Introduction

“The farmer is the only man in our economy who buys everything at retail, sells everything at wholesale and pays the freight both ways”

John F. Kennedy

Rapid growth of agriculture is critical for inclusiveness and livelihood security. Even though agriculture accounts for only 9 percent of Gross State Domestic Product (GSDP), it is still the main source of livelihood for the majority of the rural population. The focus area of 12th five year plan of the state in agriculture is on improving viability of small farms, safety nets, risk management, social capital development and service delivery. The failure to achieve targeted growth in agriculture has resulted from the inadequacies of the provision of the critical public goods such as extension services, surface irrigation, rural infrastructure, as well as on inadequate institutional and financial support.

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After two decades of indefensible neglect, agriculture must be back on agenda

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Agriculture first

The agenda for change should consider the central role of agriculture and food security in fostering inclusive and sustainable growth. Agriculture first should be the policy to spark a revolution by establishing agriculture as a top priority by boosting Government spending and targeting small and marginal farmers.

Theodore Schultz began his acceptance speech for the 1979 Nobel Prize in Economics observing,

“Most of the people in the World are poor, so if we knew the economics of being poor we would know much of the economics that really matters. Most of the world’s poor people earn their living from agriculture. So if we knew the economics of agriculture, we would know much of the economics of being poor”.

(Shultz, 1979)
Farmers in the State are subject to much greater risk in recent plan periods. The frequency and severity of risks in agriculture have increased on account of climate variability and this has been accompanied by much greater variability of world prices and their quicker transmission into the domestic economy due to greater integration with world economy resulting in fluctuation of growth performance of agricultural income. Similarly performance of crop output is strongly affected by rainfall which results in sharp year to year fluctuation in growth of crop output, since more than 80% of cropped area in Kerala is rain fed. Adequate safety nets are to be provided to farmers against risks and uncertainties.

The Task Force on Agriculture development has been constituted by the Kerala State Planning Board and issued order dated 5th May 2015. The order is enclosed as Annex.

The Task Force Report was prepared after detailed discussion of subsector wise key issues followed by processing of 12th Five Year Plan document, working group reports prepared for 12th Plan, sectoral papers, agricultural development policy, study reports, Perspective Plan 2030, analysis of secondary data and inputs from the departments. The agricultural development policy for the State was approved in 2015. The policy was prepared after elaborate discussion at various levels for nearly two years, followed by discussion in the State Assembly. The summary of the agricultural development policy is enclosed as Annex 2.

The task force report is presented in the following chapters:

1. Agriculture in Kerala - Past and Present - an overview
2. Towards a Perspective on Agriculture Green Growth
3. Strategic Framework
4. Support from Government of India
5. Best Practices
1.1: Agriculture in Kerala - Past and Present: an Overview

1.1.1: Diminishing share of agriculture in both GSDP and workforce

Though agriculture still plays a significant role in the national and state economies, growth in the sector has slowed down especially since 1990-91. The estimates of annual trend growth rates of gross domestic product of agriculture, forestry and fishery sectors along with that of overall agriculture and allied sectors and non-agricultural sector in Kerala are presented in Table 1.1. These estimates show that agriculture (including livestock) exhibited a modest growth of 2.53 per cent during the 1990s, but displayed poor performance (0.27 per cent) during the decade after 2000. A similar deceleration in growth was noticed in the forestry and logging sector too, but the fishery sector experienced a slight improvement in growth from −0.37 per cent to 0.32 per cent. Overall, agriculture in Kerala experienced a slower growth during the last decade with all its sub-sectors losing growth momentum (except fishery, but the growth rates are fairly low), whereas the non-agricultural sector grew faster during this period.

Table 1.1 Trend Growth Rates in GSDP (2004–05 Prices) of Various Sub-sectors in Kerala (% per year)

<table>
<thead>
<tr>
<th>Sector</th>
<th>1990–91 to 1999–00</th>
<th>2000–01 to 2010–11</th>
<th>2013-14#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>2.53</td>
<td>0.27</td>
<td>-2.8</td>
</tr>
<tr>
<td>Forestry and Logging</td>
<td>3.69</td>
<td>2.00</td>
<td>3.4</td>
</tr>
<tr>
<td>Fishery</td>
<td>-0.37</td>
<td>0.32</td>
<td>5.43</td>
</tr>
<tr>
<td>Agriculture and allied sectors</td>
<td>2.34</td>
<td>0.46</td>
<td>-1.36</td>
</tr>
<tr>
<td>Non-Agriculture</td>
<td>6.24</td>
<td>9.41</td>
<td></td>
</tr>
<tr>
<td>All sectors</td>
<td>5.25</td>
<td>7.96</td>
<td>6.27</td>
</tr>
</tbody>
</table>

Note: *GSDP Agriculture includes both crops and livestock.#Quick estimate (Directorate of Economics and statistics)
Data Sources: National Accounts Statistics and Central Statistical Office, Directorate of Economics and statistics

The relatively low growth of agriculture has resulted in the share of agriculture and allied sectors in GSDP declining steeply from 32.6 per cent in 1980–81 to 10.6 per cent in 2010–11 and 8.83 per cent in 2013-14. Agriculture alone accounted for about 6.8 per cent of total GSDP in Kerala in 2013-14.
1.1.2: Land-use Pattern

Agricultural land-use changes in Kerala during the past half-century were marked by an initial increase in gross cropped area followed by shifts in the coverage of individual crops. The total area under cultivation as a percentage of geographical area in the state increased from 60.8 per cent in 1960-61 to 77.3 per cent in 2000-01 but thereafter it suffered a decline in the last one decade to 67 per cent in 2013-14, mainly due to the reduction in ‘area sown more than once’ which fell from 8.15 lakhs ha in 2000-01 to 5.65 lakh ha in 2013-14. Meanwhile barren and uncultivable land as well as cultivable waste lands also showed tremendous decline during the last fifty years implying that much of the land that was put idle were reclaimed for productive purposes. The land put to non-agricultural use on the other hand has registered an increase from 5.3 percent of the geographical area to 10 per cent in 2013-14. (96 per cent increase) However, the total cropped area has increased only 10 per cent during the period. This suggests that much of the land that was reclaimed for productive use was mainly utilized for non-agricultural purposes.

1.1.3: Skewed Cropping Pattern

The cropping pattern of the state has also undergone a dramatic shift since the sixties with a large skew towards cash crops. The area under food crops decreased from 45 per cent of the total cropped area to 10.32 per cent between 1960-61 and 2013-14, while the area under cash crops increased from 36.6 per cent to 62.30 per cent during the same period. The emergence of cash crops as the dominant crop is the most notable feature of Kerala’s agricultural development in the last five decades. The main reason for such drastic fall in the area under food crops is the drastic fall in the area under paddy which is increasingly being replaced by coconut and rubber, which are more remunerative and less labour absorbing. From 40.49 per cent of Net Sown Area (NSA) in 1960-61, the area under paddy has come down to 15 per cent in 2000-01 and to 9.7 per cent of the NSA in 2013-14. The area under tapioca and pulses (the other two major food crops have also declined (12.59 per cent to 2.29 per cent –tapioca and pulses -2.29 per cent to 0.14 per cent.) Meanwhile, the share of coconut as well as rubber (the major cash crops) in NSA has increased from 26.03 per cent to 39.4 per cent and 6.39 per cent to 26.7 per cent.
respectively in the last five decades. Today rice occupies only third position in area under cultivation, among all the crops way behind rubber and coconut

**Fig: 1.1 Share of food crops and cash crops in the total cropped area of Kerala 1960-61 and 2013-14**

1.1.4: **Cropping Systems**

In Kerala four major types of cropping systems are followed viz. 1) rice based system in low lands with single or two crops of paddy, summer vegetables, pulses or oil seeds with or without aquaculture component, 2) coconut based mixed cropping system comprising a number of intercrops like pepper, arecanut, cocoa, clove, banana, vegetables, green manures and cover crops, 3) mono crop rubber plantations and 4) homesteads, unique to Kerala comprising a large number of components like trees, food and fodder crops, livestock, fishery and poultry. Apart from these there are other systems like where rubber is the major crop with cover crops, apiary etc. In hilly areas of Wayanad coffee is also a prominent component in the homesteads. Other cropping systems prevalent in selected areas of the State include pepper, coffee, arecanut and banana based systems. However in the past few decades most of the wetlands have been converted to non-agricultural purposes and secondly the mixed cropping systems revolving around homesteads have been converted to monocrop like rubber.
1.1.5: Crop wise analysis - Comprehensive decline since 90’s

When individual crops are taken, on a time series basis what emerges is that there has been a comprehensive decline in the growth rates of area as well as production of all the major crops ever since the 90’s. The growth performance of six crops in area coverage, production and productivity are shown in Table 1.2 below. In order to work out the compound growth rates, the total period has been divided into three periods covering 1960-61 to 1974-75 as the first period being the period of peak food crop production, 1975-76 to 1991-91 and 1992-93 to 2011-12 being two periods before and after economic liberalization respectively. It can be seen from the graph that rice, tapioca, coconut and pepper have all shown negative growth rates in the third phase (1992-93 to 2011-12), it being sharpest for rice while banana and plantains as well as rubber have shown positive growth rates. Whereas in production rice as well as rubber and to an extend tapioca have shown negative growth rates, while the other crops have shown positive growth rates. In the second phase, except tapioca and rice all the other crops showed positive growth rates in area as well as production while in the first phase all the crops showed positive growth rates in area as well as production. This shows the extent of decline suffered in the third phase in terms of area as well as production. However productivity has shown slight improvement in the same period.

Table 1.2  Compound growth rate in area, production and productivity

<table>
<thead>
<tr>
<th>Crops</th>
<th>Area</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>0.83</td>
<td>-2.79</td>
<td>-4.63</td>
<td>1.49</td>
<td>-1.33</td>
<td>-3.18</td>
<td>0.66</td>
<td>1.5</td>
<td>1.53</td>
</tr>
<tr>
<td>Coconut</td>
<td>2.71</td>
<td>1.3</td>
<td>-0.33</td>
<td>0.83</td>
<td>1.78</td>
<td>0.74</td>
<td>-1.83</td>
<td>0.47</td>
<td>1.08</td>
</tr>
<tr>
<td>Rubber</td>
<td>3.38</td>
<td>4.34</td>
<td>0.98</td>
<td>11.91</td>
<td>6.05</td>
<td>3.94</td>
<td>8.25</td>
<td>1.64</td>
<td>2.94</td>
</tr>
<tr>
<td>Pepper</td>
<td>1.15</td>
<td>2.97</td>
<td>-0.4</td>
<td>0.22</td>
<td>4.3</td>
<td>-1.33</td>
<td>-0.92</td>
<td>1.29</td>
<td>-0.93</td>
</tr>
<tr>
<td>Banana/Plantains</td>
<td>0.4</td>
<td>1.3</td>
<td>2.33</td>
<td>0.73</td>
<td>1.35</td>
<td>2.45</td>
<td>0.33</td>
<td>0.06</td>
<td>0.12</td>
</tr>
<tr>
<td>Tapioca</td>
<td>1.83</td>
<td>-4.79</td>
<td>-2.93</td>
<td>8.37</td>
<td>-4.07</td>
<td>-0.16</td>
<td>6.42</td>
<td>0.75</td>
<td>2.86</td>
</tr>
</tbody>
</table>

Source: Derived from Directorate of Economics and Statistics Data
In crop wise analysis, Paddy is the major crop which has undergone a shift and was replaced by more remunerative and less labour absorbing crops like rubber, coconut, banana etc. During the first two decades (1960-61 and 1970-71) there was not much change in the area under cultivation of paddy with respect to the net sown area in the state. The paddy area started declining from 1980’s and the per cent area under cultivation to the NSA declined to 24.90 % by 1990. The decline in paddy area under cultivation was more prominent since 2000 and irrespective of several policy efforts this major food crop now (2013-14) occupies only 9.73 % of the net sown area in the state.

The total area under cultivation of coconut was not much affected probably on account of the fact that many of the paddy fields were reclaimed and planted with coconut during the period (Fig.1.3). Since 2000 the coconut area with respect to the NSA started to decline. However, the recent trend indicated that the area under cultivation improved to 8.08 lakh ha in 2013-14 which is promising.

Pepper area in the state was on increase in 1960s and 1970s with a slight reduction in area during 1980s. The prominence of pepper in the cropping system of the state was established by 2000 and the total area under cultivation increased to 9.16 % of the NSA in
the state, occupying 2.02 lakh ha area. Now the area has declined to 0.84 lakh ha (2013-14).

The rubber crop acquired prominence in Kerala land use pattern by making dramatic shifts in the cropping pattern over the decades. In 1960 the crop was cultivated on a mere 1.23 lakh ha area occupying only 6.39 % of the NSA. The area under Rubber cultivation increased each year steadily many times replacing the food crops and in 2013-14, the crop occupied 26.73 % of the NSA and 20.95% of the gross cropped area in Kerala spreading over an area of 5.48 lakh ha.

Adverse factor price ratios of food crops, favourable price regimes of cash crops combined with institutional support have contributed to the shift in cropping pattern.

Fig 1.3 Percentage area under cultivation of four major crops to (NSA) since 1960

1.1.6: Structural shift in the composition of agricultural output

The differential performance of crops in terms of area, production and prices over the last two decades has resulted in significant alteration in the composition of value of product (VOP) from crops. These variations are depicted in Figure 1.4. During the Triennium Ending (TE) 1990–91, coconut topped the list of crops with the highest share of 28 per cent in total VOP from crops. Other major contributors to output were rice (11 per cent), rubber (10 per cent) and tapioca (9 per cent) with other crops contributing 5 per cent or less individually. However, by TE 2008–09, the scenario underwent a major change with the share of VOP from rubber rising to 40 per cent and the contribution of coconut declining to 15 per cent. The share of rice got squeezed to a mere 4 per cent while that of
tapioca to 7 per cent. The share of pepper also decreased to 3 per cent from 5 per cent during this span of time. Other minor crops such as tea, cashew nut and so on also lost their share, to a smaller extent. On a different note, banana improved its position with a share of 5 per cent in TE 2008–09 from 3 per cent in the previous period.

A general point emerging from the crop shift outlined above is that agriculture in Kerala has witnessed a decline in net area sown and also the increasing importance of commercial crops such as rubber.

**Figure 1.4: Shares of VOP of Major Crops in Kerala: TE 1990–91 and TE 2008–09**

Source: Agricultural Statistics at a Glance, 2011

### 1.1.7: Low Productivity in crops since last five decades

The productivity of most of the crops cultivated in the State is very low. The prevalence of the debilitating coconut root (wilt) disease, existence of a large number of senile and unproductive palms and growing of coconuts in unsuitable areas and lower investment due to inadequate incentives are the major reasons attributed to the low productivity of coconut compared to other states or countries. The productivity of coconut over the past few decades has been almost stable with slight improvement in the current decade. The productivity of pepper has improved since 1980s and the present pepper productivity is still very low compared to other countries. In the case of cashew, despite operating special schemes for expansion of area, the productivity has been steadily declining during the last two decades. Kerala has a substantial share in the four plantation crops, viz, rubber, tea, coffee and cardamom. In the plantation segment, rubber is the only
crop which could maintain steady and stable performance in productivity. Increase in production would be possible mainly from improvements in productivity through the use of location specific technology generation and adoption and modernisation of agriculture. The stabilisation and augmentation of productivity assume critical importance, given the limited scope for increasing area under cultivation of various crops. The average productivity of major crops over the past five decades is shown in Table 1.3.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>1477</td>
<td>1587</td>
<td>1942</td>
<td>2162</td>
<td>2827</td>
</tr>
<tr>
<td>Coconut*</td>
<td>5536</td>
<td>4618</td>
<td>5239</td>
<td>5980</td>
<td>7322</td>
</tr>
<tr>
<td>Cashew nut</td>
<td>1122</td>
<td>580</td>
<td>888</td>
<td>718</td>
<td>680</td>
</tr>
<tr>
<td>Pepper</td>
<td>213</td>
<td>264</td>
<td>278</td>
<td>301</td>
<td>350</td>
</tr>
<tr>
<td>Cardamom</td>
<td>26</td>
<td>55</td>
<td>52</td>
<td>184</td>
<td>352</td>
</tr>
<tr>
<td>Tea</td>
<td>1103</td>
<td>1402</td>
<td>1827</td>
<td>1876</td>
<td>2084</td>
</tr>
<tr>
<td>Coffee</td>
<td>430</td>
<td>634</td>
<td>475</td>
<td>833</td>
<td>781</td>
</tr>
<tr>
<td>Rubber</td>
<td>439</td>
<td>590</td>
<td>800</td>
<td>1222</td>
<td>1182</td>
</tr>
</tbody>
</table>

Source: Department of Economics and Statistics

*A nuts/ha

A comparison of the productivity of five major crops of Kerala with their productivity levels in neighbouring states, and other countries have been done in Table 1.4. The productivity of rice in Kerala is the lowest (2827 Kg/ha) among other southern states though it is higher than the National Average (2424 Kg/ha). China which is the major producer of rice in the world has almost three times the productivity (6744 Kg/ha) of rice in Kerala. The productivity of rice in Egypt is the highest in the world (9088 Kg/ha) which is nearly fourfold of our productivity. The productivity of Pepper in Vietnam which is the major producer in the world is nearly 15 times higher (3239 Kg/ha) than our current productivity.
Table 1.4 Productivity of major crops in 2013-14 (kg/ha) and the comparison with other states and countries

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Crop</th>
<th>Kerala</th>
<th>Tamil Nadu</th>
<th>Andhra Pradesh</th>
<th>Karnataka</th>
<th>India</th>
<th>Country having highest productivity in world (Average from 1992-2012)</th>
<th>Productivity of top producer of world</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rice</td>
<td>2827</td>
<td>3100</td>
<td>2891</td>
<td>2828</td>
<td>2424</td>
<td>Egypt- 9088</td>
<td>China-6744</td>
</tr>
<tr>
<td>2</td>
<td>Pepper</td>
<td>350</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>400</td>
<td>Cambodia-5997</td>
<td>Vietnam- 3239</td>
</tr>
<tr>
<td>3</td>
<td>Coconut*</td>
<td>7322</td>
<td>10236</td>
<td>14997</td>
<td>11808</td>
<td>10615</td>
<td>Peru- 19733</td>
<td>Indonesia-8280</td>
</tr>
<tr>
<td>4</td>
<td>Rubber</td>
<td>1182</td>
<td>1273</td>
<td>-</td>
<td>622</td>
<td>1206</td>
<td>Mexico-1988</td>
<td>Thailand-1640</td>
</tr>
</tbody>
</table>

Sources: FAOSTAT 2013, Spices Board, Rubber Board, Agriculture Statistics at a glance, 2014, Directorate of Economics & statistics, GoI, Coconut Development Board  *Nuts/ ha

In case of coconut also, the productivity in Kerala is lower (7322nuts/ ha) than that of other three southern states. Among major producers, productivity is highest in Andhra Pradesh. National average of coconut productivity is higher than that of Kerala. Indonesia is the major producer of coconut in the world with a productivity of 8280 nuts/ha. Data average from 1992 to 2012 show that productivity of coconut is highest in Peru (19733 nuts/ha; FAOSTAT, 2013). Thailand which is the major rubber producer of the world has a productivity of 1640 kg/ha. Mexico is the country having highest rubber productivity in the world (1988 kg/ha). Differences in technology adoption, unattractive incentive structure, institutional factors and the nature of technology, plant health dimension and debilitating plant diseases, extension gaps and inadequate location specific technologies are some of the reasons for the poor productivity of crops in the State. Apart from analysis of productivity at State level the mapping of yield gaps on agro-ecological unit basis will provide space for developmental interventions on project mode for substantial gains.

1.1.8: Agrarian sans agriculture

Though known to be an agrarian state, agriculture has ceased to be the principal economic activity in Kerala. The Situation Assessment Survey of Agricultural Households conducted at national level in NSSO 70th round (January-December 2013) published in 2014 to collect information on various aspects of farming have actually posed a question regarding the agrarian nature of the state. Kerala had the least percentage share of agricultural households in the country i.e.; 27.3 per cent and nearly, 61 per cent of the
agricultural households reported to have earned income from activities other than agriculture. Mere 16 per cent reported cultivation as main source of income and 0.6 per cent reported livestock as main source of income. All the major states except Kerala reported agricultural activity (cultivation, livestock and other activity) as principal source of income With regard to indebtedness of agricultural households 52 per cent of the agricultural households in the country were estimated to indebted, the average amount of loan outstanding being Rs 47000/-. Shockingly for Kerala 77.7 per cent of the agricultural households were found to be indebted, the average amount of loan to be a massive Rest. 213600/-, the highest in the country during last 365 days.

**Figure: 1.5 Situation assessment survey 2014; findings relevant for Kerala**

1.1.9: Low Irrigation Status

The status of irrigation in the state is quite low with majority of famers depending on monsoons for water. Out of the gross cropped area of 26.17 lakh ha in Kerala only 17.6 percentage is under irrigation cover which is far below the national average of 35 per cent. Well and government canals are the main source of irrigation. Among the crops, coconut leads with the highest share of irrigated area, followed by paddy, banana and arecanut.
1.1.10: Low farm mechanization

Farm mechanisation has also been abysmally low in Kerala. Even though labour availability for agricultural operations has decreased in Kerala over the years, a commensurate improvement in mechanisation did not take place. The numbers of major implements used for agricultural purposes in Kerala, based on the Livestock Census 2003, are presented in Table 1.5 (This is the latest available data on agricultural implements at the state level).

