), the implementing agency, PMDS has been taken up by 89,672 farmers of in 3,135 Gram Panchayats in Andhra Pradesh in Kharif 2020. The Institute for Development Studies Andhra Pradesh (IDSAP), Visakhapatnam is entrusted this study- **“Assessing the Impact of Andhra Pradesh Community Managed Natural Farming: A comprehensive Approach Using Crop Cutting Experiments. This report on situational analysis of PMDS is the first output of this study and is part of this study.** The assessment period is for the agricultural year 2020-21.

1.2 Objectives of the Study

The broad objective of this report is conducting a situational analysis of PMDS farming in the state. This enables to assess the impact of PMDS on Kharif and/or Rabi harvest within the PMDS plot. Hence the study contemplates the following specific objectives:

1. To understand the status of adoption of PMDS by farmers in the state;
2. To assess the adoption of PMDS practices in relations to the protocols suggested by RySS;
3. To estimate input use, costs, returns and other benefits of PMDS farming in the state;
4. To identify major challenges faced by farmers in practicing PMDS farming;

5. To suggest measures to improve the implementation of PMDS farming in the state for its rapid expansion among the farming community.

1.3 Methodology

Basic Approach

The study is conducted only in PMDS villages covered in all the 13 districts of the state.

Sampling Framework

This study uses primary data to answer objectives of the study. Primary data has been collected from the sample PMDS farmers across 13 districts of Andhra Pradesh. The universe of the study is 63,812 PMDS + CNF farmers belongs to 3,135 Gram Panchayats adopting PMDS farming as on September 2020. The district wise distribution of PMDS farmers is given in Table 1-1:

Table 1.1: District wise Number of PMDS cultivators in Andhra Pradesh (as on September 2020)

Sl. No	District	Gram Panchayats (GPs)	Total PMDS cultivators	Total PMDS+CNF cultivators
1	Anantapuramu	250	2,258	2,150
2	Chittoor	283	6,940	4,358
3	East Godavari	237	7,997	4,639
4	Guntur	219	6,951	1,653
5	YSR Kadapa	455	10,059	9,266
6	Krishna	266	5,154	3,360
7	Kurnool	270	5,481	5,178
8	PSR Nellore	246	5,587	3,180
9	Prakasam	152	4,364	1,138
10	Srikakulam	80	6,048	6,048
11	Visakhapatnam	260	4,647	4,139
12	Vizianagaram	213	18,849	14,457
13	West Godavari	204	5,337	4,246
	Total	3,135	89,672	63,812

Source: RySS, 2020

Among these 3,135 Gram Panchayats (GPs), a sample of 104 GPs are selected for the sample household survey. The number of Gram Panchayats selected for each district is proportional to the total number of PMDS farmers of that district (Table 1.2). Same procedure has been followed in selection of sample Gram Panchayats in each district. The envisaged sample size is 10 PMDS cultivators from each of the 8 GPs of each district. Thus, the total sample size envisaged is calculated as 1040. This sample is adequate to provide reliable estimates for the indicators analysed in the study. Keeping these requirements in mind, 100 additional samples are included. Three more villages have been added (see Appendix Table A-1). Thus, the sample

size is 1140 from 107 sample PMDS practicing Gram Panchayats of Andhra Pradesh (Table 1.2).

Table 1.2: District wise sample GPs and allocated sample farmers

Sl. No	District	Sample GPs for survey	Sample PMDS cultivators
1	Anantapuramu	5	32
2	Chittoor	8	84
3	East Godavari	11	111
4	Guntur	7	65
5	YSR Kadapa	8	80
6	Krishna	7	72
7	Kurnool	7	70
8	PSR Nellore	7	75
9	Prakasam	7	77
10	Srikakulam	10	101
11	Visakhapatnam	7	69
12	Vizianagaram	16	234
13	West Godavari	7	70
	Total	107	1140

Source: IDSAP, 2020

Data Base

The study utilises primary data collected from the sample Gram Panchayats. A household listing has been carried out to identify households practicing exclusively PMDS in CNF plot, PMDS in non-CNF plots, cultivating only CNF and only non-CNF crops, PMDS without any follow up crops. Details of major crops grown by farmers are also collected through household listing. The distribution of listed cultivators across these categories in 107 listed GPs shows that proportion of cultivator exclusively practicing PMDS (without any follow up crops) and PMDS farming in non-CNF plots are negligible and not sufficient to generate reliable estimates. The population for the household study is confined to the cultivators practicing PMDS in CNF plots only.

From the total sample PMDS plus CNF cultivators of each GP, 10 cultivators have been selected randomly for the household survey. The GPs having sample less than 10 are compensated from the samples of other GPs with in the same district. ***The total 1040 sample households were inadequate for providing the estimates for crop wise yields at state level.***

Thus, the study uses quantitative data collected through administrating a structured household questionnaire across sample households. The data has been analysed through the use of SPSS software for generating frequency distributions and descriptive statistics. Sample weights are generated by considering total number of PMDS+CNF farmers and sample farmers selected

for survey at each Gram Panchayat level. The district level estimates and state level estimates are derived by considering number of PMDS farmers as weights. Multivariate analysis has been conducted through econometric analysis.

1.4 Structure of the Report

The report has been organised into five chapters including the introduction chapter. The second chapter discusses about the status of adoption of PMDS farming among the sample households in the state of Andhra Pradesh. The third chapter explores various practices adopted by the cultivators as a part of PMDS farming in relation to PMDS practice protocol prepared by RySS. The fourth chapter estimates input used, cost and returns and other benefits of PMDS farming among the sample households. The fifth chapter identifies main challenges faced by the sample farmers in practicing PMDS farming. The last chapter is about summary and recommendations of the study. The executive summary is also presented.

Chapter 2

Status of Adoption of PMDS in Andhra Pradesh

2.1 Introduction

This chapter presents current status of PMDS farming in the state of Andhra Pradesh. It attempts the analysis at two levels. At first level analysis has been conducted to identify factors enabling CNF farmers for adopting PMDS in relation to farmers practicing CNF but not adopted PMDS. The second level analysis has been conducted to identify factors responsible for the variation among different farming groups, from among the sample farmers of PMDS+CNF. The proportion of farmers adopted PMDS has been estimated across land ownership categories – tenant-categories, social groups and demographic groups like male/female headed, age of farmer, literacy level, and farmers among occupational groups.

2.2 Status of PMDS Farming

The household listing data in 107 sample PMDS adopted villages indicates that about 19 per cent of cultivators (i.e., 36% of total CNF farmers) are growing PMDS in CNF plots (Table 2.1). It implies that the PMDS farming practice, which is an integral components of natural farming practices, is gaining popularity among the CNF farmers. About 33 per cent of CNF farmers are yet to be brought under PMDS. About 22-33 per cent of CNF farmers are practicing PMDS in Vizianagaram, PSR Nellore, Chittoor and Visakhapatnam districts. This proportion is quite lower in Anantapuramu, Kurnool and YSR Kadapa districts, which are drought-prone.

Table 2.1: District wise total number of cultivators classified into broad farming categories (in percentage)

Sl. No	District	Number of farmers	PMDS with CNF	Other PMDS *	CNF only	NON-CNF only
1	Anantapuramu	1352	3.7	0.0	48.1	48.2
2	Chittoor	3113	23.8	0.4	55.4	20.4
3	YSR Kadapa	4411	10.7	4.9	44.6	39.9
4	Kurnool	1900	8.8	1.9	50.4	38.9
5	East Godavari	3041	13.8	4.1	28.5	53.6
6	Guntur	3731	13.4	1.9	19.6	65.2
7	Krishna	1750	14.8	2.5	25.4	57.3
8	PSR Nellore	2262	25.4	3.0	21.9	49.7
9	Prakasam	2989	14.4	1.3	44.8	39.5
10	Srikakulam	4819	12.3	1.4	26.1	60.2
11	Visakhapatnam	2690	22.3	7.7	44.5	25.5
12	Vizianagaram	8595	33.1	12.0	23.1	31.8
13	West Godavari	2224	12.7	0.4	21.5	65.4
	Total	42877	18.5	4.5	32.9	44.1

Note: * It also includes cultivators practicing PMDS in non-CNF plot and PMDS farmers but not cultivating land in kharif season.

Source: IDSAP Field Survey, 2020

2.2.1 Factors influencing to the CNF farmers to adopt PMDS

To understand the factors, which influence the CNF farmers to adopt PMDS, two Logit Regression models have been estimated out with the listing data. Two versions of models, namely model 1 and model 2 have been estimated by using dependent variable: 1= CNF farmers adopted PMDS, 0= CNF farmers not adopted PMDS. In model 1, the independent variables considered are: (1) Operational holdings (in acres), (2) Tenancy status, (3) Regions². In model 2, the independent variables considered are: (1) Operational holdings (in acres), (2) Tenancy status, (3) Districts. The results are presented at Table 2.2. Among two models, Model 2 found to be a better fit. Model 1 indicates that with increase in size of operational landholding by an acre, the odds in favour of adopting PMDS among the CNF farmers increases by 8.0 per cent. Compared to pure tenants, the rate of adoption of PMDS by the owners and owner-cum-tenants is significantly higher by 29.2 per cent and 49.0 per cent respectively. PMDS adoption rate among the CNF farmers is significantly higher in north-coastal and south-coastal regions than that of in Rayalaseema. Further analysis has been conducted in Model 2 by including district dummies in the place of regional dummies. Model 2 also gives similar results with regards to land under cultivation and tenancy groups. However, the rate of PMDS adoption among the CNF farmers is higher in all districts compared to Anantapuramu. The rate of adoption is highest in Vizianagaram district followed by Nellore, Guntur, Krishna and West Godavari districts. Nevertheless, no pattern is observed across districts with regards to adoption of PMDS by the CNF farmers. It implies that the district-specific factors have larger influence towards adoption of PMDS by the CNF farmers.

Table 2.2: Factors influencing adoption of PMDS by the CNF farmers

	Model 1		Model 2	
	exp(b)	SE	exp(b)	SE
Operational land holding	1.080***	0.008	1.118***	0.008
Tenancy				
Pure Tenant (control group)				
Owner	1.292***	0.061	1.115*	0.066
Owner-cum-tenant	1.490***	0.084	1.398*	0.087
Region				
Rayalaseema (control group)				
North-coastal	3.481***	0.036		
South- coastal	2.424***	0.042		
District				

² In this report, the state is divided into three regions, viz. (1) North Coastal consists of Srikakulam, Vizianagaram, Visakhapatnam and East Godavari; (2) South Coastal -West Godavari, Krishna, Guntur, Prakasam and Nellore, (3) Rayalaseema – Chittoor, Kadapa, Kurnool and Anantapuramu

Anantapuramu (control group)				
Chittoor			7.281***	0.156
Kadapa			3.702***	0.157
Kurnool			2.373***	0.170
East Godavari			8.357***	0.161
Guntur			11.939***	0.162
Krishna			10.250***	0.168
Nellore			19.628***	0.162
Pakasham			5.196***	0.159
Srikakulam			7.781***	0.158
Visakhapatnam			9.759***	0.156
Vizianagaram			24.488***	0.152
West Godavari			10.742***	0.173
Constant	0.167***	-0.073	0.042***	0.165
-2 Log likelihood	28256.845		26984.700	
Nagelkerke R Square	0.081		0.152	
Number of observations	22564		22564	

Note: *** significant at 0.01 percent level, * significant at 10 per cent level.

Source: IDSAP Field Study, 2020

2.3 Category of sample farmers practicing PMDS

Land ownership status and adoption

Table 2.3 shows that mainly marginal (about 64 per cent) and small (about 22 per cent) farmers are doing PMDS farming in the state. Even about 8 per cent of tenant farmers are also practicing PMDS. But surprisingly only 6 per cent of medium and large farmers are practicing PMDS. The scrutiny of the data has revealed that medium and large farmers are mostly growing summer crops during this season which fetch higher returns.

Proportion of marginal farmers adopting PMDS farming is more than the state average in Visakhapatnam, PSR Nellore, Vizianagaram, Srikakulam and Chittoor districts. Similarly, the proportion of small farmers adopting PMDS is more than the state average in Kurnool, Chittoor, Anantapuramu, Prakasam, YSR Kadapa and Vizianagaram districts. More medium and large farmers of Anantapuramu, YSR Kadapa, West Godavari, Srikakulam and Kurnool districts have adopted PMDS farming but this proportion is low (less than 1 per cent) in PSR Nellore, Visakhapatnam, Guntur and Chittoor districts. It can be noted that more tenant farmers of Guntur, Krishna and East Godavari districts have adopted PMDS farming than small and medium and large farmers. Perhaps tenancy farming is quite prevalent in these districts. Therefore, it is evident that marginal, small and tenant farmers have opted in lesser proportion compared to medium and large farmers. This is due to the fact that medium and large farmers have practiced summer crop. This fetches higher returns.

Table 2.3: District-wise and farm category wise distribution of sample PMDS+CNF cultivators in Andhra Pradesh (in percentage)

District	No of Cultivators	Land less	Marginal	Small	Medium and Large	Total
Anantapuramu	32	11.60	31.89	33.06	23.44	100.00
Chittoor	84	0.00	65.20	33.99	0.81	100.00
YSR Kadapa	111	7.09	54.33	27.75	10.83	100.00
Kurnool	65	2.05	51.51	39.17	7.27	100.00
East Godavari	80	23.77	59.44	11.36	5.43	100.00
Guntur	70	34.53	54.18	10.06	1.23	100.00
Krishna	70	28.27	62.20	7.60	1.93	100.00
PSR Nellore	75	2.35	78.84	17.44	1.37	100.00
Prakasam	77	2.11	61.45	31.96	4.48	100.00
Srikakulam	101	1.72	70.97	19.77	7.53	100.00
Visakhapatnam	69	2.02	81.78	14.97	1.23	100.00
Vizianagaram	226	0.81	71.25	23.28	4.66	100.00
West Godavari	70	7.77	63.66	17.90	10.67	100.00
Total	1130	8.05	64.45	21.94	5.56	100.00

Source: IDSAP Field Survey, 2020

Land Tenurial status and Adoption

About 80 per cent of land owners and 11 per cent of owner-cum-tenant farmers have practiced PMDS whereas this proportion for pure tenant farmers is 8 (Table 2.4). Among the landowning class, more than 80 per cent cultivators of Chittoor, Visakhapatnam, Vizianagaram, Prakasam, Kurnool, PSR Nellore and YSR Kadapa are practicing PMDS. PMDS adoption is predominantly prevalent among pure tenant in delta districts of Guntur, Krishna and East Godavari districts. Similarly, PMDS adoption is more among the owner-cum-tenant in Guntur, Srikakulam and East Godavari districts. It implies that land security is one of the important reasons for adoption of PMDS practice. The estimates from all household listing data also give similar results (see Appendix Table A-2 & 3).

Table 2.4: District wise distribution of PMDS cultivators according to tenurial status (in percentage)

District	Owner	Owner-cum-tenant	Pure tenant	Total
Anantapuramu	75.05	13.34	11.60	100.00
Chittoor	99.22	0.78		100.00
YSR Kadapa	81.66	11.25	7.09	100.00
Kurnool	91.20	6.75	2.05	100.00
East Godavari	57.92	18.31	23.77	100.00
Guntur	44.20	21.26	34.53	100.00
Krishna	41.49	30.24	28.27	100.00
PSR Nellore	85.91	11.74	2.35	100.00
Prakasam	92.57	5.32	2.11	100.00
Srikakulam	77.51	20.77	1.72	100.00
Visakhapatnam	95.96	2.02	2.02	100.00
Vizianagaram	93.18	6.01	0.81	100.00
West Godavari	76.77	15.46	7.77	100.00

Total	80.80	11.15	8.05	100.00
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Source: IDSAP Field Survey, 2020

The proportion of farmers growing PMDS in leased-in land is about 9 per cent in the state as a whole (Table 2.5). About 1.5 per cent among landowning class growing PMDS in leased-in land is mainly observed in the Delta districts of East Godavari, Guntur and Krishna. The marginal farmers of these districts and also districts having smaller landholding like Srikakulam have adopted PMDS. PMDS among the small farmers is observed in Krishna, West Godavari and YSR Kadapa districts. Interestingly, PMDS practice among the medium and large owning class is restricted to the Srikakulam district only. Thus, it is clear that the pure tenant farmers who have adopted PMDS in the entire household land. Table 2.5: District wise and farm category wise percentage of cultivators growing PMDS in leased-in land

District	Land less		Marginal		Small		Medium and Large		Total	
	Own	Leased-in	Own	Leased-in	Own	Leased-in	Own	Leased-in	Own	Leased-in
Anantapuramu	0.0	100.0	100.0	0.0	100.0	0.0	100.0	0.0	88.4	11.6
Chittoor			100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0
YSR Kadapa	0.0	100.0	99.0	1.0	97.5	2.5	100.0	0.0	91.7	8.3
Kurnool	0.0	100.0	100.0	0.0	100.0	0.0	100.0	0.0	98.0	2.0
East Godavari	0.0	100.0	97.1	2.9	100.0	0.0	100.0	0.0	74.5	25.5
Guntur	0.0	100.0	95.4	4.6	100.0	0.0	100.0	0.0	62.9	37.1
Krishna	0.0	100.0	98.4	1.6	93.3	6.7	100.0	0.0	70.3	29.7
PSR Nellore	0.0	100.0	100.0	0.0	100.0	0.0	100.0	0.0	97.7	2.3
Prakasam	0.0	100.0	99.5	0.5	100.0	0.0	100.0	0.0	97.6	2.4
Srikakulam	0.0	100.0	94.0	6.0	100.0	0.0	74.3	25.7	92.1	7.9
Visakhapatnam	0.0	100.0	100.0	0.0	100.0	0.0	100.0	0.0	98.0	2.0
Vizianagaram	0.0	100.0	99.0	1.0	100.0	0.0	100.0	0.0	98.4	1.6
West Godavari	0.0	100.0	98.2	1.8	89.0	11.0	100.0	0.0	89.1	10.9
Total	0.0	100.0	98.9	1.1	98.5	1.5	98.8	1.2	90.8	9.2

Source: IDSAP Field Survey, 2020

Social groups and adoption

It is clear from Table 2.6 that a higher proportion of both OC and BC communities, about 38 per cent and 28 per cent respectively, have adopted PMDS farming followed by the STs (about 21 per cent) and SC farmers (about 13 per cent). Further analysis of data show that about 21 per cent of SC farmers are landless/tenants and another 62 per cent are marginal farmers whereas the proportion of tenant farmers in BC and OC categories are only 10 per cent and 4 per cent respectively.

