



Rythu Kosam: Andhra Pradesh Primary Sector Mission Delta Region Baseline Summary Report



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Rythu Kosam: Andhra Pradesh Primary Sector Mission

Delta Region Baseline Summary Report

D Kumara Charyulu, D Moses Shyam, Suhas P Wani and KV Raju

Contents

Executive Summary	1
1. Background and Objectives	3
2. Overview of Delta Region Agriculture	3
3. Pilot Sites of the AP Primary Sector Mission	6
4. Sampling Framework.....	7
5. Methodology	9
6. Findings from Baseline Survey.....	11
6.1 Distribution of sample across size groups and communities.....	11
6.2 Family size, extent of literacy and participation in labor market.....	12
6.3 Landholdings and extent of tenancy	12
6.4 Household assets and livestock ownership	12
6.5 Major crops and their productivity levels.....	13
6.6 Economics of crop and fish enterprises.....	13
7. Pilot Site GVA Estimations across Sub-sectors.....	16
8. Major Constraints and Potential Opportunities	19
9. Summary and Way Forward	21
References	23
Appendix 1	24
Appendix 2	27

List of Figures

Figure 1. Share of total cropped area among crop groups	4
Figure 2. Cropped area shares by crop in the region (2014-15)	5
Figure 3. Performance of paddy in the Delta Region.....	14
Figure 4. Performance of maize in the Delta Region	14
Figure 5. Shares in the total GVA estimation by sub-sector.....	16
Figure 6. Total GVAs estimations for the three pilot sites	17
Figure 7. Composition of pilot sites' GVAs by sub-sector.....	17
Figure 8. Shares of different sub-sectors in total GVA.....	18
Figure 9. GVA value per pilot site village (₹ Million) in the region.....	18
Figure 10. GVA value per household in the sample (₹ per household) in the region	19
Figure 11. GVA value per hectare in the pilot sites (₹ per hectare) in the Delta Region.....	19

List of Tables

Table 1. Comparative status of the Delta Region vis-à-vis Andhra Pradesh and India.....	5
Table 2. Distribution and coverage of pilot sites under AP primary sector mission	7
Table 3. Sampling strategy for cultivator households (n=4670)	9
Table 4. Sample distribution and coverage during baseline (BL) surveys	9
Appendix 1	
Table 1. Distribution of agricultural sample in the Delta Region	24
Table 2. Socio-economic details of the sample in the Delta Region	24
Table 3. Landholding particulars in Delta Region pilot sites (hectare).....	24
Table 4. Household assets and livestock ownership in Delta Region pilot sites	24
Table 5. Major crops and their average productivity levels by pilot site	25
Table 6. Economics of crop enterprises in Delta Region pilot sites	25
Table 7. Economics of prawn/fish enterprises in Delta pilot sites (₹ per cycle only).....	25
Table 8. Primary sector GVA estimations in Delta pilot sites (base year: 2014-15)	26
Table 9. District-wise pilot site GVA by unit values.....	26
Appendix 2	
Table 1. Extent of coverage of pilot site by district.....	26
Table 2. Extent of diversity in agricultural/horticultural pilot site villages	27
Table 3. Extent of diversity in selected agricultural/horticultural baseline villages.....	27
Table 4. Targeted baseline sample coverage across sub-sectors	28

Executive Summary

Andhra Pradesh has set for itself the target of becoming one of the top three states in India by the year 2022 in terms of socio-economic development and ease of doing business. The state aspires to achieve the status of a developed state in the country by the year 2029, and the vision is to lay foundation for the 'Sunrise state of Andhra Pradesh'. The achievement of this vision is incumbent upon a fast paced and sustainable double digit growth, delivered through a combination of programmatic and project interventions with a focus on sustainable and inclusive development. To achieve its vision, the government has charted out a multi-pronged strategy comprising seven missions, five grids and five campaigns. Among the seven, the primary sector mission, Rythu Kosam, is most prominent, aiming at achieving 'double digit growth' in agriculture and allied sectors. Also, a massive outlay of investments over the next five-year period (2015-2020) are targeted in the area of agricultural development under consortium approach by bringing state, national and international partners on board.

In partnership with the Government of Andhra Pradesh ICRISAT leads the consortium, and has designed a strategy to transform the agriculture and allied sectors in the state. The focus of this mission is primarily: improvement in soil fertility, access to better seed, reducing the cost of cultivation, productivity enhancement and value addition in the agriculture, horticulture, livestock and fisheries sub-sectors. Initially, 13 pilot sites corresponding to 13 districts of the state have been identified and established for introduction, testing and scaling-up of a range of technologies over a period of time. The proven technologies will be scaled-up to the entire district with suitable institutional reforms and different scales. Supply and demand side interventions are aimed for improving the livelihoods of farmers in the state.

A major objective of the present study is to document the current status of the three pilot sites covering 65 villages from eight *mandals* (administrative divisions) in three districts (West Godavari, East Godavari and Krishna) belonging to the Delta Region of Andhra Pradesh. Purposive randomized sampling framework was used to select representative villages from all study *mandals* in the region. A primary household baseline survey was conducted from representative sample farmers (1229 HHs) in the pilot sites in three districts.

The present report attempts to estimate the total gross value addition (GVA) across sample villages and pilot site as a whole from different sub-sectors in the primary sector. Innovatively, the present study has attempted to estimate the GVA at pilot site level using household survey information collected during baseline survey. Household survey and secondary sources of information were complemented to estimate the GVA values both at village and pilot site level. Methodology developed by the Directorate of Economics and Statistics (DES) for district level estimation of GVA was modified and adapted for estimation of GVA using household level data. These estimates can be used as 'benchmark values' for monitoring the project progress over a period of time. The project impact assessment studies if any could be undertaken in the future using this baseline information. The Delta Region-level baseline report also helps in identifying major constraints and devising suitable strategies in the pilot site and districts as a whole.

Small and marginal farmers dominated (56.6%) the total sample in the region. The average family size in the region is about 3.8. Nearly 59.2% of total sample are uneducated. About 47.4% of family members only participate in their farm activities/operations. The pooled average operational landholding per household was estimated at 2.39 ha. The extent of land tenancy in the total region sample was calculated at 35.7%. More than 80% of sample households have a residential house, access to television and mobile phones. The average number of livestock animals owned per household was only 1.1 in the region. Due to good access to canal irrigation facilities, the average productivity levels across major crops were on par with district average yields. Commercial crops like oil palm, tapioca and cotton are performing extremely well and realizing good net returns per ha. Overall, the crop cultivation in the Delta Region is economical and has recovered most of its investments. The cultivation of fish is more profitable per cycle when compared to prawns in the region. Agriculture including horticulture contributed around 56% share in the total GVA of the Delta Region. The fisheries sub-sector occupied second position and contributed nearly 30% of regional GVA value. Animal husbandry stood third with 14% share in total GVA value in the region.

Major findings of the baseline survey and corresponding recommendations across sub-sectors are summarized below. Immediate steps are required to address these issues for enhancing each sub-sector's contribution in the total primary sector GVA.

Key findings	Specific recommendations
<ul style="list-style-type: none"> Absence of proper infrastructure for efficient management of both supply and value chains across commodities limiting the realization of full potential in the region. 	<ul style="list-style-type: none"> Huge opportunities are available with growing peri-urban demand for vegetables, fruits, milk and meat in the region.
<ul style="list-style-type: none"> Overall, high-input cereal intensification cropping systems were observed in the region. There is a need for long-term sustainable practices to sustain the crop productivity across districts. 	<ul style="list-style-type: none"> Potential opportunities also available for strengthening market linkages and value chains for oil palm, coconut, cocoa, mango, banana, tapioca, cashewnut etc.
<ul style="list-style-type: none"> Lack of time/interest in livestock rearing is a limitation in the region. Even though the region has surplus fodder the per household owned livestock population is very low. 	<ul style="list-style-type: none"> Need to diversify cropping pattern using legumes in rotation. Good scope for introduction and piloting of sustainable crop management practices such as Integrated Crop Nutrient Management (ICNM) and Integrated Pest Management (IPM) to minimize the costs per ha and increase competitiveness across crops.
<ul style="list-style-type: none"> Labor shortage is the biggest problem in the region. Due to high intensification of both field and horticultural crops, the per ha availability of labor force is low. Farmers are incurring huge expenditure on labor, which is squeezing the net returns per ha. 	<ul style="list-style-type: none"> Huge export potential for field and horticultural crops. Animal rearing as a business model should be promoted for efficient utilization of available fodder and water. Huge opportunities for expansion of livestock rearing and processing. An integrated fodder grid should be established to move the surplus fodder availability from Delta Region to Rayalaseema region.
<ul style="list-style-type: none"> Low productivity levels and occurrences of diseases in prawn cultivation. 	<ul style="list-style-type: none"> Good potential for introduction and piloting of mechanization clusters based on Information Communication Technology (ICT) to minimize the labor problem. Lot of opportunities for introduction of mango/coconut harvesters; small-scale processors for efficient post-harvest handling operations and value enhancement through good grading practices etc.
<ul style="list-style-type: none"> Minimization of post-harvest losses in fruits and vegetable cultivation is critical to enhance the production and increase quality. 	<ul style="list-style-type: none"> Provision of good quality seed for productivity enhancement of prawns. Regulation of output prices is critical to protect the prawn growers' interest in the state. Enormous potential for development of fish and prawn industry must be harnessed. Enormous scope for introduction of scientific post-harvesting technologies across field and horticultural crops. There is a need to promote value-chains and farm-based industries to engage human resource gainfully.

1. Background and Objectives

Andhra Pradesh (AP) is poised on an interesting juncture in history as it tries to balance the varied challenges that the bifurcation has created for the residuary state against the opportunities that establishment of a new system of governance afford for the new state. The state has started with a renewed determination to make AP one of the three best states in the country by the year 2022. Challenges are far and many; however, the determination and drive to see that AP attains an enviable position in the country is a key objective, which is driving the populace of the state.

Moving away from the 'business as usual approach', the Government of AP has initiated an intensive 'mission mode' approach that will speed up the growth process. It realizes that, as we move along, every step is going to lay strong foundation in scripting the growth story of 'Sunrise Andhra Pradesh'. To achieve state goals, it has put together seven Missions, five Grids and embarked on five Campaigns. These are the three pillars of the new edifice that state is building. As part of the state's inclusive growth strategy, the prime focus is the agriculture sector linked with improvement in soil fertility, access to better seed, reducing the cost of cultivation, productivity enhancement and value addition in the agriculture, horticulture, livestock and fisheries sub-sectors. As the state is perceiving a structural change – labor force shifting from agriculture to non-farm and service sectors – necessary skills needs to be imparted to improve productivity of the abundant labor force.