Table 1.5 Number of Agricultural Implements Used for Agricultural Purposes in Kerala: 2003

<table>
<thead>
<tr>
<th>Type of Machinery</th>
<th>Rural</th>
<th>Urban</th>
<th>Total</th>
<th>Number – 1000 ha of GCA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power operated implements</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power tillers</td>
<td>1,702</td>
<td>603</td>
<td>1,765</td>
<td>0.60</td>
</tr>
<tr>
<td>Tractors</td>
<td>2,061</td>
<td>77</td>
<td>2,138</td>
<td>0.72</td>
</tr>
<tr>
<td>Mouldboard Plough</td>
<td>153</td>
<td>8</td>
<td>161</td>
<td>0.05</td>
</tr>
<tr>
<td>Cultivator</td>
<td>274</td>
<td>5</td>
<td>279</td>
<td>0.09</td>
</tr>
<tr>
<td>Disc harrow</td>
<td>254</td>
<td>17</td>
<td>271</td>
<td>0.09</td>
</tr>
<tr>
<td>Rotavator</td>
<td>35</td>
<td>1</td>
<td>36</td>
<td>0.10</td>
</tr>
<tr>
<td>Animal operated implements</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cultivator</td>
<td>934</td>
<td>5</td>
<td>939</td>
<td>0.32</td>
</tr>
<tr>
<td>Disc harrow</td>
<td>672</td>
<td>16</td>
<td>688</td>
<td>0.23</td>
</tr>
<tr>
<td>Seed-fertiliser drill</td>
<td>610</td>
<td>4</td>
<td>614</td>
<td>0.21</td>
</tr>
<tr>
<td>Leveller</td>
<td>7,453</td>
<td>248</td>
<td>7,701</td>
<td>2.61</td>
</tr>
<tr>
<td>Wetland puddler</td>
<td>378</td>
<td>3</td>
<td>381</td>
<td>0.13</td>
</tr>
<tr>
<td>Sugarcane crusher</td>
<td>69</td>
<td>1</td>
<td>70</td>
<td>0.02</td>
</tr>
</tbody>
</table>

Source: Livestock Census, 2003

On a per hectare basis, the density of implements was found to be very low in Kerala. This was much lower compared to other states. For instance, the density of use in the case of power tillers and tractors were 0.60 and 0.72 respectively. These were much lower than those for Haryana (30.3 for tractor, 4.1 for tiller), Punjab (37.8 for tractor, 4.5 for tiller) and southern states such as Tamil Nadu (9.4 for tractor, 1.9 for tiller) and Karnataka (5.3 for tractor, 2.4 for tiller). The relatively smaller size of farm holdings in Kerala, decreasing area under paddy and other field crops, predominance of plantation crops and so on could be the key reasons for this observed pattern. A disaggregated analysis indicates that the marginal and small holders that comprise about 98 per cent of the total farm households in Kerala have much lower intensity of farm mechanisation.
Considering that the agricultural wage rates are rather high and that there is a shortage of agricultural labour, low levels of mechanisation have constrained productivity growth.

1.1.11: Wide gap between supply and demand of planting materials

Although the intensity of application of fertilizers as well as seeds have increased tremendously in the state there exists a wide gap between the supply and demand of planting materials. Kerala is a relatively low fertiliser consuming state in relation to other major agricultural states in the country. Organo-phosphorous chemicals are banned in the State. In 2013-14, the total consumption of NPK (Nitrogen-Phosphorus-Potash) in Kerala was estimated to be 121.03 kg per ha of NSA. This was much lower than the levels consumed in neighbouring states such as Tamil Nadu (153.76), Karnataka (136.06 kg per ha) and Andhra Pradesh (226.72 kg per ha). The growth rate in fertiliser consumption during the last two decades (1990–91 to 2009–10) was also the lowest (0.88 per cent per year) in Kerala, while other states registered an annual rate of growth between 2–6 per cent. One reason why Kerala consumed less could be that its cropping pattern is dominated by plantation crops, which require relatively lower amounts of fertilisers. The general preference of people towards organic food could have also contributed to this pattern. What is worrisome is that despite low consumption, there remains a gap between demand for and supply of fertilisers (Table 1.6). In 2011–12, Kerala required around 649,000 tonnes of fertilisers. Out of this, 565,000 tonnes were made available by the state government and the total sales realised were 531,000 tonnes. This suggests that, there was a gap of around 118,000 tonnes of fertilisers to be met during this period.

Table 1.6: Requirement, Availability and Sales of Major Fertilisers in Kerala: 2011–12

<table>
<thead>
<tr>
<th>Item</th>
<th>Requirement</th>
<th>Availability</th>
<th>Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urea</td>
<td>182</td>
<td>150</td>
<td>149</td>
</tr>
<tr>
<td>MOP</td>
<td>45</td>
<td>44</td>
<td>41</td>
</tr>
<tr>
<td>DAP</td>
<td>175</td>
<td>151</td>
<td>142</td>
</tr>
<tr>
<td>Complex</td>
<td>247</td>
<td>220</td>
<td>199</td>
</tr>
<tr>
<td>Total</td>
<td>649</td>
<td>565</td>
<td>531</td>
</tr>
</tbody>
</table>

Note: MOP: Muriate of Potash; DAP: Di-ammonium Phosphate
Source: Lok Sabha un-starred question accessed through Indiastat, 2012
1.1.12: Seeds: Gap between the supply and requirement

Quality seeds and planting material help a long way in enhancing productivity of crops. Hence the government of Kerala has made concerted efforts producing and delivering quality seeds to the farmers. Certified seed production in Kerala is almost entirely from the government sector, unlike in other states. More than half the certified seeds are sourced from the state Department of Agriculture, whereas the rest are met from National Seeds Corporation or other government-approved agencies. At present, there are 33 state seed farms, 10 district farms, 10 special farms, and 8 coconut nurseries functioning in Kerala with the purpose of delivery quality seeds and planting material to farmers (GoK, 2012). The major share of certified seeds is of improved paddy varieties, vegetables and other minor crops. The state government also produces and distributes coconut and arecanut seedlings, rooted pepper cuttings, cashew grafts, tissue culture banana plants, grafts of other fruit crops and so on through Krishi Bhavans and other seed outlets.

For Kerala, the annual seed requirement worked out to be 12,000 tonnes, whereas the actual availability was 10,900 tonnes. This means actual availability fell short of the requirement. The other states where availability falls short of requirement are Odisha, Uttar Pradesh (UP) and West Bengal. In a majority of other states, however, seed availability exceeds requirement, indicative of the dynamic role played by seed producers and distributors in these states.
1.1.13: Credit – biased towards short term loans

The share of Agriculture credit as a percentage of total credit has shown an increasing trend in the last ten years, after a fall in the nineties, notwithstanding the decline in the share of agriculture in the GSDP of the state. Also, over the years, the role of formal institutions in the total credit availed by farmer households has shown a remarkable increase with the lead role played by commercial banks ever since bank nationalization followed by cooperatives and RRBs. The agency wise break up of annual credit flows to agriculture shows that, in 2012-13 out of the total Agriculture advances, commercial banks advances constitute a major chunk, disbursing 68.6 % of the total, followed by cooperatives (22.6%) and RRBs (8.9%).

**Figure 1.7: Agency wise disbursement of Agricultural credit**

However, starting from 2000, the share of production credit (which accounts for major portion of the credit) in the total agricultural credit has been going up whereas the share of investment credit has come down from 21 per cent in 1999-2000 to 11 % in 2011-12. (It has picked up albeit marginally in the last two years). This is not favourable for accelerating agricultural growth. A balance between short term and long term investment credit ought to be brought in to maintain sustainable agricultural growth. The declining share of investment credit indicated that farmers seem to borrow more short term credit in order to meet their input needs to maintain continuity in agricultural operation and do not pay adequate attention to capital formation for agriculture. Also, the government has
not made available the benefit of subvention for investment credit resulting in relatively high cost of the same (13%).

Also, of the total advances of Rs192010 crores in 2013-14 gold loans by banking sector comes to 43382.crores (22per cent), out of which agricultural gold loans comes to the tune of Rs 34521.23 crores. (17.97 per cent of the total advances). Disaggregated data shows that as much as 92 per cent of the gold loan disbursed by the public sector banks comes under agricultural gold loan, while for the private sector banks it is 41 per cent and for cooperative banks it is 78 per cent. This shows that there is indiscriminate issue of agricultural gold loans without ensuring its end use. Also this could be one reason for increasing share of crop loans but no proportionate increase in output or agricultural income. It may be observed that despite a fourfold increase in the credit flow during the period from 2005-06 to 2010-11, there has been a decline in agriculture income on an absolute basis and the percentage of agricultural income to GSDP of agriculture and allied sectors has been continuously declining. Therefore there is a need to look into the end use of the credit from banks towards crop loan.

1.1.14: Low share of capital formation in agricultural GSDP

The long-term trends in estimated public, private and total capital formation in agriculture are plotted in Figure 1.9 below. It is observed that public capital formation in agriculture remained more or less stagnant for a very long time in Kerala, before experiencing a boost sometime in the early 2000s. On the other hand, private capital formation started picking up in the 1990s itself and grew substantially in the following years.
Figure 1.9: Trends in Public, Private and Total GFCF in Agriculture in Kerala

![Graph showing trends in public, private, and total GFCF in agriculture in Kerala]

Note: Total Gross fixed capital formation (GFCFTOT); public capital formation (GFCFPB); private capital formation (GFCFPV).

Source: Computed by NCAER based on national figures on capital formation

1.1.15: Food security in Kerala

At present, Kerala depends on Andhra Pradesh for a considerable part of its requirement for rice, on Tamil Nadu for vegetables and Karnataka for meat and milk. Lately, there have been concerns brewing over this increasing dependence on other states for essentials. The emerging concern about importing food from other states is the quality of food, especially that it may, perhaps, be laced with pesticides. Table 1.7 presents the per capita consumption of major food items in Kerala for three points of time — 1999–2000, 2004–05 and 2009–10. The data pertains to reports of the National Sample Survey Organisation (NSSO) for the 55th, 61st and 66th rounds, respectively. The estimates indicate a slow shift in the preferences of Keralites from rice-based food preparations to wheat-based preparations such as chapattis and bread. The consumption of pulses remained more or less the same during the three periods, whereas consumption of edible oil increased perceptibly. In the case of fruits and vegetables, the increase in consumption has been rather steep.

Table 1.7: Trends in Per Capita Consumption of Major Food Items in Kerala

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Per capita consumption (Kg-capita-annum)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1999–00</td>
</tr>
<tr>
<td>Rice</td>
<td>105.4</td>
</tr>
<tr>
<td>Wheat</td>
<td>12.5</td>
</tr>
<tr>
<td>Pulses</td>
<td>7.1</td>
</tr>
<tr>
<td>Edible oil</td>
<td>5.2</td>
</tr>
<tr>
<td>Vegetables</td>
<td>43.7</td>
</tr>
<tr>
<td>Fruits</td>
<td>NA</td>
</tr>
</tbody>
</table>
Based on the latest estimates of per capita consumption, the total demand, at given price level, for major commodities at the state level was computed and is presented in Table 1.8. The total demand consists of both household demand (direct demand) as well as indirect demand. Indirect demand arises mainly from consumption outside households, industrial uses, and use on account of seed, feed, and wastage and so on. The estimates of indirect demand were arrived at based on similar calculations undertaken by past studies.

**Table 1.8 Base-year Demand for Major Food Items in Kerala: 2009−10**

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Total demand (‘000 tonnes)</th>
<th>Production * (‘000 tonnes)</th>
<th>Balance (production − demand)</th>
<th>Level of sufficiency (Production/Demand)%</th>
<th>Demand</th>
<th>Required annual growth rate if sufficiency to be 25%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>3,558.9</td>
<td>594.3</td>
<td>-2964.6</td>
<td>17.0</td>
<td>3,789.7</td>
<td>2.4</td>
</tr>
<tr>
<td>Wheat</td>
<td>524.2</td>
<td>Negligible</td>
<td>-524.2</td>
<td>0</td>
<td>627</td>
<td>188.2</td>
</tr>
<tr>
<td>Pulses</td>
<td>428.8</td>
<td>3.3</td>
<td>-425.5</td>
<td>0.1</td>
<td>488.7</td>
<td>19.8</td>
</tr>
<tr>
<td>Edible oil</td>
<td>296.4</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>395.5</td>
<td>-</td>
</tr>
<tr>
<td>Vegetables</td>
<td>2,713.2</td>
<td>993.2</td>
<td>-1720</td>
<td>37</td>
<td>3,551.4</td>
<td>-</td>
</tr>
<tr>
<td>Fruits</td>
<td>1774.2</td>
<td>2398.1</td>
<td>623.9</td>
<td>135</td>
<td>2,639.2</td>
<td>-</td>
</tr>
<tr>
<td>Spices</td>
<td>282.5</td>
<td>100.4</td>
<td>-182.1</td>
<td>36.0</td>
<td>445.1</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Note: Per capita demand of egg expressed in numbers and total demand in million numbers

*Corresponds to BE 2009−10.

Source: Computed by NCAER

Production in Kerala fell short of demand for almost all food commodities, except fruits. In terms of production as a per cent of demand, food grains such as rice, pulses and so on, fared poorly. The level of self-sufficiency for rice was only 16.7 per cent, with the rest of the demand being met through imports from neighbouring states such as Andhra Pradesh and Tamil Nadu. Since Kerala doesn’t produce wheat, but consumes it in reasonable quantities, the entire wheat demand was met from north Indian states through inter-state trade; the case of pulses was no different. Self-sufficiency in vegetables was to the level of 36.6 per cent. Kerala produced more fruits than it consumed, with the major
share coming from fruits such as banana, mango, papaya, pineapple, jack fruit and so on. However, it depends on imports to meet the demand for other types of cool-season fruits, even as it exports considerable quantities of what it produces to other states.

1.1.16: Viability of farming

The inherently vulnerable, predominantly commodity trade dependent economy of Kerala’s agriculture has been characterized by a high degree of volatility. Kerala economy had developed strong linkages with international markets and has historically been tied to trade and export. The export orientation of crops like spices, cashew, coffee and tea and indirect implication of palm oil import on coconut prices are subjected to vulnerability. The instability in farm production is also causing serious shocks to supply and farm income and there is a growing concern about the increased volatility in farm production, prices and farm income. Increased intensity and frequency of moisture stress, altered hydrological cycles and precipitation variation caused in recent periods have negative implications and cause instability in the perennial crop based agrarian economy of the State.

The predominance of marginal holdings continues to increase along with adverse terms of trade and the revival of the agriculture sector is dependent on the revival of dynamism in marginal holders. The marginalization of holdings, increase in wages and cost of cultivation and instability in prices are briefly explained below. Marginal farmers face problems not only with shrinking land assets but also lack adequate support for extension, credit, markets and other critical inputs.

1.1.16.1: Marginalisation of holdings

Kerala agriculture is characterized by marginal and fragmented land holdings. There are about 68.31 lakh operational holdings in the State during 2010-11 possessing about 15.11 lakh ha land with an average farm size of 0.22 ha. The distribution of operational holdings in Kerala over the period from 1966-67 is given in Table 1.9. There is a definite trend of marginalisation of holdings and shrinking of average size of marginal and small holdings in the state. During 1966-67 the percentage of marginal holdings in the state was only 81.8 % which increased to 92.6 % in 1990-91, again increased to 95.17 % and 96.32 % in 2000-01 and 2010-11 respectively. The average size of marginal holdings which was
0.28 ha in 1966-67 declined to 0.18 ha in 1990-91 and to 0.14 ha in 2000-01. The size has again shrunk to 0.13 ha in 2010-11. Similar trend was noticed in case of small holdings in the state also. The percentage of small holdings which was 10.1% in 1960-60 declined to its half (5.2%) by 1990-91 which again declined to 3.41% in 2000-01 and then to 2.64% in 2010-11. The average size of small holdings in the state which was 1.43 ha in 1966-67 reduced to 1.36 ha in 1990-91, again declined to 1.32 ha in 2000-01. The average size of small holdings however increased to 1.57 ha in 2010-11.

Table 1.9 Distribution of operational holdings in Kerala

<table>
<thead>
<tr>
<th>Size of holdings (ha)</th>
<th>1966-67</th>
<th>1990-91</th>
<th>2000-01</th>
<th>2010-11</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>Mean size (ha)</td>
<td>%</td>
<td>Mean size (ha)</td>
</tr>
<tr>
<td>Marginal (&lt;1)</td>
<td>81.8</td>
<td>0.28</td>
<td>92.6</td>
<td>0.18</td>
</tr>
<tr>
<td>Small (1-2)</td>
<td>0.1</td>
<td>1.43</td>
<td>5.2</td>
<td>1.36</td>
</tr>
<tr>
<td>Semi medium (2-4)</td>
<td>5.6</td>
<td>2.79</td>
<td>1.8</td>
<td>2.6</td>
</tr>
<tr>
<td>Medium (4-10)</td>
<td>2.1</td>
<td>5.6</td>
<td>0.4</td>
<td>5.27</td>
</tr>
<tr>
<td>Large (above 10)</td>
<td>0.5</td>
<td>19.86</td>
<td>0.06</td>
<td>55.74</td>
</tr>
<tr>
<td>All</td>
<td>0.74</td>
<td>0.33</td>
<td>0.24</td>
<td>0.22</td>
</tr>
</tbody>
</table>


There has been an increase in the number of marginal households with fragmenting and shrinking farm size and this trend will continue in future in the State. Institutional innovations are required to reduce transaction costs, extension services, input, technology and marketing support and incentive structure for promoting investment and viable small and marginal holder based agriculture in the State. Adequate efforts should be put in place to strengthen delivery of public services in favour of marginal farmers along with building capacity that encourages group formation and collective effort for improving bargaining power. The elements of social organization of these holdings in the structural form of social capital facilitate in particular lowering transaction costs and probability of adopting income/productivity enhancing technologies.

1.1.16.2: Increase in cost of cultivation

The cost of cultivation in the state has substantially increased in recent years. The increased cost of cultivation has affected the viability of farming in most of the crops. The increase in the cost of cultivation of Autumn paddy in 2010-11 was nearly 86.04% of its
cost of cultivation a decade back. In case of second crop of paddy, the increase in cost of cultivation was to the tune of 152.07 % and in case of summer paddy this increase was nearly 87.25 % of cost of cultivation in 2000-01. In case of coconut there has been an increase of 157.37 % in the cost of cultivation when compared to the situation a decade back. In case of pepper the increase in cost of cultivation was to the tune of 173.00 %. When this high cost of cultivation is coupled with low productivity as well as low or uncertain prices it makes the farming unviable.

Adequate returns from crop cultivation are essential not only for the survival of farmers but also to facilitate reinvestment in agriculture. Of the total cost of production, human labour still accounts for a significant portion, often around 30 per cent, though it can vary widely from crop to crop. It accounted for as high as 56 % in the case of coconut with all India weighted average share of labour in total cost of production being 30 % for the TE 2010-11 (Vishandass et.al 2013, CACP). As labour cost is the largest single factor of production with the fact that it has witnessed high growth in recent years, a closer analysis is warranted.

1.1.16.3: Increase in wages

Another factor affecting the farming viability in Kerala is the higher wage rate for agricultural workers. Kerala continues to have the highest wage rate in India contributing to the higher cost of cultivation. In 1977-78, average daily wage of male paddy field worker in Kerala was Rs 8.67 and that of a female worker was Rs. 6.06. After a decade the wages increased to Rs. 31.95 (269 % increase) and Rs. 18.59 (207 %) respectively for male and female labourers in 1988-89. In 1998-99 the wage rate reached Rs. 111.76 for male and Rs. 71.42 for female workers. The current wage rate for paddy field labourers is Rs 385 for male and Rs 299 for female (2012, Dec-Jan) which is a more than four thousand fold increase compared to 1977-78 wage rate (Fig.1.10).
The recent state wise analysis of average daily wage rates of male and female casual workers from 1999-00 to 2009-10 again placed Kerala at the top with highest wages in all these years. The lowest wages are reported in Madhya Pradesh (Jose, 2013). The agricultural household per 1000 rural labour household is 189 in Kerala in 2009-10 while it is 336 in Tamil Nadu and all India average is 223 (GOI, 2010). The average daily wage rates of farmers workers increased at an annual compound growth rate of 10.16 per cent in nominal terms and only one percent in real terms during the period 1980- 2009 (Indira Devi 2013). The increased wage rates and lower number of agricultural labour households in the State has put further pressure on farm wages and viability of farming. The agro service centres established during Twelfth Five Year plan is expected to address the labour shortages in the agriculture sector.

The ability to reduce costs of cultivation without jeopardizing productivity, thus leading to near term increase in net income is the key to the success of farming in the state. Appropriate incentives and organizational innovations can go a long way in improving viability of farming in Kerala.

1.1.16.4: Instability in farm prices

In the early 1990s, India embarked upon a liberal policy framework, which got reinforced with the signing of the Uruguay Round Agreement on Agriculture (URAA) in
1994. Agricultural price policy as a dominant policy instrument for agricultural
development as pursued during the reform period has its own limitations due to substitution
income, and wealth effects on investment, technological change and agricultural supply
(Sharma 2012). The increasing economic integration of the Indian economy with global
processes in the post reform era has brought considerable challenges in the agricultural
sector for commodity exporting state like Kerala.

Historically commodity prices are susceptible to instability in the international as
well as domestic markets of the countries. World commodity prices have risen significantly
since the turn of the millennium. It has long been noted in studies that commodity price
volatility has exceeded that of exchange rates in a number of commodities as Deaton
(1999) concluded as what commodity prices lack is trend, they make up for in variance.
Indeed, variability is large relative to trend for many commodity prices.