A higher proportion of PMDS among the ST cultivators may be because of their age-old natural farming practices. Further about 96 per cent of STs own land and the proportion of pure tenant among them is only 2 per cent. The BCs and OCs also own more land. However, their proportion in PMDS farming practice is higher. Thus, social groups have own land have adopted PMDS on larger proportion.

Table 2.6: District-wise distribution of PMDS+CNF cultivators among the social groups (in percentage)

District	SC	ST	BC	OC	Total
Anantapuramu	41.91	5.93	47.36	4.80	100.00
Chittoor	20.31	1.49	23.90	54.30	100.00
YSR Kadapa	15.80	0.00	30.00	54.21	100.00
Kurnool	6.13	0.00	91.82	2.04	100.00
East Godavari	1.72	27.32	43.68	27.28	100.00
Guntur	42.15	0.00	24.11	33.74	100.00
Krishna	20.80	0.00	60.42	18.77	100.00
PSR Nellore	24.75	15.83	42.17	17.26	100.00
Prakasam	17.76	3.38	34.85	44.01	100.00
Srikakulam	2.16	1.82	88.30	7.73	100.00
Visakhapatnam	6.06	72.91	15.97	5.06	100.00
Vizianagaram	1.62	46.28	51.52	0.58	100.00
West Godavari	2.30	45.78	11.87	40.05	100.00
Total	13.15	21.36	37.84	27.65	100.00

Source: IDSAP Field Survey, 2020

Demographic groups and Adoption

The male headed households mostly opted for PMDS farming (Table 2.7). The young and middle-aged farmers are more in PMDS than the aged farmers. More literates in comparison to the illiterates are into PMDS. Further, more cultivator communities have engaged in PMDS than that of the salaried class and other occupation holders.

Table 2.7: Farm category wise distribution of PMDS farmers according to demographic groups (in percentage)

Demographic characteristics		Land less	Marginal	Small	Medium and Large	Total
Gender of household head	Male	98.96	94.02	94.71	94.98	94.62
	Female	1.04	5.98	5.29	5.02	5.38
Age of household head	<= 40 years	29.71	29.43	31.23	20.72	29.36
	40-50 years	27.62	34.87	29.93	34.16	33.17
	50-60 years	35.87	26.73	25.81	31.46	27.53
	>= 60 years	6.80	8.97	13.03	13.66	9.94
Education of household head	Illiterate	44.89	41.19	42.12	53.35	42.37
	Primary	17.64	13.74	14.36	2.82	13.59
	Middle	13.58	10.88	10.57	17.22	11.38
	Secondary	15.58	19.55	12.71	11.15	17.26
	Higher secondary/ diploma	4.72	7.33	11.76	7.12	8.08
	Graduate and above	3.59	7.31	8.48	8.35	7.32
Occupation of household head	Cultivator	83.82	83.98	91.70	89.75	85.98
	Agricultural labour	5.00	8.14	2.87	0.83	6.33
	Salaried Work	1.31	2.94	2.30	5.02	2.78
	Others	9.86	4.93	3.13	4.39	4.91
	Total	100.00	100.00	100.00	100.00	100.00

Source: IDSAP Field Survey, 2020

2.4 Conclusions

The chapter shows that more than one-third of the CNF farmers have adopted PMDS across project areas of Andhra Pradesh. The regression analyses indicate that operational holding size has some, but small positive impact on adoption of PMDS among CNF farmers. The propensity to adopt PMDS is highest among owner cum tenant farmers, followed by owner-farmers. PMDS adoption rate among the CNF farmers is higher in north-coastal and south-coastal regions compared to Rayalaseema. The rate of adoption is highest in Vizianagaram district followed by Nellore, Guntur and West Godavari districts.

The analysis of sample farmers shows that the majority of CNF farmers belong to landowning class and BC and OC communities are practicing PMDS among the CNF farmers adopted PMDS. More male headed households, young/middle aged farmers, farmers having literacy status and whose occupation is cultivation are practicing PMDS. It may be noted that these sections are in majority in the population; hence their higher representation is on the expected lines only. The analysis also suggests that PMDS farming is found among the tenant farmers also. PMDS farming is found in leased-in land, although such phenomenon is confined to some geographical locations. PMDS practice is also getting popular among the highly educated farmers and by persons whose main source of livelihood is other than agriculture.

Chapter 3

Adoption of PMDS Practices and RySS Protocols

3.1 Introduction

This chapter explores various farming practices adopted by farmers as a part of PMDS adoption process. It also highlights whether such practices are commensurate with the practices suggested by the RySS Protocols. This analysis enables to identify constraints, if any, for better intervention by the project authorities to follow the procedures. The Protocols issued by RySS about PMDS practices is presented in Box 3.1.

Box 3.1

Protocols for PMDS farming: Highlights

- To maintain at least 0.5 acre under PMDS by each cultivator.
- Grow at least 15 to 20 varieties of crops depending on local preferences in PMDS plot with a combination of Cereals, Pulses, Oil seeds, Fodder, Vegetables, Tubers, Creepers, Leafy vegetables and flowers.
- The seed rate should be 12-15 Kg/acre and optimize based on the local farming situation
- Seeds should be treated with Beejamrutham
- Pelletize the Seed with clay, Ghana Jeevamrutham and Ash.
- Application of Ghana Jeevamrutham in case of line sowing
- Spraying of Dhruva Jeevamrutham in the soil before and also after germination of seeds.
- Restrict to minimal tillage and inter-cultural operations.
- Mandatory mulching with local availability of items. Paddy husk should not be used as mulching material.
- Application of a thin soil layer on the mulch material to prevent the loss of mulch material due to wind.
- Fencing is mandatory for all PMDS plots—fencing may be temporary of short period of time or live fencing with Sesbania, Glyricidia, or Drumstick or any other species.

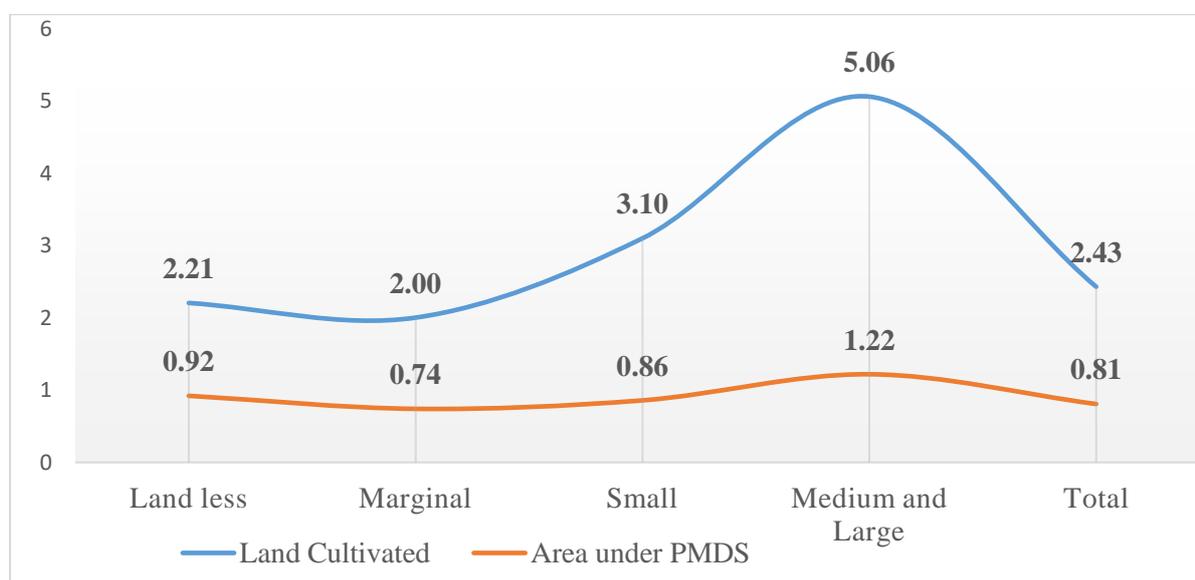
Source: RySS, GoAP

3.2 PMDS Farming Practices

3.2.1 Area under PMDS

The average land under PMDS farming is 0.81 acres whereas average land under cultivation is 2.43 acre (Figure 3.1). The estimated correlation coefficient between total area under cultivation and area under PMDS is positive but low. Though more lands of medium and large farmers is under PMDS than marginal and small farmers, the correlation coefficient between these two is negative for the medium and large farmers. The average area under PMDS among the tenant farmers is higher than the state average.

Figure 3.1: Farm category wise average area under PMDS crop (in acres)



Source: IDSAP Field Survey, 2020

Among all the sample household, 33.33 per cent operational holding is under PMDS. The same is 41.63 per cent for tenant farmers, 37 per cent for marginal farmers, 27.74 per cent for small farmers and 24.11 per cent for medium and large farmers.

The district wise area under cultivation and also PMDS area indicate that farmers of YSR Kadapa, West Godavari, Krishna, PSR Nellore, Vizianagaram and Guntur have cultivated more land under PMDS than the state average (Table 3.1). It is also clear that districts having more cultivated area are not allocating more land under PMDS in absolute terms. The extent of area under PMDS is very low in Kurnool, Chittoor and Visakhapatnam districts. The minimum area under PMDS is low at 0.10 acres in YSR Kadapa, Kurnool, PSR Nellore, Srikakulam and Visakhapatnam. It indicates that low rainfall districts and smaller landholding districts have

kept less land under PMDS. District wise and Gram Panchayat wise minimum, average and maximum area under PMDS is shown in Appendix 5. Highest percentage of (61.64 per cent) cultivated area is put under PMDS in PSR Nellore, followed by West Godavari (58.42 per cent) and YSR Kadapa (47.56 per cent). On the other hand only 14.10 per cent of cultivated area was put under PMDS in Kurnool, preceded by Visakhapatnam (14.90 per cent), Chittoor (18.30 Per cent) and Anantapuramu (19.65 per cent).

Table 3.1: District wise area under cultivation and area under PMDS (in acre & cent)

District	land cultivated			Area under PMDS			PMDS area as % of operational area
	Minimum	Average	Maximum	Minimum	Average	Maximum	
Anantapuramu`	1	3.97	16	0.25	0.78	1	19.65
Chittoor	0.5	2.18	5.1	0.2	0.4		18.30
YSR Kadapa	0.2	2.46	7.1	0.1	1.17	5	47.56
Kurnool	0.5	3.12	10	0.1	0.44	1.5	14.10
East Godavari	0.5	2.07	7.5	0.3	0.8	1.5	38.65
Guntur	0.4	2.26	11	0.35	0.84	1	37.17
Krishna	0.5	3.06	12	0.25	1.02	5	33.33
PSR Nellore	0.5	1.59	5	0.1	0.98	3	61.64
Prakasam	0.5	2.51	12.5	0.4	0.63	5	25.10
Srikakulam	0.5	2.53	13.04	0.1	0.66	1.4	26.09
Visakhapatnam	0.4	2.55	18.03	0.1	0.38	1	14.90
Vizianagaram	0.25	2.4	25	0.25	0.85	3	35.42
West Godavari	0.5	1.9	14	0.5	1.11	4	58.42
Total	0.2	2.43	25	0.1	0.81	5	33.33

Source: IDSAP Field Survey, 2020

Table 3.2 indicates that majority of farmers of all districts, except Chittoor, Visakhapatnam and Kurnool have at least 0.5 acre, as suggested by RySS, under PMDS. The most spurring result is that about 96 per cent of tenant farmers have put in RySS recommended 0.5 acre under PMDS. Majority medium and large farmers of all district except Chittoor, Kurnool and Vizianagaram have also allocated proposed 0.5 acre of land for PMDS.

Table 3.2: District wise and farm category wise percentage of farmers cultivating 0.5 acres of land under PMDS

District	Land less	Marginal	Small	Medium and Large	Total
Anantapuramu	74.4	90.7	91.0	100.0	91.1
Chittoor		32.3	40.9	0.0	35.0
YSR Kadapa	100.0	95.4	98.6	96.4	96.7
Kurnool	0.0	48.7	78.1	71.8	60.9
East Godavari	100.0	96.9	100.0	100.0	98.2
Guntur	100.0	97.7	100.0	100.0	98.7
Krishna	93.7	99.2	100.0	100.0	97.7

PSR Nellore	100.0	89.9	100.0	100.0	92.0
Prakasam	100.0	97.1	100.0	100.0	98.2
Srikakulam	100.0	73.6	98.2	100.0	80.9
Visakhapatnam	100.0	39.9	67.0	100.0	45.9
Vizianagaram	100.0	96.0	96.2	88.5	95.7
West Godavari	100.0	100.0	100.0	100.0	100.0
Total	96.0	77.2	84.6	94.4	81.3

Note: the percentages are related to the respective groups in the district and stage as a whole.
Source: IDS Field Survey, 2020

3.2.2 Quantity of Seed used

On an average 9 kg of seed were used per acre of PMDS land which is low in comparison to RySS protocol of 12-15 kgs per acre. Seed rate is high among the tenant farmers (Table 3.3). It is also evident the estimated correlation coefficient between land size and seed rate among the landowning classes are positive and statistically significant. As such seed rate among the medium and large farmers is higher than small and marginal farmers, although this trend is not prevalent in all districts. In fact, in Chittoor district higher seed rate is found among the marginal farmers which starts declining among the small, medium and large farmers. The seed rate among the farmers of Chittoor, West Godavari, Guntur, Krishna, East Godavari, Kurnool and PSR Nellore districts is higher than the state average. Even tenant farmers of these districts, except Chittoor and PSR Nellore, have used more seeds than the state average of 9 Kg per acre. Seed rate is very low among the farmers of north coastal districts of Srikakulam, Vizianagaram and Visakhapatnam. Seed rate, across the districts, may be influenced by the initiatives of the concerned DMUs, availability of seeds, composition of the seeds/ crops, purpose of PMDS (manure or yield/ revenue), local germination rates, etc.

Table 3.3: District wise and Farm category wise use of seeds in PMDS plot (kg/acre)

District	Land less	Marginal	Small	Medium and Large	Total
Anantapuramu	12.38	6.73	8.91	10.70	9.06
Chittoor		16.35	15.20	13.33	15.90
YSR Kadapa	6.96	8.06	8.92	9.79	8.47
Kurnool	3.00	9.77	9.67	11.49	9.83
East Godavari	9.37	10.21	11.08	11.88	10.25
Guntur	11.02	12.55	13.52	11.40	12.11
Krishna	12.98	11.54	17.90	3.00	11.73
PSR Nellore	8.25	10.15	6.75	8.00	9.37
Prakasam	5.88	8.74	8.37	10.23	8.58
Srikakulam	4.14	4.73	4.63	4.89	4.71
Visakhapatnam	3.00	3.17	2.70	2.04	3.04
Vizianagaram	4.00	4.21	4.40	4.18	4.25
West Godavari	13.64	12.93	11.66	13.24	12.70

Total	10.72	8.88	9.03	9.46	9.13
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Note: the percentages are related to the respective groups in the district and state as a whole.

Source: IDSAP Field Survey, 2020

Only 34 per cent of PMDS farmers have followed the RySS protocol of using at least 12 kgs of seed per acre (Table 3.4). A systematic pattern is observed among the district and among the landowning classes with regards to the use of seeds. The north coastal districts have used lower quantity of seeds for the reasons stated above. The local germination rate could also be a reason for use of less or more seeds. Supply of required number of seeds by the DPMs is one of the main reasons for higher use of seed in the PMDS plot in West Godavari and Chittoor districts. There is also a pattern with regard to seed use among the landowning classes. The seed rate is significantly correlated with the extent of land owned at the state level. However, this pattern is not observed across all the districts. The noteworthy fact is that many tenant farmers of Anantapuramu, Guntur, Krishna, and West Godavari districts have used required quantity of seed as per the RySS protocol. *The findings suggests that use of seeds probably depends on germination rate, availability of adequate seeds due to DPM's interventions, geographical characteristics, type of crops planned and need of the farmers.* Hence, local farming conditions determine the seed rate of PMDS.