Recently, the Government of Andhra Pradesh has unveiled its 'Double Digit Growth Action Plan'. The plan aims to help AP achieve the status of a developed economy with per capita income likely to touch ₹0.662 million by the year 2029-30 if the economy grows consistently at the 10% level. In the event of growth rates crossing this critical threshold, the per capita income may even cross the ₹0.800 million mark. In order to achieve 'double digit growth' in agriculture, the government has initiated the 'Primary Sector Mission' (or the Rythu Kosam Mission) with massive outlay of investments over the next five-year period (2015-2020) under a consortium approach by bringing state, national and international partners on board. Thirteen pilot sites corresponding to 13 districts of the state have been identified for introduction, testing and scaling-up of range of technologies over a period of time. Both supply and demand side interventions are aimed at improving the livelihoods of the farmers in the state.

With this background, the major objective of this study is to document the current status of the three pilot sites covering 65 villages from eight *mandals* in three districts (East Godavari, West Godavari and Krishna) of the Delta Region of Andhra Pradesh. A primary household baseline survey was conducted from representative sample farmers (1229 HHs) in the three districts of the region. This total sample comprised 1030 agricultural sample households and 199 fishery sample households. Information on socio-economic status, area allocation under different crops, average productivity levels, constraints for achieving double digit growth, accessibility to different technologies, credit and market access, perception about climate change, risk coping mechanisms etc. were collected and summarized before the implementation of the project. The present report attempts to estimate the total gross value addition (GVA) across sample villages and pilot site as a whole from different sub-sectors in the primary sector. Both household survey and secondary sources of information were complemented to estimate the GVA values both at village and pilot level. These estimates will be used as 'benchmark values' for monitoring the project progress over a period of time. The project impact assessment studies if any could be undertaken in the future, using this baseline information. The current comprehensive Delta Region baseline report helps in identifying major constraints and devising suitable strategies in the pilot sites and districts as a whole.

2. Overview of Delta Region Agriculture

The Delta Region is a geographic region in the Indian state of Andhra Pradesh. It includes the southern districts of East Godavari, West Godavari and Krishna. With a total geographical area of 27,000 sq km, it occupies approximately 18.4% of the state territory. It has a population of 13,798,964 (2011 census), which is 27.83% of the state population. East Godavari district is the most populous (5.2 million) in the state.

The region comprises 3547 census villages and 49 (statutory and census) towns. The average density of the population is estimated at 467 persons per sq km. The highest population density in the region was observed in Krishna (518 persons per sq km) while the lowest noticed in East Godavari district (413 persons per sq km). The average decadal growth of population in the region was estimated at 5.51%. Among the districts in the region however, the highest growth in decadal population was observed in Krishna (7.87%). Based on 2011 census, the average literacy rate in the region was 73.12%. Overall, urban population has higher levels (81.92%) of literacy rates than the rural population in the region (69.49%). The annual normal rainfall here ranged between 1030-1216 mm. Of the three districts, East Godavari (1216.9 mm) receives better annual normal rainfall followed by West Godavari (1153.0 mm) and Krishna (1033.5 mm).

Of the total geographical (2.73 million ha) area of the Delta Region, about 51.5% (1.40 million ha) is the net area sown (including fish and prawn culture) under different crops. Around 29.6% of the total geographical area (0.80 million ha) is sown more than once. The gross irrigated area in the region is estimated to be only about 1.61 million ha (around 39.4% share in the state). Agriculture, which is mostly irrigated, has been the main livelihood occupation of the farmers. Nearly 85.2% of the total cropped area is under food crops and the remaining is under non-food crops.

Cereals and millets together contribute about 60.9% of the total cropped area (see Figure 1). It was followed up by other commercial crops (such as cotton, tobacco including fruits and vegetables), which accounted for 28.4%. Pulses as a group occupied third place (7.9%) in the total sown area in the region. Oilseeds as a group only secured fourth place and have coverage of about 2.9% in the region.

The individual crop area shares in total cropped area of the Delta Region during the year 2014-15 are depicted in Figure 2. More than 56% of total cropped area in the region is occupied by rice. It was followed by black gram (5.9%), maize (4.6%), cotton (4.1%) and mango (3.8%). All these five crops together had a total share of nearly 74.5% of the total cropped area in the region during the study period. Among horticulture crops, mango is leading followed by cashewnut, banana, turmeric and onion.

The break up of 19th livestock census conducted in the region is summarized below. Buffaloes are the single largest (43.3%) contributor in total livestock population in the region, followed by sheep (26.5%), cattle (14.8%) and goats (14.3%). Also, pigs and other livestock animals together had a share of only 1.2% in the census. Around 43.14 million population of poultry also existed in the region, which accounts for 52.7% of total state poultry population.

Relatively, fisheries play a major role in the Delta Region. Marine fish and prawn production contribute to the GVA in the region. Around 32.4% of the total marine fish and prawn production in the state is in the Delta Region. Similarly, inland fish and prawn production is a significant activity in the region. This region has a share of nearly 84% in the state's inland fish and prawn production. Approximately 50% of the total brackish water prawn production in the state also takes place in this region. Overall, this region contributes significantly to the state GVA of fisheries sector. Overall, a comparative status of Delta Region with the whole state as well as India has been summarized and presented in Table 1.

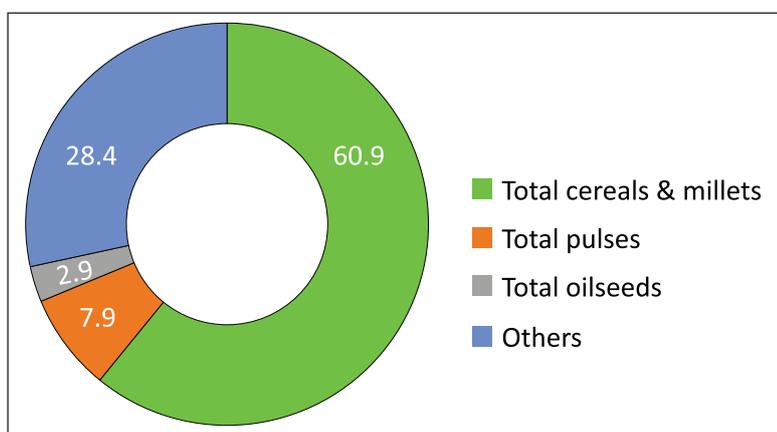


Figure 1. Share of total cropped area among crop groups.

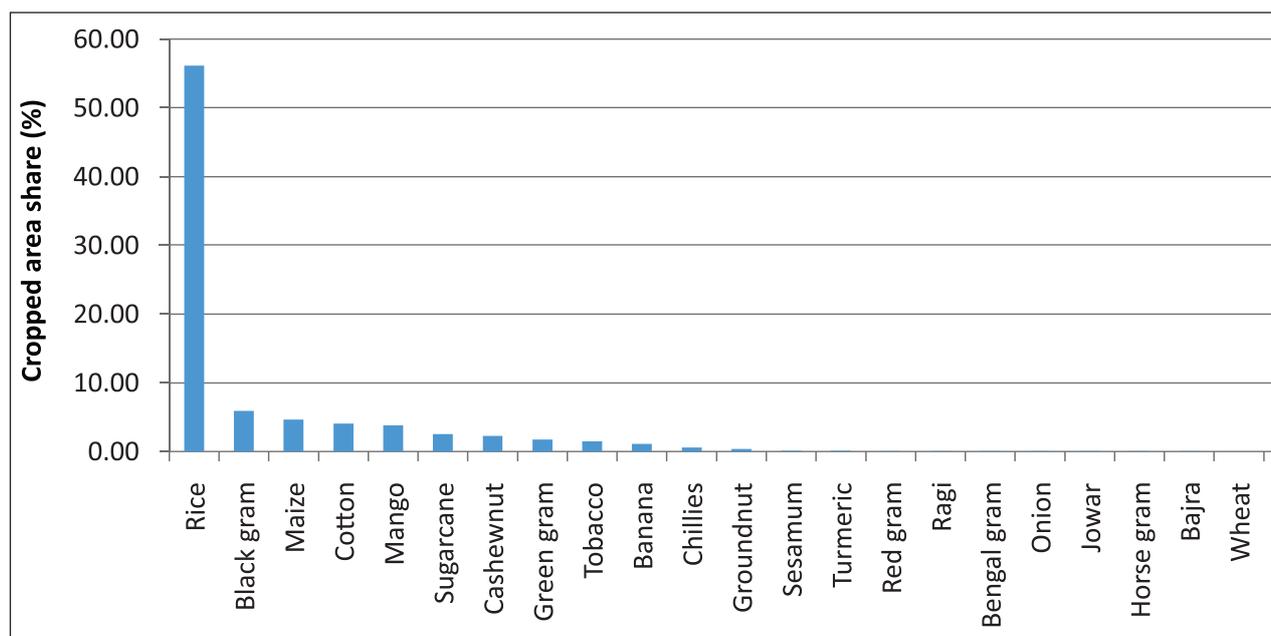


Figure 2. Cropped area shares by crop in the region (2014-15).

Table 1. Comparative status of the Delta Region vis-à-vis Andhra Pradesh and India.

Parameter	India	Andhra Pradesh	Delta Region
Geographical area (000 sq km)	3287.5	163.0	27.0
Population (million 2011 census)	1210.9	49.6	13.7
Males (million)	623.2	24.8	6.9
Females (million)	587.5	24.7	6.8
Urban (million 2011 census)	377.1	14.6	4.0
Males (million)	195.4	7.2	2.0
Females (million)	181.6	7.3	2.0
Rural (million 2011 census)	833.7	34.9	9.8
Males (million)	427.7	17.5	4.9
Females (million)	405.9	17.4	4.9
Literacy (% in 2011)	74.04	67.35	73.12
Males (%)	82.14	74.77	76.91
Females (%)	65.46	59.96	69.35
GDP (₹ million in current prices, 2014-15)	124986620	5200300	1609820
Agriculture and allied sectors (₹ million)	23372498	1434980	522590
Industry sector (₹ million)	39620758	1072240	269100
Service sector (₹ million)	61993363	2693070	818130
Shares of sub-sectors in GDP (%)			
Agriculture and allied sectors	18.0	27.6	32.5
Crops	11.8	15.4	14.6
Livestock	3.9	7.1	8.5
Forestry and logging	1.4	1.0	0.8
Fisheries	0.9	4.1	8.5

3. Pilot Sites of the AP Primary Sector Mission

The Government of Andhra Pradesh has designed a strategy to transform agriculture and its allied sectors in partnership with ICRISAT. This strategy will be operationalized in a phased manner, setting the standards for a new development paradigm in tune with the changed scenarios to enable Andhra Pradesh take its place among the three best-performing states in India by the year 2022. Initially they called this massive effort 'Primary Sector Mission' and later renamed it 'Rythu Kosam' (pro farmers) Mission. The mission will be implemented by adopting 4 'I's: Innovate, Inclusive, Intensive and Integrated approaches; 4 'C's: Convergence, Collective action, Consortium to build partnerships and Capacity building; and 4 'E's: Efficiency, Equity, Environment Protection and Economic Gain.