In the domestic markets apart from price shocks, the frequency and severity of risks
in agriculture particularly in last few decades in the state has increased on account of
climate variability and change. The monsoon pattern has changed and rainfall has become
erratic in the state. Occurrence of drought and flash floods has become more common in
the state. The early warning systems of climate abnormalities are not effectively
institutionalised in the state. The major crops of the state exhibit volatility in prices. The
price fluctuations in the international markets reflect in the demand and local prices of
plantation crops which are the major commodity of agricultural exports in the state.

In a recent analysis of prices of major crops in the state it was found that in the post
reform period (1991-2010) instability of real prices measured using Cuddy-Valle instability
index is found to have increased for black pepper, natural rubber and coffee (Anoop
Kumar, 2012; Table 1.10)
Table 1.10 Price instability index (Cuddy Valle index) on real prices of major crops in Kerala

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tea</td>
<td>17.37</td>
<td>16.14</td>
<td>-7.08</td>
</tr>
<tr>
<td>2</td>
<td>Natural rubber</td>
<td>6.94</td>
<td>26.67</td>
<td>284.29</td>
</tr>
<tr>
<td>3</td>
<td>Small cardamom</td>
<td>51.01</td>
<td>33.68</td>
<td>-33.97</td>
</tr>
<tr>
<td>4</td>
<td>Black pepper</td>
<td>33.33</td>
<td>56.26</td>
<td>68.80</td>
</tr>
<tr>
<td>5</td>
<td>Coffee</td>
<td>8.19</td>
<td>30.03</td>
<td>266.55</td>
</tr>
</tbody>
</table>

(Source: Anoop Kumar 2012, NRPPD DP 13; CDS)

Agricultural commodity price volatility is an ongoing concern in Kerala agriculture. The instability is affecting the realization of farm income and further investment in agriculture. Along with instability the price realization for the farmers from the consumer’s rupee is also lower for major crops in the State. In the case of coconut the producers share in consumer’s rupee was only 61 per cent implying a high price spread (Narayanan and Latha Bastine, 2004).

1.2: Animal Husbandry

1.2.1: Declining livestock population

The livestock in Kerala are raised both in backyard and commercial farms. Cattle, buffaloes, goats, pigs, ducks and fowl and rabbits are the main livestock categories raised for milk and meat in the State. The livestock population in Kerala is diminishing. There is a decrease in livestock population over 2007 to 2012 from 3.58 million to 2.73 million registering a negative growth of 23.76% in the total number of animals of various species. Following Table 1.12 shows it.

Table 1.12: Trends in livestock population in Kerala

<table>
<thead>
<tr>
<th>Animal</th>
<th>Type</th>
<th>Number in thousands</th>
<th>% change from 2007-2012</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2003</td>
<td>2007</td>
</tr>
<tr>
<td>Cattle</td>
<td>Crossbreed</td>
<td>1735</td>
<td>1621</td>
</tr>
<tr>
<td></td>
<td>Indigenous</td>
<td>387</td>
<td>119</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>2112</td>
<td>1740</td>
</tr>
<tr>
<td>Buffalo</td>
<td>All</td>
<td>65</td>
<td>58.15</td>
</tr>
</tbody>
</table>
The table shows that cattle population diminished by 23.65% and buffalo population increased by 75.89% during 2012 census period compared to 2007.

1.2.2: Highly skewed distribution of livestock ownership

Like land ownership, the pattern of livestock possession in Kerala is also highly skewed, but skewed towards marginal farmers who own less than one hectare (ha) of land. Marginal farmers in Kerala owned nearly 87.7 per cent of the total cattle in the State, followed by small farmers (8.4 per cent). The other three holding categories owned the remaining 4 per cent of cattle. A similar pattern was seen in the ownership of buffaloes as well. Goats, as is the case elsewhere, were found to be the property of small and marginal farmers in Kerala too. Marginal farmers owned a substantial proportion (92.6 per cent) of goats in the State. While marginal farmers possessed 57.5 per cent of the pigs, the rest was more or less equally divided among other categories of farmers, except large farmers. Marginal farmers also predominantly owned poultry (93.5 per cent), followed by small farmers (4.55 per cent).

Table 1.13: Farm size-wise ownership of Livestock in Kerala 2006-07 (%)
1.2.3: Declining value of product

As with the population, livestock products also experienced a slump in growth during the 2000s compared to the 1900s. This is demonstrated by a decline in growth of Value of Product (VOP) (total livestock) from 3.87 per cent per annum to 0.55 per cent per annum (Table). Major livestock products – milk and milk products and meat and meat products- exhibited negative growth rates of -1.84 per cent and -4.16 per cent respectively in the latter period. VOP of eggs also suffered a reduction in growth momentum during this decade. Only minor products such as wool and hair and other miscellaneous products showed positive growth, with negligible effects on the overall performance. In terms of physical units, milk production in Kerala increased from 1.89 million tonnes in the Triennium Ending (TE) 1992-93 to 2.52 million tonnes in TE 2000-01 and declined thereafter to 2.41 million tonnes in TE 2009-10. In a similar fashion, egg production increased from 1.774 million in TE 1992-93 to 2.044 million in TE 2000-01 and then decreased to 1,508 million in TE 2009-10 (GoI, 2010). A major part of the meat in Kerala is produced in the unorganized sector and there is little data available on this. However, available data from the Animal Husbandry Department shows that meat production, including that from the unorganized sector, increased from 0.18 million tonnes to 2002-03 to 0.32 million tonnes in 2009-10.


<table>
<thead>
<tr>
<th>Sector</th>
<th>1990-91 to 1999-00</th>
<th>2000-01 to 2008-09</th>
<th>1990-91 to 2008-09</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk and milk products</td>
<td>4.82</td>
<td>-1.84</td>
<td>1.56</td>
</tr>
<tr>
<td>Meat and meat products</td>
<td>3.01</td>
<td>-4.16</td>
<td>-2.14</td>
</tr>
<tr>
<td>Egg</td>
<td>5.23</td>
<td>2.56</td>
<td>3.42</td>
</tr>
<tr>
<td>Wool and hair</td>
<td>0.72</td>
<td>7.24</td>
<td>2.87</td>
</tr>
<tr>
<td>Others</td>
<td>-0.38</td>
<td>2.47</td>
<td>-0.34</td>
</tr>
<tr>
<td>Total livestock</td>
<td>3.87</td>
<td>0.55</td>
<td>1.64</td>
</tr>
</tbody>
</table>
1.2.4: Increasing consumption of livestock products

Kerala’s food consumption pattern has experienced a clear diversification towards high value commodities as has happened in the rest of India. Among livestock products, milk consumption was to the tune of 37.7 kg per capita in 1999–2000, which improved to a level of 40.2 kg per capita by 2009–10. Similarly, egg and meat consumption also increased appreciably.

Table 1.15: Per capita Consumption of Major Livestock Products in Kerala, 1999–2000 to 2009–10

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Per capita consumption (Kg/capita/annum)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1999–00</td>
</tr>
<tr>
<td>Milk</td>
<td>37.7</td>
</tr>
<tr>
<td>Egg*</td>
<td>33.3</td>
</tr>
<tr>
<td>Meat</td>
<td>3.4</td>
</tr>
</tbody>
</table>

Note:* Per capita demand of egg expressed in numbers
Source: Reports of NSSO for the 55th61st and 66th rounds of surveys

1.2.5: Increasing milk production

The total milk production in the State was 27.18 lakh tonnes in 2001-02 which declined to 21.10 lakhs tonnes in 2004 and subsequently increased to 27.2 lakhs tonnes in 2011-12 and further to 27.86 lakh tonnes in 2013-14. The contribution of Kerala to national milk production which was 2.4 per cent during 2003-04 showed a declining trend and reached to 1.99 per cent in 2013-14. The average annual growth rate of milk production is shown in table.

Table 1.16: Average annual growth rate of milk production (%)

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Year</th>
<th>Kerala</th>
<th>India</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2002-03 to 2006-07 (Xth plan)</td>
<td>-4.64</td>
<td>3.99</td>
</tr>
<tr>
<td>2</td>
<td>2007-08 to 2011-12 (XIth plan)</td>
<td>5.11</td>
<td>4.40</td>
</tr>
<tr>
<td>3</td>
<td>2012-13</td>
<td>2.76</td>
<td>3.54</td>
</tr>
<tr>
<td>4</td>
<td>2013-14</td>
<td>-0.18</td>
<td>6.00</td>
</tr>
</tbody>
</table>

Source: Economic Review 2014
1.2.6: Weak feed and fodder base

Rationalising input costs, streamlining input supply and enhancing supply of scarce inputs are essential for the development of livestock sector in the State. Feeds and fodder are by far the most actually scarce inputs in the State. The total production of cattle feed during 2013-14 won only 3.92 lakh tonnes, which is far below the requirement. Various initiatives for the promotion of fodder production have not resulted in increasing the supply.

1.3: Fisheries

Kerala is endowed with a long coast line of 590 kms and rich inland water bodies consisting of 44 rivers (having an area of 0.85 lakh hectares), 30 major reservoirs (0.30 lakh ha), fresh water ponds and tanks (0.25 lakh ha), 45 backwater bodies and extensive brackish water area (2.43 lakh ha). This makes Kerala a leading fish producing state in the country. Fishery is an important source of income and employment to rural farmers, particularly women. It contributes about one per cent to the GSDP of the state and provides livelihood to 10.02 lakh fisher folk of Kerala which accounts for 3 per cent of the State population. The sector provides cheap protein to the people of Kerala. Average consumption of fish by the people of Kerala is 23.5 Kg/annum against national average of 9.4 Kg/annum. This is stated to be one of the reasons for greater longevity of the Kerala people.

1.3.1: Contribution to GSDP

The fishery share in Gross State Domestic Product (GSDP) stood at 4.7 per cent in 1970-71. Over time, it declined and remained at 1 per cent by 2009–10 and further declined to 0.85 per cent during 2013-14 as per the quick estimates. The Gross State Domestic Product of the state has increased by about 89.7 per cent during the period from 2004-05 to 2013-14 and the share of fisheries sector in the State Domestic Product has declined from 1.52 to 0.85 per cent in the period. (Fig 1.11).
1.3.2: Fish production

The total production of fish increased from 0.75 lakh tonnes in 1950–51 to 6.8 lakh tonnes in 2002–03. Thereafter it fluctuated around this level. The total fish production in Kerala during 2013-14 was 7.08 lakh tones. The marine fish production in Kerala tended to fluctuate while the inland fish production shows a sign of improvement from 1999-2000. The inland fish production is estimated as 1.86 lakh tones in 2013-14 and the share of inland fish production to the total fish production of the state was 26 percent. At national level more than 64 per cent of the fish production is contributed by the inland sector. Fish production at the national level increased continuously from 62 lakh tonnes to 95.79 lakh tonnes from 2002-03 to 2013-14. As a result, the share of the state in national fish production declined from 10.94 per cent in 2003-04 to 7.4 per cent in 2013-14.
1.3.3: Export

Marine fish production is also one of the major contributors to foreign exchange earnings through sea food exports. Kerala contributed 19 per cent of the foreign exchange earnings through exports of marine products in 2004–2005. The state share in all India export has been declining and it declined to 15.58 percent during 2013-14. The marine product export from the state during 2013-14 was 1.66 lakh tonnes and it valued 4706.36 crore constituting 16.84 percent in terms of volume and 15.58 per cent in terms of value to Indian marine product export. Some migratory marine fish like Pelagic fin fish (71% of total fish landings), molluscs, demersal fin fish and crustaceans are the most saleable items in the international market. Major export in marine products is frozen fish. Shrimps, which are the most saleable item in the international market, are also found in abundance in India including the Kerala coastline. However, excessive pollution has adversely affected shrimp farming in India.
1.3.4: Marine fish production

Kerala is the second highest contributor of marine fish after Tamil Nadu in India. During 2013-14, 5.22 lakh tones of marine fish were produced in Kerala accounting for 74 per cent of the total fish production in the state. It accounted for over 15.25 per cent of the national marine fish production in 2013-14. Further, the share of marine fish in total fish production in Kerala is higher than the national average. Over time, the share of marine fishing has come down but it still remains 74 per cent. At the all India level, marine fish production is less than 36 per cent of the total fish production.
1.3.5: Declining marine fishing

Decline in marine fishing is a worrisome trend. Marine fishing in Kerala has been declining since 2004-05, except for 2006-07. As a matter of fact, the world has been facing a global fishing crisis of unprecedented proportions. Marine ecosystems are on the decline worldwide. According to the U.N. Food and Agriculture Organization (FAO), 70 per cent of the world's commercially important marine fish stocks are fully fished, overexploited, or depleted. The global situation is mirrored in Kerala. The main reason for this scenario is unsustainable fishing practices. In general, over dependence on marine fisheries has resulted in excessive and indiscriminate fishing on the Kerala coastline. This, in turn, is because of a number of factors such as inappropriate incentives, high demand for limited resources, inadequate knowledge, ineffective enforcement, and interactions between fishery sector and other aspects of the environment.

1.3.6: Inland fish production

Inland fish production has been growing in Kerala since the late 1980s. This is due to the rise of aquaculture (carp, molluscs, crustaceans) in the state. Inland fish production potential is not fully captured in the state. Kerala has over 7 per cent of the inland water bodies in the country, but it share in inland fishing is just above 3 per cent nationally. The Table 1.17 shows that Kerala’s productivity in inland fishing is lower than in many other states. The inland water resources potential is therefore, not fully exploited in Kerala.

<table>
<thead>
<tr>
<th>State</th>
<th>Total production (Inland) ('000 tonnes)</th>
<th>Total water bodies (Inland) ('000 ha)</th>
<th>Yield (Inland) (kg/ha)</th>
<th>Total production (Marine) ('000 tonnes)</th>
<th>Approx. length of coastline (Marine) ('000 ha)</th>
<th>Yield (Marine) (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andhra Pradesh</td>
<td>1580.2</td>
<td>811</td>
<td>1948</td>
<td>438.25</td>
<td>97.4</td>
<td>4499</td>
</tr>
<tr>
<td>Gujarat</td>
<td>97.8</td>
<td>426</td>
<td>230</td>
<td>695.58</td>
<td>160.0</td>
<td>4347</td>
</tr>
<tr>
<td>Karnataka</td>
<td>198.0</td>
<td>740</td>
<td>268</td>
<td>357.36</td>
<td>30.0</td>
<td>11912</td>
</tr>
<tr>
<td>Kerala</td>
<td>186.3</td>
<td>543</td>
<td>343</td>
<td>522.31</td>
<td>59.0</td>
<td>8853</td>
</tr>
<tr>
<td>Maharashtra</td>
<td>135.2</td>
<td>383</td>
<td>353</td>
<td>467.46</td>
<td>72.0</td>
<td>6493</td>
</tr>
</tbody>
</table>
### Tamil Nadu

<p>| | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Tamil Nadu</td>
<td>192.0</td>
<td>693</td>
<td>277</td>
<td>432.27</td>
<td>107.6</td>
<td>4017</td>
</tr>
<tr>
<td>West Bengal</td>
<td>1392.4</td>
<td>545</td>
<td>2555</td>
<td>188.24</td>
<td>15.8</td>
<td>11914</td>
</tr>
</tbody>
</table>

Source: Department of Animal Husbandry, Dairying & Fisheries – Annual Report 2014-15

### 1.3.7: Inadequate coastal social and physical infrastructure

The total fish processing and storage facility in Kerala is grossly inadequate compared to the potential for fish production and processing. Most exports are in the form of frozen fish. The lack of storage facilities and processing plants lead to inefficient supply chain in the sector. The sector also lacks the infrastructure in terms of sufficient life boats and patrol craft. Besides social infrastructure, provision for safe shelter and drinking water, improvement of public health and education facilities and total sanitation & solid waste management, coastal roads etc. needs special care and attention. Coastal fishermen are highly vulnerable to sea erosion, cyclones and other disastrous weather events. Sea erosion and flooding requires a permanent solution.

### 1.3.8: Projections

Extrapolation of NSSO data shows that household domestic consumption of fish is projected to rise (Table 1.18).

#### Table 1.18: Projections for Domestic Consumption of Fish and Prawns: Average Monthly Consumption per person (kg), 2012–16 to 2027–30

<table>
<thead>
<tr>
<th>Year</th>
<th>Rural</th>
<th>Urban</th>
<th>Rural</th>
<th>Urban</th>
<th>Rural</th>
<th>Urban</th>
<th>Rural</th>
<th>Urban</th>
<th>Rural</th>
<th>Urban</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011–12</td>
<td>1.99</td>
<td>1.90</td>
<td>0.192</td>
<td>0.196</td>
<td>2.03</td>
<td>1.89</td>
<td>0.28</td>
<td>0.28</td>
<td>2.04</td>
<td>1.88</td>
</tr>
<tr>
<td>2024–29</td>
<td>2025–30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Perspective Plan 2030, Kerala State Planning Board

Extrapolation of available export data for Kerala fishery will show that exports will fall because it will be based on existing trends. While it is difficult to forecast the international demand for fish from Kerala, the FAO 2010 report says that “the contribution of fish to global diets has reached a record of about 17.2 kg per person in 2009 on average,
supplying over three billion people with at least 15 percent of their average animal protein intake. This increase is due mainly to the ever-growing production of aquaculture which is set to overtake capture fisheries as a source of food fish.

In sum, at current levels, while demand for fish is forecast to increase both within and outside India, Kerala’s production of fish is growing at very slow rate (0.4 per cent between 2003–04 and 2010–11).

1.4: Irrigation

In most developing countries, agriculture is the dominant user of water, accounting for more than 85 percent of all water use. Irrigation plays an important role in the growth of agricultural income of the State. At the same time the greater agriculture water use raises significant issues for water resource management like issues dealing with water scarcity, competing demands from other sectors, irrigation service delivery and system management, water use efficiencies and so forth. The primary objective in coming years will be to balance water supply and demand among users to ensure adequate water for agriculture and sustainable irrigation system management while satisfying other needs. The basic premise of water resource management is that river basins are best managed and developed as an integrated whole. This is always legally and politically complex due to the challenges of allocation between users and between uses. The total annual yield of all the rivers together is 78,041 Million Cubic Meters (MCM) of which 70323 MCM is in Kerala. The surface irrigation constitute major chunk of irrigation infrastructure in the state. 67.29% of the surface water area of 3.61 lakh hectares is constituted by brackish water lakes, back waters and estuaries. There are 18 dams in the state intended for irrigation. Out of this, 13 have storages and 5 are barrages.

1.4.1: Current scenario of water resources and irrigation in Kerala

1.4.1.1: River Basins of Kerala

Kerala is gifted with 44 rivers of which 41 rivers flow towards the west and 3 rivers flow to the east. A river basin is a portion of land drained by a river and its tributaries. It encompasses the entire land surface dissected and drained by many streams that flow downhill into one another. River basins of Kerala can be categorized into four:-
1. First category includes major basins with more than 1000 sq.km basin area. *Bharathapuzha, Muvattupuzha, Periyar, Valapattanam, Chaliyar, Karuvannur, Chalakkudi, Meenachil, Pamba, Achankovil, Kallada and Kabani* fall in this category.

2. Second category of basins has more than 500 sq.km area but less than 1000 sq.km. *Chandragiri, Kuttiyadi, Manimala, Ithikkara, Vamanapuram, Karamana and Bhavani* come under this.

3. Third category includes basins extending over less than 500 sq.km but more than 100 sq.km. *Shiriya, Chittari, Neeleswar-Kariangode, Kavvayi-Peruvamba, Kuppm, Anjarakandy, Thalassery, Mahe, Tirur, Kecheri, Neyyar and Pambar* come under this category.

4. Fourth category includes small coastal basins with less than 100 sq.km area and *Manjeswar-Uppala basin* is included in this category.