Table 3.4: District wise and Farm category wise percentage of farmers used 12 kgs and above of seed per acre of PMDS land

District	Land less	Marginal	Small	Medium and Large	Total
Anantapuramu	74.4	16.8	47.9	43.6	40.1
Chittoor		72.9	77.1	100.0	74.6
YSR Kadapa	16.1	36.4	41.4	37.7	36.6
Kurnool	0.0	38.0	39.8	57.6	39.3
East Godavari	18.5	19.2	54.0	67.7	25.6
Guntur	66.0	56.4	44.7	72.8	58.8
Krishna	62.0	71.3	100.0	50.0	70.5
PSR Nellore	0.0	32.3	20.8	0.0	29.0
Prakasam	0.0	27.5	2.3	49.4	19.8
Srikakulam	0.0	2.9	0.0	0.0	2.0
Visakhapatnam	0.0	0.0	0.0	0.0	0.0
Vizianagaram	0.0	1.1	3.4	0.0	1.5
West Godavari	67.4	62.0	75.8	90.7	67.9
Total	41.8	31.3	38.5	43.2	34.4

Source: IDS Field Study, 2020

Seed treated with Beejamrutham

All most all the farmers treated seed with Beejamrutham. The rate of response is about 96 per cent (Table 3.5). It is noteworthy that all medium and large farmers have treated seed with Beejamrutham, the responses for tenant, marginal and small farmers are close to 100 percent. Among the tenant, proportion of farmers treated seed with Beejamrutham is more in Krishna, YSR Kadapa, East Godavari and Guntur. However, no systematic pattern exists across districts and landholding class with regards to treating seed with Beejamrutham.

Table 3.5: District wise and farm category wise seeds treated with Beejamrutham (in percentage)

District	Land less	Marginal	Small	Medium and Large	Total
Anantapuramu	100.00	100.00	100.00	100.00	100.00
Chittoor		100.00	100.00	100.00	100.00
Kadapa	100.00	98.71	90.34	100.00	96.44
Kurnool	100.00	100.00	97.68	100.00	99.09
East Godavari	100.00	96.92	100.00	100.00	98.17
Guntur	100.00	100.00	100.00	100.00	100.00
Krishna	87.45	98.47	100.00	100.00	95.53
Nellore	100.00	95.41	100.00	100.00	96.41
Prakasham	100.00	100.00	98.62	100.00	99.56
Srikakulam	100.00	97.15	94.00	100.00	96.86
Visakhapatnam	100.00	87.48	69.79	100.00	85.21
Vizianagaram	100.00	96.24	95.80	100.00	96.34
West Godavari	100.00	100.00	100.00	100.00	100.00
Total	95.98	96.35	93.63	100.00	95.92

Note: percentage are respective totals. Source: IDSAP Field Survey, 2020

Pelletizing seed

The RySS protocol states that pelletizing seed is essential in Rayalaseema and Prakasam districts, in irrigated dry conditions and Rabi fallows in all districts. Most of the farmers have not pelletized the seed. The response rate for pelletizing the seed is only 7.5 per cent at the state (Table 3.6). The response rates among the farmers of YSR Kadapa, Prakasam, Chittoor and PSR Nellore districts are higher than that of state average. In other districts i.e., Anantapuramu, Visakhapatnam, Krishna and Vizianagaram, the response rate is less than 3 per cent. No farmers of Kurnool, East Godavari, Guntur, Srikakulam and West Godavari districts have pelletized the seed. None of the medium and large farmers of all districts, except YSR Kadapa, have pelletized the seed. Also, tenant farmers of all districts, except Prakasam, YSR Kadapa and Krishna have not pelletized the seed. It implies that some of the districts have not fulfilled the RySS protocol although palletisation of seeds is one of the important components for better germination and better plant growth in dry condition. The RySS staff should take initiative to create awareness and conduct demonstration programmes to popularise the process/benefits of palletisation of seed.

Table 3.6: District wise and farm category wise of farmers pelletized the seed (in percentage)

District	Land less	Marginal	Small	Medium and Large	Total
Anantapuramu	0.00	0.00	8.19	0.00	2.71
Chittoor		18.64	8.28	0.00	14.97
YSR Kadapa	16.14	14.99	41.69	3.34	21.81
Kurnool	0.00	0.00	0.00	0.00	0.00
East Godavari	0.00	0.00	0.00	0.00	0.00
Guntur	0.00	0.00	0.00	0.00	0.00
Krishna	6.28	0.00	0.00	0.00	1.76
PSR Nellore	0.00	9.13	18.87	0.00	10.53
Prakasam	47.75	15.76	21.49	0.00	17.65
Srikakulam	0.00	0.00	0.00	0.00	0.00
Visakhapatnam	0.00	2.33	0.00	0.00	1.89
Vizianagaram	0.00	0.92	0.00	0.00	0.68
West Godavari	0.00	0.00	0.00	0.00	0.00
Total	5.28	5.94	14.39	1.24	7.50

Note: Percentages are related to the respective to totals. Source: IDSAP Field Survey, 2020

3.2.3 Mulching

Mulching is a critical component of PMDS farming. RySS protocol presumes mulching as a mandatory PMDS farming practice. It captures water vapor from atmosphere. It saves water use and maintain adequate moisture content in the soil. About 66 per cent of PMDS farmers have followed mulching at the state level (Table 3.7). The proportion of farmers practicing mulching is higher among the small, marginal and tenant farmers. Further, all sample farmers of Anantapuramu, Chittoor, and Visakhapatnam districts have followed mulching. The extent of mulching in Kurnool, Prakasam, PSR Nellore, Guntur and Krishna is also higher, as compared to the state average. Less proportion of farmers of East Godavari, Vizianagaram and West Godavari have followed mulching. This lower proportion may be due to better access to irrigation facilities and availability of better soil moisture. But lower rate of mulching in some of the dry regions (YSR Kadapa) require a critical attention by RySS authorities.

Table 3.7: District wise and Farm category wise Percentage of Cultivators followed mulching

District	Land less	Marginal	Small	Medium and Large	Total
Anantapuramu	100.0	100.0	100.0	100.0	100.0
Chittoor		100.0	100.0	100.0	100.0
YSR Kadapa	60.7	52.9	75.8	19.5	56.2
Kurnool	100.0	100.0	94.8	100.0	98.0
East Godavari	0.0	9.1	0.0	0.0	5.4
Guntur	88.0	100.0	58.6	100.0	91.7
Krishna	100.0	76.4	100.0	100.0	85.3
PSR Nellore	100.0	95.1	89.7	100.0	94.3
Prakasam	100.0	93.0	100.0	100.0	95.7
Srikakulam	21.1	40.2	21.3	59.6	37.6
Visakhapatnam	100.0	100.0	100.0	100.0	100.0

Vizianagaram	0.0	17.6	0.0	0.0	12.5
West Godavari	16.8	18.5	21.0	0.0	16.8
Total	66.6	66.7	71.0	38.0	66.0

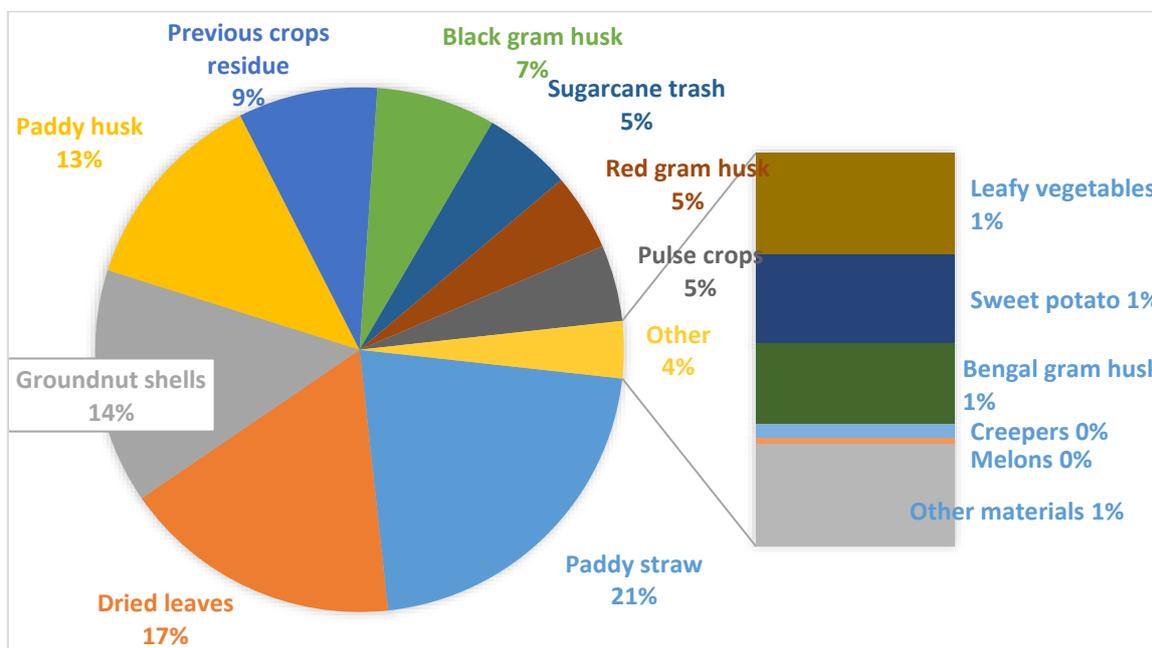
Note: the percentages are related to the respective groups in the district and stage as a whole.

Source: IDSAP Field Survey, 2020

Material used for Mulching

Farmers have used different materials for mulching. The main materials used for mulching are paddy straw, dried leaves, groundnut shells, paddy husk, crop residue, black gram husk, etc. Use of creepers, melons, sweet potato, leafy vegetables and Bengal gram husk as mulching material is low (Figure 3.2). In other words, farmers mainly used the residuals of crops grown in previous season (i.e., rabi season) for mulching. Use of such items are freely available and don't require much labour and investment. Since paddy is the staple crop in the state, paddy straw and paddy husk are mostly used for mulching. Paddy husk, a prohibited material for mulching, has been used in Chittoor, YSR Kadapa and Krishna districts. Since use of paddy husk for mulching need to be avoided as per the RySS protocol, DPMs of these districts should find out the reasons for it and discourage the practice.

Figure 3.2: Materials used for mulching in the State (in percentage)



Source: IDSAP Field Survey, 2020

The tenant farmers mainly used paddy husk, Bengal gram husk and dried leaves for mulching. Paddy straw, residue of previous crops, sugarcane trace, and pulses crops are mostly used by the marginal farmers (see Appendix Table B-1). Many small farmers have used dried leaves,

groundnut shells, sugarcane trash, pulses and red gram husk as mulching material. Most of the medium and large farmers have used groundnut shells, black gram husk, red gram husk, Bengal gram husk and leafy vegetables as mulching materials.

District wise extent of materials used for mulching is shown in Appendix Table C-2. It shows that all sample farmers of East Godavari and majority farmers of Srikakulam, Vizianagaram, West Godavari and Guntur have used paddy straw as main material for mulching. Use of groundnut shells is limited to Anantapuramu, Chittoor, East Godavari, Kurnool and Vizianagaram districts. Use of pulses husk is also limited to fewer districts. Only farmers of Chittoor district have used sugarcane starch as mulching material. Similarly use of leafy vegetables is confined to Anantapuramu and Visakhapatnam districts. Some farmers of East Godavari and Guntur districts have used pulses crop as mulching. District-wise analysis suggests that use of mulching materials is highly governed by the crops grown in the previous season i.e., Rabi season. Major crop wise estimates for mulching material used is shown in Appendix Table D-2.

3.2.4 Soil layer for protecting mulching materials

Use of soil layer for mulching is also widely practiced. On average about 30 per cent of the responses reported about use of soil layer for protecting mulching materials (Table 3.8). The rate was as highest in Chittoor district and low/absent in East Godavari, Srikakulam and West Godavari districts. Lower use of soil layer for protecting mulching material in these districts is attributable to higher use of paddy straw as mulching material which does not require soil layer to protect it. It is widely practiced by the marginal and small farmers and quite low among the medium and large farmers. However, there is no systematic trend among the districts and farm category groups about the reason for use of soil layer for protecting mulching. Except Chittoor and, to some extent PSR Nellore and Kurnool, all other districts are lagging behind in following this protocol of PMDS. It may be noted that putting soil layer on mulching may be counter-productive. The soil normally absorbs moisture from mist in the morning and allow it to evaporate during the day time, leaving less or no moisture to percolate down.

Table 3.8: District wise and farm category wise use of soil layer on mulching (in percentage)

District	Land less	Marginal	Small	Medium and Large	Total
Anantapuramu	51.11	27.09	17.94	10.24	22.90
Chittoor		100.00	96.60	100.00	98.84
YSR Kadapa	16.14	17.06	48.56	5.13	25.14
Kurnool	100.00	71.64	73.65	64.71	72.51
East Godavari	0.00	3.08	0.00	0.00	1.83
Guntur	15.92	16.01	0.00	0.00	14.17
Krishna	31.25	31.74	0.00	0.00	28.61
PSR Nellore	41.57	84.06	60.30	100.00	78.97
Prakasam	90.80	16.95	24.25	71.51	23.48
Srikakulam	0.00	0.00	0.00	0.00	0.00
Visakhapatnam	0.00	8.12	36.45	39.90	12.83
Vizianagaram	0.00	15.50	0.00	0.00	11.42
West Godavari	0.00	0.00	0.00	0.00	0.00
Total	19.33	28.99	41.42	13.35	30.12

Note: Percentages are respective to totals. Source: IDSAP Field Survey, 2020

3.2.5 Temporary fencing and live fencing

Fencing is one of the mandatory protocols of PMDS farming. But only 33 per cent of farmers have undertaken either temporary, live or both types of fencing in the state as a whole (Table 3.9). While 15 per cent of sample farmers undertook temporary fencing, 26 per cent have live fencing and 8 per cent have both temporary and live fencing. It implies that live fencing is more preferred than the temporary fencing. The proportion of tenant farmers undertaking any of the fencings is lowest and this proportion for the small farmers is highest.

District wise analysis shows that no farmers of West Godavari, Vizianagaram, Krishna and East Godavari did neither temporary fencing nor live fencing (Table 3.9). While more proportion of farmers of PSR Nellore, Chittoor, Anantapuramu, Kurnool and Visakhapatnam undertook temporary fencing; a higher proportion of farmers of Prakasam, PSR Nellore, Chittoor and YSR Kadapa have live fencing. Further, farmers of PSR Nellore and Chittoor also followed both temporary and live fencing.

Table 3.9: Farm category wise and district wise percentage of farmers undertaken temporary fencing, live fencing and both the fencings

	Temporary Fencing	Live fencing	Both fencings	No fencing
Farm category-wise				
Land less	15.0	24.1	1.0	85.4
Marginal	19.2	41.6	8.4	69.2
Small	9.7	13.1	12.7	51.9
Medium and Large	14.7	26.4	2.6	79.7
Total	15.0	24.1	8.4	67.3
District -wise				
Anantapuramu	37.7	5.1	2.4	59.6

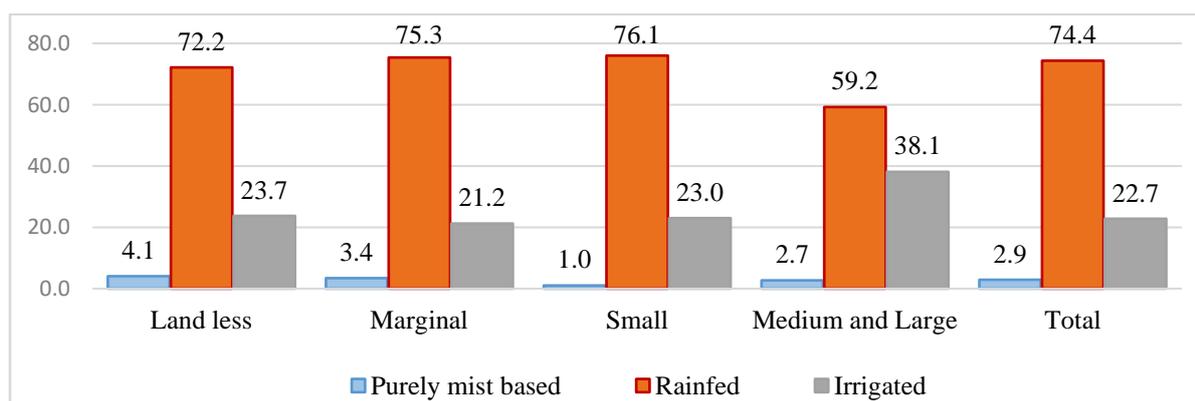
Chittoor	45.5	65.4	32.9	21.9
YSR Kadapa	3.2	42.3	3.2	57.7
Kurnool	34.0	10.2	6.1	61.9
East Godavari	0.0	0.0	0.0	100.0
Guntur	0.0	1.1	0.0	98.9
Krishna	0.0	0.0	0.0	100.0
PSR Nellore	63.7	81.5	51.8	6.6
Prakasam	6.1	95.4	2.6	1.0
Srikakulam	0.8	1.6	0.8	98.4
Visakhapatnam	19.8	15.6	5.0	69.6
Vizianagaram	0.0	0.0	0.0	100.0
West Godavari	0.0	0.0	0.0	100.0
Total	14.7	26.4	8.4	67.3

Note: Percentages are related to the respective to totals. Source: IDSAP Field Survey, 2020

3.2.6 Source of Moisture

PMDS practice is mainly mist/dew/non-seasonal rainfall-based farming practice. It is evident that maximum of PMDS crops is grown under rainfed condition (74 per cent) and mist based (3%) is a testimony to it (Figure 3.3). However, farmers with own bore-wells, might be using irrigation as the supplementary source, especially, at times of prolonged dry-spells. As expected, the extent of irrigation use is more among the medium and large farmers and low among the marginal farmers. This implies that PMDS is highly suitable to the marginal and small farmers who mainly grow crops under the rainfed condition and don't have their own borewell.