Overall the mission in the state will broadly focus on:

- a. Increasing productivity of the primary sector comprising Agriculture, Horticulture, Livestock, Fisheries & Sericulture;
- b. Mitigating the impact of droughts through water conservation and micro-irrigation;
- c. Postharvest management to reduce wastages; and
- d. Establishment of processing units, value addition capacity and supply chain of identified crops.

To execute the mission strategy effectively, 13 pilot sites (10,000 ha each) of learning in each of the 13 districts of Andhra Pradesh have been identified to operationalize the convergence of the primary sector in order to increase productivity, profitability and sustainability through science-led development and climate-smart agriculture. In order to integrate, innovate, intensify while ensuring inclusivity, a pilot site with a spread of 10,000 ha spread is being established in each study district. These pilot sites provide an on-farm field laboratory to test and evaluate technological, institutional, policy innovations and fine-tune them as needed before scaling-up in the districts. In marketing parlance, these pilot areas are test markets for innovations, which will be demand-driven and impact-oriented with measurable indicators.

The general criteria followed for selecting the pilot sites in each district are:

- a. Site must be representative of the district in terms of Agro-Ecological Zones (AEZ) and cropping systems
- b. It must have good potential for impact to bridge yield gaps
- c. It must be accessible
- d. The farmers must be willing to adopt new technologies
- e. Presence of suitable institutions to support the project
- f. There must be a predisposition for change among all the partners contributing to the study

The identification of the pilot site in each district was done in several iterations with proper consent of the District Administrators (Collectors and Chief Planning Officers), consultations with line department officials at district and *mandal* level, interactions with farmers and communities, and discussions with NGOs. These criteria and steps were followed in all 13 districts to identify the pilot sites. The district-wise distribution and coverage details of each pilot site are furnished in Table 2.

The pilot sites cover 267 villages (both agriculture- and fishery-oriented) under 38 *mandals* in 13 districts of the state. Approximately 0.192 million farmer households are directly targeted for mission interventions across the 13 pilot sites. A total population of 0.685 million are covered initially during the 2015-16 cropping season. As much as 0.142 million ha of cropped area (including agricultural and horticultural crops) has been covered. Nearly 0.99 million population of livestock animals are also covered for wide range interventions. Roughly 8892 ha of fishery area (including both prawns and fish cultivation) are included under mission interventions. In a nutshell, the cumulative pilot area represents about 1.75% of the total cropped area in the state. Approximately 1.4% of the total state's population is being targeted in these pilot sites.

4. Sampling Framework

The sampling framework has been designed for the entire Rythu Kosam Mission, that includes 13 pilot sites across the 13 targeted districts in the state, by considering the extent of diversity among study villages. Each pilot site has been identified with an approximate cropped area coverage of 10,000 ha. In general, the pilot site comprised both agricultural and few fishery (majorly growing fish and prawns) villages. The project sites taken together are distributed over 30 *mandals* and 227 villages in the case of agricultural villages while 47 more villages engaged in fishery were covered across 11 *mandals*. As shown in Table 2, there are three *mandals* and seven villages across the pilot sites that are engaged in both agriculture and fisheries. On the whole, the Rythu Kosam mission involves 13 districts, 38 *mandals* and 267 villages. This vast spread of the total project area represents a large diversity and variation among selected villages across districts. All these sample villages together represent the state of Andhra Pradesh and its rich diversity across three regions (Rayalaseema, Coastal Andhra and North Coastal) and four AEZs.

A systematic sampling framework has been developed to cover this diversity by undergoing the following steps:

1. Characterization of all sample villages using information on type of agriculture (irrigated/rainfed), major crops cultivated both in rainy and post-rainy season, major horticultural crops grown, rearing of sericulture, fish and prawns cultivation and finally extent of forest area available.
2. Based on dominance of each sub-sector (Agriculture, Horticulture, Sericulture, Fisheries and Forestry) in the sample villages, a scale of 1 to 3 (1 for low presence and 3 for significant area) was provided for better categorization of study villages. Six diversity categories of sample villages were decided on.
3. A cumulative diversity scale for each sample village was calculated by adding the respective scales given for each sub-sector (Agriculture, Horticulture, Sericulture, Fisheries and Forestry). This value has been ranged from a minimum of '4' to a maximum of '9'.

Table 2. Distribution and coverage of pilot sites under AP primary sector mission.

District	No. of <i>mandals</i>	No. of villages	No. of households	Population	Pilot site cropped area (ha)	Livestock population (no.)	Fisheries area (ha)
Chittoor	2	18	6762	31317	9001	93412	0
Kadapa*	4	13	11246	46745	10314	146771	0
Anantapur*	3	14	5019	13556	12411	20,000	0
Kurnool	2	10	6864	26736	10299	24057	0
Nellore	3	11	9469	33876	11780	39915	367
Prakasam	4	28	20899	86722	8500	225550	3898
Guntur [#]	4	18	17634	63202	12987	19980	217
Krishna*	3	27	22805	76762	15182	60240	260
West Godavari**	2	12	23155	84044	12803	25400	1022
East Godavari	3	26	17487	67843	10470	146939	2163
Visakhapatnam	3	23	21673	33411	10516	31232	360
Vizianagaram [#]	2	23	8753	35976	8494	32555	451
Srikakulam [#]	3	44	20721	85581	9914	126595	154
Total	38	267	192487	685771	142671	992646	8892

* Minor changes are being carried out during the baseline survey

** One *mandal* and eight villages are covered under both agriculture and fishery sub-sectors

[#] One *mandal* is covered under both agriculture and fishery sub-sectors

4. The baseline survey covering 38 *mandals* and 267 villages from 13 pilot sites in 13 study districts is a challenge. To minimize the cost of survey and time, a sub-sample of 150 villages (covering 119 agricultural and 31 fishery villages) were identified using randomization procedure, without losing their representativeness and by covering all the *mandals* in the study. Roughly 55% sample villages have been selected from 40 *mandals*.
5. The total cumulative area covered in the primary sector mission (13 pilot sites at 10,000 ha each) is estimated at 1,30,000 ha. The average operational landholding per household in the state was calculated at 1.08 ha based on the 2011 landholding census survey. The estimated coverage of households in the primary sector mission would be nearly 120,370. In case of large-scale representative household surveys, a reasonable coverage of 5% of the total population is good enough to minimize the marginal error. Thus, the present baseline survey uses this thumb rule and targets an approximate sample of 6500 households (5% of 130,000 HH) across 13 districts.
6. As per 2011 census nearly 73% of total households are small (less than 2 ha of operational landholding), 9% medium (with operational landholding of above 2 ha and less than 4 ha) and 3% sample are large (> 4 ha). Nearly 15% of the total households are fall under landless category. Farmers of this category are highly dependent on the primary sector for their livelihood. So, their representation in the household survey is critical for understanding the direct and indirect impact of different interventions in the pilot sites. A minimum of six landless farmers per village (150 x 6 = 900) are accommodated in the household survey to represent this category in the study.
7. The classification of fishery farmers' operational landholding details are not available at the state level. The household data collected in the fishery villages will be post-stratified to deeply understand the economies of scale of their cultivation. However, to keep enough representation in the household survey, a minimum of 30 farm households per village were surveyed. Thus, a total of 930 HH have been targeted to cover from 31 fishery villages in 10 *mandals*.
8. The left over sample of 4670 HH (6500-900 landless + 930 fishery HH) have been distributed among 119 agricultural villages using sampling weights illustrated in Table 3. The majority of the sample villages exhibited medium to high levels of diversity scale (6 to 8) in their distribution. Thus, majority sample has been allocated to this category of villages.
9. Using the sampling framework shown in Table 3, a sub-sample of 55% villages have been identified for a primary household survey in the AP Primary Sector Mission. All villages fall in the calculated cumulative diversity scale range between 4 and 9 because of the dominance of agricultural and horticultural crops, presence of sericulture cultivation, fisheries rearing and existence of forestry. More details on total study sampling framework, distribution of sample villages based on diversity scales, break up of different categories of sample farmers across pilot sites and distribution of the sample among different sub-sectors etc. are furnished in Appendix 2. However, the sampling strategy was planned for collecting the primary household data from targeted sample of 6462 HHs is outlined in Table 4. The primary household survey was conducted during June, 2015, with structured questionnaires and trained field investigators. About 5222 sample households were interviewed from selected villages and information was collected on various points including socio-economic status, assets, cropping pattern, extent of adoption of technologies, average productivity levels for major crops, details about credit and market access, perceptions about climate change and risk coping mechanisms. About 1240 HH of the targeted sample were not covered by the baseline surveys because of higher homogeneity in population and non-cooperation in a few villages (especially fishery-dominant villages). The complete break up of pilot site-wise details are summarized in Table 4. Overall, 81% of total targeted sample households were covered during the household survey. Of the total sample interviewed (5222 HH), nearly 4794 HH were covered in agricultural villages while the rest (428 HH) were from fishery villages.

Table 3. Sampling strategy for cultivator households (n=4670).

Diversity category	Diversity scale	Diversity weight	Distribution of sample villages	Cumulative weight	Distribution of target sample (n=4670)	Avg. sample per village
1	4	0.10	4	0.41	97	24
2	5	0.13	4	0.51	121	30
3	6	0.15	68	10.46	2469	36
4	7	0.18	21	3.77	889	42
5	8	0.21	17	3.49	822	48
6	9	0.23	5	1.15	272	54
Total	39	1.00	119	19.8	4670	

Table 4. Sample distribution and coverage during baseline (BL) surveys.

District	Targeted BL sample	Sample covered in BL
Chittoor	486	481 (0)
Kadapa	396	396 (0)
Anantapur	402	366 (0)
Kurnool	228	228 (0)
Nellore	372	264 (48)
Prakasam	546	342 (91)
Guntur	444	359 (48)
Krishna	570	491 (125)
West Godavari	606	332 (22)
East Godavari	618	406 (52)
Visakhapatnam	462	423 (0)
Vizianagaram	504	460 (18)
Srikakulam	828	674 (24)
Total	6462	5222 (428)

Note: Figures in parenthesis indicate absolute no. of fishery HH in the total sample

5. Methodology

Simple tabular average analysis was used to analyze the household data collected in the primary household survey. The results are summarized by district in Section Six of this consolidated Delta Region baseline report.

For estimation of GVA in the primary sector from pilot sites in each district, a production/value added approach was used. Among the three approaches (production, income and expenditure) available, production/value added approach is mostly applied for the estimation of value added in the primary sector. The income approach is normally applied for the industry sector, while the expenditure approach is applied in the case of service sector.

As per standard definitions, the primary sector includes agriculture, horticulture, animal husbandry, fisheries, sericulture, forestry & logging and mining & quarrying. In the present study the primary sector is confined to agriculture, horticulture, animal husbandry and fisheries. The standard methodology defined by the Directorate of Economics Statistics¹ was adapted with suitable modifications for the estimation of GVA from different sectors using various estimates derived from household survey. The methodology followed for estimation of 'Gross Product' by sector is summarized below:

¹. National Account Statistics: Manual on Estimation of State and District Income (2008), published by CSO.