### Table 1.19: Water Potential in the River Basin of Kerala

<table>
<thead>
<tr>
<th>Sl No.</th>
<th>Name of Basin</th>
<th>Name of rivers</th>
<th>Length of river in kms</th>
<th>Catchment area in sq.km</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Total</td>
</tr>
<tr>
<td>1</td>
<td>Manjeswar</td>
<td>Manjeshwar</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Uppala</td>
<td>Uppala</td>
<td>50</td>
<td>340</td>
</tr>
<tr>
<td>2</td>
<td>Shiriya</td>
<td>Shiriya</td>
<td>67</td>
<td>587</td>
</tr>
<tr>
<td>3</td>
<td>Chandragiri</td>
<td>Mogral</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chandragiri</td>
<td>105</td>
<td>1538</td>
</tr>
<tr>
<td>4</td>
<td>Chittari</td>
<td>Chittari</td>
<td>25</td>
<td>145</td>
</tr>
<tr>
<td>5</td>
<td>Neeleswar</td>
<td>Neeleswar</td>
<td>46</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kariangode</td>
<td>Kariangode</td>
<td>64</td>
<td>751</td>
</tr>
<tr>
<td>6</td>
<td>Kavvayi</td>
<td>Kavvayi</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Peruvamba</td>
<td>Peruvamba</td>
<td>51</td>
<td>495</td>
</tr>
<tr>
<td></td>
<td>Ramapuram</td>
<td>Ramapuram</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Location</td>
<td>Village</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>---</td>
<td>----------------</td>
<td>-------------</td>
<td>---</td>
<td>-----</td>
</tr>
<tr>
<td>7</td>
<td>Kuppam</td>
<td>Kuppam</td>
<td>82</td>
<td>539</td>
</tr>
<tr>
<td>8</td>
<td>Valapattanam</td>
<td>Valapattanam</td>
<td>110</td>
<td>1867</td>
</tr>
<tr>
<td>9</td>
<td>Anjarakandy</td>
<td>Anjarakandy</td>
<td>48</td>
<td>412</td>
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<tr>
<td>10</td>
<td>Tellichery</td>
<td>Tellichery</td>
<td>28</td>
<td>132</td>
</tr>
<tr>
<td>11</td>
<td>Mahe</td>
<td>Mahe</td>
<td>54</td>
<td>394</td>
</tr>
<tr>
<td>12</td>
<td>Kuttiyadi</td>
<td>Kuttiyadi</td>
<td>74</td>
<td>583</td>
</tr>
<tr>
<td>13</td>
<td>Chaliyar</td>
<td>Korapuzha</td>
<td>40</td>
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<td></td>
<td>Kallayi</td>
<td></td>
<td>22</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chaliyar</td>
<td></td>
<td>169</td>
<td>4765</td>
</tr>
<tr>
<td></td>
<td>Kadalundi</td>
<td></td>
<td>130</td>
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</tr>
<tr>
<td>14</td>
<td>Tirur</td>
<td>Tirur</td>
<td>48</td>
<td>117</td>
</tr>
<tr>
<td>15</td>
<td>Bharathapuzha</td>
<td>Bharathapuzha</td>
<td>209</td>
<td>6186</td>
</tr>
<tr>
<td>16</td>
<td>Keecheri</td>
<td>Keecheri</td>
<td>51</td>
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<td>Puzhakkal</td>
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<td>635</td>
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<tr>
<td>17</td>
<td>Karuvannur</td>
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<td>22</td>
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<td>23</td>
<td>Pamba</td>
<td>Pamba</td>
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<td>2235</td>
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<td>Achankovil</td>
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<td>Pallikkal</td>
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<td>121</td>
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<td>Neyyar</td>
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<td>56</td>
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<tr>
<td></td>
<td>River</td>
<td>Volume</td>
<td>Year 1</td>
<td>Year 2</td>
</tr>
<tr>
<td>-----</td>
<td>---------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td>30</td>
<td>Kabani</td>
<td>1920</td>
<td>1920</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>Bhavani</td>
<td>562</td>
<td>562</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>Pambar</td>
<td>384</td>
<td>384</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Grand Total</td>
<td></td>
<td>42978</td>
<td>38334</td>
</tr>
</tbody>
</table>

(Source: Land resource of Kerala state, Land Use Board 2009 & Working group report on water management & watershed management, 2011)

1.4.1.2: Low Per capita Water Availability

The water availability per capita in Kerala is one of the lowest in the country and has been declining overtime. A distinctive feature of rivers of Kerala is their short length and difference in elevation between the high and low lands which causes rapid flow of water that is quickly discharged into the sea and hence the state has not been able to utilize its river water sources to a major extent.

1.4.1.3: Changing Rainfall patterns & Poor Retention Capacity

The water availability of Kerala is dependent on rainfall and other climatic factors, particularly the spatial and temporal distribution of rainfall. There is considerable spatial variation of rainfall within the state with northern districts receiving more annual rainfall than southern districts. Based on the analysis of rainfall in Kerala between 1871 and 2005, during the past 14 years, there has been a significant decrease in rainfall in June & July whereas there is an increasing trend in January, February and April. Overall, a gradual decline in rainfall is noted in the state and is more pronounced in northern districts.

Due to poor retention capacity of the soil, water available through rainfall cannot be conserved effectively. The thick forest cover and vegetation that characterized the state had facilitated relatively high percolation of rainwater, but now, the situation is changing rapidly due to large scale encroachment of forest land, destruction of forests, reclamation of natural ecosystem buffers such as ponds, wetlands and paddy fields and changes in the cropping pattern.
1.4.1.4: Dominance of Major Irrigation in Investment on Irrigation

Irrigation development in Kerala is mainly centred on the development of major & medium irrigation projects. About 60 to 70 percent of the investment in each plan of the state was earmarked for major and medium irrigation.

On analysing the investment pattern during IXth, Xth & XIth plan period, it is evident that major irrigation occupies a major portion of the outlay. The share has been as high as 78 percent during 10th plan and 63 percent during eleventh plan.

This increased sharing pattern was provided for completing the long pending major irrigation schemes. Moreover, it can also be analysed that increased investment on major irrigation adds to ground water recharge which addresses the problem of drinking water to a certain level. The dominance of major irrigation during the period is evident from the following graph (Fig 1.14).

**Fig 1.14: Investment aggregation during 9th, 10th and 11th Five Year Plan**
Though major irrigation continues to occupy a major share even during 12th plan, focus that has been given to minor irrigation sector during the plan period is noteworthy.

1.4.1.5: Underexploited Minor Irrigation

Minor irrigation plays an important role in the state of Kerala, where the average farm size is small, land labour ratio is low and capital and foreign exchange resources are scarce. Some of the advantages of MI are lower investment needs per hectare, shorter payback period, easier management, reduced environmental damage and better suitability to agro ecologies.

The availability of large number of water bodies in the form of rivers, rivulets and ponds and the ease of institutional intervention through user groups makes minor irrigation the preferred option for irrigation development in the state. Nevertheless of all the advantages, the area under lift and minor irrigation is minimal in most districts. Despite the advantages in terms of unit cost, their poor coverage calls for deeper exploration. During 12th plan period, special emphasis has been given to this sector with special emphasis to the development of tanks and ponds lift irrigation and other minor irrigation structures.

1.4.1.6: Not achieving the potential

A survey conducted during 2004-05, to assess the performance of minor irrigation in Kerala, revealed that minor irrigation initiatives were able to achieve only (a) a little over 53% of the targeted area coverage (b) actual area irrigated is only half the potential created (c) actual number of beneficiaries supported is 5 lakh against the proposed 7.9 lakh
**Difficulties**

1. Non-functioning of MI schemes due to physical damage. The highest proportion of non-functioning schemes identified is those constructed against saltwater intrusion, followed by IPD yelah schemes. The lowest failure is in the case of lift irrigation.
2. Conversion of agricultural land for other purposes
3. Reluctance of people to take up agriculture as a profession. When there is no agriculture there is no need of spending money on irrigation activities.
4. Due to scarcity of funds, several proposed MI schemes could not be initiated.
5. Deterioration of irrigation canals due to filling up, encroachment and waste dumping.

**1.4.2: Significance of Micro Irrigation**

In the context of water scarcity and the need to increase water use efficiency, micro irrigation is getting widely adopted. The expansion of area under irrigation is essential for obtaining increased agriculture production and this expansion could be done only by additional development conservation and efficient management of the available water resources. In spite of the fact that the major and medium irrigation projects have contributed much, inefficient conventional methods of irrigation leads to wastage of water. In this context, Micro irrigation assumes great significance.

Micro Irrigation technique enables frequent application of small amounts of water direct to the root zone of the plant thereby enabling minimal surface evaporation, runoff and deep percolation losses. It is an efficient method having an overall irrigation efficiency of 90%.

Various types of micro irrigation systems adopted in India are Drip irrigation, Sprinkler irrigation, Porous irrigation & Rain –Gun irrigation.
The task force to assess the feasibility of micro irrigation has estimated that about 42 million ha of cultivated land has the potential to be brought under micro irrigation. Against this potential, the actual achievement at the national level is only 9 percent. In Kerala, it is below the national average, only about 7.8 percent. Kerala has the potential for about 2.1 lakh ha to be covered under micro irrigation – 1.8 lakh ha under drip irrigation and the remainder under various types of sprinkler irrigation.

As part of promoting micro irrigation technologies in the country, GOI has launched a Micro Irrigation scheme during VIII Five Year Plan. To analyse the importance and adoption of micro irrigation projects, a study was conducted during 2011 covering nine states (EPW, 2011). Kerala was one among the chosen states. In Kerala, the percentage of utilization of actual area against the potential under MI is only 7.77. It is 7.89% & 7.19% for drip & sprinkler irrigation respectively. Moreover, majority of the farmers who were adopting MI in Kerala are marginal farmers (52%) followed by small (28%) and large farmers (20%).

Limitations

1. Small sized and fragmented holdings
2. High cost
3. Clogging of emitters
4. Lack of sufficient technical backup & insufficient knowledge on optimum utilization
5. Breakage/ Damage of the system by animals
6. Unavailability of quality materials with professional dealers/manufacturers
Adoption of drip irrigation

Drip irrigation is the targeted, intelligent application of water, fertilizer and chemicals, which, if properly used can provide great benefits. Farmer driven irrigation methods are better than public irrigation. Overhead drip irrigation systems can be used for coconut also.

Another option is rain gun irrigation. This system gives complete coverage of water in all areas, which helps the perfect functioning of roots to absorb all manure. So cultivation of intercrops such as banana, grams and fodder is very easy.

1.4.3: Low Conveyance Efficiency

Irrigation is the largest user of water in the basin, followed by domestic use. Irrigation schemes suffer from poor reliability of water supplies, excessive seepage from canals causing inundation of fields and excessive conveyance losses with frequent water scarcity in the tail end. During droughts, the ayacut areas face water shortage. All these lead to yield losses in paddy.

The water distribution and delivery infrastructure is in poor condition. Against a total length of 237.8 km of main canals, 5 percent is unlined and 7 percent is partially lined. Against the total length of approximately 1000 km of distributaries covering eight irrigation schemes, only 1 % is lined, 24 % partially lined and 75% unlined. The total area of canal surface required to be lined was estimated to be 4.045 million sq.km, of which 80 percent require complete lining and the rest is partially lined.

1.4.4: Contribution of Tanks & Ponds

A tank is a low, earthen bund constructed across a shallow valley to hold the rainfall runoff from its catchment area. Rainfall pattern is neither predictable nor uniform over space and time. The incidence of rainfall is also seasonal, occurring mainly during the southwest monsoon (June to September) in most of this State. Being confined to a few
monsoon months, rainfall behaviour is highly erratic. This hydrological characteristic of the State’s monsoon necessitated the creation of storage facilities to hold the rainwater of the monsoon and utilize the same at a later date.

Tanks are created essentially as multiple-use structures for irrigation, livestock, and human uses. They have been the main source of irrigation in many parts of India for centuries. Tank rehabilitation had been aimed to increase agricultural production. The benefits will go to the landholders mainly as increase in produce and to the agricultural labourers as increased wages.

A pond is a body of standing water, either natural or man-made. They are important hotspots for bio diversity. Ponds were constructed mostly as multiple use structures for irrigation, livestock, fisheries and human use. Ponds are having at least four different functions in irrigated agriculture - water conservation, soil conservation, flood control and protection of ecology of the surrounding area.

A reliable estimate of the number of tanks and ponds existing in this state is not known while the reported number varies anywhere between 40,000 and 50,000. With extraordinary engineering, managerial, and social skills, an extensive system of rainwater harvesting structures comprising tanks and ponds had been built and maintained by the people for centuries.

1.4.5: Impact of Irrigation

Investments in irrigation are changing globally in response to changes in environment and experience with previous projects. Irrigation in Kerala started with major and medium irrigation projects and has since then received significant fund flow throughout the Five Year Plans. Irrigation development in Kerala is mainly centred on the development of surface water resources. In each Annual Plan priority is being given to the development of major and medium irrigation projects. However, the long term returns that could be realized from this investment are under serious reconsideration, both in terms of financial recovery of the projects and in terms of the intended crop benefits.
1.4.5.1: Insufficient irrigation

Despite the continued efforts to irrigate crops through major and minor irrigation programmes, only about one-sixth of the total area could be brought under irrigation. A close examination of the irrigation development of the State reveals that gross irrigated area has remained almost stagnant in the past decade. During 2009-10, the gross irrigated area was about 4.55 lakh hectares. But, this accounted for only 17% of the gross cropped area and about 16% of the net cropped area. Gross irrigated area increased to 4.68 lakh ha during 2013-14. The percentage of Gross irrigated area to Gross Cropped Area was 17.94 during the period. The percentage of net area irrigated to net area sown for the period 2011-12, 2012-13 and 2013-14 is 20.04, 19.32 & 19.37 respectively.

1.4.5.2: Dominance of wells as a source of irrigation

Major source of irrigation in the state are wells, which accounts for about 31% of the total area under irrigation, followed by government canals contributing around 20%. Despite the investment in canal irrigation, the area under this system has not increased much. The dependence on canal irrigation is the highest (in terms of area) in Palakkad, Thrissur and Ernakulam districts, wells (open and bore) in Palakkad, Thrissur and Kasargode districts and ponds in Kasargode, Idukki, Palakkad and Malappuram districts.

Table 1.20: Source of Irrigation

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Source</th>
<th>2011-12</th>
<th>2012-13</th>
<th>2013-14</th>
</tr>
</thead>
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<tr>
<td>1</td>
<td>Government canals</td>
<td>81737</td>
<td>80718</td>
<td>80007</td>
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<td>2</td>
<td>Private canals</td>
<td>1971</td>
<td>2457</td>
<td>1448</td>
</tr>
<tr>
<td>3</td>
<td>Tanks</td>
<td>47112</td>
<td>43558</td>
<td>45283</td>
</tr>
<tr>
<td>4</td>
<td>Wells</td>
<td>137193</td>
<td>122338</td>
<td>124850</td>
</tr>
<tr>
<td>5</td>
<td>Other sources</td>
<td>140901</td>
<td>146797</td>
<td>145588</td>
</tr>
<tr>
<td>6</td>
<td>Total</td>
<td>408914</td>
<td>395868</td>
<td>397176</td>
</tr>
</tbody>
</table>

Source: - Department of Economics & Statistics
1.4.6: Coconut & Paddy – the most benefitted crops

The yield of irrigated rice fields was always higher than that from un-irrigated conditions, irrespective of the season. Data for 2007 shows that irrigation pushes up the rice yield to about 840 kg/ha during summer season, 360 kg during winter season and about 120 kg during autumn season. This shows that rice yield is positively affected by irrigation.

Apart from rice, coconut is another crop that is benefitted most out of irrigation. The following graph (Fig 1.15) reveals that during the period 2013-14, coconut was the most benefitted crop. It accounted for about 35.5 per cent followed by paddy 33 percent, banana 10 percent, arecanut 8 percent and vegetable 4.5 percent. There has been a significant increase in irrigated area for banana cultivation and vegetable cultivation during 2013-14 compared to previous years. Though the irrigated area for paddy and coconut cultivation has increased, the percentage of increase is not prominent.

![Fig 1.15 Crops benefited out of Irrigation](image)

1.4.7: Dependency of Ground Water

Ground water makes up about 20% of world’s fresh water supply which makes it an important resource that can act as a natural storage that can buffer against shortage of surface water in times of drought. Groundwater has rapidly emerged to occupy a dominant place in India’s agriculture and food security and it accounts for over 60 percent of the irrigated area in the country.
Groundwater is a major source of water in Kerala. As per 2011 census, 65 percent of rural and 59 percent of urban households have wells.

**Limited groundwater potential**

The ground water potential of Kerala is limited because 88 percent of the total geographical area of the State is underlain by crystalline rocks devoid of any porosity. There are 10 different principal aquifer systems in Kerala. Groundwater in Kerala has a potential of 34-601 metres below ground level (mbgl) and the yield varies between 0.1 – 38 lps (litres per second) depending on the area. Alappuzha, Kollam and Kozhikode witnessed the highest depth level whereas discharge range is higher in Palakkad, Alappuzha and Pathanamthitta.

**1.4.8: Relatively low levels of ground water development**

The main source of ground water is recharge from rainfall, which contributes about 82 percent of the total annual replenishable resources. As per Ground water resource data 2009, in the state of Kerala, the total annual ground water availability is 6.620 Billion Cubic Meter (BCM) and the net ground water availability is 6.029 BCM. The annual ground water draft for all uses in the state is 2.81 BCM out of which 1.304 BMC is for irrigation purpose. 3.021 BCM is the net Ground water availability for future irrigation development in the state.

**Categorization of revenue blocks**

Out of the 151 revenue blocks assessed in the State for groundwater potential and draft, 5 blocks (Kasargode, Kozhikode, Chittur, Kodungalloor and Athiyanoor) are categorized as over exploited, 15 blocks as critical, 30 blocks as semi-critical and 101 blocks as safe.

**1.5: Investment in Agriculture and Allied sectors**

The state investment in agriculture and allied sectors including irrigation and the expenditure of local bodies during 2006-07 was Rs 713.36 crore and it was increased to Rs 1731.36 crore during 2013-14. Even though the investment has increased, the share of these sectors in total state plan expenditure has decreased from 14.9 per cent to 11.62 percent in
the period 2006-07 to 2013-14. Also the central sector investments under these sectors are given in the following figure (Fig 1.16). The central sector investment has been tripled from 2009-10 onwards on the introduction of the scheme RKVY.

**Fig 1.16: Investment in Agriculture & Allied Sectors & CSS including RKVY**

![Graph showing investment in Agriculture & Allied Sectors & CSS including RKVY from 2006-07 to 2013-14.](image)

**Fig 1.17: Share of Agriculture & Allied in State Plan (%)**

![Graph showing share of Agriculture & Allied in State Plan from 2006-07 to 2013-14.](image)
Chapter 2: Towards a perspective on Agriculture Green growth

Towards Green Economy
Agriculture – Investing in Natural capital
UNEP, 2011

2.1: Towards Agriculture Green Growth

21st century agricultural development strategies must respond to new realities, while learning from the success, disappointments and unintended consequences of last century’s narrowly defined prescriptions for agricultural intensification. Such strategies should embrace new technologies and management system that enable farmers to produce more with fewer inputs, less waste and less pollution.

Sustainable and least risky farming systems will be those that easily allow farmers to adapt to changing agronomic, environmental and social condition. Sustainability requires action both on the part of individual farmers and the part of Government, local self-Governments, private sector and civil society working together at large scales to maintain healthy soils and landscapes. And such strategies must recognize that society now looks to agricultural landscapes to provide a range of goods and services, not just food and industrial raw materials, but also clean water, habitat for natural enemies of pests, healthy environments for people, stable climate and those markets increasingly reward farmers for doing so.

The new approach could be put under the frame work for Agriculture Green Growth (AGG) by defining the key elements and parameters of a strategy for coordinating investment and development in agricultural production, processing and distribution that is efficient, profitable, sustainable and resilient to climate change while protecting key natural resources and providing social benefits to the population. While AGG incorporates traditional environment management with focus on identifying and catalysing new opportunities in agricultural production, technical and institutional infrastructure and conservation and livelihood activities for sustainable economic growth.
The agriculture green growth strategies stem from an understanding that finite resources and a new climate of opportunities and risks necessitate new green development strategies. The framework of AGG identifies current and emerging opportunities for harmonizing agricultural development with ecosystem conservation. The framework also identifies promising technologies and innovation for transforming the agricultural sector which recognise ecosystems as key productive assets. The AGG framework positions the agriculture sector as a principal engine for human and economic development within an overall green economy and green growth strategy.

The greening of agriculture refers to the increasing use of farming practices and technologies that simultaneously:

(a) Maintain and increase farm productivity and profitability while ensuring the provision of food and ecosystem services on a sustainable basis.
(b) Reduce negative externalities and gradually lead to positive ones and
(c) Rebuild ecological resources (i.e. soil, water, air and biodiversity –natural capital assets) by reducing pollution and using resources more efficiently.

A diverse, locally adaptable set of agricultural techniques, practices and market branding certification such as Good Agricultural Practices (GAP), organic agriculture, Ecological agriculture, conservative agriculture and related techniques and food supply protocols exemplify the varying shades of green agriculture (UNEP 2011).

Farming practices and technologies that are instrumental in greening agriculture include

- restoring and enhancing soil fertility through the increased use of naturally and sustainably produced nutrient inputs, diversified crop rotations, and livestock and crop integration.
- reducing soil erosion and improving the efficiency of water use by applying minimum tillage and cover crop cultivation technologies
- reducing chemical pesticides & herbicide use by implementing integrated and other environment friendly biological pest and weed management practices and
- reducing food spoilage and loss by expanding the use of post-harvest storage and processing facilities.
AGG focuses on practices and strategies that ensure agricultural development while safeguarding ecosystem services. The concept of AGG takes into account the specificities of each agro ecological zone or units and helps to develop their potential. The agro ecological intensification neither over extends local resource stocks nor pollutes or degrades the environment and wherever possible encourages production practices that have positive benefits for biodiversity and ecosystem services.

Sustainable intensification of production may be achieved through a diversity of means, ranging from the application of modern technology to the strategic management of farm ecosystems to improve water, soil and nutrient cycling, pest control and other critical interventions.

2.2: Agro ecological approach

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**Greening Economy with Agriculture as the key message for Rio +20**

*FAO*

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Long neglected by mainstream development actors, agro ecology is gaining momentum as a farming and landscape approach as the recent FAO symposium demonstrates.
**Agro ecological approaches** – while working with farms of very small sizes – have led to improved diets, livelihoods and income, through soil restoration, water conservation, water harvesting, diverse crops, organic inputs and improved seeds and practices.

**Symposium on Agro ecology for food security and nutrition** –  
**18-19 September 2014, Rome, FAO**

Agroecological farming has a clear set of ecological principles. In order to frame strategies and action plan, a major scientific work on delineation of the State into agro ecological zones and agro ecological units was initiated in 2007-08 under the leadership of the National Bureau of Soil survey and Land use Planning coordinated by the Kerala State Planning Board. The purpose was to separate areas with similar sets of potential and constraints for development. Agro ecological zoning defines zones on the basis of combination of soil, landform and climatic characteristics.