Figure 3.3: Landholding category wise percentage of responses with regards to source of moisture in PMDS plot by farmers



Source: IDSAP Field Survey, 2020

The proportion of PMDS farmers growing crops under the rainfed condition is more than state average in all districts, except Vizianagaram, West Godavari and YSR Kadapa (Table 3.10). Majority of farmers of YSR Kadapa (58.76%), have irrigated their plots. The same is 46.88 per cent in West Godavari, 39.44 per cent in Vizianagaram and 22.38 per cent in East Godavari

districts which have assured water from irrigation facilities. The extent of use of water by proportion of farmers, used for irrigation is less than 5 per cent in PSR Nellore, Anantapuramu, Prakasam, Srikakulam, Chittoor and Visakhapatnam. Major crop wise source of moisture is shown in Appendix Table D-1.

Table 3.10: District wise source of moisture in PMDS plot (in percentage)

District	Purely mist based	Rainfed	Irrigated	Total
Anantapuramu	0.00	94.89	5.11	100.00
Chittoor	2.24	96.23	1.53	100.00
YSR Kadapa	1.62	39.62	58.76	100.00
Kurnool	0.00	93.87	6.13	100.00
East Godavari	3.02	74.61	22.38	100.00
Guntur	4.80	77.85	17.35	100.00
Krishna	0.00	100.00	0.00	100.00
PSR Nellore	0.00	94.60	5.40	100.00
Prakasam	1.78	94.42	3.80	100.00
Srikakulam	20.07	78.09	1.83	100.00
Visakhapatnam	9.26	90.09	0.65	100.00
Vizianagaram	0.17	60.39	39.44	100.00
West Godavari	0.00	53.12	46.88	100.00
Total	2.90	74.36	22.74	100.00

Source: IDSAP Field Survey, 2020

3.3 Crops Grown in PMDS Plot

3.3.1 Major crops

Varieties of crops are grown in a single PMDS plot. For simplicity these are classified into eight groups. Most of sample farmers cultivate poly-crops (66 per cent) followed by pulses (15 per cent) and vegetables (10 per cent) as major crop (Table 3.11). Poly-crop is a mixture of different crops without major share of any single crop. It is treated as major diversity in the crops above the land and below the soil. The share of cereals, oil seeds and cash crops is low (for more details see Appendix Table B-2). Among the crops, black gram, green gram, sesamum, red gram, tomato and jowar constitute the major share. The tenant farmers mainly cultivated poly-crops, pulses and cereals which requires less resource. Cultivation of vegetables is mainly found among marginal and small farmers.

Table 3.11: Farm category wise major crops grown in PMDS plot (in percentage)

	Poly-crops	Pulses	Vegetables	Oil seed	Cereals	Cash crops	Others
Land less	69.73	13.98	0.41	0.76	8.43	0.00	6.70
Marginal	63.46	17.30	12.33	3.79	0.73	0.00	2.39
Small	71.86	9.56	9.65	1.91	4.16	2.65	0.21
Medium and Large	63.77	13.49	5.03	0.98	1.28	0.00	15.46

Total	65.84	15.09	10.41	2.98	2.12	0.59	2.97
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Source: IDSAP Field Survey, 2020

All farmers of Krishna, Prakasam, and Srikakulam districts have grown poly-crops. More than 95 per cent cases in West Godavari, Guntur and Chittoor have also cultivated poly-crops (Table 3.12). A major proportion of farmers of PSR Nellore, Kurnool and YSR Kadapa also grown poly-crops. On the other hand, Vizianagaram, East Godavari, Anantapuramu and Visakhapatnam districts have cultivated less poly-crops and grown more pulses, vegetables, oil seeds, and cereals (the district level segregated crop wise estimates are shown in Appendix Table C-3. Vegetable cultivation is high in Visakhapatnam district whereas oilseed cultivation is more in Anantapuramu district. Cereals are mainly found in East Godavari district and cash crops in YSR Kadapa district.

Table 3.12: District wise major crops grown in PMDS Plots (in percentage)

	Poly-crops	Pulses	Vegetables	Oil seed	Cereals	Cash crops	Others
Anantapuramu	29.28	24.01	2.40	39.51	4.80	0.00	0.00
Chittoor	94.94	5.06	0.00	0.00	0.00	0.00	0.00
YSR Kadapa	81.51	3.26	0.00	0.00	0.00	2.88	12.36
Kurnool	85.20	8.67	0.00	0.00	6.13	0.00	0.00
East Godavari	32.29	49.66	0.00	0.00	17.83	0.00	0.22
Guntur	98.94	0.00	1.06	0.00	0.00	0.00	0.00
Krishna	100.00	0.00	0.00	0.00	0.00	0.00	0.00
PSR Nellore	88.10	10.92	0.00	0.00	0.98	0.00	0.00
Prakasam	100.00	0.00	0.00	0.00	0.00	0.00	0.00
Srikakulam	100.00	0.00	0.00	0.00	0.00	0.00	0.00
Visakhapatnam	3.52	15.57	65.92	11.96	0.00	0.00	3.04
Vizianagaram	19.02	60.84	8.97	4.20	5.67	0.22	1.09
West Godavari	99.52	0.24	0.24	0.00	0.00	0.00	0.00
Total	65.85	15.09	10.39	2.98	2.12	0.59	2.97

Source: IDSAP Field Survey, 2020

3.3.2 Number of crops grown in each plot

The average number of crops grown in each plot is 10 which is less than the RySS protocol of 15-20 varieties in each plot (Table 3.13). Less than 2 per cent of farmers have grown more than 20 varieties of crops. In the state as a whole, there is not much difference among the landholding classes with regards to average number of crops grown in PMDS plot. Majority farmers of East Godavari and West Godavari have cultivated more than 15 crops. On the other hand, farmers of Chittoor, Krishna, Srikakulam, Vizianagaram and YSR Kadapa have grown less than 10 crops. There is no systematic trend among the farmers of different landholding categories of each district with regards to cultivation of number of crops grown in each PMDS plot. But farmers of all landholding categories of East Godavari, West Godavari, Kurnool,

Guntur, PSR Nellore and Anantapuramu districts have cultivated more crops than the state average at 10.

Table 3.13: District wise and farm category wise average number of crops grown in PMDS plot

District	Land less	Marginal	Small	Medium and Large	Total
Anantapuramu	15	11	11	11	11
Chittoor		10	10	9	10
YSR Kadapa	7	6	7	6	7
Kurnool	13	13	13	17	13
East Godavari	17	16	18	18	17
Guntur	12	12	18	13	13
Krishna	9	9	9	9	9
PSR Nellore	12	10	10	12	10
Prakasam	12	10	10	9	10
Srikakulam	8	9	9	9	9
Visakhapatnam	9	11	14	10	11
Vizianagaram	1	8	11	9	8
West Godavari	16	15	16	18	16
Total	11	10	11	10	10

Source: IDSAP Field Survey, 2020

3.3.3 Crops grown on bunds

About 23 per cent of responses mentioned of growing crops on bunds in the state as a whole (Table 3.14). The responses were more in Chittoor, West Godavari, Visakhapatnam and East Godavari districts; the same is negligible in Srikakulam, PSR Nellore, Krishna, Kurnool, Guntur and Anantapuramu districts. Further, responses were lower among the tenant farmers and they steadily increased for marginal and small farmers and then declined for medium and large farmers. However, there is no systematic pattern among the tenant, marginal, small, and medium and large farmers across the districts. For instance, while responses were higher among the tenant farmers in Prakasam and Vizianagaram districts, more responses came from marginal farmers of West Godavari district and, similarly, more responses came from small farmers of Chittoor and Visakhapatnam districts.

Table 3.14: District wise and farm category wise crops grown on Bund (in percentage)

District	Land less	Marginal	Small	Medium and Large	Total
Anantapuramu	0.00	0.00	0.00	11.55	2.71
Chittoor		60.23	60.57	0.00	59.85
YSR Kadapa	0.00	7.96	25.09	0.00	11.68
Kurnool	0.00	0.00	0.00	0.00	0.00
East Godavari	27.12	26.46	21.60	0.00	24.63
Guntur	3.65	2.32	0.00	0.00	2.52
Krishna	0.00	0.00	0.00	0.00	0.00
PSR Nellore	0.00	0.00	0.00	0.00	0.00
Prakasam	78.53	20.95	6.71	16.47	17.59

Srikakulam	0.00	0.00	0.00	0.00	0.00
Visakhapatnam	0.00	44.58	69.75	39.90	47.52
Vizianagaram	100.00	22.01	15.72	23.37	21.75
West Godavari	50.58	54.81	32.86	36.74	48.62
Total	11.75	24.03	27.07	10.26	22.98

Note: percentages are respective totals. Source: IDSAP Field Survey, 2020

3.4 Conclusions

The analysis found that most of the PMDS cultivators have followed the norms of 0.5 acre under PMDS, treated seeds with Beejamrutham and followed mulching. Majority farmers in some districts have also followed the protocol of the use of required quantity of seed, soil layer to protect mulching, live/temporary fencing, and crop diversification in terms of growing varieties of crops. These positive practices may be due to intervention of RySS staff interest and awareness of farmers, perceived benefits of PMDS farming, better access to inputs and services, choice of crops, climatic conditions, etc. It is also a fact that some protocols may not be equally important to all geographical conditions and crop. An understanding about climate specific and agrarian structure of regions and interventions accordingly can help most cultivators to adopt PMDS practices as per the protocol.

Chapter 4

Costs, Monetary Returns and Non-Monetary Benefits of PMDS Farming

4.1 Introduction

This chapter estimates cost, returns and benefits of PMDS farming among the sample households in Andhra Pradesh. Such an analysis will enable us to understand the financial viability of PMDS and reasons for adoption of PMDS practice.

4.2 Cost of Cultivation

On an average, total cost of cultivation in PMDS plot is Rs. 11,939/- per hectare in the state as a whole (Table 4.1). As almost all farmers have cultivated about 0.2 to 0.3 ha, under PMDS, the actual expenditure by each farmer on an average is about Rs.3,000 to Rs.4,000. It includes the value of own labour and exchanged labour. It implies, that the actual average paid-out expenditure from each farmer is about Rs.3,000. The cost of cultivation is higher among small farmers and low among tenant. It may be due to tenant farmers inability to invest on PMDS crops which mainly used manure to enhance soil productivity. Among various items, cost was mainly incurred on seeds, use of hired labour/labour exchange, biological inputs, and mulching.

Table 4.1: Farm category wise cost of cultivation (Rs./hectare)

District	Land less	Marginal	Small	Medium and Large	Total
Seeds	2,238	2,430	2,489	2,582	2,438
CNF biological inputs	1,036	2,121	2,044	1,071	1,911
Fencing	26	294	533	166	313
Mulching	320	1,146	1,580	643	1,125
Irrigation	272	431	540	280	428
family, exchange and hired labour	1,506	2,019	1,960	1,180	1,886
Other expenses	2,274	3,856	4,170	4,606	3,839
Total Cost	7,672	12,297	13,315	10,527	11,939
Gross Revenue	911	9,069	7,949	6,844	7,840
Net Revenue	-6,761	-3,227	-5,366	-3,682	-4,099

Note: other expenses include bullock labour, machine labour, implements, transportation cost, marketing, threshing, etc.

Source: IDSAP Field Study, 2020-21

The average cost of cultivation incurred by the PMDS farmers in Chittoor, Anantapur, YSR Kadapa, Kurnool, Prakasam and PSR Nellore is about twice that of other districts (Table 4.2). Expenditure incurred by the delta and north coastal districts such as East Godavari, Krishna, Vizianagaram, and West Godavari is lowest among all districts. This may be due to favourable climatic conditions. Due to lack of assured irrigation facilities, farmers of Anantapuramu, Prakasam, Chittoor, and Kurnool districts have spent more on mulching. Use of CNF

biological inputs and cost of fencing is also higher in these districts. Only farmers of YSR Kadapa, Kurnool and Visakhapatnam districts have spent more on irrigation. Perhaps these districts have access to some sort of irrigation facilities. While average expenditure on seed is higher among the farmers of Anantapur, Chittoor, YSR Kadapa and Guntur districts, average expenditure on labour is higher in Anantapuramu, Kurnool, Visakhapatnam, PSR Nellore and YSR Kadapa districts.

It is to be noted that there is a higher degree of significant correlation between the expenditure on mulching CNF biological inputs, use of family and hired labour, seed and fencing³. The correlation coefficients among these with irrigation are low, although significant.

Nearly Rs.12,000 per hectare investment on PMDS crops appears to be a daunting task. It is also irrelevant figure for the farmers, who have mostly cultivated about 0.33 ha. What matter to the farmer is their actual expenditure on PMDS. On average, each farmer has invested Rs. 3,941 on PMDS (Table 4.3). It appears to be more reasonable and practical. The per farmer expenditure on PMDS varies from Rs. 3,026 for land less category to Rs. 5,212 for medium and large farmers. The same varies from Rs.1,434 in Visakhapatnam to Rs. 9,191 in Anantapur.

Table 4.2: District wise cost of cultivation of PMDS crops (Rs./Hectare)

District	Seeds	CNF biological inputs	Fencing	Mulching	Irrigation	family, exchange and hired labour	Other expenses	Total Cost	Gross Revenue	Net Revenue
Anantapuramu	6,961	3,310	974	5,371	471	6,420	5,482	28,988	45,327	16,339
Chittoor	4,731	8,188	1,549	4,063	376	1,160	10,706	30,773	38,435	7,662
YSR Kadapa	2,765	2,423	183	1,380	1,009	1,850	5,739	15,349	4,295	-11,054
Kurnool	2,064	1,641	645	3,313	878	3,600	3,993	16,133	2,772	-13,360
East Godavari	1,660	156	0	47	73	1,117	669	3,723	21	-3,701
Guntur	2,545	941	0	989	15	1,839	2,426	8,755	325	-8,430
Krishna	1,877	659	0	0	89	1,684	1,372	5,681	0	-5,681
PSR Nellore	2,159	2,504	1,800	1,903	50	2,971	3,559	14,944	5,507	-9,436
Prakasham	2,332	1,569	24	4,069	11	1,795	5,254	15,054	294	-14,759
Srikakulam	1,372	417	0	1,133	0	1,291	3,492	7,705	814	-6,891
Visakhapatnam	1,449	1,469	154	303	519	3,367	2,254	9,516	19,432	9,916
Vizianagaram	2,098	1,362	0	6	0	1,517	2,166	7,149	19,048	11,900
West Godavari	2,224	1,032	0	0	393	707	2,906	7,262	0	-7,262
Total	2,438	1,911	313	1,125	428	1,886	3,839	11,939	7,840	-4,099

Source: IDSAP Field Survey, 2020

³ Pearson Bivariate correlation coefficients are calculated between expenditure incurred on Seed, CNF biological inputs, chemical inputs, fencing, mulching, irrigation and labour. The correlation coefficients are significant at 5 per cent level.