Agriculture, horticulture and floriculture

This sector includes major agricultural crops (25), minor crops (17), small millets, other pulses, commercial crops, horticultural crops, plantation crops, flowers, sugars, oilseeds, fruits and vegetables, fodders and by-products.

Item	Source of data	Method of estimation
Agriculture Horticulture Floriculture	Household survey and secondary statistics available at village level	Value of output = production x price (base year 2014-15)
Gross value of output (1)		
Less: - inputs		
Seed Chemical fertilizers Organic manures Market charges Irrigation charges Electricity charges Pesticides and insecticides Diesel oil cost Machinery cost	Household survey	Average cost per hectare per crop
Total inputs (2)		
Gross product (1-2)		

Livestock

This sector includes milk production from cows, buffaloes and goat. Also, wool production from sheep and goats, egg production from poultry, ducks etc, meat production from poultry, sheep, goat and donkeys and dung and other by-products from milch animals and other livestock. The incremental livestock value will also be considered in the estimation of GVA.

Item	Source of data	Method of estimation
Milk Meat Wool Egg Dung cakes/dung	Household survey and secondary statistics available at village level	Value of output = production x price (base year 2014-15)
Incremental stock value	DES latest report	Value of output= production x price
Gross value of output (1)		
Less: - inputs		
Livestock feed & roughages Concentrates Marketing cost Medicines and other costs	Household survey	Average cost per animal
Total inputs (2)		
Gross product (1-2)		

Fisheries

The value of inland fish, marine fish and prawns by village is estimated by multiplying the production with corresponding output prices. Fish that is sold as salted, dried and frozen should also be accounted. The average productivity level and various input material costs per ha were estimated from the primary household survey. The gross product from the fisheries sector is estimated by deducting the input costs from the total gross value product.

Forestry

Major components of this sector are industrial wood (recorded and un-recorded), fuel wood and major/minor forest produce. However, the present study has attempted to capture information about fuel wood and forest produce components only. The gross value of output is estimated by multiplying the total forest produce with corresponding output prices (base year 2014-15). In case of forestry, input costs were not captured in the household survey.

All the household survey information was collected with agricultural reference year 2014-15 crops. For obtaining the complete information on the three seasons, previous year's data was collected. The methods of estimation of GVAs across sub-sectors are as summarized here.

Sources of data across sub-sectors					
Source of information	Agriculture including horticulture (a)	Livestock (b)	Fisheries (c)	Forestry (d)	Total primary sector (a+b+c+d)
Estimation of Output (1)	HH survey and secondary information	HH survey and secondary information	HH survey and secondary information	Only secondary information	Total primary sector output
Estimation of input costs/unit (2)	HH survey	HH survey	HH survey	DES guidelines	Total input costs excluding labor costs
Gross product (1-2)	Gross product from agriculture including horticulture, floriculture, vegetables, fodder crops etc.	Gross product from cows, buffaloes, goat, sheep, poultry, ducks and incremental value etc.	Gross product from prawns, fish (inland and marine), salted fish, dried fish etc.	Gross product will be estimated using DES guidelines and methodology	Primary sector GVA estimation for pilot site/district

6. Findings from Baseline Survey

The findings from baseline surveys conducted across three study districts in the Delta Region are summarized and discussed in the following sub-sections. Simple tabular analysis was used to analyze the primary household survey data collected during baseline survey referring to the cropping year 2014-15. Specifically, the results presented below are summarized from agricultural and fishery sample villages (nearly 37) covering about 1229 (1030 agricultural + 199 fishery) sample households in three pilot sites corresponding to three study districts in the region. Due to the dominance of the fishery sector in the three study district pilot sites, the baseline study has also captured information about 199 fishery sample households in the total targeted. Overall a total of 1229 sample baseline farmers' household data have been analyzed and summarized in this report.

6.1 Distribution of sample across size groups and communities

The distribution of the total baseline survey sample (agricultural sample HHs only) by district in the region is presented in Appendix 1, Table 1. Overall, 1030 sample households were interviewed from 28 sample

agricultural villages in the three pilot sites of the Delta Region. All the sample farmers are distributed and categorized under different size groups based on their total operational landholding during the 2014-15 cropping season. Of the total 1030 sample, 583 sample households belonged to small farmer category (< 2 hectares) followed by medium (between 2 and 4 hectares) size (172 HH, represents 16.7%) and large (> 4 hectares) size (119 HH which represents 11.5%) category. Nearly a total of 156 sample households belong to landless category (zero operational landholding) were also covered in the baseline survey. They contribute approximately 56.6%, 16.7%, 11.5% and 15.2% shares in the total baseline sample respectively for small, medium, large and landless categories. This allocation among size groups is truly representative of the year 2011 census survey conducted on 'operational landholdings' at state level. The pattern of distribution of sample among study districts also closely mirrored the district-level situation generated in the year 2011 census survey.

The total baseline sample in the region was categorized based on the community they belonged to and by district. This is presented in Appendix 1, Table 1. The majority of sample households (397 HHs) belong to the general or Open Category (OC) followed by Backward Caste (BC) category (338 HHs), Scheduled Caste (SC) category (151 HHs) and Scheduled Tribe (ST) category (144 HHs). They contributed approximately 38.5%, 32.8%, 14.7% and 14.0% respectively. The distribution pattern of the sample by community varied from district to district.

6.2 Family size, extent of literacy and participation in labor market

Details of the average family size, extent of literacy and participation in labor market etc. are analyzed and presented in Appendix, Table 2. The average family size of the household for the total sampled farmers in the region is 3.8. The highest family size (4.1) was noticed in case of East Godavari district while the lowest (3.6) was observed in Krishna district. On the whole, only 40.8% of total sample in the region were literate. Of these, 11.4% had primary level of education, 29.4% had education levels of upper primary and above. Households making up 59.2% of the total sample were uneducated or did not have access to education. The extent of illiteracy was much higher in the case of East and West Godavari districts. Special attention needs to be placed for the promotion of education and other basic amenities in these districts. The highest literacy rate was noticed in Krishna district. A majority of family members (47.4%) in the sample work in their own farm. Most of the sample districts exhibited similar levels of own-farm labor participation in the Delta Region. About 28.9% persons also worked in the outside labor market for their livelihood. Most districts showed lower levels of engaging in labor outside their own farm.

6.3 Landholdings and extent of tenancy

The particulars of landholdings and extent of tenancy details by district in the Delta Region are furnished in Appendix 1, Table 3. The average total own landholding per household for the entire region sample was estimated at 1.69 ha. Of this, 1.24 ha of land was covered with irrigation access while 0.45 ha was grown under rainfed situations. Specifically in the Delta Region districts, irrigated landholdings dominate the total own landholdings. However, in the case of Rayalaseema, rainfed landholdings occupy the lion's share. The extent of average operational landholding for the total sample was calculated at 2.39 ha. Also, a significant share of cropped land (0.70 ha per HH) was also leased-in from outside. The extent of tenancy for the total sample households in the region was 35.7% (excluding landless households).

6.4 Household assets and livestock ownership

Household assets and livestock for the total sample are presented by district in Appendix 1, Table 4. Nearly 96.2% of the total sample declared that they possessed a residential house. Only 19.4% sample households indicated that they also own a cattle shed for accommodating buffaloes, cows and bullocks. Television sets (85.6%) and mobile (81.4%) are most common consumer durables owned. About 43.1% owned two wheelers. Slight variation in ownership was observed from item to item among study districts in the region.

The details of average livestock ownership per sample household are also summarized in Appendix 1, Table 4. On an average, every tenth HH in the sample had one draft animal. Similarly, every fifth HH owned one cow. Almost every alternate household also possessed one buffalo. Apart from these animals, many households also own young stock, sheep, goats and poultry to a significant extent. The total number of livestock animals owned by each household was estimated at 1.1. The composition of different livestock animals varied significantly from district to district in the region. Overall, the highest number of livestock animals per household was in West Godavari (1.4) while the lowest was in Krishna (0.7).

6.5 Major crops and their productivity levels

The details about major crops grown in each pilot site in the region and their corresponding productivity levels in comparison with district, state and national average yields are summarized in Appendix 1, Table 5. The district and pilot site-wise productivity levels are discussed below:

Paddy, maize and cotton are predominant crops grown in the Krishna district pilot site. Paddy (4.80 t/ha) and maize (6.50 t/ha) are performing on par or even better than district average yields (3.23 t/ha for paddy; 6.92 t/ha for maize). There is good scope for further improvement of productivity in case of cotton (2.68 t/ha) crop. The mean productivity levels were significantly lower in the case of sugarcane and cotton than the district average yield reported by the Directorate of Economics and Statistics. Issues such as labor shortage and sustaining long-term productivity levels of major cereal crops are among the biggest challenges in the pilot site. More efforts are required to strengthen markets and value chains.

In the case of West Godavari, paddy, maize and oil palm are major crops preferred by sample farmers in the pilot site. All three crops performed well in terms of productivity (5.33 t/ha for paddy; 6.43 t/ha for maize and 26.8 t/ha for oil palm). However, huge scope still exists for the introduction of mechanization, improving market access and value chains. Sustaining the long-term productivity levels coupled with increasing the competitiveness of production through reduction in costs of cultivation per ha is the key concern and needs special focus in this district.

Paddy, tapioca and cotton are major crops grown in the East Godavari district pilot site. All three crops are performing well (4.06 t/ha for paddy; 12.9 t/ha for tapioca and 1.57 t/ha for cotton) and are on par with the district average yields (2.99 t/ha for paddy and 1.13 t/ha for cotton). The mean productivity levels were slightly lower in the case of sugarcane compared to the district average yield reported by the Directorate of Economics and Statistics. Introduction of mechanization and sustaining long-term productivity levels are the key issues that need immediate attention. Improved market access and strengthening of value chains are the major initiatives required.