### 2.3: Perspective: Kerala Agriculture in a dynamically changing World agriculture

In order to secure a sustainable path for a prosperous agriculture sector of the State the Perspective Plan 2030 prepared by the State Planning Board, projects a minimum average growth rate of 2 percent per annum. The focus will be on increasing competiveness and productivity in agriculture so as to raise incomes and wellbeing of farmers and bring prosperity, not only for this generation, but for future generation too.

Kerala needs to adopt a holistic approach to the management of water resources. Despite the continued efforts to irrigate crops through both major and minor irrigation schemes, only about one sixth of the total area could be brought under irrigation. A paradigm shift in strategic framework on irrigation development is required in the State focusing more on improved water use efficiency, investing in minor and micro irrigation leading to more crops per drop of water. It is targeted to achieve 50 percent net irrigated area in 2030 with an average minimum growth rate of 2 percent per annum.

Livestock have been an integral component of agriculture in the state, and an important element of the livelihoods of rural households. Animal husbandry sector provide large self-employment opportunities. By countering the reduction in animal population and
maintaining the yield dividends through various institutional and technological improvements milk production could be enhanced to 39.18 lakh tonnes in 2030, leading to a milk surplus State beyond the projected demand of 35.20 lakh tonnes.

The projected demand of egg in 2030 is 3381.4 million and targeted to meet 80 percent of the demand by internal production. In order to achieve that, Kerala will have to shift from existing models of production to achieve its growth potential. Kerala meets 73 percent of its meat demand from its own production. Kerala can sustain its present level of self-sufficiency even if the sector grows at a rate of 2.5 percent annually. Therefore the focus now should be on devising means that can sustain the existing momentum of growth so that the presently thriving sector can be sustained in the long run.

A sustainable livestock strategy aims at reducing the environmental footprint of farms, while improving milk production, farm profitability and the wellbeing of the people and animals involved.

The contribution of fishery activities to National economy is multifaceted. Kerala is the fourth largest State in India in terms of fish production after West Bengal, Andhra Pradesh and Gujarat, and contributes 19 percent of foreign exchange earnings through seafood exports. At current levels, while demand for fish is forecast to increase both within and outside India, Kerala’s production of fish is growing at very slow rate of 0.40 percent between 2003-04 and 2010-11. In the perspective plan 2030, it is targeted to achieve a growth rate of 1 percent in production through a strategic framework of improved productivity, Value addition, and stock replenishment ensuring social security of fisher folk and through production of robust and environmentally sound aquaculture. There is consensus globally that it is no longer sufficient to focus on the sustainability of target species and the broader ecosystem impacts of fishing have to be considered as well. The drivers of non-sustainable fishing are well known.

Anticipating future developments in agriculture is by no means a simple exercise. In the last few years, after the liberalisation and integration with world markets, many of the acute phenomena observed have complicated further the formulation of long-term prospects. The turbulence of world agricultural markets and the wide climate variability experienced in recent years, have added further uncertainty on the future of agriculture in
the State. Technically, there seems to be considerable scope for pushing the agricultural technology frontier outwards. But much could also be done by simply applying the existing technologies. However it is also evident that current agricultural production is imposing serious strains on ecosystems globally with widespread soil degradation, water overdraft and ecological impacts such as loss of biodiversity and the proliferation of resistant pest species. Evidence exists to show that ecologically sustainable cropping system can supply overall outputs comparable to intensive high input agriculture.

Commodity markets will continue to seek a new normal as Economic Turmoil subsides

USDA – 2013

2.4: Agro ecology

The core approach in agricultural planning is driven by recognition that growth to a new plateau of performance cannot be achieved by continuing existing approaches and practices in the State. A basic change of approach in agriculture introduced in 12th plan towards exploitation of regional potential in a broader framework of agro ecological planning needs to be expanded. The state has been divided into 5 Agro Ecological Zones (AEZ) and 23 Agro Ecological Units (AEU) based on climate and soil in a recent study coordinated by the State Planning Board. It is essential to prepare strategies and action plan for each AEZ and AEU for the development of agriculture and allied sectors. Each district has been divided into agro ecological units on panchayat basis within the overall framework of technical parameters. The yield gaps as well as the potential and issues in AEZ/AEU have to be addressed separately considering the socio economic setting. There are several region specific gaps which limit the opportunity of realising higher yield of the crops/livestock/fish potential. Future crop yields and food security may hinge on the ability of farmers to narrow the gap between the current yields and yield potential ceilings. The Agro Ecological Unit wise and consolidated district level yield gaps for various crops, technology adoption index for various practices, occurrence of pests and diseases, soil fertility, constraints like labour availability, marketing, mechanization, irrigation and researchable issues are to be addressed on AEZ/AEU wise for the growth and development
of agriculture in the state. It is essential to divide the state level targets among different Agro ecological units based on the potential, constraints and possibilities. The linkage of resource allocation on zonal basis would result in realization of outputs in a time bound manner.

The agro ecological zones and units are shown in map.
Under each agro ecological zones further agro ecological units were delineated at the district level. The strategies and action plans have to be prepared for each agroecological unit under the overall framework of agroecology for the re-vitalisation of agriculture in Kerala.

Fig: Ecological engineering practiced in a field in Palakkad

**FOREST AGRO ECOTONES OF WESTERN GHATS**

India is one of the 17 mega diverse countries with 2.4% of total land area, accounting for 7-8% of the species of the world, including about 91,000 species of animals and 45,500 species of plants, that have been documented in its ten biogeographic regions. India is also recognized as one of the nine Vavilovian centres of origin of crop plants. The Western Ghats stretching for nearly 1600 km in length from the Tapti river in the north to Kanyakumari in the south is recognized as one of the 34 global biodiversity hotspots, one of the eight hottest hotspots and the UNESCO
has recognized 39 serial sites in Western Ghats as World Heritage sites.

The Western Ghats form the major watershed in Peninsular India and as many as Fifty Eight major Peninsular Indian rivers originate from it. The Ghats supports the lives of people in six states of India and roughly 250 million people depend on these rivers. The hot and humid tropical climate coupled with heavy precipitation from southwest monsoon create ideal conditions for the luxuriant growth of plant life. The high western slopes of the Ghats harbour evergreen forest, and rolling Shola grasslands above 1,500 mt. As one moves from western to eastern slopes the vegetation changes to moist and dry deciduous forest types along the rainfall gradient and scrub forest in the low lying rain shadow areas and plains. The vegetation attains its luxuriant growth towards the southern tip in Kerala, where rich tropical rainforests flourish. Nearly 4000 species of flowering plants or about 27% of the country’s total species are known from the Ghats. Of 645 species of evergreen trees about 56% is endemic to the Ghats.

The domestication of hardy breeds of cattle and sheep, and drought-resistant crop species of indigenous cereals and tubers, have generated important crop and livestock diversity. Natural and artificial selection in different agroclimatic zones have resulted in number of cultivars with resistance to biotic and abiotic stresses. Lowland areas of Western Ghats have traditionally been used for rice cultivation and provided several cultivars of rice with beneficial traits. Agroforestry systems such as coffee, tea and spices in association with diversity of trees, rice based and coconut based agroforestry systems dominate. The Western Ghats also harbour a number of wild relatives of cultivated plants, including pepper, cardamom, mango, jackfruit and plantain. The commercially important species as teak, cashew, rubber, bananas, areca nut, coconut, etc. occupy large area and also make the forest landscape highly diverse.

Forest agricultural ecotones are critical for the maintenance of the livelihood of people that inhabit these areas and Western Ghats provides an example of efficient integration of natural landscapes and human settlements.

Source: Kerala State Biodiversity Board
Chapter 3: Strategic framework

The strategic framework provides the overarching direction for Kerala’s agriculture on strategic orientation.

3.1: Strategic framework – Agriculture

The strategic framework for Kerala Agriculture is developed to promote green economy based on agro-ecology principles that results in improved human well being and social equity while significantly reducing environmental risks and promoting environmental services. The strategic framework is suggested under four pillars with identified focus areas under each pillar. The strategic pillars are shown below.

1. Pillar I : Raise Agriculture productivity
2. Pillar 2 : Raise investment in infrastructure
3. Pillar 3 : Strengthening livelihood and assured income
4. Pillar 4 : Service delivery

The focus areas under each pillar are given below.

1. **Pillar 1 : Raise Agriculture productivity**
   - Closing the yield gap
   - Improved Soil Health Management
   - Improved Plant Health Management
   - Promote new technologies
   - Develop Technology Infrastructure
   - Promote innovation

2. **Pillar 2: Raise investment in Support Infrastructure**
   - Soil and water conservation
   - Minor irrigation
   - Input production infrastructure
   - Laboratory net works
   - Market/storage/post-harvest

3. **Pillar 3 : Strengthening livelihood and assured income**
   - Revival of the perennial Tree crop systems
   - Promote homesteads and Integrated Farming Systems
   - Food and Nutrition Security
Mechanisation
Climate smart agriculture
Support for low cost credit
Promote value added agriculture
Risk management
Urban agriculture
Expand social safety nets

4. **Pillar 4: Improve Service delivery**
- Prominent and mainstreamed extension system
- Expand Agroservice centres
- Promote social capital development
- HRD and continuing Agriculture education
- Leveraging ICT application

3.1.1: **Pillar 1: Raise agriculture productivity**

With growing resource scarcity, and increasing demand for food and industrial raw materials, agriculture production depends more than ever on increasing crop and livestock productivity. Reviving the agriculture sector needs a quantum increase in productivity from the current levels. This in turn requires a technological breakthrough given the limited supply of land and other structural rigidities, addressing low level of mechanisation, shortage of irrigation facilities, treatment of soil acidity and multiple nutrient deficiencies, plant health management, remunerative prices and poor extension services.

The productivity of most of the crops cultivated in the State is very low. The prevalence of the debilitating coconut root (wilt) disease, existence of a large number of senile and unproductive palms and growing of coconuts in unsuitable areas and lower investment due to inadequate incentives are the major reasons attributed to the low productivity of coconut compared to other states or countries. The productivity of coconut over the past few decades have been almost stable with slight improvement in the current decade. The productivity of pepper has improved since 1980s and the present pepper productivity is still very low compared to other countries. In the case of cashew, in spite of operating special schemes for expansion of area, the productivity has been steadily declining during the last two decades. Kerala has a substantial share in the four plantation crops, viz, rubber, tea, coffee and cardamom. In the plantation segment, rubber is the only crop which could maintain steady and stable performance in
productivity. The stabilization and augmentation of productivity assume critical importance, given the limited scope for increasing area under cultivation of various crops. The average productivity of major crops over the past five decades is shown in Table 3.1.

Increase in production would be possible mainly from improvements in productivity through the use of location specific technology generation and adoption and modernisation of agriculture.

The focus areas are shown below

3.1.1.1: Closing the yield Gaps: Yield gaps in selected agro-ecological units of Kerala

An Agro-ecological Unit (AEU) is a homogenous geographical area which has the production environment in terms of agro-climate, resource endowments and socio-economic conditions is homogenous, and majority of the farmers have similar production constraints and research needs. The agro-ecological methods can be utilized in efficient land use planning, determining suitable crops and varieties in a region, risk analysis of climatic hazards, analysis of production potential, optimum resource use and in developing appropriate intervention strategies.

Realising wide agro-climatic variability of Kerala, the National Bureau of Soil Survey and Land Use Planning (ICAR), Regional Centre, Bangalore has demarcated the State into 23 Agro-ecological Units. (Nair et al., 2012). Each AEU has distinct soil and climatic features which permits the cultivation of different types of crops. There are inter-zonal variations in the productivity of crops among AEUs owing to the distinct features of the unit. However gap in productivity is noticed within the AEUs. If this could be properly addressed, it would help to enhance the productivity levels of the AEU as well as the state. Productivity gaps in major crops of the state have been worked out by Kerala Agricultural University as part of the project on agro ecology funded and coordinated by the Kerala State Planning Board. Productivity gaps in selected AEUs are indicated in Table 3.1.

The Onattukara sandy plains which generally have the lowest productivity in rice have a yield gap of 145.28 %. This low productive zone also has a yield gap of 207.69 % in coconut. A yield gap of 76 % in the yield of paddy and 628.86 % in coconut is observed in
case of coconut in Kuttanad. In Kole lands yield gap of paddy is 112.53 % and in Pokkali the yield gap in coconut is 185.7%. The average productivity of Pepper in Kerala is very low. However the appreciable yield gap is existing in Northern Laterites and Northern Hills which are 385 and 346 % respectively. There exist a yield gap of 45.49 % in Northern Hills and 150 % in Central Plateau in case of Coffee. The Wayanad Central Plateau has reported a pepper yield as high as 3500 Kg/ha making a yield gap of 500 % in the unit. In case of cashew and areca nut, the yield gap in Northern Coastal Plains of Kannur District is 63.64% and 176.92 % respectively. The yield gap of rice is to the tune of more than 100 % in Kaipad lands in the district. In Northern Laterites of Kannur district the banana crop has a yield gap of 197.03%. In Southern High Hills of Idukki the Rubber is having a yield gap of 25 % and cardamom is having a yield gap of 67.74 %. In South Central Laterites of Alappuzha District, the Tapioca crop is having a yield gap of more than 300 %.

Table 3.1: Yield gaps in major crops in selected AEUs in Kerala

<table>
<thead>
<tr>
<th>Name of AEU</th>
<th>Crop</th>
<th>Productivity in zone</th>
<th>Productivity in district</th>
<th>Best farmer yield</th>
<th>Productivity gap of AEU in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onattukara sandy plain (ALP 2)</td>
<td>Paddy (t/ha)</td>
<td>2.65</td>
<td>3</td>
<td>6.5</td>
<td>145.28</td>
</tr>
<tr>
<td>Onattukara sandy plain (ALP 2)</td>
<td>Coconut (nuts/palm)</td>
<td>52</td>
<td>40</td>
<td>160</td>
<td>207.69</td>
</tr>
<tr>
<td>Kuttanad (TM-1)</td>
<td>Paddy (t/ha)</td>
<td>4.26</td>
<td>2.58</td>
<td>7.50</td>
<td>76.06</td>
</tr>
<tr>
<td>Kuttanad (KTM-1)</td>
<td>Coconut (nuts/palm)</td>
<td>41.16</td>
<td>29</td>
<td>300</td>
<td>628.86</td>
</tr>
<tr>
<td>Kole lands (TSR3)</td>
<td>Paddy (t/ha)</td>
<td>4.47</td>
<td>2.50</td>
<td>9.50</td>
<td>112.53</td>
</tr>
<tr>
<td>Pokkali lands (EKM 1)</td>
<td>Coconut (nuts/palm)</td>
<td>35</td>
<td>31</td>
<td>100</td>
<td>185.7</td>
</tr>
<tr>
<td>Northern laterites (KZD 3)</td>
<td>Pepper (Kg/ha)</td>
<td>567.6</td>
<td>98</td>
<td>2750</td>
<td>385.0</td>
</tr>
<tr>
<td>Northern laterites (KZD 3)</td>
<td>Rice (Kg/ha)</td>
<td>2.3</td>
<td>1.50</td>
<td>5.0</td>
<td>117.39</td>
</tr>
<tr>
<td>Northern Hills (WYD 1)</td>
<td>Pepper Kg/ha</td>
<td>199</td>
<td>217</td>
<td>888</td>
<td>346</td>
</tr>
<tr>
<td>Northern Hills (WYD 1)</td>
<td>Coffee</td>
<td>1031</td>
<td>705</td>
<td>1500</td>
<td>45.49</td>
</tr>
<tr>
<td>Central Plateau (WYD 2)</td>
<td>Pepper Kg/ha</td>
<td>583</td>
<td>217</td>
<td>3500</td>
<td>500.0</td>
</tr>
<tr>
<td>Central Plateau (WYD 2)</td>
<td>Coffee (Kg/ha)</td>
<td>1200</td>
<td>705</td>
<td>3000</td>
<td>150</td>
</tr>
<tr>
<td>Northern Coastal (KNR 1)</td>
<td>Cashew (Kg/ha)</td>
<td>1100</td>
<td>1071</td>
<td>1800</td>
<td>63.64</td>
</tr>
<tr>
<td>Northern Coastal (KNR 1)</td>
<td>Areocanut (Kg/palm)</td>
<td>1.3</td>
<td>0.93</td>
<td>3.6</td>
<td>176.92</td>
</tr>
<tr>
<td>Kaipad lands (KNR 2)</td>
<td>Paddy (t/ha)</td>
<td>2.90</td>
<td>1.73</td>
<td>6.0</td>
<td>106.90</td>
</tr>
<tr>
<td>Northern laterites</td>
<td>Banana (t/ha)</td>
<td>20.2</td>
<td>7.8</td>
<td>60</td>
<td>197.03</td>
</tr>
</tbody>
</table>
Future crop yields may hinge on the ability of farmers to narrow the gap between the current yields and Yield Potential Ceilings. Improving crop yields at a pace commensurate with growth in output demand will require significant reduction in current yield gaps. A wide range of yield gaps are observed in various AEUs. Many rainfed cropping systems appear to have relatively large yield gaps that could be closed with existing technologies, but persist largely for economic and development reasons. These gaps have basically emanated due to ecological distortions i.e., soil & water, availability of inputs particularly certified/quality seeds of improved varieties and imbalanced use of fertilizers across the regions and inadequate incentives.

Over several plan periods the wide gap in target and achievements are reported in growth, production and yield levels. There is no concerted effort to divide the target across agro climate/agro ecological units of the state. A comprehensive exercise has to be initiated at state level to implement developmental interventions at various agro-ecological units with well-defined physical targets. In each agro-ecological unit resource based plan including the yield gap could be addressed in a time bound manner.

a) Adoption of technologies in selected agro-ecological units of Kerala

The technology adoption indices have been worked out by Kerala Agricultural University as part of the project on agro-ecology funded and coordinated by the Kerala State Planning Board for fertilizer application and the plant protection practices for various crops in Kerala and also percentage of farmers adopting various technologies has also been derived. The details were worked out based on key informant surveys and limited farmer surveys. The study will provide an indication and detailed studies are required to decompose further dimension of technology adoption.
A definite relation between the productivity gap (Table 3.2) and adoption percentage is obvious. In case of Onattukara coastal plains yield gap in rice is 145.28 % and that in coconut is 207.69 %. About 11.11 % of rice farmers of the region do not apply any lime and insecticides and more than 55 % do not apply any fungicides though fungal diseases are serious issue in the zone. Low productivity of coconut in the zone could be linked with the fact that nearly 44 % are not applying any chemical fertilizers to already unproductive soil and 96 % of the farmers are not applying any fungicides even though fungal diseases like bud rot and leaf rot are serious problems in the zone.

Table 3.2: Adoption Percentage of major technologies in selected AEUs

<table>
<thead>
<tr>
<th>Name of AEU</th>
<th>% of farmers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not applying Lime</td>
</tr>
<tr>
<td>------------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td><strong>Onattukara sandy plain</strong></td>
<td></td>
</tr>
<tr>
<td>Rice</td>
<td>11.11</td>
</tr>
<tr>
<td>Coconut</td>
<td>12.0</td>
</tr>
<tr>
<td><strong>Kuttanad</strong></td>
<td></td>
</tr>
<tr>
<td>Rice</td>
<td>0.0</td>
</tr>
<tr>
<td>Coconut</td>
<td>3.6</td>
</tr>
<tr>
<td><strong>Kole lands</strong></td>
<td></td>
</tr>
<tr>
<td>Paddy</td>
<td>20.8</td>
</tr>
<tr>
<td><strong>Pokkali lands</strong></td>
<td></td>
</tr>
<tr>
<td>Coconut</td>
<td>7.1</td>
</tr>
<tr>
<td><strong>Northern laterites</strong></td>
<td></td>
</tr>
<tr>
<td>Pepper</td>
<td>NA</td>
</tr>
<tr>
<td>Rice</td>
<td>83.33</td>
</tr>
<tr>
<td><strong>Northern Hills</strong></td>
<td></td>
</tr>
<tr>
<td>Pepper</td>
<td>NA</td>
</tr>
<tr>
<td>Coffee</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Wayanad Central Plateau</strong></td>
<td></td>
</tr>
<tr>
<td>Pepper</td>
<td>NA</td>
</tr>
<tr>
<td>Coffee</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Northern Coastal Plain</strong></td>
<td></td>
</tr>
<tr>
<td>Arecanut</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Kaipad Lands</strong></td>
<td></td>
</tr>
<tr>
<td>Paddy</td>
<td>26.67</td>
</tr>
<tr>
<td><strong>Northern Laterites</strong></td>
<td></td>
</tr>
<tr>
<td>Banana</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Southern High</strong></td>
<td></td>
</tr>
</tbody>
</table>

63
In Kuttanad the productivity gap in rice is 76.06 % and for coconut 628.86 %. In case of rice the gap is due to low adoption of plant protection practices. About 83 % of the farmers apply only less than 50 % of recommended dose of insecticides and 74 % rice farmers do not apply any fungicides. The coconut farmers in the zone donot apply any fungicides. In Kole lands yield gap in rice is about 112.53 %. More than 20 % rice farmers in the zone do not apply any lime and more than 40 % apply only half the required quantity. Similarly there is a low adoption of plant protection practices in the zone and more than 45 % rice famers do not apply any insecticides and more than 83 % do not apply fungicides. Yield gap in coconut in Pokkali area of Ernakulam district is 185.7 %. In this region very low adoption of plant protection measures could be attributed to the yield gap. In Northern Laterites the gap in pepper productivity is huge (385 %). Very low adoption of nutrient management and plant protection practices prevail in the zone. More than 70 % of the farmers do not apply any chemical fertilizers and more than 95 % do not apply any insecticides and fungicides.