Table 4.3: Per farmer average cost cultivation of PMDS (Rs. per farmer)

	Area	Seeds	CNF biological inputs	fencing	Mulching	Irrigation, if any	family, exchange and hired labour	Other expenses	total cost of cultivation	Gross revenue	Net Return
Farmer category wise											
Land less	0.97	883	409	10	126	107	594	897	3,026	359	-2,667
Marginal	0.75	734	640	89	346	130	610	1,164	3,713	2,739	-975
Small	0.86	864	710	185	549	187	681	1,448	4,624	2,760	-1,864
Medium and Large	1.22	1,278	530	82	318	138	584	2,280	5,212	3,389	-1,823
Total	0.82	805	631	103	371	141	623	1,267	3,941	2,588	-1,353
District wise											
Anantapuramu	0.78	2,207	1,049	309	1,703	149	2,036	1,738	9,191	14,372	5,181
Chittoor	0.40	765	1,325	251	657	61	188	1,732	4,978	6,218	1,239
YSAR Kadapa	1.17	1,307	1,145	86	652	477	875	2,713	7,256	2,030	-5,226
Kurnool	0.44	366	291	114	588	156	639	709	2,865	492	-2,373
East Godavari	0.96	643	61	-	18	28	433	259	1,443	8	-1,434
Guntur	0.84	864	320	-	336	5	625	824	2,973	110	-2,863
Krishna	1.02	774	272	-	-	37	695	566	2,343	-	-2,343
PRS Nellore	0.99	861	998	718	759	20	1,185	1,419	5,958	2,196	-3,762
Prakasam	0.60	567	382	6	990	3	437	1,278	3,662	72	-3,590
Srikakulam	0.68	376	114	-	310	-	354	957	2,111	223	-1,888
Visakhapatnam	0.37	218	221	23	46	78	507	340	1,434	2,928	1,494
Vizianagaram	0.85	720	467	-	2	-	520	743	2,452	6,535	4,082
West Godavari	1.11	999	463	-	-	176	318	1,304	3,260	-	-3,260
Total	0.82	805	631	103	371	141	623	1,267	3,941	2,588	-1,353

Source: IDSAP Field Survey, 2020

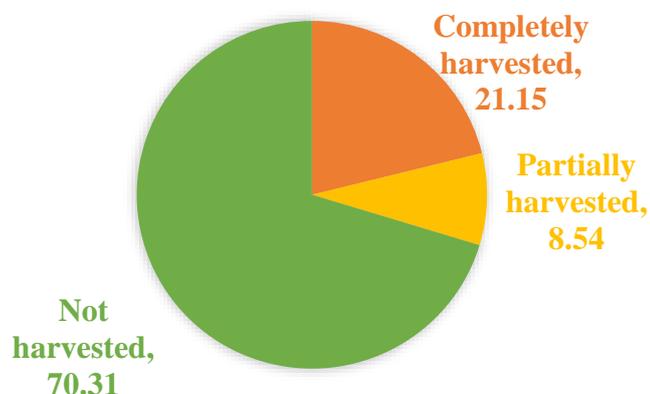
4.3 Revenue Generated from PMDS Farming

Gross revenue generated from crops grown in PMDS plots is Rs. 7,840/- per hectare which is lower than the average cost incurred by all sample cultivators in the state (Table 4.2). As such the net revenue is negative. The gap is highest in the case of tenant farmers followed by small, and medium and large farmers. The average net returns of farmers of Anantapuramu, Chittoor, Visakhapatnam, and Vizianagaram are positive. For other districts total cost is higher than the gross revenue generated.

The main reasons for lower returns from PMDS farming is that such crops are not grown to generate net income. They are rather grown to use as green manure to enhance the soil fertility and productivity. Figure 4.1 clearly indicates that only 21 per cent of sample responses have completely harvested PMDS crop. The remaining crop output was either partially harvested or incorporated to serve as manure. Mostly land less and farmers belonging to medium and large farming category have not harvested the crop. This phenomenon is widely practiced in West Godavari, Krishna, East Godavari, Prakasam, Srikakulam, YSR Kadapa and Guntur districts. Only farmers of Anantapuramu, Chittoor, Vizianagaram and Visakhapatnam districts have

completely harvested crops to generate income. The above estimates for farm category wise and at the district level are shown in Appendix Table B-3 and C-4.

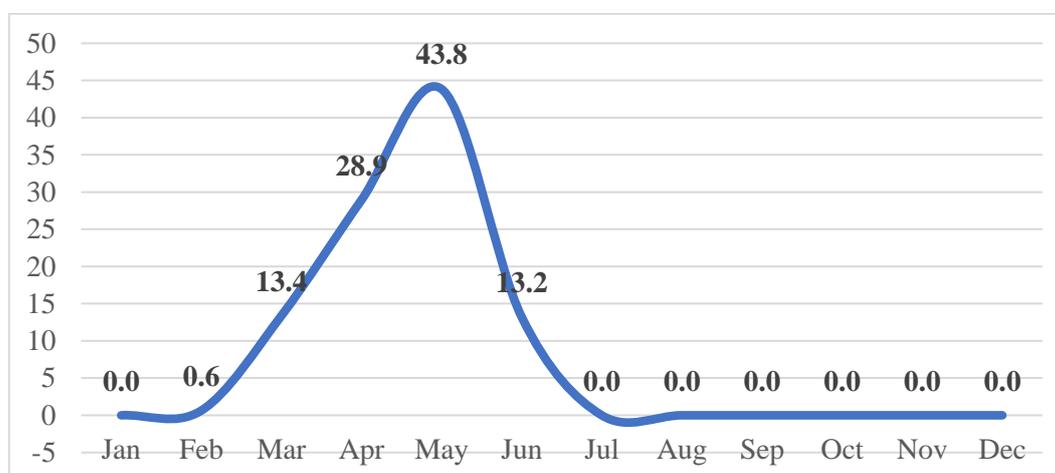
Figure 4.1: Percentage of responses with regards to harvesting of PMDS Crop



Source: IDSAP Field Survey, 2020

Delayed crop sowing is another reason for not harvesting the PMDS crop and rather use as manure for the kharif season. Over 43 per cent farmers, in the state have sown PMDS in the month of May, just before onset of the monsoon. Figure 4.2 shows the month of sowing of PMDS crops. About 86 per cent of farmers across the state have sown during April-June which is expected to be late sowing. The ideal time for sowing of PMDS crops that would not affect kharif crop is February-March. But only 13 per cent of farmers have sown in these months. It is clearly showing that districts such as Anantapuramu, Chittoor, Visakhapatnam and Vizianagaram started early sowing (i.e. March) were able to generate income from the PMDS crops. But due to late sowing i.e. April-May, net income from PMDS for the other districts is negative. It also clearly visible that no outputs have been generated by farmers from West Godavari and Krishna who started sowing late by May and June. The district wise and month wise proportion of farmers sowing PMDS crop is shown in Appendix Table C-1.

Figure 4.2: Percentage of responses with regards to Month of sowing



Source: IDSAP Field Survey, 2020

4.4 Scope for increased returns and resources use efficiency

Further analysis suggests that net returns from the PMDS farming can be enhanced if there is scope for sowing crops that generate income besides using it as manure for the next crop (Table 4.4). Then, increased cost of cultivation will not be a hinderance to spread of PMDS. It is also clearly found that net return can be enhanced with less additional investment. The delay in sowing season also needs to be controlled in order to enable the farmers to harvest the crop before starting Kharif sowing.

Table 4.4: Total Cost, Gross Returns and Net Returns from crops fully harvested, partially harvested and not harvested (Rs/Hectare)

	Not harvested	Partially harvested	Completely harvested	Total
Seeds	2,324	2,646	3,025	2,438
CNF biological inputs	1,818	2,516	2,229	1,911
Fencing	297	624	290	313
Mulching	1,080	1,564	1,226	1,125
Irrigation, if any	453	100	402	428
family, exchange and hired labour	1,554	3,054	3,390	1,886
Other expenses	3,894	4,195	3,388	3,839
Total cost	11,419	14,698	13,951	11,939
Gross Return	0	27,433	46,234	7,840
Net Return	-11,419	12,734	32,283	-4,099

Source: IDS Field Survey, 2020

To know the relation between crop output and resources used by PMDS farmers Cobb-Douglas Production function is estimated. This is estimated with the data of PMDS farmers who have

completely harvested the crop. In the function, output per acre is used as dependent variable and total cost, operational holding, number of crops, rainfall, mulching, non-monetary benefits, fencing, pelletizing of seeds, soil-layer on mulching, and tenancy types have been used as independent variables. The input elasticities are presented in Table 4.5. The sum of input elasticities is 2.75. That is, an additional investment of 1 per cent on PMDS would yield more than 2.75 per cent increase in output. It implies that PMDS farmers have experienced an increasing returns-to-scale. Among the individual variables, total cost, rainfall, fencing, pelletizing the seed, and tenancy status have positive and significant relation with output. Mulching, though positive, is not significant. On the other hand, the soil-layer on the mulching, is negative, though not significant.

Table 4.5: Factors influencing gross output of PMDS farmers fully harvested the crop

Parameters	B	Std. Error
Ln Total Cost per acre	0.427***	0.112
Ln Operational landholding	0.101	0.083
Ln Number of crops grown	-0.069	0.060
Ln Rainfall	1.133***	0.276
Whether Mulching adopted	0.211	0.167
Perceived about non-monetary benefits	-0.217	0.222
Whether fencing adopted	0.232	0.160
Pelletized the seed	0.501**	0.252
Used soil layer for mulching	-0.111	0.144
Tenancy type		
Pure tenant (reference group)		
Owner	0.473	0.348
Owner-cum-tenant	0.069	0.423
Constant	-10.712***	2.352
F	4.747***	
Adj.	0.160	

Note: Dependent variable: Ln Output per acre of land. *** significant at .01 per cent, ** significant at .05 per cent level.

Source: IDS field study, 2021

To know the resource use efficiency (technical efficiency) at household level who have completely harvested their produce from the PMDS plot, **Stochastic Frontier**-production function has been estimated. The dependent variable is gross output per acre of land whereas explanatory variables are total cost, use of mulching, adopting temporary/live fencing, palletizing the seed, use of soil layer to protect mulching, perception about non-monetary benefits, landholding class and tenancy group. The results are shown in Table 4.6 and Figure 4.3. Households are distributed according to: efficiency levels, focus on non-monetary benefits, adoption of various protocol recommendations, ownership class, tenancy type, district dummies, etc. The distribution of households as per efficiency levels indicates that there is no

pattern in number of households falling in each efficiency level intervals. The average efficiency levels of small and marginal farmers are found to be higher than that of land less and medium and large farmers. The average efficiency levels of farmers, who have given more importance non-monetary benefits is higher than those who have not perceived about non-monetary benefits. Obviously, they might have invested less on PMDS. The farmers, who have provided mulching proved to be less efficient. Perhaps, the soil layer on mulching might have nullified the potential benefits from the mulching. The fencing results indicate that though fencing is beneficial it may not have cost-effective. There is no difference in terms of efficiency with respect to palletisation. The farmers who provided soil layer on mulching appear to be less efficient. There is no big difference between owner and owner cum tenant farmers. Among six districts, which got positive gross returns, farmers in Vizianagaram are most efficient, followed by YSR Kadapa and Chittoor.

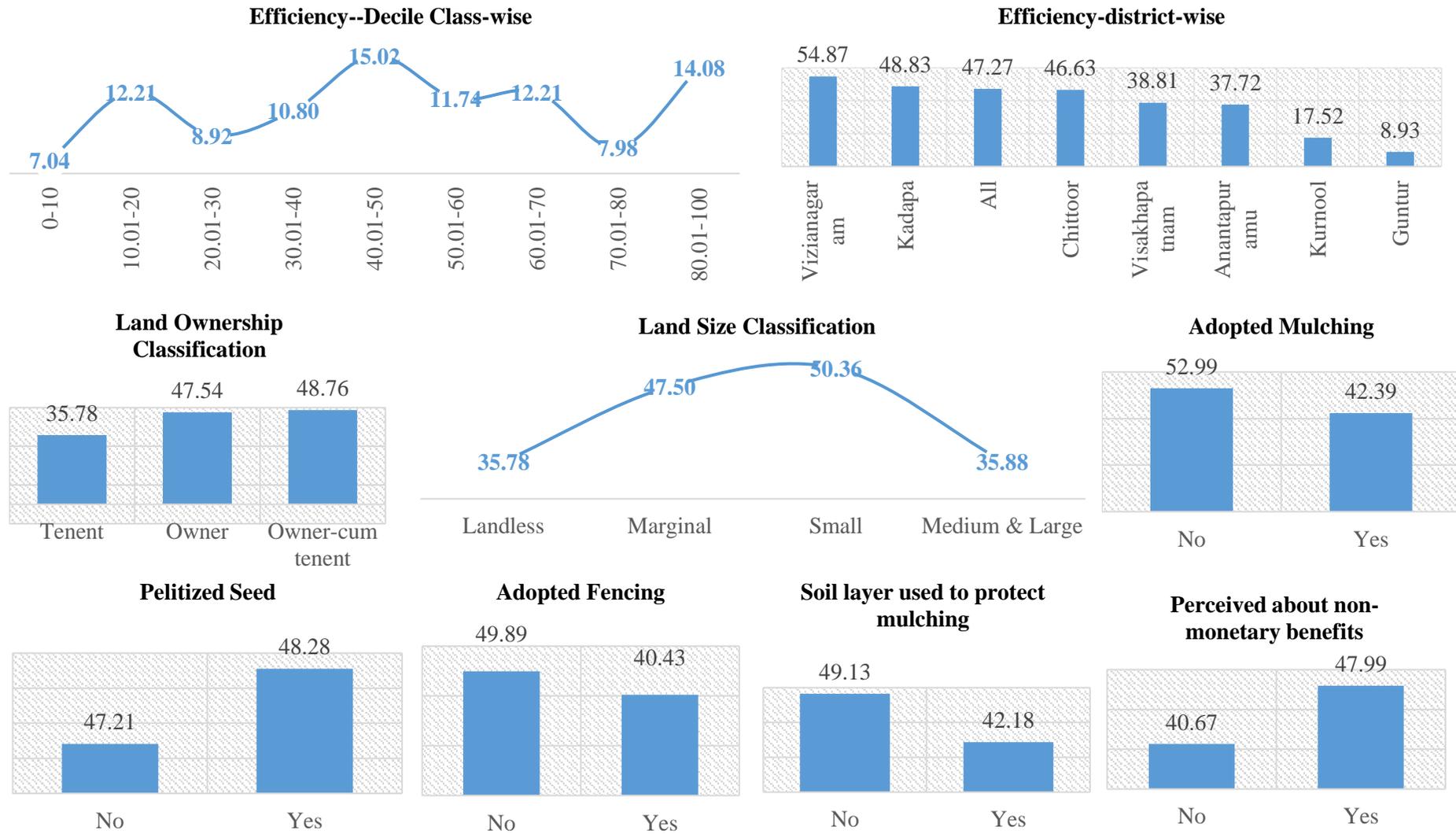
Table 4.6: Factors influencing gross revenue of farmers completely harvested their produce

	Coef.	Std. Err.
Ln Total Cost	0.1652*	0.0825
Land holding classification		
Medium and large (reference group)		
Tenant	0.0925	0.2327
Marginal	0.2709	0.1741
Small	0.0071	0.1812
Perceived about non-monetary benefit	-0.2834*	0.1381
Used mulching	-0.091	0.1122
Adopted fencing	0.3427**	0.1214
Pelletized seed	-0.0311	0.1504
Used soil layer for mulching	0.1584	0.1122
Land ownership classification		
Pure tenant (Reference group)		
Owner-cum-tenant	-0.107	0.2078
Const.	8.5483**	0.7158
sigma_u	1.2724**	0.0797
sigma_v	0.1740**	0.0507
Lambda	7.3119**	0.1128
R-square		
Prob F-Value		
Prob Chi2		0.0000**

Note: Dependent variable: ln Gross Revenue per acre, ** significant at 0.5 per cent level, * significant at .10 per cent level.

Source: IDS Field Survey, 2020

Figure 4.3: Level of Efficiency of PMDS farmers according to different groups and PMDS practices adopted (in percentage)

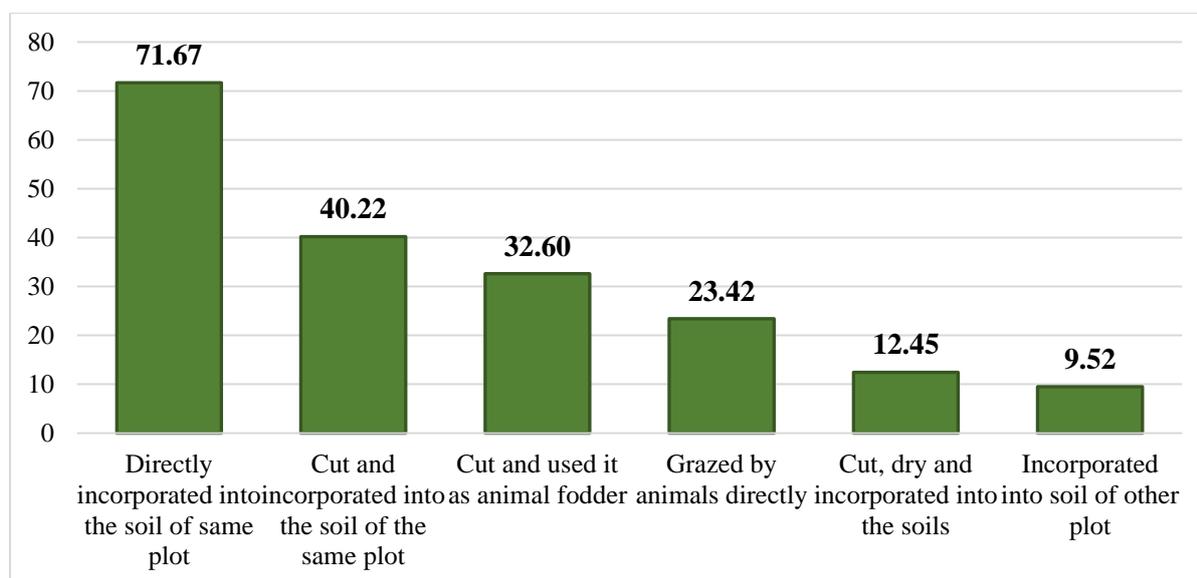


Source: IDS Field Survey, 2020

4.5 Non-monetary Benefits of PMDS Practice

About 99.6 per cent of farmers have incorporated complete crop or crop residuals in the same or other plots (Figure 4.4). The main practice of incorporating crop/crop residuals is one or a combination of directly incorporation of residues into the soil of same plot (72 per cent), cut and incorporated into the soil of the same plot (40 per cent), cut and used as animal fodder (33 per cent), and grazed by animals directly (24 per cent). A smaller proportion is incorporated into the soil of other plots. Such practices are more prevalent among the tenant and marginal farmers. The district level analysis also gives same picture where farmers of all districts have directly or cut-and-incorporated crop residue in the soil of the same plot. These estimates on broader farm category wise and at district level are shown in Appendix Table B-4 and C-5.