6.6 Economics of crop and fish enterprises

The economics of major crop enterprises per ha across pilot site districts are summarized in Appendix 1, Table 6. The costs and returns per ha information across crops cultivated in the pilot site were collected during the primary household survey from one-fourth sample households. The information was also elicited and complemented through village-level focus group discussions (FGDs) conducted at each sample village in the baseline survey. This information was collected on a one-year recall basis and pertaining to the year 2014-15 cropping year. While calculating the economics of crops cultivation, only total variable costs (paid out costs across each operation such as seeds, fertilizers, pesticides, machinery, labor and irrigation costs if any) was considered for deducting from total returns (includes total output plus by-products if any) per ha. Fixed costs such as rental value of own land per ha, depreciation of farm implements etc. was not considered. The net returns per ha were estimated after deducting the total variable costs per ha from total returns per ha. The benefit–cost ratio (B:C ratio) was calculated by dividing the total returns with total variable costs per ha. Details of performances of major crops in the Delta Region, pilot site-wise, are discussed and summarized below:

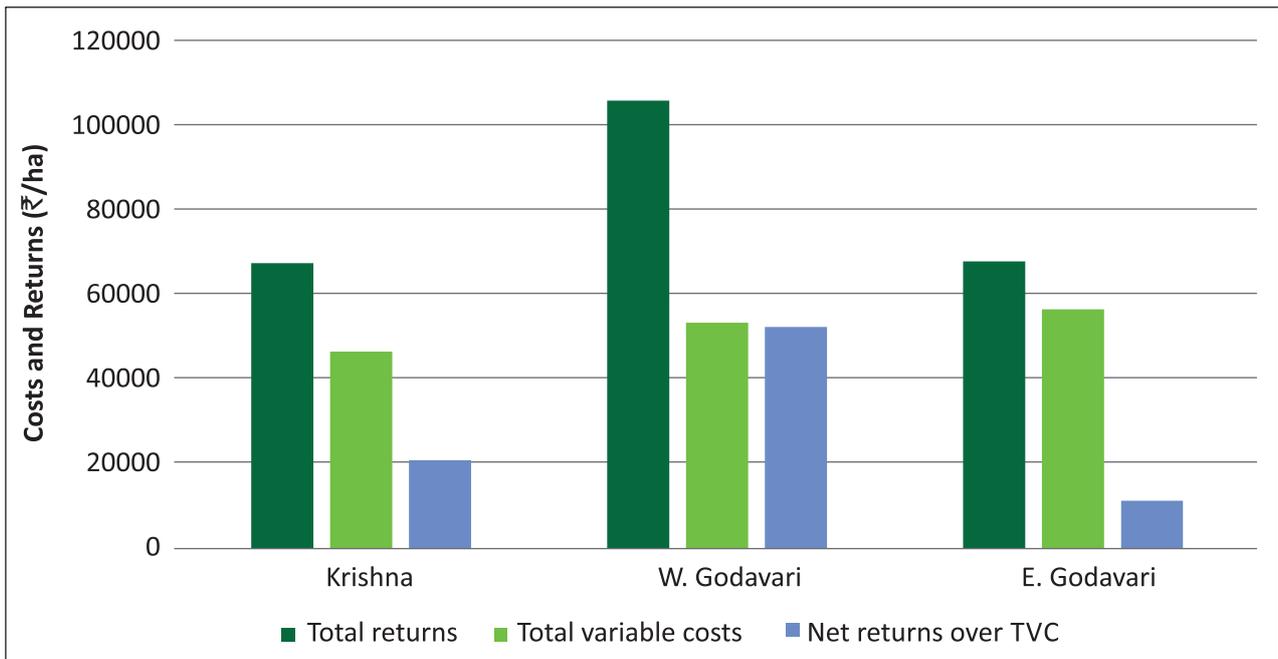


Figure 3. Performance of paddy in the Delta Region.

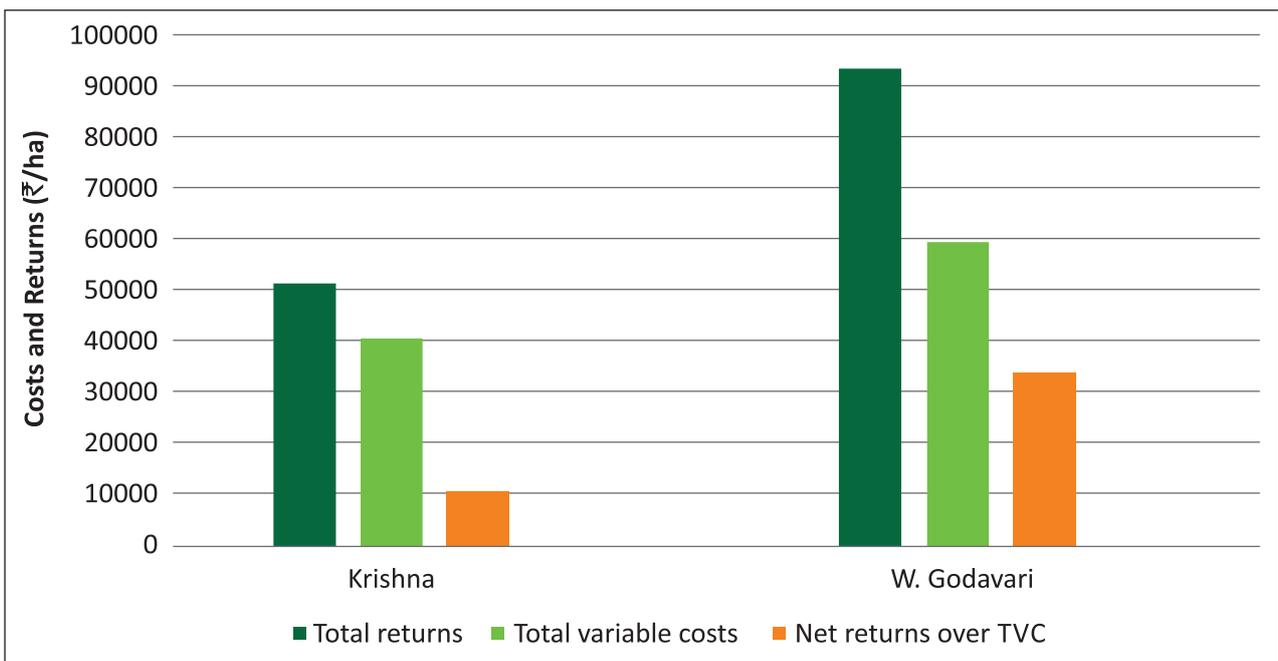


Figure 4. Performance of maize in the Delta Region.

All the major crops cultivated in the pilot sites of Krishna, West Godavari and East Godavari recovered their total variable costs and earned some marginal net returns per ha. Paddy performed quite well in all three districts (see Figure 3). Similarly, maize also recovered its total variable costs in Krishna and West Godavari districts (see Figure 4). Commercial crops such as cotton, oil palm, tapioca and banana did well with significant net returns per ha. Among all the crops, tapioca performed extremely well and earned significant returns (3.10 B:C ratio) on each rupee invested in its cultivation. The assured irrigation facilities in all three study districts and reasonably good exposure of sample farmers towards better management practices seem to have helped them make agriculture a viable option or enterprise. However, enormous scope still exists for the introduction or setting-up of scientific postharvest handling facilities and value

chains across commodities in these districts. For further details on costs and returns of various crops per ha across pilot sites are available in the district-specific baseline reports prepared under similar guidelines.

Details about the economics of prawn/fish cultivation enterprises (per cycle per ha) across pilot sites in the region are furnished in Appendix 1, Table 7. As indicated in the earlier sections, the cumulative area covered under fish/prawn cultivation in the 13 district pilot sites was 8892 ha (refer Table 2). This total area spread over approximately 47 fishery villages covered in 11 *mandals* of the 13 study districts. Enough care was taken to accommodate a significant number of fishery sample households in the representative baseline survey conducted for the Rythu Kosam Mission. Around 428 fishery sample households were also interviewed with a well-structured questionnaire in the state. Specifically, 199 fishery sample households were interviewed from 14 sample villages in the three districts of the Delta Region. These primary household surveys were also complemented with village-level focus group discussions (FGDs). The details about socio-economic characteristics, average productivity levels and economics of fish/prawn cultivation were captured during the survey. The data were thoroughly analyzed and results for the Delta Region are discussed district-wise in this section.

The cultivation of fish and prawns was a dominant activity in all three districts. Total variable costs (seed, feed, medicines, electricity and watch and ward) per cycle per ha and total returns (outputs plus by-products if any) per cycle per ha were elicited from one-fourth sample farmers across sample villages and districts. The net returns per cycle per ha, was estimated after deducting the total variable costs from total returns per cycle per ha. Overall, the economics of cultivation of prawns per cycle is only viable in Krishna and East Godavari districts. It is not economically viable in the West Godavari district as it did not recover its total variable costs per cycle per ha. Some of the major reasons for low total returns per cycle per ha in the prawn cultivation are as follows:

- a. Poor seed quality – private hatcheries dominate the supply and there is no monitoring from the government
- b. Low success rate and susceptibility to diseases
- c. Low productivity levels (hardly one ton per cycle per ha)
- d. High feed and medicinal costs – there is no monitoring or regulation from the government
- e. High electricity costs per unit
- f. Fluctuating out-prices (₹260 per 40 count of prawns); there is no regulation or source of information in the entire state

Similarly, the economics of fish cultivation per cycle per ha across sample districts are also summarized in Appendix 1, Table 7. The cultivation of fish is also a dominant economic activity in the three study districts of the Delta Region. As for prawns, the costs and returns from fish farmers were collected during primary household survey. Overall, fish rearing is a more profitable enterprise than the cultivation of prawns in these districts. All indicated good economic returns over total variable costs per ha per cycle in the region. The average productivity levels in case of fish are good and relative feed prices are lower. The fish market enjoys good domestic demand and very stable market prices. However, very slight fluctuations were observed mainly due to traders or middlemen. The region has very good scope to further enhance production in the near future. Introduction of scientific postharvest handling measures, value and supply chains etc. will further propel this industry in the region.

7. Pilot Site GVA Estimations across Sub-sectors

The details about pilot site-wise Gross Value Addition (GVA) estimations across sub-sectors in the primary sector are furnished in Appendix 1, Table 8 for the Delta Region. As described in the earlier sections, estimation of current value of GVA in the 13 pilot sites corresponding to 13 districts of Andhra Pradesh state is one of the major objectives of the AP Primary Sector Mission baseline survey. However, the present report summarizes the results for the three major districts in the Delta Region.

These values will be used as bench mark value before the implementation of the Rythu Kosam Project activities across three district pilot sites in the region. Any monitoring or impact studies in the future will use this baseline information as reference bench mark points. The primary household survey coupled with secondary sources of information such as focus group discussions, were used for the estimation of GVAs across sub-sectors. The complete details about methodology used across sub-sectors are furnished in Section 5 of this report. The present study has considered only four major sub-sectors in the estimation of total GVAs of the primary sector. They are: agriculture, horticulture, animal husbandry and fisheries. The current estimation of GVAs does not include sericulture and forestry contributions due to limited or insufficient data. However, additional efforts are in place to estimate these contributions as well. The results generated from primary household data analysis are discussed in detail sub-sector-wise in this section.

The total estimated GVA from three pilot sites in the Delta Region from the Rythu Kosam Mission is ₹5083.8 million. Of this, ₹2844.1 million (55.94%) is contributed by the agriculture sub-sector that includes horticulture. About ₹720.9 million is contributed by animal husbandry which accounts for 14.18% share in the total GVA in the region. The fisheries sub-sector contributed ₹1518.8 million towards total GVA value. The sector-wise contributions and corresponding share value are depicted in Figure 5.