In Northern Hills of Wayanad district the yield gap in pepper is 346 % and that in coffee is 45.49 %. Very low adoption of plant protection measures prevail in the region. More than 84 % of the farmers do not apply any insecticides and more than 80 % do not apply any fungicides even though fungal diseases are serious problem in the region. In case of coffee more the 90 % of farmers do not apply any insecticides and none of them follow any fungicide application. The plant protection adoption trend in Wayanad Central Plateau also shows the same trend which is reflected in the low productivity of pepper and coffee in the region.

In Northern Coastal plains, the yield gap in arecanut is 176.92 %. The adoption of technology analysis shows that more than 46 % of the farmers do not apply any chemical fertilizers and 80-100 % arecanut farmers do not adopt any plant protection which might
have contributed to low productivity of the crop. In Kaipad lands, the gap in Paddy productivity is 106.90 %. More than 26 % of rice farmers do not apply any liming material in the zone and more than 50 % of farmers do not apply any insecticides and nearly 100 % of rice farmers avoid fungicide application.

In Northern Laterites 197 % the yield gap exists in banana. More than 96 % of the banana farmers of the region do not apply any fungicides for their crop though fungal diseases are prevalent. In Southern High Hills yield gap in rubber is 25 % while that in cardamom is 68 %. It could be seen that nearly 37.5 % of the rubber farmers are not applying any chemical fertilizers and more than 56 % do not apply any fungicides in the zone. The low productivity of cardamom in the region is probably on account of poor adoption of plant protection measures. Complete ignorance of plant protection measures could have contributed to yield gap of tapioca in Southern Central Laterites.

Extension activities focusing on better dissemination of location specific and standard technologies along with a mission mode project for addressing yield gap would be helpful in narrowing the yield gap in major crops across different agro-ecological situations of the state. In designing any development intervention for addressing the yield gaps the practical realities on viability of farming in the State has also to be taken in to account.

b) Agro-ecological unit- wise technology packages

The package of practices recommendations developed for the state does not often addresses the regional variations in crop production potential and constraints. Since the Agro-ecological unit-wise studies show distinct intra unit variations with respect to crop yields, specific package mitigating the yield barriers in each AEU should be developed to address the yield gap and to enhance the general productivity of the AEU in match with the highest productivity obtained from the AEU.

Soil Resource Management is another issue to be addressed at the AEU level. Wide spread deficiency of secondary and micro-nutrients are observed in several Agro-ecological units. Specific soil ameliorating strategy has to be developed and recommended
for each AEU and AEU-wise recommendation of manures, soil amendments and fertilizers need to be developed for realising this objective.

Technology refinement is another aspect to be addressed while developing an AEU-wise package. Though traditionally and otherwise different farming systems are practiced in different AEUs of the state the gaps in technology should be addressed to reap maximum benefits. The aspects like development of varieties suited to each AEU, addressing AEU specific issues, technology package for optimum productivity in each AEU, soil resource and fertility management etc. are some of the issues to be addressed under Technology Refinement.

3.1.1.2: Improved Soil Health Management

Intensive cultivation often with incorrect soil and crop management practices have given rise to heavy loss in soil quality. Organic manure application has been greatly neglected in the state in recent years due to lack of availability and high cost. This may have an adverse effect on soil quality parameters. Improper or excessive use of chemical fertilizers has created imbalances in plant available nutrients in the soil. The comprehensive study on soil health for State co-ordinated by Kerala State Planning Board revealed the acidity of soils in about 90% of samples, Magnesium deficiency in 74 percent of samples, boron deficiency is 54 percent and excess of phosphorous in 62 percent samples.

Based on soil studies conducted in all parts of the State, use of micro nutrients, such as Boron will be promoted where ever necessary. The need based nutrients will be popularized based on the Panchayat wise nutrient management plans. Adequate soil testing facilities for micro nutrients will also be established.

The practices like liming which can rectify acidity are not given enough attention. All these have affected the productivity of Kerala soils. A major soil health management initiative is under implementation in 12th Plan, focusing on acidity management, application of secondary and micronutrients and correction of phosphorous. More proactive steps are required to regain the soil health for improving productivity. The experience of
Brazil in reviving agriculture through soil health management is an amazing example (Box 3.1).

**BOX 3.1: Agriculture in Cerrado: the Brazilian Miracle**

In less than thirty years Brazil has turned itself from a food importing nation to one of the world’s great bread baskets, catching up with the traditional “big five” grain exporters: America, Canada, Australia, Argentina and European Union. It is also the first tropical food giant: total value of country’s crops rose from $20 billion (1990) to $120 billion in 2010. Equally impressive gains were recorded for beef exports (surpassing Australia), cattle herd (next only to India), export of poultry, and production of sugarcane, ethanol and coffee. Interestingly this was achieved without deforestation of the Tropical Amazon rainforests.

This great feat, unparalleled in history, was achieved by application of modern soil science, spearheaded by tropical soil science research in Brazil, for utilization of vast uncultivated areas of Cerrado, long considered unsuitable for human food production, into highly productive agricultural lands. The Cerrado is the second largest biome after Amazonia in Brazil, covering 2.04 million sq. kilometer and representing the most extensive savanna type vegetation in South America. The major areas of Cerrado are on the central Brazilian plateau where annual rainfall is typically between 1,100 to 1,600 mm. Most soils of Cerrado are deep with favourable physical characteristics. However, the tropical highly weathered soils (Oxisols and Ultisols) have very unfavourable chemistry and serious limitations for crop production in terms of natural soil fertility: highly acid soils with low reserves of organic matter, nitrogen, phosphorus, potassium, calcium, magnesium, sulphur, copper, zinc, boron and molybdenum but high aluminium saturation and phosphorus fixation capacity. Although the vast areas of Cerrado in the central-west Brazil had vegetation of grasses and small trees, the natural vegetation is chemically so poor that there are no accounts indicating large herds of mammals inhabiting the savanna. In the Cerrado, the domestic cattle often died from broken bones after grazing only calcium and phosphorus deficient grasses and ranchers came to refer Cerrado as the place to loose cattle.
A breakthrough in tropical soil management technology for surmounting the limitations, ushered in during seventies of last century, made the Cerrado region the focus of agricultural production in Brazil. In 1955 only 200,000 ha of Cerrado were considered arable. In 2005, over 40 million ha were in cultivation. This phenomenal achievement over a span of less than 50 years is the world’s single largest increase in farm land expansion since the settlements of Midwest USA, starting 1850. The technological breakthrough was centered around better scientific understanding of the chemical constraints of the tropical soils, long considered by many as insurmountable. The components of the technology pack that achieved the breakthrough are listed briefly.

1. Liming to correct low pH and Al in surface soil. Agricultural lime was supplemented with dolomitic lime stone to supplement for magnesium. Lime rate of 3-4 tonnes per ha met the immediate needs and provided for residual effect for 3 to 5 years. The rate for different areas was based on Al saturation and desirable base saturation for intended crops.

2. Amelioration of subsoil acidity: Low levels of calcium in subsoil and high Al toxicity restricting root extension was ameliorated through application of gypsum, a cheap byproduct of phosphoric acid production. Increase in yields from gypsum use is mainly due to increased rooting depth and more efficient use of subsoil water and nutrients.

3. Building up of soil phosphate levels: The availability of phosphorus in Cerrado soils is abysmally low. Again, much of the added nutrient is fixed by the very high amounts of the oxides of iron and aluminium present is these soils. Therefore it was essential to build up the phosphorus levels to satisfactory levels for crop production. Common approach adopted was to gradually build P status in little excess, say 25% of crop requirement, every year for 5 to 6 years.

4. Building up potash, secondary and micro-nutrients following the same strategy as that for phosphorus.

5. Building up organic matter through minimum or no-tillage, crop rotation, return of crop residues, agro-forestry etc.

6. Maintaining fertilization after the initial build up.
7. Introduction and improvement of grasses through breeding to suit the tropical soils to produce high levels of fodder.

8. Breeding of crops like soybean and corn to suit the tropical acid soil conditions.

9. Integrated farming involving agriculture, agro-forestry and livestock.

Though Cerrado’s agriculture miracle had very high technological component, it did not happen as a simple technological fix, rather through EMRAPA’s (the Brazilian Agricultural Research Establishment) system approach of technology adoption and continuous improvement. Brazil has 300 m ha of arable land (if not more): only 50 m ha is currently being used. If the rapid pace at which the infertile Cerrado is converted into crop lands is any indication, the potential of agriculture development in the country is enormous.

3.1.1.3: Improved Plant Health Management

The new approach of crop health management envisaged is management towards sustainable ecosystems and people's health through Good Plant Protection Practices (GPPP). Pest management strategies need to recognize that crop health is an essential element of sustainable agriculture. Improvements in integrated pest management can lead to sound crop health management.

Plant health clinics were established in Krishi bhavans to support pest and disease surveillance and advisories. Diagnostic tool kits was also provided to the clinics attached to the Krishi bhavans. Farmer Field Schools (FFS) were established in all Panchayats as part of work plan under ATMA, for promoting plant health management and integrated pest management District Diagnostic Team was constituted as part of pests and disease surveillance project. Pests and disease diagnostic materials were developed to support the clinics.
A PG Diploma programme has also been initiated focusing to expand ecological engineering, in farm production units for trichoderma etc. Further expansion of innovative crop health management in various agroecological units will significantly improve adoption of ecological agriculture practices.

3.1.1.4: Promote new technologies

Hi-Tech Agriculture has been given priority in the State during the 12th Plan period. The promotion of Hi-tech agriculture and open precision farming was initiated in 2012-13 as part of Vegetable Development programme in the state.

Production under protective cultivations has become the principal way for Isreali growers to ensure a constant, year round supply of high quality products while minimizing the use of chemicals. The philosophical approach is to take advantage of local climatic conditions and adjust the plants to the existing conditions and technologies with minimal or non-energy inputs. This approach requires high skills and excellent supporting systems and technologies. There are more than 50 countries now in the world, where cultivation of crops is undertaken on a commercial scale under cover.

Protected cultivation is a method of cultivation of plants/crops in artificial environment to protect the plants/crops from wind, excessive radiation, temperature extremes, insect-pests and diseases. In the present scenario of perpetual demand of fruits and vegetables, in order to increase their production round the year and shrinking land holding drastically, protected cultivation is the best alternative and drudgery-less approach for using land and other resources more efficiently. In protected cultivation, the natural environment is modified to suitable conditions for optimum plant growth, which ultimately provides quality fruits, vegetables and flowers. Greenhouse is now better understood as a system of controlled environment agriculture (CEA), with precise control of air and root temperature, water, humidity, plant nutrition, carbon dioxide and light. It will lead to
superior quality produce with high yield (300-600% increase), Percentage of germination of seeds and success of grafted and tissue cultured plants under protected cultivation is high (98 to 100%). Greenhouses are suitable for automation of irrigation, application of other inputs and environmental controls by using computers and artificial intelligence techniques.

In Kerala about 1200 green houses were established mainly for the production of vegetables and a series of capacity building programmes were organized. Drip irrigation with fertigation as well as rain shelter are also being promoted to enhance vegetable production in the state. However further technical support for construction, crop management as well as service facilities are required for developing the protected and technology oriented cultivation in the state. A beginning on new technology has been initiated for the last three years in the State which has to be sustained and expanded.

Nano technology – Nano technology based products and its application in agriculture include nano fertilizers, nano herbicides, nano-pesticides, recalcitrant contaminants from water, nano scale carriers, nano sensors etc. This fast growing technology is already having a significant commercial impact, which will certainly increase in future.

3.1.1.5: Develop Technology Infrastructure

Adequate infrastructure support in research and development institutions should be supported for state of the art technology infrastructure, focusing more on biotechnology, nanotechnology, high-tech, diagnostics etc.

3.1.1.6: Promote Innovation

There is considerable wealth of farmer innovations in agriculture. Further financial support and hand holding support can go a long way in improving productivity in agriculture through local innovations.
3.1.2: Pillar 2: Raise Investment in Infrastructure

Public investment in agriculture has a potential to enlarge the potential base of agriculture through the stimulation effect. Productivity increase in agriculture is an effective driver of economic growth both within and outside agricultural sectors. Such productivity increase depends on good rural infrastructure, well-functioning domestic markets, appropriate institutions and appropriate technology.

The focus areas are shown below

1. Promote block level soil and water conservation
2. Promote minor irrigation including micro irrigation
3. Investment in Input production Infrastructure
4. Market/storage/post harvest

3.1.2.1: Soil, Water conservation and Irrigation

Investment in irrigation and soil and water conservation is a prerequisite for the improvement of agriculture in Kerala. Detailed strategies and focus areas are mentioned in the section on irrigation.

3.1.2.2: Input production

The shortage of planting material production is to be addressed to augment productivity as well as to improve growth of the sector. There is a widening gap in the supply and demand of planting materials. Investment in farms, nurseries, setting up of block level nurseries, as well as investment in the production of biocontrol agents are to be supported.

3.1.2.3: Laboratory networks

The department of Agriculture is having a network of laboratories in the state covering soil testing, tissue culture production, quality control, bio control, etc. A significant increase in investment is required to equip the laboratories to cater to the need of the farmers.
3.1.2.4: Market/ storage/ post-harvest

Efficient marketing infrastructure and storage facilities is essential for cost effective marketing. Market infrastructure is required at all stages of the supply chain. Strengthening of existing wholesale markets, farmers markets, markets of clusters and apex bodies, low cost storage structures are essential for the development of agriculture. Govt. should increase direct investment in basic market oriented infrastructure like storage, processing and marketing. Appropriate regulatory mechanism should be provided to ensure quality standards of produce.

3.1.3: Pillar 3: Strengthening livelihood and assured income

Different contexts and needs require different types of investments to guide the specific choice of interventions to improve livelihoods of farmers. Each individual farm has its own specific characteristics, which arise from variations in resource endowments and family circumstances. Appropriate development interventions have to be promoted to exploit the potential under the socioeconomic circumstances of the Agroecological units.

The focus areas are shown below

1. Revival of the perennial Tree crop systems
2. Promote homesteads & Integrated Farming Systems
3. Food and nutrients security
4. Mechanisation
5. Climate smart agriculture
6. Support for low cost credit
7. Promote value added agriculture
8. Risk management
3.1.3.1: Revival of the perennial Tree crop systems

As already mentioned the cropping pattern in the state is skewed towards cash crops. But the productivity of these tree crops especially pepper and coconut is low. Hence their revival is necessary. Coconut is largely affected by root wilt disease. The threatening effect of root wilt disease of coconut on the stability of production of coconut is a matter of grave concern. The disease is rampant in all the southern districts of the state and has already affected over 30 million palms. Replanting and rehabilitation of disease affected coconut palms, diversification of farming systems, cluster development and incentivisation for the promotion of investment, mechanisms for effective procurement at remunerative prices and support mechanisms for labour are required for the development of the most important crop of the State. Unless incentive systems are encouraging, investment for scientific management of holdings may not materialize. Regarding pepper, India is a major producer of pepper in the world with 25 per cent share in production. Moreover, Kerala continues to enjoy a near monopoly in area and production of pepper accounting for 95 per cent each in the country. However the productivity achieved is very low in Kerala which is only about 1/10th of the productivity of Vietnam which is the largest producer of pepper in the world. On the production side low yield, damage to standards, crop loss due to pests and diseases, post-harvest losses and fluctuating prices are causing declining area and production of spices in the State. Massive rehabilitation and revival programme is needed to enhance the productivity. The results of Sugandhi project implemented in Wayanad focusing on soil health management could be scaled up. The model of pepper gardens in Vietnam are shown below in Box 3.2. Lessons need to be learned from Vietnam on the management of pepper for increasing productivity.
LESSONS TO BE LEARNT FROM VIETNAM ON BLACK PEPPER CULTIVATION

The high production and productivity of black pepper in Vietnam is due to the following procedures they adopt in pepper cultivation

1) Source of planting material: They collect leader orthotropic shoots from 1-2 year old vines. Shoots of 4-5 nodes are planted at the rate of 3-4 per standard. A conventional nursery as adopted in India is seldom noticed in general, in Vietnam!. After field planting, the top and sides are completely covered (with nylon nets/ dried coconut leaves ensuring adequate light). High humidity and moisture provided through sprinklers would ensure maximum germination of the planted cuttings. The overhead shade is maintained at least for two years in the field.

2) As the shoot grows, they are trained /tied to dead standard. The growing shoots are pruned at 6-8 months and later after fourteen months. This would ensure good canopy coverage of the bush with good number of fruiting laterals, right from the base as they grow up. This pruning method helps quick canopy development.

3) Since they adopt dead standards/supports, all the nutrients applied will be utilized by pepper alone unlike in India where there is a competition for nutrients between the pepper and live supports and hence the limitation. However the nutrients are applied in 4-5 splits in Vietnam and are very high (5-6kg/vine). This practice is detrimental to soil health. However farmers are prone to adopt high fertilizer dose to get higher yields ignoring soil health.

4) The method that pepper farmer adopts, micro sprinkler irrigation systems at the base of the vine is very important. This would ensure adequate soil moisture that helps in supporting feeder root system of the vine for its health, sustenance and longevity of the vines.

5) In general farmers adopt dead logs as standard/supports. In recent years due to non-availability of the dead wood poles, farmers are adopting the erection of concrete poles (14 feet, 2 feet for anchorage & 12 feet to maintain the height of the bush).
Of late, some of the Vietnam farmers are adopting pepper as a mixture crop in coffee plantations, which is in vogue in India.

The disease problems in the plantation are the same as we notice in India and disease management practices are adopted. However, there is an intensive phytosanitation and replanting without any time gap, even though it is not advisable. Farmers are generally happy if they get 10-15 harvest (on an average 2-3kg/vine).

In India it is important to adopt massive replanting programs with healthy rooted cuttings of leader orthotropic shoots, followed by adequate shade regulation for at least 2 years. The nutrient management followed by moisture management are two basic prerequisite that need to adhered through implementation of GAP, IPM & INM.

Ready for planting with background of grown up vines-Replanting is continuous process
Pepper planted with leader orthotropic shoots at the base of the dead standards

Pepper with live supports (10 month old)
Pepper plantation (Approximately 14 months) with a canopy development

10 year old pepper vines in high ranges of Vietnam
3.1.3.2: Promote Homesteads and Integrated farming systems

According to the Ninth Agricultural Census of Kerala, the average size of an operational holding was 0.22 ha in 2010-11. This was against 0.24 ha in 2000-01. Also, out of the total holdings, the size group below one ha (marginal farmers) accounts for 96.33 per cent of the total number of holdings. The total area operated by these holdings works out to 58.62 per cent of the total area and the average size of the group is 0.13 ha. It is for these populous marginal farmers that intensive land use practices like integrated farming are becoming increasingly important.

The goal of sustainable agriculture is to conserve the natural resource base, protect the environment and enhance prosperity for a longer period of time. This assumes great importance, especially in view of the fact that the year 2014 has been declared as the “International Year of Family Farming” by the United Nations General Assembly. This worldwide celebration, declared, aims to stimulate active policies for sustainable development of agricultural systems based farmer families, communal units, indigenous groups, cooperatives and fishing families.
An integrated farming system consists of a range of resource-saving practices that aim to achieve acceptable profits and high and sustained production levels, while minimizing the negative effects of intensive farming and preserving the environment (IFAD, 2005). Based on the principle of enhancing natural biological processes above and below the ground, the integrated system represents a winning combination that reduces erosion, increases crop yields, soil biological activity and nutrient recycling, intensifies land use, improves profits and can therefore help reduce poverty and malnutrition and strengthen environmental sustainability. Homesteads in Kerala are predominantly practicing integrated farming. The bioresource flows in an integrated farming system model developed by cropping system research station of Kerala Agricultural University in shown in Figure. These are traditional farming systems practiced in Kerala.
Fig 3.1: Bio-resource flows in an integrated farming system model developed for central Kerala

Source: FSRS, KAU

Integrated farming satisfies the requirements of sustainability by being productive, ecologically sound, stable, economically viable and socially acceptable. The productive facet arises from the fact that home gardens are resource islands that provide a wide variety of goods for domestic consumption such as food, beverages, construction materials, firewood and household supplies. Nutrient cycling processes become particularly relevant in Integrated Farming Systems.
In integrated farming systems, removal from the nutrient pool includes mainly uptake by the trees and crops which is either locked up in the vegetative parts (mainly in trees) or exported through harvested produce. Nutrient removal through harvested produce is compensated by nutrient input through manure, fertilizer, recycled crop residues and tree nutrient cycling processes. Leaching loss, which is considerably high in most non-agroforestry land-use systems, is minimized in integrated farming systems. The tree components by virtue of their deep roots intercept, absorb and recycle nutrients that would have been otherwise lost by leaching, thereby making the nutrient cycle more closed. Furthermore, the dense canopy cover provided by the trees/crops protects the soil against the direct action of rain, thus reducing surface runoff. A dynamic equilibrium can be expected with respect to organic matter and plant nutrients due to the continuous addition of leaf litter and its constant removal through decomposition.

The presence of livestock in integrated farming systems, through its continuous supply of manure, permit the efficient recycling of a portion of the nutrients locked up in its feed (cultivated fodder, leaves of trees, crop waste, hay, oil cakes etc.). However, sale of manure leads to export of nutrients from the system and should therefore be used in composting or applied as slurry for crops in the system. It can be summarized that, plant nutrients are, therefore, involved in a constant and somewhat closed cycling within the soil and plant compartments, with minimal output (loss) from the system.