Figure 4.4: Percentage of farmers used crop residues for manure

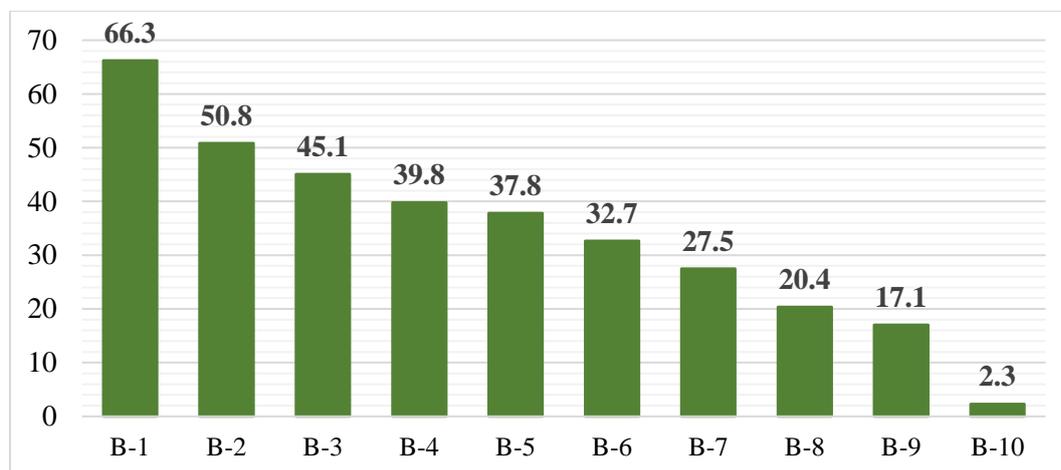


Source: IDSAP Field Survey, 2020

The other, perhaps the major, benefits of PMDS farming are to keep the soil under cover and protect microorganisms in the soil (66 per cent), conserve soil moisture (51 per cent), capture atmospheric moisture (45 per cent), used as fodder for the cattle (40 per cent), increase soil quality and productivity (38 per cent), etc. (Figure 4.5). On the other hand, the proportion of responses stating financial benefits through selling PMDS crop (27.5 per cent) and generation of cash income throughout the year (17 per cent) are relatively low. The district level and farm-holding classification category wise analysis also yields similar results. It implies that the perceived non-monetary benefits of PMDS farming are quite higher than the monetary benefits received by the farmers in terms of consumption and sale of PMDS crop outputs. As such, the

dominant perception of sample households about the non-monetary benefits of PMDS farming encouraged them to continue PMDS farming, despite considerable monetary losses. The farm category level estimates and district level estimates are shown in Appendix Table B-5 and C-6.

Figure 4.5: Percentage of farmers reported benefits of PMDS farming



Note:

- B-1 : Keep the soils under the shade and protect the microorganism
- B-2 : Keep the soils under the shade and conserve the soil moisture
- B-3 : Capture the atmospheric moisture
- B-4 : Grazing animals
- B-5 : Incorporate the biomass into the soils to increase the soil quality and productivity
- B-6 : Fodder for the livestock
- B-7 : Additional financial benefits from sale and consumption of PMDS produces
- B-8 : Availability of the quality and nutrition food for the family throughout the year
- B-9 : Cash income throughout the year
- B-10 : Do not know

Source: IDSAP Field Survey, 2020

4.6 Conclusions

An overwhelming majority of sample farmers have invested over Rs.11,000 per hectare⁴ on PMDS farming, just for ecological and environmental services, without expecting any monetary returns. It includes almost all tenant farmers. At the same time, about 8.54 per cent of farmers, who have partially harvested their PMDS crops, have got Rs.12,734 per hectare net

⁴ As almost all farmers have cultivated about 0.2 to 0.3 ha, under PMDS, the actual expenditure by each farmer would be about Rs.3,000 to Rs.4,000. It includes the value of own and exchanged labour; implies that the actual paid-out expenditure is about Rs.3,000 per farmer.

returns and 21.15 percent farmers have earned Rs.32,283 per hectare net returns through complete harvesting of PMDS crops. These two categories of farmers have incurred, on average, additional cost of Rs. 3,000 and Rs. 2,500 per hectare respectively. The timing of the crop sown and composition of crops grown are major influencing factors. The results indicate that with some planning and preparation, significant monetary benefits can also be reaped along with valuable non-monetary benefits from the PMDS crops.

Chapter 5

Challenges in Adopting PMDS Farming

5.1 Introduction

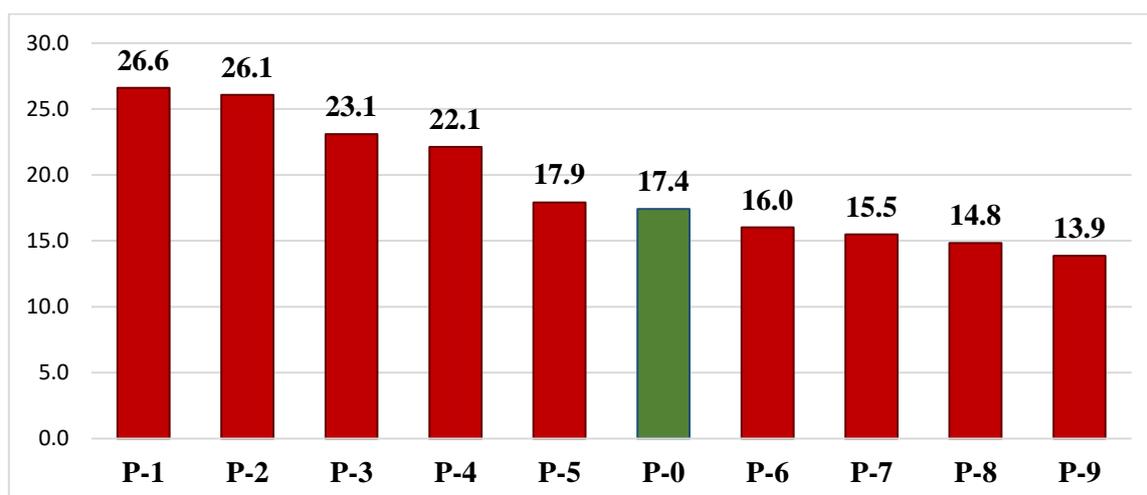
Though PMDS is helping in improving soil quality and improved yield during the subsequent next crop seasons, the issues and challenges encountered by the farmers in the cultivation of PMDS need to be proactively identified and addressed for the seamless expansion of the program. Previous chapters have clearly highlighted that the scope for expansion of PMDS is high. Further, it is evident that there is a good scope for increasing the monetary returns, along with reaping the ecological and environmental benefits. Those practicing PMDS have incurred higher cost without any return. To make the PMDS farming profitable and also to bring more farmers into the fold of PMDS farming, it is necessary to identify challenges faced by the sample farmers while practicing the PMDS farming.

In this background this chapter identifies different challenges faced by farmers while adopting PMDS farming.

5.2 Challenges in Adopting PMDS

Sample farmers have reported various challenges in adopting PMDS. Figure 5.1 explains the nature and extent of problems faced by the sample PMDS farmers in the state as a whole. Main challenges faced by the farmers are: protection of crops from grazing animals, shortage of labour, lack of protective irrigation facilities, shortage of mulching materials, etc. Shortage of family labour is another constraint in adopting PMDS farming. High maintenance cost of temporary fencing and the fear of delay in kharif and rabi crop timings due to extended PMDS harvesting timings are other challenges of PMDS farming. However about 17 per cent of farmers did not report any challenges in adopting PMDS farming.

Figure 5.1: Percentage of farmers reported problems while adopting PMDS



Note:

- P-0 : No problem
- P-1 : Protection of crops from grazing animals
- P-2 : Shortage of labour
- P-3 : Shortage of protective water sources
- P-4 : Shortage of mulching materials
- P-5 : Shortage of family labour
- P-6 : Maintenance of temporary fencing
- P-7 : May affect the Kharif and Rabi crops timings
- P-8 : Non-availability/shortage of seeds
- P-9 : Non-availability of suitable machinery for harvesting/threshing

Source: IDSAP Field Survey, 2020

The tenant and marginal farmers are facing more problems than small, medium and large farmers (Table 5.1). Arranging mulching materials is the most challenging task for both tenant and marginal farmers. Higher cost of mulching materials may be hindering the tenant farmers to invest more on leased-in land. These farmers are also facing problem of crop loss due to cattle grazing. Low or nil investment on fencing may be increasing the risk of cattle grazing. They are also facing challenges of not getting seeds and timely availability of labour. On the other hand, the land-owning classes of different categories are mainly facing labour shortage problem along with shortage of protective irrigation during long dry spells and mulching materials. Since mulching is a critical integral part of PMDS farming, adequate steps need to be taken to provide mulching materials at a subsidised price to all. It is also clearly visible from the Table 5.1 that except protective irrigation, the medium and large land-owning farmers are not facing many problems like the other landowning cultivators. These farmers could be able to arrange sufficient mulching materials from crops grown during the Rabi season on their own.

Table 5.1: Farm category wise percentage of farmers reported problems in expanding PMDS farming

Problem	Land less	Marginal	Small	Medium and Large
a. No problem	15.74	16.73	18.72	22.69
b. Shortage of labour	28.60	28.77	21.51	9.20
c. Shortage of family labour	12.31	19.87	15.24	14.01
d. Shortage of mulching materials	50.87	22.07	14.31	12.21
e. May affect the Kharif and Rabi crops timings	12.48	17.02	13.08	11.49
f. Non-availability/shortage of seeds	31.06	14.77	12.49	1.44
g. Protection of crops from grazing animals	35.89	25.55	26.79	24.65
h. Maintenance of temporary fencing	28.02	16.84	9.93	13.20
i. shortage of protective water sources	20.67	25.96	17.03	17.35
j. Non-availability of suitable machinery for harvesting/threshing	18.23	17.13	4.98	4.98
Average	23.81	18.85	13.54	10.85

Note: percentages are respective totals. Source: IDSAP Field Survey, 2020

District wise analysis shows that all sample farmers in Vishakhapatnam, Anantapuramu, Chittoor and East Godavari districts faced one or more challenges as reported in Table 5.2. Many farmers of these districts including Krishna and Guntur reported of facing many challenges. Farmers of Visakhapatnam district faced all challenges except shortage of mulching materials. Protection of crops from grazing animals, shortage of labour and shortage of mulching materials are the common problems of these districts. On the other hand, shortage of irrigation and non-availability of suitable machinery for harvesting/threshing are least occurred problems although severe in Visakhapatnam and Krishna districts.

Very few farmers of West Godavari, PSR Nellore, YSR Kadapa, and Kurnool districts reported of facing any challenge while adopting PMDS farming. Average response to facing any of these challenges is less than the state average. But a considerable proportion of cultivators of these districts still have the challenges of crop damage due to animal grazing, shortage of both family and hired labour, and shortage of mulching materials.

Table 5.2: District wise percentage of farmers reported problems while expanding PMDS farming

District	P-0	P-1	P-2	P-3	P-4	P-5	P-6	P-7	P-8	P-9	Average
Anantapuramu	0.00	24.22	17.63	0.00	56.67	2.97	5.93	0.00	0.00	0.00	10.74
Chittoor	0.00	20.64	30.82	2.53	5.77	33.24	1.49	0.71	3.11	1.69	10.00
East Godavari	0.00	65.18	50.54	1.97	92.66	16.58	67.11	0.00	5.90	0.00	29.99
Guntur	53.93	27.70	34.73	16.23	44.22	16.06	25.11	8.32	17.64	0.00	19.00
YSR Kadapa	18.24	15.70	8.04	22.42	10.34	12.39	2.95	2.97	5.85	0.56	8.12
Krishna	2.44	46.29	30.33	29.55	50.72	10.79	42.72	29.07	67.44	68.86	37.58
Kurnool	11.12	10.62	21.59	14.77	7.72	15.23	7.67	3.91	5.39	2.05	8.90
PSR Nellore	37.98	8.74	16.75	0.00	11.43	7.96	2.45	8.67	1.89	0.96	5.89
Prakasam	2.16	57.06	6.30	5.27	6.60	0.29	14.43	0.73	5.38	0.00	9.61
Srikakulam	2.18	13.01	0.00	6.17	12.08	2.12	5.67	93.88	5.48	0.00	13.84
Visakhapatnam	0.00	30.87	78.27	94.72	10.43	30.96	22.32	34.55	22.49	51.60	37.89
Vizianagaram	33.64	22.22	11.31	3.64	34.87	37.94	10.20	31.86	23.48	0.58	17.61
West Godavari	67.80	24.28	0.43	9.33	1.99	1.43	15.66	0.00	0.00	0.00	5.31
Total	17.42	26.60	26.07	23.10	22.14	17.92	16.02	15.48	14.84	13.88	17.64

Note: Cells marked yellow implies more severe problem. For abbreviations same as Figure 4.1

Source: IDSAP Field Survey, 2020

5.3 Conclusions

The above analysis suggests that PMDS farmers are facing some challenges which may hinder them in the expansion of the total area under PMDS farming. The main problems reported by the farmers such as damage of crops due to animal grazing, higher cost of fencing, shortage of mulching materials, shortage of hired labour, and lack of protective irrigation facilities need to be addressed, to brought in more area under PMDS farming.

Chapter 6

Summary and Recommendations

6.1 Introduction

PMDS practice is a good initiative for improving the soil quality and productivity. As per the scientific principles behind this model, PMDS has an enormous potential to resolve the current life-threatening problem of *global warming*. The practical objectives of the programme are: to keep land under green cover for all 365 days of a year; to improve soil quality and productivity, to reduce the cost of cultivation and to enhance crop profitability. The major objective of this study is to understand the current situation of PMDS farming in the state. Household survey has been undertaken in PMDS practicing villages of all 13 districts of Andhra Pradesh to riposte the objectives of the study.

6.2 Major processes and findings of the study

1. It was planned to cover 1,040 of PMDS farmers in the sample, at the rate of 10 per GP; from 104 GPs at the rate of eight GPs per district. Because of uneven spread of the program across the districts and requirement of subsequent surveys during Kharif and Rabi seasons, the sample design has been altered and the sample size has been slightly enlarged. Data has been collected from 1,130 PMDS farmers from 107 GPs across all 13 districts, in proportion to the spread of the programme. The sample size per district varies from 32 in Anantapuramu to 234 in Vizianagaram.
2. The characteristics of the sample farmers, broadly reflect the characteristics of cultivators in the project area in terms of land-owning and tenurial categories, social groups and demographic categories.
3. Almost all farmers have adhered to the recommendations related to application of Beejamrutham. Mulching, the all-important input of PMDS, is followed by 66%, and about half of them have applied soil-layer on the mulch to protect it from blowing away. Over one-third of sample farmers have adhered to the suggested seed rate of 12 plus kgs per acre. Less than one-third have put in the fencing around their plots. Only 7.5 per cent farmers have pelletized the seeds, which is a mandatory recommendation. Even lesser proportion of farmers have sown more than 15 varieties of crops, minimum number of crops recommended by RySS's protocol. Needless to say, that there are wide variations across the districts.