Among all the three pilot sites, West Godavari contributed the highest value (₹2683.8 million) followed by Krishna (₹1436.1 million) and East Godavari (₹963.9 million). The lowest GVA value was recorded in the East Godavari pilot site. The total GVA values pilot site-wise are presented in Figure 6.

The highest value of GVA contributed by the agricultural sub-sector including horticulture was observed in the West Godavari pilot site (₹1635 million) followed by the Krishna pilot site (₹632 million). The lowest value was contributed by the East Godavari pilot site (₹577.1 million). In the case of the animal husbandry sub-sector, the highest value was contributed by Krishna (₹570.3 million) followed by West Godavari (₹84.8 million).

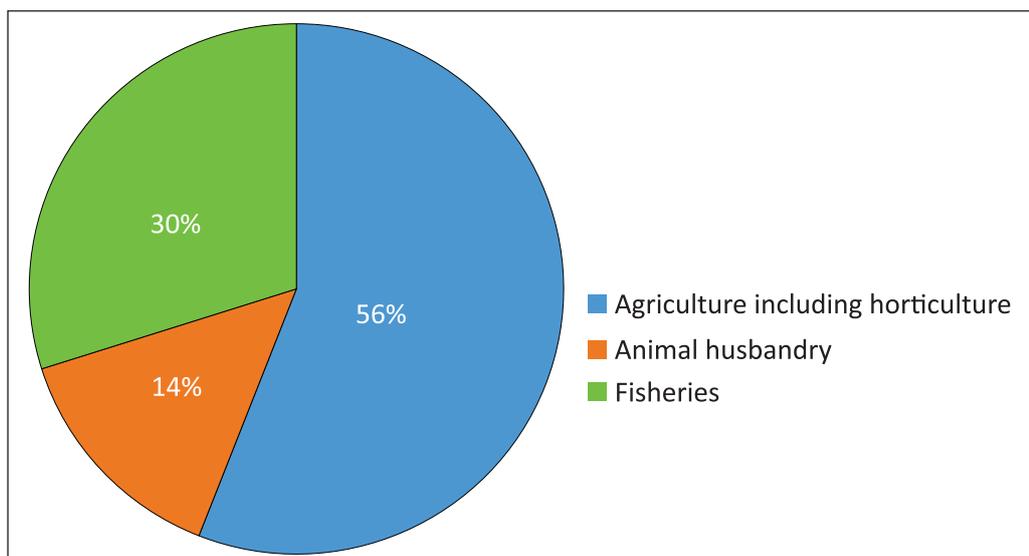


Figure 5. Shares in the total GVA estimation by sub-sector.

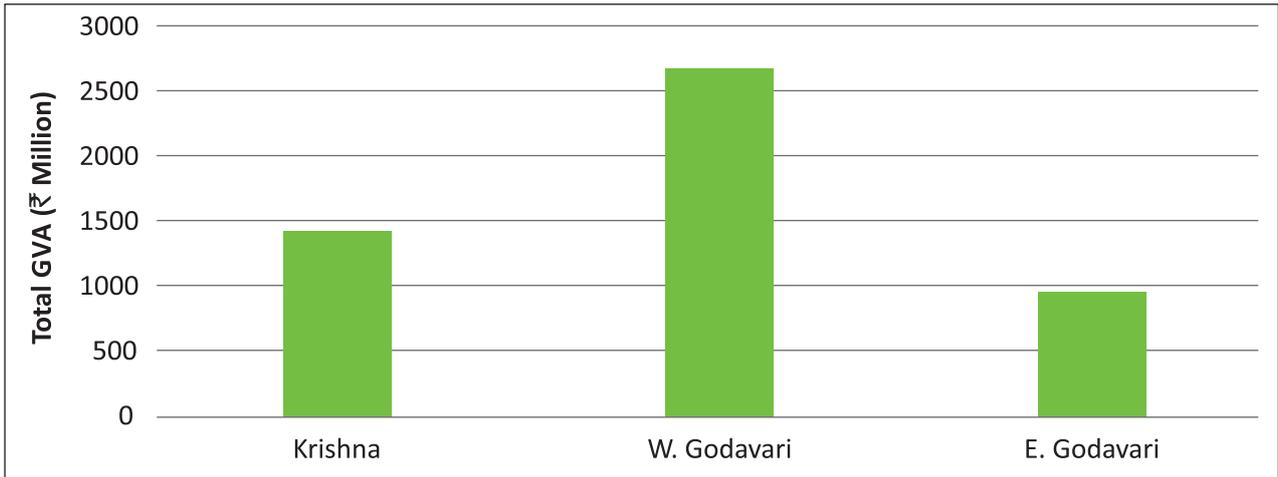


Figure 6. Total GVAs estimations for the three pilot sites.

The Krishna district pilot site contributes significantly in the animal husbandry sub-sector even though it was relatively backward in agriculture sub-sector in the region. The lowest value GVA from animal husbandry sub-sector in the region was contributed by East Godavari district (₹65.8 million). But, the fisheries sub-sector contributed significantly in the West Godavari district pilot site (₹964 million) followed by East Godavari (₹321 million) and Krishna (₹233.8 million). The composition of each pilot site's GVA by sub-sector is summarized in Figure 7.

The significant share contributions of different sub-sectors in each district's GVA estimations are presented in Figure 8. Nearly 61% share of the total GVA in West Godavari pilot site is contributed by agriculture including horticulture sub-sector. On the other hand, Krishna pilot site had the highest share (39.71%) from animal husbandry, although agriculture (including horticulture), animal husbandry and fisheries sub-sectors played a significant role in the total GVA contributions.

The total district GVA value per pilot site village was estimated to understand the extent of potential contributed by each pilot village in the Delta Region. Estimations by district are summarized in Figure 9. The per village contribution of GVA was highest in the case of West Godavari followed by Krishna and East Godavari. It is very interesting to understand that each village in the sample in West Godavari is contributing nearly six times higher the GVA value than its counterpart in East Godavari. There is a clear disparity in terms of potentiality to contribute to total GVA.

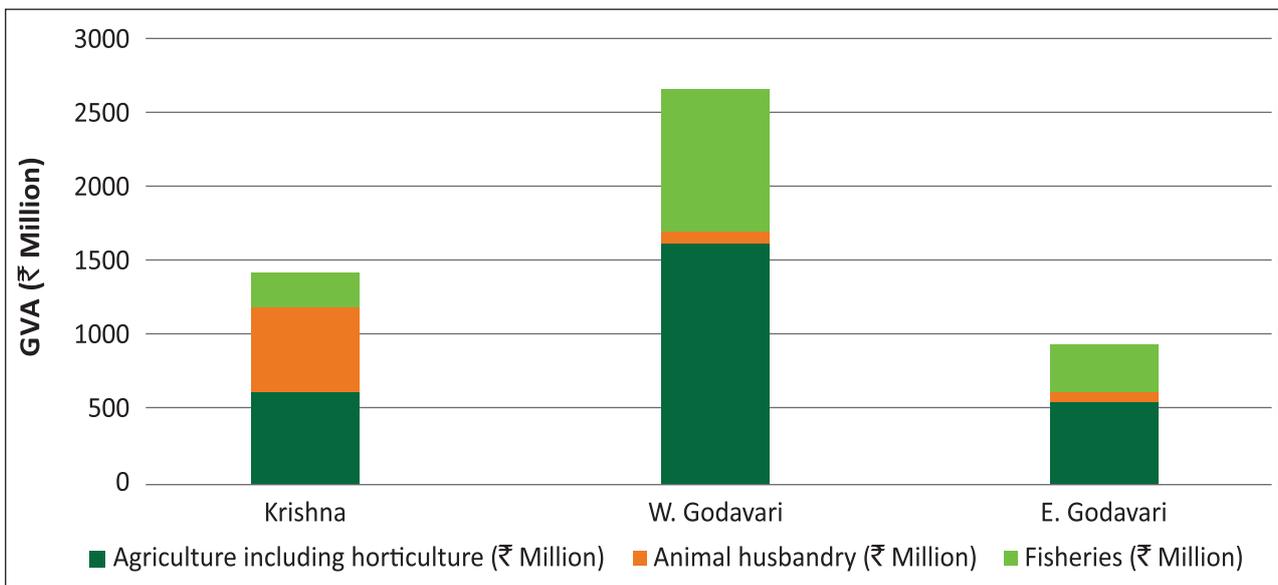


Figure 7. Composition of pilot sites' GVAs by sub-sector in the region.

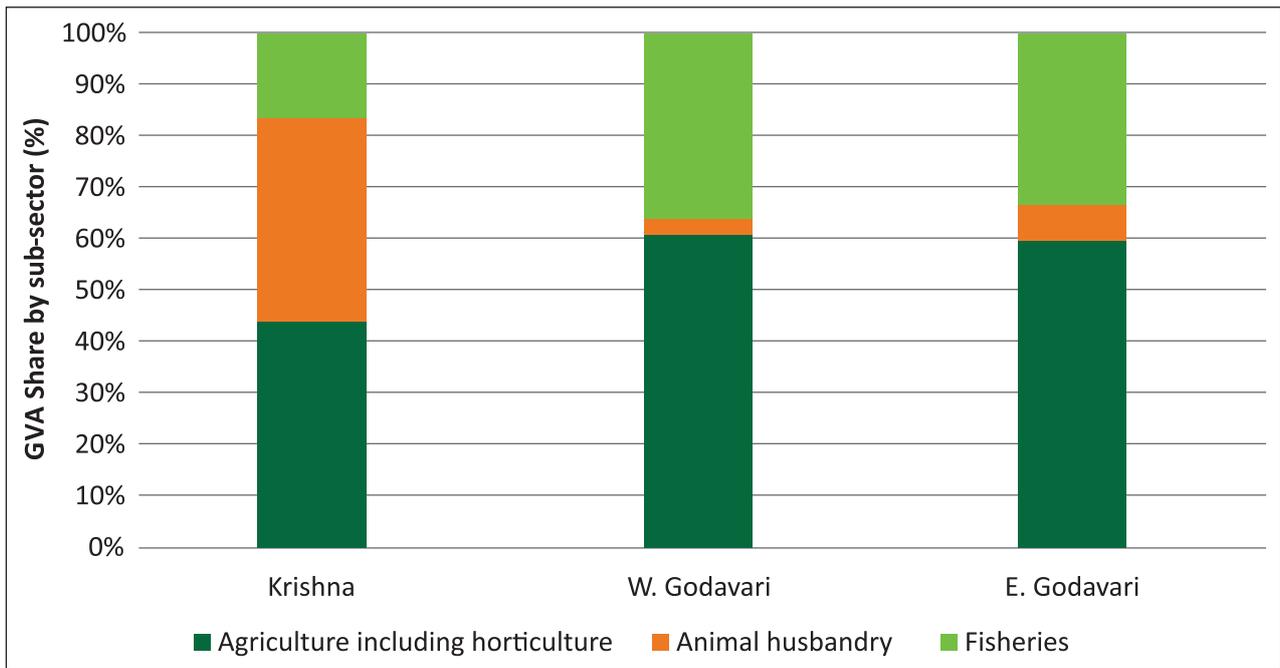


Figure 8. Shares of different sub-sectors in total GVA.