A negative nutrient balance means the natural capital of the farm is being mined. Farmers can maintain nutrient balances in the soil by recycling locally available organic materials or recycled farm wastes, utilizing microorganisms that fix nitrogen and mobilize phosphates. Besides, preventing soil erosion can help to avert and compensate for losses and exports of nutrients and organic matter. Farmyard manure, urine, slurry, compost, composted poultry manure, vermi-compost, green manure and green leaf manure, crop residues such as straw and stems, fallen dry leaves, kitchen waste, and azolla can be used in manuring if produced in the farm itself.

One way to improve utilization of manure is through biogas production and cultivation of earthworms. Biogas is considered one of the cheapest renewable energies in rural areas of developing countries. Production of biogas not only saves firewood but is also beneficial for integrated farming systems by converting manure into an improved
fertilizer for crops or in ponds for fish and water plants. When livestock are available, a simple and low-cost biodigester can be developed. For medium and large scale farmers, biogas can be used to replace part of the oil to produce electricity and the effluent can be used to fertilize the crops. Earthworms provide another route for the recycling of manure and are especially appropriate for the processing of excreta from goats and rabbits which, for physical reasons, is not suitable as a substrate for biodigesters. Further hand holding, financial support and extension support are crucial for the development of integrated farming systems. The pilot project supported though ATMA Plus needs to be scaled up substantially.

3.1.3.3: Food and Nutrition Security

Rice is a socially and hydrologically important crop for Kerala. The wet humid tropical climate of Kerala is conducive to the cultivation of rice and traditionally rice occupied a prime position in Kerala’s agriculture. However, area under paddy has been declining over the years, with a possibility of extinction of rice farming in the state on a long term perspective.

Intensive efforts need to be taken to arrest further conversion of paddy lands so as to retain the existing paddy area and at the same time, bring more fallow land under cultivation, promote lease land cultivation and also convert sizable area from single crop to double crop and double to triple crop. The current productivity of 2.30 t/ha has to be increased to 4.0 t/ha so as to achieve the production target. This increased productivity could be achieved through popularization of SRI, regional rice development projects on AEU wise, risk management, plant health and water management strategies and popularisation of appropriate rice hybrids in larger areas and promotion of scientific rice farming through group approach coupled with remunerative procurement price. The ongoing projects need to be scaled up substantially to augment production in the State.

The production of vegetables in the State is not sufficient to meet the requirement. The Vegetable and Fruit Promotion Council, Department of Agriculture, State Horticulture Mission and Local governments are involved in the promotion of vegetables. By the end of 12th Five Year Plan, the requirement of vegetables for the state is estimated to be 38.62
lakh tons based on population projections. Within the limitations and situations that prevail in the state, a wide variety of vegetables are grown in Kerala.

The challenge of ensuring equitable access to safe, sufficient and nutritious food will intensify in coming years. The strategies encompasses using the same or less land and water, fewer inputs and have a lower environmental impact to produce safe and nutritious food. Comprehensive project for the production of vegetables in achieving self-sufficiency by the end of 13th five year plan is in place covering development of clusters, homestead and urban vegetable cultivation, rainshelter cultivation, micro irrigation with fertigation, hybrid production, setting up of demonstration units for micronutrients, organizing block level federated organization as apex bodies of clusters, bio inputs, nurseries and markets, promotion of school and vegetable garden under an overall safe to eat and safe to environment approach. The success of vegetable development scheme achieved though social capital development and convergence is shown in Box as an example. Further consolidation of vegetable initiatives are proposed to increase productivity, setting up of low cost storage structures, Participatory Guarantee System (PGS) mode of good agricultural practices, marketing, consolidation of social capital development etc.

**Box:89**

**Mobilisation of Social Capital in Vegetable Cultivation : Experience of Irinave Haritha Vegetable Cluster in Kalliasseri Grama Panchayath, Kannur District.**

Kalliasseri Panchayath is located 12 km north of Kannur Town. It is a highly urbanized village with an area of 15 sq. km. and more than 7500 households. As per the Krishi Bhavan basic data vegetable cultivation is limited to 3 ha which is confined in scattered household kitchen garden.

In 2013-‘14 vegetable cultivation in 5 ha in the form of a Cluster was undertaken in Irinave area of Kalliasseri Panchayath, under Vegetable Development Programme (VDP), Department of Agriculture, and Government of Kerala. Being a non-traditional area for commercial vegetable cultivation widespread consultation with various stakeholders were undertaken to find a suitable site. The area was fallow for more than 20 years. The local farmers Organization, Irinave Co-op. Bank Officials, and Department
officials together took efforts to get the consent from the land owners and published a supplementary newspaper to create awareness among the local people about the scheme, as a result of which they could identify 2 more hectares and expand the area to 5 Ha. A Cluster Committee was formed with 70 member farmers. These farmers had no previous experience in vegetable cultivation.

**Group Dynamics**

The entire area was divided into 13 plots and 70 farmers were organized into 13 groups. The 70 farmers rallied in the field created a festive mood leading to the development of positive group dynamic. This resulted in teamwork, mutual respect, cooperation and leadership. The synergy created by this ambience added fuel for initiating and mobilizing the activities of the cluster.
CONVERGENCE

ATMA, Capacity building component was utilized in training 20 farmers in tiller operation. As a result ploughing charges could be reduced considerably. Participation of leaders like Grama Panchayath President, Block Panchayath President in tiller operation enhanced enthusiasm and confidence among the farmers.

Soil and water were tested with the help of District Soil Testing Laboratory and Mobile Soil Testing Laboratory. The Cluster Committee functioned as a support group to help the entire cluster; they also cultivated vegetable as a group. The Secretary, Service Co-operative Bank and Agricultural Officer together prepared a layout for the entire area which facilitated scientific and systematic cultivation.

Seedlings and seeds were procured from State Horticulture Mission and Vegetable and Fruit Promotion Council Keralam. FYM/cattle manure produced by farmers themselves, neem-cake and other inputs supplied by Service Co-operative Bank, and Trichoderma, Pseudomonas, insect traps etc. purchased from KVK, Kannur who acted as the support group. Land preparation, Liming, spraying basal dose application was carried as per the instruction of Agricultural Officer. The interest free loan to the limit of Rs. 1,50,000/-sanctioned by Irinave Service Co-operative Bank helped the cluster to carry out its activities smoothly.

At this stage the cluster was rated on merits and upgraded to ‘A’ Grade Cluster. Creation of water harvesting structure, Open Field Precision Farming, Plastic Mulching, Zero Energy Cool Chamber, Rain Shelter, Nursery and Seedling Production Centre, land property purchase worth Rs.2 lakhs, Bio-input Centre and market were the main attractions of the ‘A’ Grade Cluster.

ATMA Capacity building, with in District Training, FFs, Exposure visit to
community Agro-biodiversity Centre Wayanad, demonstrations all lead to massive adoption of scientific technology which focused on ICM which lead to high yield of vegetables free of toxins.

The support group procured the produce from the field and marketed through a farm gate market outlet. Consumers from nearby areas and neighbouring villages visited the field and purchased safe to eat vegetables from the outlet. The balance produce were sold in the ‘A’ Grade market situated in the highway. The awareness against residual toxicity in the vegetables that came across the state borders prompted the villagers to buy locally produced vegetables.

The marketing was made possible without the exploitation of middlemen. The production during the first year in the cluster was 60 tones which was increased to 75 tones during 2014-15.

Assistance worth Rs. 6,30,000/- for ‘A’ Grade cluster and Rs.75,000/- for cultivation was received during the 1st year and Rs. 2,75,000/- during the 2nd year. Around Rs. 12 lakhs worth vegetables were produced in 1st year and Rs. 15 lakhs worth vegetables during 2nd year.

**IMPACTS**

1. The formation of local people in to Farmer Groups promoted team work.
2. Capacity building to undertake various innovative activities.
3. Leadership development among the farmers and further improvement in the leadership qualities of the organizers.
4. Wide spread technology adoption
5. Ownership and asset creation
6. Suitable linkage between Department of Agriculture, Service Co-operative Bank, Farmer Groups, KVK, Kerala Agriculture University, VFPCK, ATMA which will guarantee the sustainability of vegetable cultivation in farmers.
7. Got rid of anti-social elements from the location.
8. Area expansion of vegetables in Panchayath and nearby Panchayath. Non-traditional area for vegetables became a traditional belt and area of cultivation increased from 3 ha to 25 ha.
9. Virtually the cluster area turned out to be a Farm School, School of Students and Teachers, Officials Experts from various agencies visited the area.
10. Local Economic Development. Income of the member farmers increased, change in lifestyle and attitude was hastened as safe mode was made possible.

3.1.3.4: Mechanization

Mechanization is an important element in agriculture development of the state. A number of initiatives are under implementation in the state. The agroservice centres are working in selected blocks. New initiatives are needed to increase mechanization in the state. Farm mechanization is a crucial input for improving agricultural production along with improving labour productivity. Without farm power and appropriate tools, implements and machines that can support the production of marketable surpluses, farmers would struggle to emerge from subsistence farming. To improve and maintain competitiveness, cost of production must be low which could be achieved through mechanization. The demand for sustainable mechanization and services are expected to
rise. Strategies and projects have been formulated to provide support to new machines, expanding custom hiring and agroservice centres, introduction of technologically advanced equipments etc.

3.1.3.5: Climate smart agriculture

Climate smart agriculture is an evolving concept. Climate smart agriculture is not a new agricultural system, nor a set of practices. It is a new approach, a way to guide the needed changes of agricultural systems, given the necessity to jointly address fluctuation in crop production and weather and climate change. Weather variability is expected to further impact crop production both directly and indirectly. Increase of mean temperature, changes in rain patterns, increased variability of rain patterns, changes in water availability, the frequency and intensity of extreme events, sea level rise projected, perturbations in ecosystem all will have profound compacts on agriculture and allied sectors. Building resilience can be achieved by reducing vulnerabilities and increasing adaptive capacity, increasing soil organic carbon improves both efficiency and resistance, which improves nutrient and water intake by plants, increasing diversity of production at farm level regions. A reorientation of agriculture towards climate smart practices is essential to build resilience.

3.1.3.6: Support for Low cost credit

Additional support is required for the interest subvention as well as for supporting interest subvention in investment credit. Details are given in the chapter on support from Government of India.

3.1.3.7: Promote value added agriculture

India processes less than 2 percent of fruits and vegetables as compared to 30 percent in Thailand and 80 percent in Malaysia. Studies also reveal that more than four dozen value added products are produced form derivatives of paddy in a small country like Japan which produces only 2 percent of the total world production. Creation of food chain starting from farm gate to retail outlets is inevitable. Strategies are required to find ways for farmers to earn a greater share of the product sales revenue after adding value to their own produce. Strategies & organizational model will vary from crop to crop. Cluster based interventions, producer companies & individual initiatives are required to develop
value addition. A network of incubation centres, entrepreneurship development programmes and reorientation of SFAC are proposed in the State for the development of value addition focusing on spices, fruits and vegetables, coconut, neera, natural fibres, bamboo etc. Additional support both in terms of financial and technical aspects are required to utilize the potential.

3.1.3.8: Risk Management in Agriculture

The climate risk needs to be addressed for the sustainability of Agriculture. Innovative insurance products, risk management funds as well as climate change adaptation strategies are to be developed for the support of small and marginal farmers. Agro ecological zone wise weather prediction as well as advisories is essential to move towards climate adaptation. Weather advisory services are to be developed for various locations for dissemination. Mechanisms for the price risk management also needs to be put in place. The required support for risk management from Government of India is mentioned in Chapter 4. Risk management initiatives are highly essential for the basic survival of farmers of the state considering the nature of cropping pattern predominating with perennial crops.

3.1.3.9: Urban Agriculture

Urban and periurban agriculture provides food production from different types of crops, - grains, root crops, vegetables, mushrooms, fruits –animals –poultry, rabbit, fish etc) as well as non-food products – aromatic and medicinal herbs, ornamental plants, trees etc).

UA can make an important contribution to habituated food security, particularly of fresh produce. The contribution of UA to food security and healthy nutrition is probably the most important, aspect. Waste disposal has become a serious problem for most cities. UA can contribute to solving this and related problems by turning urban waters into productive resources. Compost production, vermiculture, irrigation with water, tree planting also impact on the greening of the cities, the improvement of the urban microclimate and the maintenance of biodiversity. They may also reduce the city’s ecological foot print by producing fresh foods close to the consumers, thereby reducing every use for transport, packaging and cooling among officers.
Among the major Indian States, Kerala recorded the highest growth in urbanization, over the past decade. As per the projection of NCEAR, the share of urban population is projected to be 68.87 per cent in 2031 in Kerala. The rapid urbanization process also accelerates the extension of the city into the rural areas. According to a survey by UN State of the World population report in 2007, by 2030, 40.76 % of country’s population is expected to reside in urban areas.

The rapid increase in urban population suggests the need for a reorientation of ongoing urban agriculture initiatives. The challenges in urban agriculture include inadequate availability of technical experts, organic inputs, service support etc. New technologies are required for waste water processing and recirculation, new land saving agricultural technologies etc. The urban agricultural production system is characterized by a variety of agricultural microenterprises, the performance of which is only limited by bioclimatic, land and socioeconomic restrictions, but also by important technical restrictions. Although urban farmers are quite dynamic and innovative and have a vast scope for technical improvement, the rate of technology development and diffusion in these systems is still limited.

3.1.3.10: Expand Social Safety Nets

The need for safety nets for the farmers were not given adequate attention in the past. Various support measures like pension have been introduced from 11th plan onwards. This needs to be expanded with innovative models including health insurance and support for education assistance of the children of farmers focusing on human development dimensions. Income guarantee scheme has already been proposed in the state Agricultural Development policy approved in 2015. The required support for safety nets from Government of India is mentioned in chapter 4.

3.1.4: Pillar IV. Improve Service delivery

Services contribute to strengthening the assets of farmers and hence adapting and sustaining their livelihoods in a changing context. This context changes continuously and services are even increasingly becoming important. The focus areas under service delivery are shown below:
3.1.4.1: Prominent and mainstreamed Extension system

Over the years several agricultural extension approaches have evolved. Among them Training & Visit (T&V) system propounded by Daniel Bernor developed in early 1970’s and implemented in the state with the support of World Bank from 1980 was the predominant approach. The system was vigorously introduced by World Bank as a new approach in extension. The system strengthened the research extension linkages by making research findings more relevant to the needs of the state. The system was designed to facilitate regular training of extension workers to enable them deliver recommended technologies to farmers on a fortnightly basis. The system was abandoned in 1987 due to its structural weakness and inherent administrative cost overrun, even though a number of advantages were documented. Subsequently the ATMA model of extension was introduced in the State during 10th Five Year Plan in the state to address the key constraints faced by the extension system focusing on decentralized and demand driven approach. The extension delivery was oriented towards group approach catering to the location specific requirement of farmers. The district level ATMA is often highlighted as an innovative model of public sector agricultural extension involving decentralization as well as participatory and bottom up approaches.

In order to strengthen extension further in the state and to utilize the potential of innovative lead farmers, a state supported scheme on lead farmer centered. Extension and delivery services was initiated for implementation from 2010-11 onwards in two districts and subsequently extended to two more districts where regular field visit followed in T &V system and regular advisory system also introduced under the overall ATMA framework. Further ATMA plus model by integrating another 15 components like promotion of integrated farming, farmer technology development for the promotion of farmer innovation, constitution of block level farmer extension organization, model panchayat extension plan etc was initiated for implementation in all districts from 2013-14 using State plan support based on SREP under the ATMA framework.

Strengthening of extension system is further visualised towards expansion of successful development models along with service delivery focusing on labour support, input support and other services like soil testing, crop health management, facilitating
setting up of micro irrigation, polyhouses and rain shelters as part of modernization of agriculture in an evolving labour scarce economy. Leveraging social capital is a key element in the mainstreaming of extension in agriculture. The activities of farmer extension organization organised at block level as an apex body of the Panchayat level groups is given in box.

Box: 3.4

**Oachira Farmers Extension Organization (OFEO), Kollam**

The Organization is constituted by a group of selected farmers from seven Panchayaths of Oachira block. It started functioning from 2/4/2014. The main objectives of OFEO include popularization of modern agricultural practices and technologies to the farmers, providing easy availability of agricultural inputs to group members, mechanization and other services within the block etc. The United Nations declared 2014 as International year of family farming raising this slogan of self sustainability in food production. Kulashekharapuram Panchayat took up the challenge of Family Farming and implemented Vegetable cultivation in 12230 families in 23 wards. The project aimed to produce toxic free vegetables in each household. Oachira Farmers Extension Organization (OFEO) entrusted for this mission and eight varieties of vegetable seeds were purchased from KAU and packed and supplied to the families. For the successful implementation, house to house campaign, pamphlets distribution, corner meetings, trainings, street plays, establishment of posters, etc were done by OFEO. The programme was a great success and about 74 tonnes of vegetables were produced and the venture still ongoing. Two members of the Training Input Extension Service (TIES) were sent to IIHR Bangalore and were given training on Scientific Organic Vegetable Cultivation. Under The LSGD Programme of Oachira Block Panchayt and Kulasekharapuram Grama Panchayt 16675 Grow bags were prepared by OFEO and supplied to the beneficiaries. One lakh vegetable seedlings were prepared by the OFEO members for this purpose. Two outlets were established by OFEO one at Oachira Block Panchayt premises on the side of NH-47 and one at Kulasekharapuram Panchayath where farmers were made available with inputs planting materials and other need based services. Principal Agricultural Office Kollam has accorded license
for fertilizer & pesticide sales. Two organic manure units have been set up by farmers and 25 tones of organic manure were prepared and supplied to farmers at a reasonable rate. The prestigious KERAGRAMAM project implemented in Kulasekharapuram Gramapanchayth were successfully implemented with the help of OFEO. Under this project a coconut seedlings nursery was established by OFEO and 6000 nuts were collected from mother palms of farmers from this district as well as from other places and 6000 DXT,&TXD good quality seedlings were raised and sold to the farmers at reasonable rates. The second phase preparation is ongoing. Monthly pre MTA meetings of the Block, the ‘TIES’ participates and delivers their monthly roles in imparting extension services.

### 3.1.4.2: Expand Agro Service Centers

Extension messages are often not accompanied by the availability of physical inputs. Government extension system has been criticized since long for not delivering the production inputs in time to the places where they are needed and in the right quantities and qualities. There is inherent inefficiency in the performance of the agricultural produce marketing. The most important but limiting factors for the development of agriculture of the State comprises of inadequate services of production units, marketing of inputs and outputs, mechanization and labour support groups. The relevance, efficiency and effectiveness of the agricultural extension system are also contingent upon these factors.
Agricultural service primarily addresses the farmers and activities of crop production both annual and perennial crops, animal production and their natural resource base. These activities also include backward and forward linkages. Agricultural services facilitate access to and use of factors of production. With these objective agro-service centres have been established at block level in 2012-13 in the State. Delivery of services covering mechanization, labour support, input and marketing support are expected to be addressed through the agro-service centres in association with extension delivery through ATMA and ATMA plus. It is also envisaged to set up laboratories for soil testing as well as production units for bio-control agents through the agro-service centres.

Extension has addressed only the delivery of quality agricultural extension services which is the centre of attraction and all the approaches were built around this aspect. Over a period the constraints in services acted as a stumbling block in technology adoption and faster development of agriculture.

Small scale farmers have inadequate access to basic inputs and services such as seeds and planting materials, bio inputs, machinery services etc. Lack of skilled and unskilled labourers, non-availability of labourers at the peak periods of cultivation are further compounding the crisis in agriculture.

Agroservice centres are an innovative experiment to expand service support to farmers on labour, mechanization, planting materials, bio inputs, machinery repairs and other services, excluding marketing, initiated in 2012-13 and proposed to generate income for meeting operational cost and wages. Block panchayats are also mainstreamed to support the centres additionally.

The department of Agriculture has established 49 agro service centres and the department of co-operation another 60 Farmer Service centres in identified blocks for the last three years. The development of agroservice centres can go a long way in facilitating development of agriculture along with extension support.

It is envisaged to develop agroservice centres in all blocks over the Twelfth Five Year plan and at panchayat level Karshika Karma Sena are also proposed in about 200 potential panchayats for addressing labour shortage in agriculture. The agroservice centres
are planned to develop as apex coordinating centres of Karshika Karma Sena on value added services.

3.1.4.3: Promote Social capital development

Farmers have been working in groups ever since farming started. In order to leverage how farmer organization/groups can better use the existing social capital, it is important to foster different types of farmer groups in innovation development, as well as for different services. Social capital refers to the value of connectedness and trust between people and is a multidimensional concept. ATMA Groups, padasekhara samithies for paddy cultivation, A grade and potential clusters for vegetable development, Kera samithies for coconut and pepper samithies for pepper development were established in the state for the development of these commodities focusing mainly on service delivery. Farmer Extension Organisation (FEO) is a new addition on extension oriented service delivery. Farm Schools and Farmer Field Schools are promoted for technology oriented services. The emphasis on social capital underlines how such non-monetary forms of capital can be important sources of influence. Social capital can improve productivity through different channels, improve marketing, input support as well as facilitate extension and service support. New empirical research has shown that rural communities endowed with a rich stock of social capital are in a stronger position to resolve disputes, share useful information and implement successful development projects. Capacity building, development of leadership qualities, entrepreneurship development initiatives, ICT support, financial support for critical gaps, handholding and monitoring are the essential prerequisites for expansion of social capital in service delivery for agriculture.
3.1.4.4: HRD and Continuing Agricultural Education (CAE)

There is increasing evidence and recognition that what matters for development, more than natural resources and manmade physical capital is the capability of people to be effective and productive economic agents (Human capital). The low level of training of a large proportion of extension workers must be addressed in future. The quantity and quality of trained technical and professional man power in agriculture are critical factors investing in technical and professional education has a high multiplier effect. In recent years initiatives have been made under the leadership of SAMETI to improve quality of training like preparation of course materials, identification of good resource persons, updation of contents, training follow up action, monitoring and introduction of practical field training. Continuing Agricultural Education (CAE) needs top most priority for equipping the extension workers, for service delivery. The recently introduced PG diploma in plant health management through NIPHM for the technical officers is another initiative to be scaled up for improving technical orientation. Capacity of extension staff for adaptive research is another area to be strengthened in future to address location specific technology refinements.