4. The major material used in the mulching are Paddy straw (21%), dried leaves (17%), Groundnut shells (14%), Paddy husk (13%), previous crop residue (9%), etc. Though Paddy husk is prohibited, in the protocol, to use as a mulch, about 11% farmers have used it. It is mostly used in Chittoor, YSR Kadapa and Krishna districts. The practice may be discouraged.
5. The application of soil-layer on mulch needs to be reviewed.
6. Over 77 per cent of sample farmers have successfully cultivated PMDS crops, under completely rainfed conditions, with mist and non-seasonal erratic rainfall. However, many farmers felt that provision of protective irrigation may enhance yields and returns.
7. In about 66 per cent total cultivated plots, poly-crops, which are commonly known as Navadanyalu (nine crops) are grown, without any main crop. In the remaining plots, pulses are grown as main crop on 15.09 per cent plots; vegetables are grown on 10.39 per cent plots; followed by oilseeds (2.98%) and cereals (2.12%).
8. RySS may collaborate with MGNREG to provide farm ponds to the farmers. The ponds should be designed in such way, to hold the water throughout the year.
9. Average cost of PMDS cultivation is Rs,11,939 per ha and average area cultivated is 0.33 ha. It turns out to be an average PMDS cost of Rs.3,941 per farmer.
10. About 70 per cent farmers have not at all harvested the crop. They incorporated the entire crop in the field into the soil.
11. However, over 21 per cent, sample farmers, who have completely harvested the PMDS crops got Rs.32,283 net returns per hectare and 8.54 per cent of farmers, who have partially harvested their PMDS crops, have got net returns of Rs.12,734 per hectare.
12. As majority of farmers have not harvested crops, the overall average net return from crops grown in PMDS plot is negative of Rs.7,840 per ha.
13. Despite overall negative net returns from PMDS farming, expectations of higher yield and lower cost of cultivation during the kharif and Rabi seasons are the driving forces behind PMDS.
14. There are many perceived non-monetary benefits of PMDS farming. These are protection of microorganisms, conservation of soil moisture, capture of atmospheric moisture and creating fodder for livestock, etc.
15. The shortage of inputs such as labour, mulching materials, seeds, and biological inputs, is a major hindrance in adopting PMDS.

6.3 Recommendations

1. The farmers contribution in reducing the global warming need to be recognized and rewarded. It will give a big boost to the PMDS in the state.
2. To influence the deeper layers of the soils, trees, including forestry species, may also be included in the model/ crops. In other words, tree based cropping models may also be considered. Trees need less care, once they have established. Hence, they are less labour intensive. There is a huge unmet demand for forest species and products.
3. About 74 per cent of net sown area (NSA) in the state is used for single season only. Through PMDS, the cropping intensity could be increased from present 1.26 to more than 2.00.
4. The experiences of over 30 per cent sample farmers indicate that significant economic returns (higher positive net returns) can be achieved, along with ecological and environmental benefits, with little additional investment on paid-out costs. Based on their experience the PMDS model may be tweaked.
5. As this is a novel and very useful model, this needs to be popularized through media and all possible means and methods.
6. The reasons for lesser proportion of farmers adopting some of recommended protocols, such as palletisation of seeds, seed-quantities per acre, number of crop varieties grown in a plot, putting soil layers on the mulch, etc., need to be analysed and resolved.
7. Before addressing the field issues, the conceptual issues may be reviewed. For example, almost all protocol recommendations are uniform to the entire state. These rates and practices may be reviewed. Diverse factors such geographical conditions, soil types, local rainfall, local germination rates, composition of crops, inclusion of main crop, etc., have to be considered. while recommending various rates and practices.
8. One important recommendation, viz. providing soil layer on the mulch, needs to be reviewed. It may be possible that soil may absorbs the morning dew and allow it to evaporate during the day time, leaving no moisture to percolate down. *The statistical analysis also indicated that soil layer has significant negative relation with crop returns.*
9. Since only seven per cent sample farmers have pelletized the seeds, the issue has to be attended. Apart from reviewing its applicability across all regions and crop composition, RySS may take up the awareness and field demonstration programs.

10. Shortage of mulching material is widely felt constraint. As a lot of biomass is available in different areas, a coordination is required to link the shortage areas with the surplus areas.
11. The issue of use of Paddy husk as mulching material in Chittoor, Krishna and YSR Kadapa districts need to be discouraged.
12. RySS may collaborate with MGNREGS to provide farm ponds to the farmers. The ponds should be designed to hold the water throughout the year.
13. Grazing animals is one of the serious challenges to the PMDS plots. Live fencing may take time to establish. Building up of strong temporary fencing may be expensive. Social control of grazing may be a good option, under which, the livestock may be guarded collectively or PMDS plots may be protected collectively.
14. There is a general shortage of biological inputs, and raw material and knowhow to prepare the biological inputs. The network of biological inputs shops (popularly known as NPM shops) may be established and strengthened. Further, awareness and training programs may be conducted about the preparation of the biological inputs. Self - learning pamphlets and hand-outs may be printed and distributed for ready reference and use.
15. There is a need for a close coordination of all departments and institutions, dealing with the farmers and farming, such as agriculture, rural development, animal husbandry, forestry, civil supplies, Rythu Bharosa Kendras, Gram Sachivalayas, etc. Such integration enables the RySS/ field staff to share their resources and responsibilities for the productive/ fruitful engagement with the farmers and for the rapid expansion of the program/ project.

Appendix

Appendix A: Tables from Household Listing

Table A-1: District wise distribution of sample households and crops grown by them (in number)

Sl. No	District	Paddy	Groundnut	Cotton	Red Gram	Chilli	Maize	Bengal Gram	Green Gram	Horse Gram	Sugarcane	Black Gram	Ragi	Total sample cultivators	Total sample villages
1	Anantapuramu	6	27	0	3	5	5	0	1	0	0	0	5	32	5
2	Chittoor	51	59	0	0	2	1	0	0	11	9	0	7	84	8
3	YSR Kadapa	75	15	15	11	3	1	0	0	0	0	0	0	111	11
4	Kurnool	16	15	16	23	2	0	1	0	0	0	0	0	65	7
5	East Godavari	74	0	3	7	0	8	0	0	0	0	1	0	80	8
6	Guntur	48	0	17	2	11	1	0	0	0	0	1	0	72	7
7	Krishna	69	0	5	0	2	2	0	0	0	0	0	0	70	7
8	PSR Nellore	62	10	0	0	2	1	0	1	0	0	11	4	75	7
9	Prakasam	28	20	22	9	18	0	2	3	1	2	4	0	77	7
10	Srikakulam	82	0	0	0	2	19	0	0	0	2	0	0	101	10
11	Visakhapatnam	69	0	0	3	3	2	0	1	0	12	1	13	69	7
12	Vizianagaram	196	1	9	87	1	10	0	1	38	25	32	56	234	16
13	West Godavari	170	0	0	0	0	1	0	0	0	0	0	0	70	7
	Sample total	946	147	87	145	51	51	3	7	50	50	50	85	1140	107

Source: IDSAP Field Survey, 2020

Table A-2: Distribution of household listed PMDS farmers in 107 sample Gram Panchayats according to land holding classification (in percentage)

Sl. No	District	Total number of PMDS Farmers	Land less Farmers	Marginal Farmers	Small Farmers	Medium and Large Farmers	Total
1	Anantapuramu	50	2.00	30.00	54.00	14.00	100.00
2	Chittoor	754	0.27	59.95	36.87	2.92	100.00
3	YSR Kadapa	687	2.91	55.90	33.62	7.57	100.00
4	Kurnool	203	0.99	57.14	30.54	11.33	100.00
5	East Godavari	543	18.78	67.96	10.87	2.39	100.00
6	Guntur	569	26.19	57.12	12.83	3.87	100.00
7	Krishna	302	12.91	70.86	11.59	4.64	100.00
8	PSR Nellore	643	0.47	83.67	14.46	1.40	100.00
9	Prakasam	468	8.55	64.96	20.73	5.77	100.00
10	Srikakulam	661	6.20	80.33	11.95	1.51	100.00
11	Visakhapatnam	806	1.61	62.90	26.55	8.93	100.00
12	Vizianagaram	3875	0.95	69.29	23.97	5.78	100.00
13	West Godavari	291	23.71	44.33	25.09	6.87	100.00
14	Total	9852	5.26	66.68	22.84	5.23	100.00

Source: IDSAP Field Survey, 2020

Table A-3: Distribution of listed PMDS farmers in 107 sample Gram Panchayats according to land ownership classification (in percentage)

Sl. No	District	Total number of PMDS Farmers	Owner	Owner-cum Tenant	Pure Tenant	Total
1	Anantapuramu	50	86.00	4.00	10.00	100.00
2	Chittoor	754	88.46	0.27	11.27	100.00
3	YSR Kadapa	687	77.29	5.09	17.61	100.00
4	Kurnool	203	99.01	0.99	0.00	100.00
5	East Godavari	543	68.51	30.94	0.55	100.00
6	Guntur	569	46.22	52.72	1.05	100.00
7	Krishna	302	69.21	30.46	0.33	100.00
8	PSR Nellore	643	86.16	0.93	12.91	100.00
9	Prakasam	468	80.98	13.68	5.34	100.00
10	Srikakulam	661	77.16	21.63	1.21	100.00
11	Visakhapatnam	806	94.42	5.33	0.25	100.00
12	Vizianagaram	3875	95.69	4.08	0.23	100.00
13	West Godavari	291	48.45	29.90	21.65	100.00
14	Total	9852	84.64	11.19	4.17	100.00

Source: IDSAP Field Survey, 2020

Appendix B: Farm category wise Tables on PMDS farming

Table B-1: Farm category wise materials used for mulching (in percentage)

Mulching materials	Land less	Marginal	Small	Medium and Large	Total
Paddy straw	16.74	25.40	14.85	8.65	21.52

Groundnut shells	5.06	13.43	20.09	14.87	14.48
Blackgram husk	22.79	6.17	4.86	9.75	7.29
Redgram husk	1.36	3.11	8.18	18.24	4.74
Paddy husk	28.96	11.10	11.80	9.11	12.64
Bengalgram husk	0.48	0.49	1.24	1.87	0.72
Sugarcane trash	0.00	6.30	5.70	0.00	5.44
Dried leaves	18.62	16.88	17.84	13.68	17.15
Residue of previous crops	2.77	9.87	7.32	5.89	8.53
Creepers	0.00	0.09	0.23	0.00	0.12
Melons	0.00	0.00	0.23	0.00	0.06
Sweet potato	0.00	0.68	1.15	2.35	0.80
Leafy vegetables	0.57	0.49	1.07	8.51	0.90
pulse crops	2.64	5.19	4.70	0.26	4.70
Others	0.00	0.79	0.75	6.83	0.91
Total	100.00	100.00	100.00	100.00	100.00

Source: IDSAP Field Survey, 2020 **Table B-2: Farm category wise major crops grown in PMDS Plots (in percentage)**

Crop	Land less	Marginal	Small	Medium and Large	Total
Paddy	0.00	0.00	0.40	0.00	0.09
Maize	0.00	0.31	0.43	0.00	0.30
Groundnut	0.76	0.59	1.61	0.99	0.85
Cotton	0.00	0.00	2.64	0.00	0.58
Tomato	0.00	1.53	0.00	2.92	1.15
Chillies	0.00	1.35	0.00	1.26	0.94
Black gram	11.80	6.29	2.74	3.79	5.80
Green gram	1.03	6.96	1.84	2.62	5.12
Bengal gram	0.47	0.13	0.00	0.00	0.12
Jowar	8.43	0.29	1.25	0.00	1.12
Bajra	0.00	0.00	0.72	0.00	0.16
Ragi	0.00	0.13	1.35	1.28	0.46
Red gram	0.00	1.70	2.53	2.87	1.81
Other pulses	0.69	2.20	2.53	3.93	2.25
Sesamum	0.00	2.99	0.30	0.00	2.00
Other oil seeds	0.00	0.22	0.00	0.00	0.14
Other vegetables	0.41	2.72	5.51	0.87	3.05
Turmeric	0.00	6.73	4.13	0.00	5.26
Poly-crops	69.70	63.48	71.80	63.93	65.83
Other crop	6.70	2.39	0.20	15.53	2.97

Note: percentages are to the respective totals. Source: IDSAP Field Survey, 2020

Table B-3: Farm category wise percentage of responses about harvesting of crops

Harvesting status	Land less	Marginal	Small	Medium and Large	Total
Completely harvested	9.60	23.58	20.16	12.77	21.15
Partially harvested	0.00	10.89	5.69	4.10	8.54
Not harvested	90.40	65.53	74.15	83.13	70.31
Total	100.00	100.00	100.00	100.00	100.00

Source: IDSAP Field Survey, 2020

Table B-4: Distribution of farmers according to use of PMDS crop for the disposal (in percentage)

	Land less	Marginal	Small	Medium and Large	Total
a. Directly incorporated into the soil of the same plot	85.17	69.95	70.37	77.16	71.67
b. Cut and incorporated into the soil of the same plot	48.44	43.01	34.36	19.21	40.22
c. Cut and incorporated into the soil of other plots also	1.17	10.29	11.87	3.40	9.52
d. Cut, dry it and incorporated into the soils	0.13	15.75	9.11	5.13	12.45
e. Cut and used it as animal fodder	19.59	35.84	31.50	18.22	32.60
f. Grazed the animals directly	20.61	24.60	20.74	24.33	23.42

Note: Percentages are to the respective totals. Source: IDSAP Field Survey, 2020

Table B-5: Farm Category wise percentage of farmers reported benefits of PMDS farming

Benefit	Land less	Marginal	Small	Medium and Large	Total
a. Additional financial benefits from sale and consumption of PMDS produces	14.20	29.80	28.69	14.93	27.47
b. Capture the atmospheric moisture	65.79	47.00	33.99	36.41	45.07
c. Keep the soils under the shade and protect the microorganism	79.74	68.09	58.15	57.30	66.25
d. Keep the soils under the shade and conserve the soil moisture	60.74	54.20	41.18	35.36	50.82
e. Fodder for the livestock	24.97	36.56	27.96	17.01	32.66
f. Grazing animals	31.80	44.82	32.41	21.62	39.76
g. Incorporate the biomass into the soils to increase the soil quality and productivity	25.20	41.88	30.75	36.65	37.80
h. Cash income throughout the year	11.59	17.60	18.70	12.28	17.06
i. Availability of the quality and nutrition food for the family throughout the year	15.70	22.82	15.61	17.44	20.37
j. Do not know	1.14	2.05	2.56	6.44	2.33

Note: Percentages are to the respective totals. Source: IDSAP Field Survey, 2020

Appendix C: District level Estimates for PMDS farming

Table C-1: District wise percentage of responses about month of sowing PMDS Crops

	January	February	March	April	May	June	July	August	September	October	November	December
Anantapuramu	0.00	0.00	59.33	35.00	5.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chittoor	0.00	0.00	16.06	37.02	46.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00
YSR Kadapa	0.00	0.00	8.09	25.94	60.07	5.91	0.00	0.00	0.00	0.00	0.00	0.00
Kurnool	0.00	0.91	0.00	0.00	97.05	2.04	0.00	0.00	0.00	0.00	0.00	0.00
East Godavari	0.00	1.72	0.00	98.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Guntur	0.00	0.00	0.00	35.40	51.89	12.71	0.00	0.00	0.00	0.00	0.00	0.00
Krishna	0.00	0.00	0.00	0.00	36.62	63.38	0.00	0.00	0.00	0.00	0.00	0.00
PSR Nellore	0.00	0.00	7.83	56.64	33.68	1.85	0.00	0.00	0.00	0.00	0.00	0.00
Prakasam	0.00	8.81	5.26	13.94	71.26	0.74	0.00	0.00	0.00	0.00	0.00	0.00
Srikakulam	0.00	0.00	22.08	16.36	37.53	24.04	0.00	0.00	0.00	0.00	0.00	0.00
Visakhapatnam	0.00	0.33	54.88	44.30	0.00	0.49	0.00	0.00	0.00	0.00	0.00	0.00
Vizianagaram	0.00	0.51	0.00	20.23	66.24	13.02	0.00	0.00	0.00	0.00	0.00	0.00
West Godavari	0.00	1.00	0.00	0.00	55.85	43.16	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.00	0.63	13.38	28.94	43.85	13.20	0.00	0.00	0.00	0.00	0.00	0.00

Source: IDSAP Field Survey, 2020

Table C-2: District percentage of responses about materials used for mulching

District	P a d d	G r o	B I a	R e d	P a d d	B e	S u s s	D r i	R e s	C r	M e	S w	L e	P u I	O t h
Anantapuramu	8.8	53.4	0.0	13.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.8	0.0	17.3
Chittoor	4.9	35.3	0.0	0.0	9.4	0.0	19.4	12.8	0.0	0.0	0.0	0.0	0.0	18.0	0.3
East Godavari	67.6	32.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Guntur	59.3	0.0	11.8	0.0	2.0	3.9	0.0	0.0	0.3	0.0	0.0	0.0	0.0	22.7	0.0
YSR Kadapa	1.3	12.1	1.7	9.4	35.0	1.6	0.0	34.7	2.9	0.0	0.0	0.0	0.0	0.0	1.3
Krishna	8.9	0.0	30.6	0.0	36.2	0.0	0.0	24.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Kurnool	0.0	30.2	0.0	55.5	0.0	0.0	0.0	3.5	10.9	0.0	0.0	0.0	0.0	0.0	0.0
PSR Nellore	42.1	10.3	11.5	0.0	0.0	0.0	0.0	36.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prakasam	9.9	13.7	47.1	11.4	0.2	8.4	0.0	1.2	8.0	0.0	0.0	0.0	0.0	0.1	0.0
Srikakulam	81.0	5.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.8
Visakhapatnam	44.1	1.0	0.0	0.0	0.0	0.0	5.2	9.9	32.2	0.5	0.3	3.5	3.2	0.0	0.2
Vizianagaram	79.6	20.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
West Godavari	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	21.5	14.5	7.3	4.7	12.6	0.7	5.4	17.2	8.5	0.1	0.1	0.8	0.9	4.7	0.9