Figure 9. GVA value per pilot site village (₹ million) in the region.

The GVA values per household was estimated and compared across study districts. The details are furnished in Figure 10 in descending order of merit. West Godavari households retained their first rank followed by Krishna and East Godavari. The average household earning per annum during 2014-15 in West Godavari was calculated at ₹116,338. The household earning lowest per annum (₹55,120) was observed in East Godavari. The average earnings from agriculture and allied sectors in West Godavari was 2.11 times higher than an average sample household in East Godavari.

The average total GVA contributions per ha was also calculated and compared (see Figure 11). Each ha of agricultural land in West Godavari is contributing almost ₹210,404 per annum towards total GVA of the district primary sector. This was the highest value observed in the Delta Region among the study districts. The average earning per ha of cultivated land was the lowest in East Godavari (₹92,063). Good access to irrigation facilities and intensive cultivation of crops appear to help West Godavari earn 2.28 times more income than East Godavari. Further detailed break up of GVA values across the three pilot sites in the region are summarized in Appendix 1, Table 9.

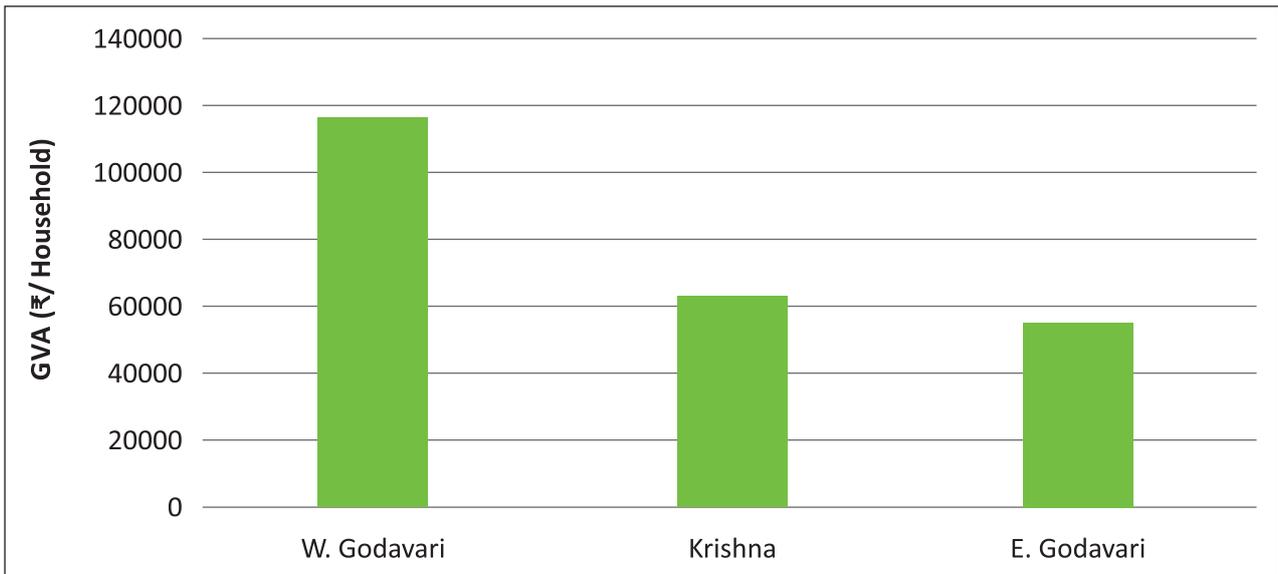


Figure 10. GVA value per household in the sample (₹ per household) in the region.

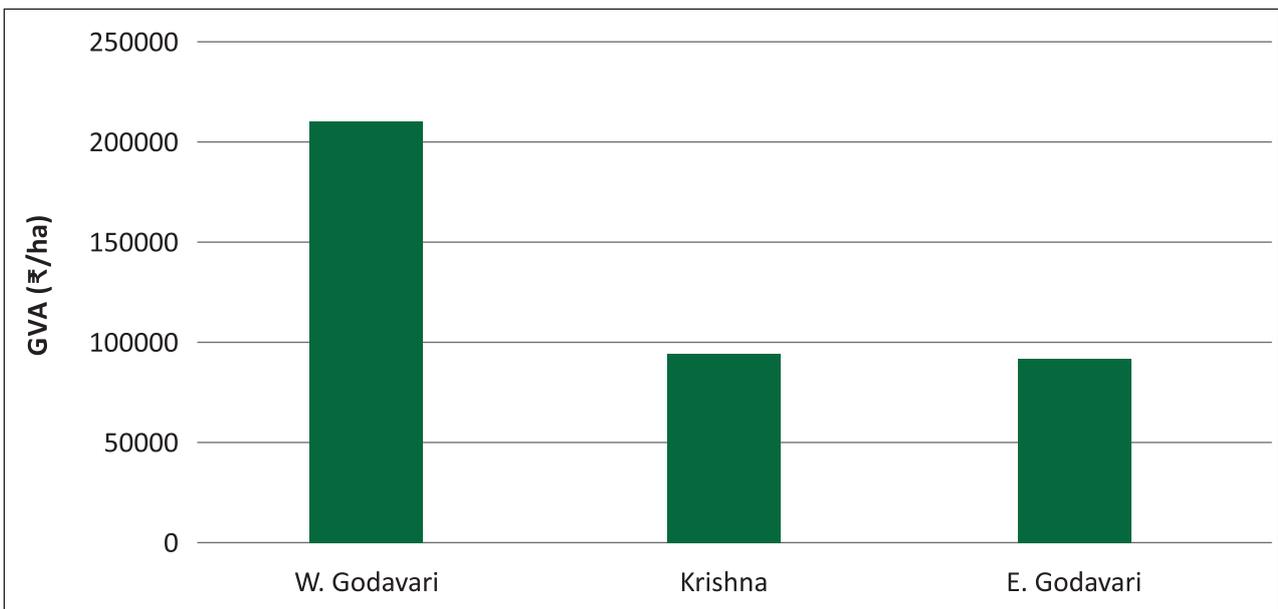


Figure 11. GVA value per hectare in the pilot sites (₹ per hectare) in the Delta Region.

8. Major Constraints and Potential Opportunities

All the district pilot sites have enormous potential to grow and contribute to the GVA of the region and the state in the primary sector. The sample farmers across pilot sites are highly determined and have a strong interest to continue in agriculture and allied activities provided it becomes highly remunerative. However, there are a few constraints observed across pilot site locations, which are hindering the growth and development of agriculture and allied activities. To reap the fullest potential across sub-sectors, the state has to undertake certain immediate measures to address these constraints. There is also a need for proactive policies and institutional reforms to achieve the targeted 'double digit growth' in primary sector of the state. The pilot-site wise constraints and potential opportunities available across sub-sectors of Delta Region primary sector are listed below:

District	Major constraints	Potential opportunities
Krishna	<ul style="list-style-type: none"> • Low yields in case of water intensive crops such as sugarcane • Absence of proper infrastructure for efficient management of supply & value chains across commodities • Poor milk productivity levels even though fodder is abundantly available • Poor quality seed supply for prawn cultivation • There is no development of non-farm employment skill-sets to meet the demands of new capital city – Amaravati. 	<ul style="list-style-type: none"> • Growing peri-urban demand for vegetables, fruits, milk and meat • Good scope for introduction of disease-resistant cultivars in case of black gram and green gram crops • Good potential for introduction of mechanization clusters in the district pilot site • Yield gaps in milk productivity levels across pilot site villages can be reduced • Scientific processing, grading and packaging aspects would allow significant margins in both prawns and fish cultivation in the pilot site
West Godavari	<ul style="list-style-type: none"> • High input cereal intensification cropping systems/rotations • Labor shortage is the biggest problem • High costs of cultivation and narrow margins • Lack of time/interest in livestock rearing • Low productivity levels and occurrences of diseases in prawn cultivation 	<ul style="list-style-type: none"> • High potential for introduction of legumes in rice fallows and subsequent increase in cropping intensity • Good scope for introduction of mechanization clusters • Potential for piloting IPM/better management practices for long-term sustainability of crop yields • Abundant fodder availability and good potential for increasing milk productivity • Potential opportunities for strengthening market linkages and value chains for oil palm, coconut, cocoa, mango, chillies, banana etc. • Enormous potential for development of fish and prawn industry
East Godavari	<ul style="list-style-type: none"> • Scope for further increase in productivity levels in case of sugarcane, cashewnut, tapioca etc. • Labor shortage and high input costs per ha • Low milk productivity levels • Low productivity levels and occurrences of diseases in prawn cultivation • Dominant role of traders or middle men in trading horticultural crop outputs 	<ul style="list-style-type: none"> • Huge scope for introduction of better technologies and improved cultivars in case of all commercial crops • Good potential for piloting of mechanization clusters • Abundant fodder availability for increasing milk productivity levels • Vast potential for processing, grading and exporting of tapioca, oil palm, cashewnut, mango and banana products • Enormous potential for development of fish and prawn industry

9. Summary and Way Forward

The comprehensive baseline survey conducted in the region has covered about 1229 sample HHs spread over 65 villages from eight *mandals* in three districts (Krishna, West Godavari and East Godavari) of the Delta Region of Andhra Pradesh. Specifically, the results are summarized from agricultural and fishery sample villages (nearly 37) covering about 1229 (1030 agricultural + 199 fishery) sample households in three pilot sites corresponding to three study districts in the region.

Small and marginal farmers dominated (56.6%) the total baseline sample in the region. The average family size in the region is about 3.8. Nearly 59.2% of total sample are un-educated. About 47.4% of family members only participate in activities/operations on their farm. The pooled average operational landholding per household was estimated at 2.39 ha. The extent of land tenancy in the total region sample was calculated at 35.7%. More than 80% of sample households have residential house, access to television and mobile phones. The average number of livestock animals owned per household was only 1.1 in the region. Due to good access to canal irrigation facilities, the average productivity levels across major crops were on par with district average yields. Commercial crops such as oil palm, tapioca and cotton are performing extremely well and realizing good net returns per ha. Overall, the crops cultivation in the Delta Region is more economical and recovered its most of their investments. The cultivation of fish is more profitable per cycle than prawns in the region. Agriculture (including horticulture) contributed around 56% share in the total GVA of the Delta Region. The fisheries sub-sector occupied the second position and contributed nearly 30% of regional GVA value. Animal husbandry secured the third place with 14% share in total GVA value at the Delta Region.

Major findings of the baseline survey and corresponding recommendations across sub-sectors are summarized below. Immediate steps are required to address these issues for enhancing each sub-sector's contribution in the total primary sector GVA of the Delta Region.

Key findings	Specific recommendations
<ul style="list-style-type: none"> Absence of proper infrastructure for efficient management of both supply and value chains across commodities, limiting the realization of full potential in the region. 	<ul style="list-style-type: none"> Huge opportunities are available with growing peri-urban demand for vegetables, fruits, milk and meat in the region.
<ul style="list-style-type: none"> Overall, high input cereal intensification cropping systems were observed in the region. There is a need for long-term sustainable practices to sustain the crop productivity across districts. 	<ul style="list-style-type: none"> Potential opportunities also available for strengthening the market linkages and value chains for oil palm, coconut, cocoa, mango, banana, tapioca, cashewnut etc. Need to diversify cropping pattern using legumes in rotation. Good scope for introduction and piloting of sustainable crop management practices including ICNM/IPM etc. to minimize the costs per ha and increase competitiveness across crops. Huge export potential for field and horticultural crops.
<ul style="list-style-type: none"> Lack of time/interest in livestock rearing is a limitation in the region. Even though the region has surplus fodder the per household owned livestock population is very low. 	<ul style="list-style-type: none"> Animal rearing as a business model should be promoted for efficient utilization of available fodder and water. There are huge opportunities for expansion of livestock rearing and processing. An integrated fodder grid should be established to move surplus fodder from the Delta Region to Rayalaseema.
<ul style="list-style-type: none"> Labor shortage is the biggest problem in the region. Due to high intensification of both field and horticultural crops, the per ha availability of labor force is low. Farmers are incurring huge expenditure on labor, which is squeezing the net returns per ha. 	<ul style="list-style-type: none"> Good potential for introduction and piloting of ICT based mechanization clusters in the region to minimize the labor problem. Lot of opportunities for introduction of mango/coconut harvesters as well as small scale processors for efficient post-harvest handling operations and value enhancement through good grading practices etc.
<ul style="list-style-type: none"> Low productivity levels coupled with frequent failure of prawn cultivation in the region. 	<ul style="list-style-type: none"> Provision of good quality seed to enhance productivity of prawns. Regulation of output prices is critical to protect the interests of prawn growers. Enormous potential for development of fish and prawn industry.
<ul style="list-style-type: none"> Minimization of postharvest losses in fruits and vegetable cultivation is critical to enhance production and increase its quality. 	<ul style="list-style-type: none"> Enormous scope for introduction of scientific postharvesting technologies across field and horticultural crops. Promote value-chains and farm-based industries to engage human resource gainfully.

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Appendix 1

Table 1. Distribution of agricultural sample in the Delta Region.

District	Total sample	Distribution by size group				Distribution by community				
		Small	Medium	Large	Landless	OC	BC	SC	ST	Others
Krishna	366	222	56	41	47	155	88	114	9	0
W. Godavari	310	149	61	44	56	123	164	22	1	0
E. Godavari	354	212	55	34	53	119	86	15	134	0
Delta Region*	1030 (100)	583 (56.6)	172 (16.7)	119 (11.5)	156 (15.2)	397 (38.5)	338 (32.8)	151 (14.7)	144 (14.0)	0 (0.0)

*Figures in parenthesis indicate their respective shares to the total sample.

OC=Open category, BC=Backward Class, SC=Scheduled Caste, ST=Scheduled Tribe

Table 2. Socio-economic details of the sample in the Delta Region.

District	Average family size* (no.)	Sample farmers' educational status (%)			Extent of labor participation	
		Un-educated	Primary	Upper primary and above	Own farm* (no.)	Outside farm* (no.)
Krishna	3.6	55.2	8.7	36.1	1.7	1.1
W. Godavari	3.7	55.8	11.3	32.9	1.6	0.7
E. Godavari	4.1	66.7	14.1	19.2	2.0	1.4
Delta Region	3.8	59.2	11.4	29.4	1.8	1.1

*including children in the family

Table 3. Landholding particulars in Delta Region pilot sites (hectare).

District	Own landholding (ha)			Operational landholding (ha)			Extent of tenancy in the sample%
	I	R	T	I	R	T	
Krishna	1.30	0.20	1.50	2.27	0.28	2.55	45.1
W. Godavari	1.82	0.20	2.02	2.51	0.20	2.71	31.0
E. Godavari	0.61	0.93	1.54	0.85	1.05	1.90	31.0
Average	1.24	0.45	1.69	1.88	0.95	2.39	35.7

I: Irrigated; R: Rainfed; T: Total

Table 4. Household assets and livestock ownership in Delta Region pilot sites.

District	% sample households possess assets					Average no. per sample HH			
	Residential house	Cattle shed	Television	Mobile	Two wheelers	Draft animals	Cows	Buffaloes	Total livestock animals*
Krishna	98.4	12.8	92.3	83.9	44.8	0.0	0.1	0.4	0.7
W. Godavari	96.1	22.3	78.4	78.3	56.5	0.0	0.2	0.9	1.4
E. Godavari	94.0	23.0	86.0	82.0	28.0	0.2	0.2	0.4	1.1
Average	96.2	19.4	85.6	81.4	43.1	0.1	0.2	0.5	1.1

* includes draft animals, cows, buffaloes, young stock, sheep, goats and poultry

Table 5. Major crops and their average productivity levels by pilot site.

District	Major crops	Productivity during BL (2014-15) (Kg/ha)	District average productivity (Kg/ha)	State average productivity (Kg/ha)	Nation average productivity (Kg/ha)
Krishna	Paddy	4810	3230	3090	2460
	Maize	6500	6920	6290	2360
	Cotton	2690	3790	3230	490
W. Godavari	Paddy	5330	3190	3090	2460
	Maize	6440	7090	6290	2360
	Oil palm	26870	NA	NA	NA
E. Godavari	Paddy	4060	2990	3090	2460
	Tapioca	12890	NA	NA	NA
	Cotton	1570	1130	3230	460

Table 6. Economics of crop enterprises in Delta Region pilot sites.

District	Crop	Total returns (₹per ha)	Total variable costs (₹per ha)	Net returns over total variable costs (₹per ha)	B:C Ratio
Krishna	Paddy	67757	46782	20975	1.40
	Maize	51687	40891	10796	1.30
	Cotton	88663	48748	39915	1.80
W. Godavari	Paddy	106259	53624	52636	1.98
	Maize	93887	59789	34098	1.57
	Oil palm	168543	135850	32693	1.24
E. Godavari	Paddy	68172	56810	11362	1.20
	Tapioca	130742	41990	88752	3.10
	Banana	142188	103740	38448	1.40

Table 7. Economics of prawn/fish enterprises in Delta pilot sites (₹ per cycle only).

District	Prawn/fish	Total returns (₹per ha)	Total variable costs (₹per ha)	Net returns over TVC (₹per ha)	B:C Ratio
Krishna	Prawns	954756	791593	163163	1.21
	Fish	613360	456194	157166	1.34
West Godavari	Prawns	1078303	1180262	-101959	0.91
	Fish	683039	278495	404546	2.45
East Godavari	Prawns	1163610	986399	177210	1.18
	Fish	810958	390969	419989	2.07

Table 8. Primary sector GVA estimations in Delta pilot sites (base year: 2014-15).

District	Sub-sector wise			Total GVA Estimation (₹ million)	Sub-sector wise share		
	Agriculture including horticulture (₹ million)	Animal husbandry (₹ million)	Fisheries (₹ million)		Agriculture Including horticulture	Animal hus-bandry	Fisheries
Krishna	632	570.3	233.8	1436.1	44.01	39.71	16.28
W. Godavari	1635	84.8	964	2683.8	60.92	3.16	35.92
E. Godavari	577.1	65.8	321	963.9	59.87	6.83	33.30
Regional total	2844.1	720.9	1518.8	5083.8	55.94	14.18	29.88

Table 9. District-wise pilot site GVA by unit values.

District	GVA/pilot site village (₹ million)	GVA/pilot site HH (₹/HH)	GVA/pilot site cropped area (₹/ha)
Krishna	53	62,973	94,592
W. Godavari	224.4	1,16,338	2,10,404
E. Godavari	37	55,120	92,063

Appendix 2 (Sampling Details)

Table 1. Extent of coverage of pilot site by district.

Sl. No.	District	Pilot site coverage		Pilot site coverage	
		No. of <i>mandals</i>	No. of agricultural/horticultural villages	No. of <i>mandals</i>	No. of fishery villages
1	Anantapur	2	14	0	0
2	Kurnool	2	10	0	0
3	Kadapa	4	14	0	0
4	Chittoor	2	18	0	0
5	SPS Nellore	2	8	1	3
6	Prakasam	2	13	2	15
7	Guntur	2	14	3	4
8	Krishna	2	22	1	3
9	West Godavari	2	12	1	8
10	East Godavari	2	16	1	10
11	Vishakapatnam	3	23	0	0
12	Vizianagaram	2	21	1	2
13	Srikakulam	3	42	1	2
	Total	30	227	11	47

Table 2. Extent of diversity in agricultural/horticultural pilot site villages.

District/Diversity scale	4	5	6	7	8	9	Total
Anantapur			12		2		14
Chittoor					18		18
East Godavari			9	7			16
Guntur			14				14
Kadapa			3	7	4		14
Krishna			22				22
Kurnool		6	4				10
Nellore			5	3			8
Prakasam			13				13
Srikakulam	9		14	19			42
Visakhapatnam			13	3	7		23
Vizianagaram			17	4			21
West Godavari			4			8	12
Grand Total	9	6	130	43	31	8	227

Table 3. Extent of diversity in selected agricultural/horticultural baseline villages.

District/Diversity scale	4	5	6	7	8	9	Total
Anantapur			7		2		9
Chittoor					9		9
East Godavari			5	4			9
Guntur			8				8
Kadapa			1	4	3		8
Krishna			11				11
Kurnool		4	2				6
Nellore			4	2			6
Prakasam			7				7
Srikakulam	4		6	8			18
Visakhapatnam			6	1	3		10
Vizianagaram			8	2			10
West Godavari			3			5	8
Grand Total	4	4	68	21	17	5	119

Table 4. Targeted baseline sample coverage across sub-sectors.

District	Agricultural sample				Total	Fishery sample*	Grand total
	Landless	Small	Medium	Large			
Anantapur	54	290	31	27	402	0	402
Chittoor	54	369	36	27	486	0	486
East Godavari	54	230	72	46	402	216	618
Guntur	48	208	56	24	336	108	444
Kadapa	48	286	38	24	396	0	396
Krishna	66	297	66	33	462	108	570
Kurnool	36	156	18	18	228	0	228
Nellore	36	172	38	18	264	108	372
Prakasam	42	203	28	21	294	252	546
Srikakulam	108	472	118	58	756	72	828
Visakhapatnam	60	307	65	30	462	0	462
Vizianagaram	60	312	30	30	432	72	504
West Godavari	48	273	71	34	426	180	606
Grand Total	714	3575	667	390	5346	1116	6462

*A few landless households were also covered in the fishery sample.

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