Note: cells marked in yellow implies higher than the state average. Percentages are respective totals. Source: Field Study

Table C-3: District wise percentage distribution of responses about major crops grown in PMDS Plots

Anantapuramu	0.00	4.80	39.51	0.00	0.00	0.00	0.00	2.71	0.00	0.00	0.00	0.00	5.37	15.94	0.00	0.00	2.40	0.00	29.28	0.00
Chittoor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.06	0.00	0.00	0.00	0.00	94.94	0.00
YSR Kadapa	0.00	0.00	0.00	2.88	0.00	0.00	0.00	0.00	0.19	0.00	0.00	0.00	3.07	0.00	0.00	0.00	0.00	0.00	81.51	12.36
Kurnool	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.22	0.00	6.13	0.00	0.00	0.45	0.00	0.00	0.00	0.00	0.00	85.20	0.00
East Godavari	0.00	2.58	0.00	0.00	0.00	0.00	31.71	16.23	0.00	15.25	0.00	0.00	0.00	1.72	0.00	0.00	0.00	0.00	32.29	0.22
Guntur	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.06	0.00	98.94	0.00
Krishna	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	0.00
PSR Nellore	0.00	0.98	0.00	0.00	0.00	0.00	0.98	9.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	88.10	0.00
Prakasam	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	0.00
Srikakulam	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	0.00
Visakhapatnam	0.00	0.00	0.00	0.00	8.25	6.76	7.44	7.56	0.48	0.00	0.00	0.00	0.00	0.00	11.99	0.00	13.21	37.74	3.53	3.04
Vizianagaram	0.71	0.00	0.46	0.22	0.00	0.00	23.75	17.41	0.13	0.00	1.28	3.66	8.77	10.75	2.60	1.12	9.09	0.00	18.96	1.09
West Godavari	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	0.00
Total	0.09	0.30	0.85	0.58	1.15	0.94	5.80	5.12	0.12	1.12	0.16	0.46	1.81	2.25	2.00	0.14	3.05	5.26	65.83	2.97

Note: percentages are respective totals. Source: IDSAP Field Survey, 2020

Table C-4: District wise percentage of responses about whether crops harvested from PMDS Plot

District	Completely harvested	Partially harvested	Not harvested	Total
Anantapuramu	81.55	12.52	5.93	100.00
Chittoor	13.66	10.46	75.88	100.00
YSR Kadapa	6.75	0.58	92.67	100.00
Kurnool	12.51	4.22	83.27	100.00
East Godavari	0.00	0.22	99.78	100.00
Guntur	7.94	0.00	92.06	100.00
Krishna	0.00	0.00	100.00	100.00
PSR Nellore	0.00	13.40	86.60	100.00
Prakasam	0.57	0.00	99.43	100.00
Srikakulam	2.09	0.00	97.91	100.00
Visakhapatnam	56.12	43.88	0.00	100.00
Vizianagaram	64.24	0.00	35.76	100.00
West Godavari	0.00	0.00	100.00	100.00
Total	21.15	8.54	70.31	100.00

Source: IDSAP Field Survey, 2020

Table C-5: District wise percentage of farmers used/disposed the PMDS crop residue (in percentage)

District	Directly incorporated into the soil of the same plot	Cut and incorporated into the soil of the same plot	Cut and incorporated into the soil of other plots also	Cut, dry it and incorporated into the soils	Cut and used it as animal fodder	Grazed the animals directly
Anantapuramu	25.14	42.41	5.37	12.78	21.30	5.93
Chittoor	69.53	84.20	6.66	5.14	61.00	52.95
YSR Kadapa	95.60	0.19	4.81	5.63	27.51	29.80
Kurnool	85.87	8.00	0.00	1.82	13.35	15.26
East Godavari	96.34	26.73	1.23	1.83	12.88	10.38
Guntur	63.94	48.28	0.00	4.16	20.08	19.71
Krishna	100.00	94.60	0.00	0.86	27.29	19.37
PSR Nellore	79.55	12.95	14.92	15.66	21.93	2.90
Prakasam	70.83	35.73	0.29	0.29	38.72	6.15
Srikakulam	100.00	0.00	0.00	0.00	9.66	5.49
Visakhapatnam	22.33	75.93	15.42	48.39	69.18	43.90
Vizianagaram	34.12	58.06	44.96	24.78	26.41	16.56
West Godavari	87.22	0.00	0.00	0.00	8.86	0.00
Total	71.67	40.22	9.52	12.45	32.60	23.42

Source: IDSAP Field Survey, 2020

Table C-6: District wise percentage of farmers reported benefits of PMDS farming

District	Additional financial benefits from sale and consumption of PMDS produces	Capture the atmospheric moisture	Keep the soils under the shade and protect the microorganism	Keep the soils under the shade and conserve the soil moisture	Fodder for the livestock	Grazing animals	Incorporate the biomass into the soils to increase the soil quality and productivity	Cash income throughout the year	Availability of the quality and nutrition food for the family throughout the year	Do not know
Anantapuramu	34.95	35.87	14.31	15.58	25.65	2.97	26.31	7.51	40.43	24.92
Chittoor	37.34	12.35	73.10	63.53	7.79	52.60	11.86	18.00	3.11	3.24
YSR Kadapa	5.44	3.11	44.93	30.93	33.07	40.39	47.63	10.78	5.34	0.00
Kurnool	16.08	8.36	8.81	11.27	38.20	28.60	13.74	9.63	16.73	16.77
East Godavari	10.15	77.27	88.51	33.60	10.43	33.15	1.03	0.00	0.00	0.95
Guntur	34.41	83.70	94.18	60.78	22.58	21.45	3.19	4.16	8.33	3.78
Krishna	1.15	65.63	80.94	73.63	56.44	40.34	40.17	8.27	6.36	0.00
PSR Nellore	32.33	17.50	25.52	25.22	29.11	37.36	18.49	12.18	9.01	0.84
Prakasam	1.76	77.29	82.01	64.46	5.56	3.43	1.14	5.57	0.00	0.00
Srikakulam	0.00	37.64	83.08	51.37	10.47	6.30	44.07	0.00	0.00	0.00
Visakhapatnam	91.37	100.00	98.28	97.04	55.39	74.77	89.83	53.90	79.22	2.44
Vizianagaram	27.24	38.04	79.11	45.80	48.49	44.60	37.43	21.37	8.96	1.26
West Godavari	24.70	78.04	59.78	39.37	19.83	15.57	43.18	13.60	53.76	0.00
Total	27.47	45.07	66.25	50.82	32.66	39.76	37.80	17.06	20.37	2.33

Note: percentages are respective totals. Source: IDSAP Field Survey, 2020

Appendix D: Major Crop wise estimates for PMDS farming

Table D-1: Major crop wise irrigation practices in PMDS plot (in percentage)

Crop	Purely mist based	Rainfed	Irrigated	Total
Paddy	0.00	46.09	53.91	100.00
Maize	19.29	71.06	9.65	100.00
Groundnut	0.00	93.21	6.79	100.00
Tomato	17.99	82.01	0.00	100.00
Chillies	14.63	85.37	0.00	100.00
Black gram	8.81	58.82	32.37	100.00
Green gram	0.00	72.55	27.45	100.00
Bengal gram	0.00	100.00	0.00	100.00
Jowar	0.00	58.34	41.66	100.00
Ragi	0.00	100.00	0.00	100.00
Red gram	0.00	100.00	0.00	100.00
Other pulses	1.03	44.34	54.63	100.00
Sesamum	0.00	86.50	13.50	100.00
Other oil seeds	0.00	45.16	54.84	100.00
Other vegetables	1.05	97.46	1.49	100.00
Turmeric	7.96	92.04	0.00	100.00
Poly-crops	2.28	74.50	23.21	100.00
Other crop	0.00	53.83	46.17	100.00
Total	2.90	74.36	22.74	100.00

Source: IDSAP Field Survey, 2020

Table D-2: Major crop-wise materials used for mulching (in percentage)

Crop	Paddy straw	Groundnut shells	Blackgram husk	Redgram husk	Paddy husk	Bengalgram husk	Sugarcane trash	Dried leaves	Residue of previous crops	Creepers	Melons	Sweet potato	Leafy vegetables	pulse crops	Others	Total
Maize	16.15	27.08	0.00	13.54	0.00	0.00	0.00	16.15	0.00	0.00	0.00	0.00	0.00	0.00	27.08	100.00
Groundnut	14.94	79.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.45	0.00	0.00	100.00
Tomato	25.34	0.00	0.00	0.00	0.00	0.00	1.28	24.07	31.18	1.95	0.00	7.12	9.06	0.00	0.00	100.00
Chillies	46.39	0.00	0.00	0.00	0.00	0.00	2.61	3.97	29.83	0.00	0.00	3.97	13.22	0.00	0.00	100.00
Black gram	64.45	8.09	0.00	0.00	0.00	0.00	3.00	15.75	8.71	0.00	0.00	0.00	0.00	0.00	0.00	100.00
Green gram	50.92	11.67	1.59	2.25	0.00	0.00	0.00	9.78	23.79	0.00	0.00	0.00	0.00	0.00	0.00	100.00
Bengal gram	21.57	11.76	0.00	11.76	0.00	0.00	21.57	11.76	21.57	0.00	0.00	0.00	0.00	0.00	0.00	100.00
Jowar	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
Red gram	0.00	27.88	0.00	21.20	9.69	0.00	0.00	0.00	9.69	0.00	0.00	0.00	0.00	0.00	31.55	100.00
Other pulses	0.00	33.46	0.00	2.37	10.94	0.00	21.87	0.00	0.00	0.00	0.00	0.00	2.37	21.87	7.12	100.00
Sesamum	58.42	9.21	0.00	0.00	0.00	0.00	1.58	0.00	30.79	0.00	0.00	0.00	0.00	0.00	0.00	100.00
Other vegetables	31.52	1.47	0.71	1.06	0.00	0.00	1.00	18.35	35.74	0.00	0.00	6.08	4.05	0.00	0.00	100.00
Turmeric	49.00	0.00	0.00	0.00	0.00	0.00	4.64	5.41	37.13	0.76	0.76	0.76	1.53	0.00	0.00	100.00
Poly-crops	13.80	16.53	10.13	6.24	17.43	1.01	6.01	20.33	1.61	0.00	0.00	0.00	0.11	6.02	0.79	100.00
Other crop	38.25	19.42	0.00	0.00	0.00	0.00	12.26	0.00	0.00	0.00	0.00	25.99	0.00	0.00	4.09	100.00
Total	21.52	14.48	7.29	4.74	12.64	0.72	5.44	17.15	8.53	0.12	0.06	0.80	0.90	4.70	0.91	100.00

Source: IDSAP Field Survey, 2020

Appendix 5: District-Wise and Gram Panchayat wise minimum, average and maximum area under PMDS (Acre and Cents)

District	Gram Panchayat	Area under PMDS (Acres and Cents)		
		Minimum	Mean	Maximum
Anantapuramu	Jantaluru	1.00	1.00	1.00
	Muddulapuram	0.25	0.61	1.00
	Ganthimarri	1.00	1.00	1.00
	Govindapuram	0.50	0.60	1.00
	Chintharlapalli	0.50	0.90	1.00
	Total	0.25	0.78	1.00
Chittoor	SS.Puram	0.20	0.45	1.00
	Vavilathota	0.20	0.41	0.55
	Kotala	0.25	0.37	0.50
	Sakirevu Palli	0.25	0.37	0.50
	Gundugallu	0.25	0.42	0.60
	Mangaadu	0.20	0.36	0.50
	Kuppam badur	0.25	0.40	0.50
	Malepadu	0.25	0.43	0.50
	Total	0.20	0.40	1.00
YSR Kadapa	Gontuvari palle	0.50	0.80	1.00
	Nandyalampeta	0.50	1.44	4.16
	Chagaleru	0.50	0.72	1.10
	Madithadu	0.10	1.41	5.00
	Pathasanghatipalli	0.20	0.80	4.85
	Alireddypalli	0.75	1.08	2.00
	Dirasavancha	0.35	1.07	2.00
	Munnelli	0.25	0.70	1.00
	Rajupalyam	0.50	1.31	3.00
	Variga	0.50	1.15	3.00
	Annallur	0.70	1.16	2.21
	Total	0.10	1.17	5.00
Kurnool	KAMAGANIKUNTLA	0.20	0.62	1.00
	Eddupenta	0.20	0.35	0.50
	Guvvalakuntla	0.50	0.55	1.00
	Markapuram	0.50	0.55	1.00
	Balapanur	0.50	0.81	1.50
	Pasupala	0.20	0.37	0.50
	Kandhikayapalli	0.10	0.13	0.20
	Total	0.10	0.44	1.50
East Godavari	Sankhavaram	0.70	0.97	1.00
	Anaparthi	0.50	0.70	1.00
	VegiPaddypalem	0.30	0.77	1.20
	Arkuru	0.50	0.80	1.00
	Gangampalem	0.50	0.70	1.00
	Chebrolu	0.50	0.80	1.00
	Pedamallapuram	0.50	0.93	1.50
	Rampa Yerrampalem	0.50	0.85	1.00
	Total	0.30	0.80	1.50
Guntur	Revendrapadu	0.35	0.90	1.00
	Mvpalem	0.50	0.60	1.00
	Epuru	0.50	0.83	1.00
	Davuluru	0.50	0.63	1.00
	Pvpalem	0.50	0.65	1.00
	Thallacheruvu	0.75	0.98	1.00
	Solasa	0.50	0.71	1.00
	Total	0.35	0.84	1.00
Krishna	Satuluru	0.40	0.51	0.70
	kammanamolu	0.50	0.70	1.50
	Perikegudem	0.50	0.50	0.50
	Anjineyapuram	0.50	1.20	2.00
	s.n palem	0.50	1.40	5.00
	JAMIGOLVEPALLI	0.25	0.85	1.70

	Nelakuru	0.50	0.79	1.50
	Total	0.25	1.02	5.00
PSR Nellore	Kommineturu	0.50	0.54	0.75
	D Velampalli	0.50	0.77	1.00
	Utlapalli	0.00	1.35	3.00
	kothapalli	0.10	0.69	1.50
	PEDDAPUTHEDU	0.30	0.80	1.00
	Tallaaplem	0.50	1.04	1.70
	Vavilla	0.50	0.91	2.50
	Total	0.00	0.98	3.00
Prakasam	Tripurantakam	0.50	0.53	0.82
	y.palem	0.50	0.55	1.02
	pallamalli	0.50	1.89	5.00
	Peridepi	0.50	0.74	2.00
	Kothapatham	0.40	0.84	1.80
	Dornala	0.50	0.50	0.50
	Chevuru	0.50	0.55	1.00
	Total	0.40	0.63	5.00
Srikakulam	Yalamanchili	0.20	0.57	1.00
	Ranasthalam	0.10	0.30	0.54
	Tulugu	0.50	0.92	1.00
	Akkarapalli	0.25	0.47	1.00
	NADIMIKELLA	0.30	0.78	1.00
	Singupuram	0.50	0.52	0.70
	Thandyam	0.30	0.68	1.00
	Gopalapuram	0.20	0.72	1.40
	Veeraghattam	0.50	0.67	1.04
	Domam	0.40	0.84	1.25
Total	0.10	0.66	1.40	
Visakhapatnam	U Boddaputtu	0.20	0.32	0.50
	Pedhalabudu	0.40	0.51	1.00
	Mallavaram	0.20	0.50	1.00
	Iradapalli	0.30	0.61	1.00
	Vanjangi	0.10	0.28	0.50
	cheedikada	0.40	0.48	0.50
	konam	0.40	0.48	0.50
	Total	0.10	0.38	1.00
Vizianagaram	Balesu	0.40	0.62	1.00
	thotapalli	0.30	0.93	2.00
	Golladi	0.50	1.03	3.00
	Chamalapalli	1.00	1.00	1.00
	pittalametta	1.00	1.20	3.00
	Gajarayanivalasa	0.50	0.50	0.50
	Cheedivalasa	0.50	1.03	1.50
	padmapuram	0.30	0.52	1.00
	R.Jammu	0.50	0.73	1.00
	Gumma	0.25	0.69	1.00
	kalamrajupeta	0.50	0.55	1.00
	Ch.Binnidi	0.50	0.75	1.00
	P.Amiti	0.40	0.95	2.00
	Duddukhallu	0.50	0.67	1.00
	Gotivada	0.40	0.62	1.00
Total	0.25	0.85	3.00	
West Godavari	Duvva	0.50	0.60	1.00
	venkatayypalem	1.00	1.37	3.00
	Marri Gudem	0.50	0.92	2.00
	cheemalavarigudem	1.00	1.40	3.00
	Tadikalapudi	1.00	1.30	4.00
	Nelaturu	1.00	1.40	3.00
	Daatlavaripalem	1.00	1.50	4.00
	Total	0.50	1.11	4.00

Source: IDSAP Field Survey, 2020