3.1.4.5: Leveraging ICT application

With the booming mobile, wireless, and Internet industries, ICT has found a space even in poor smallholder farms and in their activities. The ability of ICTs to bring momentum to agriculture appears even more compelling in light of rising investments in agricultural research, the private sector’s strong interest in the development and spread of ICTs, and the upsurge of organizations committed to the agricultural development agenda.

The main phases of the agriculture industry include crop cultivation, water management, fertilizer application, fertigation, pest management, harvesting, post-harvest handling, transport of food products, packaging, food preservation, food processing/value addition, quality management, food safety, food storage, and food marketing. All stakeholders of agriculture industry need information and knowledge about these phases to manage them efficiently. The strategies for use of ICT-enabled services that function towards these goals are discussed below:
The agricultural websites and computer programmes form examples under this category. These systems based on their level of interactivity, moves from simple information system to complex expert systems. Information support systems provide contents mostly similar to reading a book. The decision support system takes inputs and guides to reach the right decision. The diagnosis of a pest attack on the basis of structured questions and photos forms an example. On the other side, expert system calculates the amount of fertilizer needed to apply in the field based on fertility status and other considerations.

The basic design of the knowledge management systems shows wide variation. There are e-learning platforms where in users can register and get access to online courses. There are also systems where the user can contact the expert and get direct feedback. The answered questions are mostly kept under FAQ (Frequently asked questions) section. While some systems have built in calculators and decision pathways where by the users are guided to find an answer to their problem. There are also systems which advice what crop to be planned on the basis of soil, climatic and field variations.

There are systems which connect to market websites and give online price information. A modified version of the same does complex calculation based on historic data and give prediction and other strategic advices. E-commerce and future market trading
are newer innovation in this direction. Web-based trading platforms offering one-stop shop facilities are emerging, especially for main commodities.

Knowledge management systems work through various personal computers, laptops, notepads, mobile phones, touch screen kiosks etc. Based on the programming language used in development, the system will work in online and offline mode. The required browser specifications and operating system needs also show wide variations. The online modules can have many advance features, while the touch screen kiosk version needs the simplest design.

**Mobile phone technology**

Mobile phones have now become a platform for exchanging information on agricultural and rural development. Through Short Messaging Services (SMS) and Voice Short Messaging Services (V-SMS) the agricultural department of Kerala is now connected to over one lakh farmers. These facilities help to provide advices on cultivation and plant protection aspects of various crops and enterprises on a regular basis. Besides, the schemes and programmes of the department can be popularized. There are also efforts to disseminate the weather and market related information through the channel. There are also programmes where a farmer can also register his crops and planting details to get customized information on a regular basis.

The development of mobile applications that can be easily downloaded for ready to use is a new promising area. The FEM@Mobile is a promising one in this direction which covers 100 crops. The application serves as a ready to use pocket dictionary on crop production and protection aspects. With whatsapp facility in mobile, farmers can send field photos and get online consultation with research scientist. Besides, most of the mobile have internet connection. Various online resources can be easily reached through mobile.

**Social media**

Social media is now a mainstream form of communication around the world. It continues to grow in popularity with the increase in the number of smart phones. There are now 1.5 billion users of social networking platforms in the world.
Traditionally, agricultural information exchange has been dominated by industrial media such as newspapers, television, and magazines. In recent years, however, technology awareness and computer literacy are increasing across all demographics and various forms of social media are being used more and more by people looking for news, education, and other information related to agriculture.

Social networking websites like Facebook allow users from all over the world to remain in contact and communicate on a regular basis. In Kerala, the ‘Adukkala Thottam’ group have over one lakh members where people share latest agricultural technologies for the use of others.

**Broadcast media**

Wireless technologies have numerous applications in agriculture. A number of AM and FM stations are functioning in Kerala. These stations are working under private and public sector. These stations telecast a number of farm programmes at regular intervals.

Community radio is another innovation in this direction. Community radio provides a mechanism for facilitating individuals, groups, and communities to tell their own diverse stories and to share experiences. It provides farmers, tribes, dalits, women and children an opportunity to speak out, and be heard. As of now, nine community radio stations got registration from ministry of broadcasting to run in Kerala.

Television forms another major area of ICT application in agriculture. With the availability of camcorder and other video production equipments at reduced cost, there is tremendous growth in number of farm videos produced and broadcasted. The increase in number of competing media channels and you tube facility enhanced the media reach to public. The Kissan Kerala project has made available over 450 agricultural videos in internet. And people have started viewing these movies through their mobile on travel.

**E-learning programmes**

The development in e-learning platform helps to redefine the distance education programmes. The opening of community learning centers and running various educative programmes is yet another move with the progress in ICT.
Farm automation devices

Farming is now moving from subsistence to precision. And in precision farming a number of automated systems and application find a place. Just like a Sphygmomanometer measuring the blood pressure, automatic NPK sensors are the need of the hour. Similarly, development of a number of sensors to automate the irrigation and other farm process has to be attempted. The milking of dairy farms can be fully automated in the same way as automatic drinkers can be used to supply water.

Geographic information systems (GIS) devices can be extensively used in agriculture, especially in precision farming. Land can be mapped digitally. Similarly, the use of the Global Positioning System provides benefits in geo-fencing, map-making and surveying. With the use of GPS, extension personal can produce simple yet highly accurate digitized map without the help of a professional cartographer. In Kenya, for example, the solution to prevent an elephant from wandering into farms and destroying precious crops was to tag the elephant with a device that sends a text message when it crosses a geo-fence. Using the technology of SMS and GPS, the elephant can roam freely and the authorities are alerted whenever it is near the farm.

Office automation has to happen along with progress in ICT. The departments can develop computer networks and online bill payment facilities that can result better resource utilization. Other, more-specialized applications, such as software used for supply chain or financial management are also becoming more relevant in today’s farming.

These examples represent only a minute subset of the information and communication services that can be provided to the agricultural sector through increasingly affordable and accessible ICTs. Hundreds of agriculture-specific applications are now emerging and are showing great promise for smallholders. Further technical support is required to mainstream the application of ICT in agriculture development of the State.
3.2: Strategic framework for Animal Husbandry and Dairy Development

The need for increased livestock production is pressing, given the rapidly growing demand for animal products and important contribution to the income of the small and marginal farmers.

The strategic frame work for the development of the sector in Kerala is shown below.

The strategic frame work is suggested under four pillars with identified focus areas

Four pillars suggested are:

1. Pillar I : Raise productivity
2. Pillar II : Raise investment in Basic Infrastructure
3. Pillar III : Strengthening Livelihood security and assured Income
4. Pillar IV : Service delivery

3.2.1: Pillar 1 - Raise Productivity

The focus areas for increasing productivity are shown below:

- New technology
- Artificial insemination
- Commercial diary
- Innovations
- Ration Balancing – Mineral mixture

3.2.2: Pillar 2 - Raise Investment in Basic Infrastructure

The focus areas are

- Young one production
- Strengthening co-operatives
- Strengthening laboratory networks
- Strengthening Hospitals
- Feed Production Units/factories
- Marketing
- Modernisation of slaughter houses
3.2.3: Pillar 3 - Strengthening Livelihood security and assured Income

The focus areas are

- Low cost credit
- Milk shed development programme
- Mixed livestock production systems and integrated farming system
- Fodder and feed sufficiency
- Goat and backyard poultry
- Mechanization animal housing and milking
- Quality control
- Value addition
- Risk management
- Meat promotion
- Safety nets

3.2.4: Pillar 4 - Service delivery

The focus areas are

- Mainstreaming Veterinary Extension
- Veterinary Services - door step, night
- Social capital for service delivery
- HRD and CVE
- ICT

3.2.1: Pillar I: Raise productivity

The animal per day average production has reached 9.11 litres. Even after 40 years of operation of cross breeding, the outcome needs to be improved. It is high time to achieve an average production of 15 litres of milk per day for which focus areas are shown below:

3.2.1.1: New technology

The role of technology is crucial for improving productivity and efficiency. Funding for research must the improved. More research is needed on animal health, improved husbandry and production systems and possibly on breeding, forage crops and
utilization of crop by products. In addition socio-economic research is needed on various dimension of existing system, input delivery etc. Alternate system of veterinary care also to be examined especially on Ayurveda, homeo etc. Agro ecology based research for closing the yield gap also to be examined. The RFID based data identification and retrieval mechanism would be an effective tool to monitor, evaluation and upgrade the livestock population of the State as approved in the State Agriculture Policy. The low yielding animals must be used as foster mothers for the production of improved breed by the embryo transfer technology.

3.2.1.2: Artificial insemination

Assuring a female calf by the cross breeding is a consistent demand of farmers over the years. It is desirable to introduce yield guaranteed sexed semen to achieve a state average production of 15 litres of milk per day.

3.2.1.3: Commercial dairy

The entrepreneurial and adaptive management capacity of farmers and versatility for changing markets, technologies including opportunities to use agricultural machineries should be supported.

Cow unit of Smt. Beena Thomas of Kattappana Block (10 units)

![Cow unit of Smt. Beena Thomas of Kattappana Block (10 units)](image-url)
3.2.1.4: Innovation

A number of innovations are reported in the sector. Innovations like bucket type milking machine, and other machines, housing as well as management innovation. Appropriate incentivisation is required to promote innovation in livestock sector.

3.2.1.5: Ration Balancing

The concept of Ration balancing is already in place in most of the advanced countries, where the feed resources are available in abundance. NDDB has developed user friendly software for advisory milk producers on their door step to balance the ration of their lactating animals with available feed resources and area specific mineral mixtures. Feeding balanced ration to dairy animals plays a pivotal role in improving productivity and reproduction efficiency. Dairy animals are fed mainly with straw based diet supplemented with locally available one or two feed ingredients. This often causes an imbalance of protein, energy and minerals in the ratio of animals. Ration Balancing programme (RBD) can be implemented with the help of dairy co-operatives. Similarly, even calf born in the State out of cross breeding programme should be guaranteed a well-balanced feed to utilize the potential of the calf. The expansion of Special Livestock Breeding Programme should also be ensured for this.

3.2.2: Pillar II: Raise Investment in Basic Infrastructure

3.2.2.1: Young one Production

There is a widening gap between demand and supply of young ones for cattle, goat, piggling, chicks etc. Sufficient infrastructure support is required for strengthening farms, setting up of satellite units for production of young ones around farm, strengthening hatcheries and private investment are required to meet the gaps.
3.2.2.2: Strengthening of co-operatives

Co-operatives play a significant role in the dairy sector of the state. Improvement in infrastructure of dairy co-operatives focusing on storage of milk, cooling, automation etc can go a long way in improving the profitability of dairy farming in the state.

3.2.2.3: Strengthening laboratory networks

An integrated laboratory diagnostic network with defined capabilities can go a long way in supporting the veterinary services. A project has been initiated in 2014-15 for the upgradation of the laboratories. Further support is required to modernize the labs with the state of the art facilities.

The Institute of Animal Health and Veterinary Biologicals, was set up in 1979 at Palode Thiruvananthapuram with the view to cater to the need for Veterinary Biologicals in the state for protecting domestic animals and birds against major infectious and contagious diseases that could be controlled by vaccination.

The various sections are located in a campus that extends over 46.526 acres. The Institute has 14,000 square feet of clean area designated for the production of biologicals with facilities like walk in Incubators, Walk in freezers, GMP Compliant Sterilization equipments and lyophilization facility. The Institute has 2 imported freeze driers with a total capacity to lyophilize 13,500 vials of 2ml capacity in a cycle, dedicated for production of freeze dried
vaccines. The Institute also has 2 pilot scale freeze driers for optimization of lyophilization cycle and undertaking seed work.

The separately located Standardization Section along with the Lab Animal Section is capable of testing and assuring the quality of all the vaccines and biologicals produced. The Tissue Culture RP Section provides back support for introducing new biologicals and technology upgradation.

The Institute offers training and project work in subjects relating to biological production to graduate and post graduate students of Microbiology & Biotechnology. The final year students of the Veterinary Colleges in Kerala undergo regular training in this institute as part of their course curriculum.

Various vaccines produced at IAH&VB, Palode include Viral Vaccines, Bacterial Vaccines and Antigens & Diagnostics. Further support is required to augment capacity of the institute and other laboratories to augment production of vaccines.

**3.2.2.4: Strengthening Hospitals**

State Government has initiated modernization programme of veterinary hospitals with the support of GoI. A comprehensive project mode initiation is required to augment infrastructure base of veterinary dispensaries, polyclinics and hospitals to support the requirement of farmers. A block level speciality support also a required to develop the ever growing demand to veterinary services.

**3.2.2.5: Feed Production units/factories**

The cattle feed production capacity is inadequate in the state. Additional investment is required for setting up of cattle feed products units, goat feed, etc. The co-operative sector also to be supported to establish feed production units. However the quality standards as well as costeffectiveness to be given prime importance in committing investment in feed production.
3.2.2.6: Marketing

Markets for live animals are not well developed. Bulk of the trade in small ruminants taken place between producers and intermediary traders. Additional infra-structure investment is required for the modernization of cattle and small ruminants market in the state.

3.2.2.7: Modernization of slaughter houses

Modernisation of slaughter houses to produce quality and safe meat is a priority. The existing slaughter houses to be upgraded and modernized to ensure quality meat production.

3.2.3: Pillar III : Livelihood security and assured income

3.2.3.1: Low cost credit

Credit for animal husbandry and dairy developments is treated as investment credit and the interest rate is above 12 percentage. Credit for AH should be treated at par with crop loan. The facility of the KCC should be extended to livestock farmers, also.

3.2.3.2: Milk Shed Development Programme

In order to achieve self-sufficiency in milk production as well as to support livelihood of farmers, a comprehensive project mode support on identified milk sheds need to be supported. Support for conservation of indigenous and accepted breeds of cattle also to be ensured to promote the development of the sector.

3.2.3.3: Mixed Crop livestock production systems and integrated farming system (IFS)

Mixed crop-livestock production systems are important as the source of the bulk of the ruminant livestock production is concentrated in small and marginal farmers. Complementary relationship exist with livestock fed on crop by-products and other plant materials, contributing manure, additional source of food and income, savings and buffer against risk. In mixed and integrated farming systems livestock contribute to both
intensification and diversification of income streams. Complementary relationships between crops and livestock may be exploited and system needs to be supported financially and technically in the state.

3.2.3.4: Fodder and Feed Sufficiency

Though feed and fodder is one of the most important contributing factors for the growth of livestock sector, development of this has not received the required level of focus in the past. Fodder banks have to be created in potential panchayats along with storing them as silage or fodder blocks to meet the requirement in lean season. The high-tech fodder production initiatives also to be scaled up. Fodder enrichment and diversification could be some of the focused areas for enhancing the productivity. It is estimated that 60-70% of total cost in livestock production is due to feed and fodder. Any attempt towards enhancing feed availability and economizing the feed cost would result in increased margin of profits of livestock farmers.

Over the years considerable technological advancement has taken place in to feed and fodders focusing on enhancement of nutritional quality and Productivity enhancement. The by – pass nutrient technology has been taken up by private feed manufactures as well as NDDB and dairy federation. The area specific mineral mixture technology has helped to a considerable extent in overcoming the problem of infertility. Benefits of these technologies need to be fully exploited. Efforts need to be focused on augmenting feed resources by tapping non – conventional feed resources.
3.2.3.5: Goat and Backyard Poultry

Small ruminants and backyard poultry provides direct livelihood and income generating opportunities to landless and marginal farmers and other vulnerable section of the society. Promotion of malabari breed and backyard poultry with institutional support can go a long way in improving livelihood security of marginal farmers and landless labourers of farmers groups and intervention in innovative marketing supports further development of the vulnerable groups. Need based micro cage layer system also to be popularised to augment egg production.

3.2.3.6: Mechanization animal housing and milking

The automated system most commonly used by selected farmers are in animal production are for modernization of animal housing, milking, control of feeding, water supply, monitoring of the animal’s physiological and lactation practices, temperature control, fodder production etc.. More proactive steps are required for supporting mechanization in animal husbandry to improve viability of farming.

3.2.3.7: Quality control

Food safety and standards regulation mandates that milk should the handled hygienically and kept cold along the value chain. Further investment in this area is required to improve the competitiveness of the small holder livestock producers.

3.2.3.8: Value Addition

Entrepreneurship development of small growers/ groups could be initiated to produce value added products. The isolated attempts imitated in the state needs to be scaled up with appropriate hand holding, capacity building and financial support.

3.2.3.9: Risk management

The incidents of risk in livestock sector is reported to be increasing with the introduction of exotic animals. Various insurance schemes are in operation over the years in addressing the risk. However the progress of livestock insurance has not been encouraging, due to design of insurance products and the procedures involved in
settlement. A pro poor farmer friendly insurance product is highly essential for addressing the risk incidence.

3.2.3.10: Meat promotion

As one of the major meat consuming States in the country, demand for meat in Kerala is burgeoning. Purposive meat production programmes to augment meat supply to be promoted. Along with milk production purposive meat production programmes to augment meat supply also to be supported. As Kerala is one of the meat consuming states in the country, demand for meat is burgeoning. Male calf fattening has already been initiated which also need to be supported in the identified milk sheds to utilize the backward linkage.

3.2.3.11: Safety nets

Adequate provision for safety nets is required for supporting the farmers focusing mainly on marginal and vulnerable groups.

3.2.4: Pillar IV : Service delivery

3.2.4.1: Mainstreaming Veterinary Extension

Veterinary extension was not given a priority over the plan periods. There is profound impact on veterinary extension for technology adoption, expansion of good management practices etc. Additional support for farm schools, and other need based extension to be given priority in livestock sector.

3.2.4.2: Veterinary Services – door step and night services

Diagnostic facilities at field level in terms of good clinical laboratories, equipment, quick and quality diagnosis and the human resource play a pivotal role in the development of livestock sector in the state. Animal health services are important in reducing losses due to diseases. Technologies for disease control and care are known, but delivery system to be strengthened. A comprehensive fertility management programme for bovines to be integrated in veterinary services to address the serious issues of infertility reported in cross
breeds. The farmers of the State have to be assured with a livestock population free of all contagious diseases by universal vaccination and necessary steps to be taken to declare as animal disease free zone. The door step and night services introduced in 12th Five Year Plan need to be expanded.

3.2.4.3: Social capital for service delivery

The social capital in service delivery, improvement of income, livelihood security, and innovative ways of marketing plays a key element in fostering the sector. The group based intervention in livestock production, marketing of farm fresh milk and egg, integrated service delivery are some of the success stories in the state. Capacity building, hand holding support, entrepreneurship development, support for investment and technology are crucial to nurture the social capital development.

3.2.4.4: Human Resource Development and Continuing Veterinary Education (CVE)

State Government has set up a network of Livestock Management and Training Centres, Dairy Training Centres and Training centres in potential blocks. At State level SAMETI and Veterinary Council are providing continuing veterinary education. Capacity building in leading National institutes has also been initiated. A focused quality HRD and CVE needs to be further developed to augment the human resources for the development of the sector.

3.2.4.5: Information Communication Technology

The Information Communication Technology plays a key role in livestock sector in the state. The technology dissemination, disease mapping initiative, the expansion of Kiosks, software based support for diagnostic and clinical area are to be further expanded with appropriate institutional tie up. The innovative application of Geographic Information System initiated in the department needs to be supported and expanded.
Box 3.5

GIS Based Disease Mapping - Web GIS application design and development

The main objective of the project is to design, develop and establish advanced Web based Spatial Decision Support System for Disease Mapping, Monitoring and Disease Spread Modeling.

A highly interactive, open source technology based Web GIS application has been developed. Hospital location database was integrated into the application with proper IDs.

Pic 1: Location of all departmental institutions on a google map
Pic 2: Location of Farmers captured as part of the project on google map

Pic 3: Selected a buffer zone of 3 KMs from the disease location - identified for ring vaccination to prevent spread of the disease
Android application development and testing

Android application was developed to collect location tagged farmer information from the field. Future Plans proposed are building a real time Out Patient management System and integrate with the proposed GIS Decision Support System, Collection of the geographic location of all the farmers across Kerala and to Provide a 7 inch tablet computer to all the livestock inspectors, who actually visit the farmers’ houses regularly for delivering routine functions, so as to collect the geographic details (latitude and longitude) of the farmer for further application development.

3.3: Fisheries Development

The strategic framework under four pillars of fisheries development are shown below.

3.3.1: Aquaculture Productivity

The focus areas under aquaculture productivity are shown below:

- Technology
- Stock enhancement in Reservoirs through culture based Fisheries
- Mariculture
- Re-circulatory Aquaculture System

3.3.2: Basic Infrastructure

The focus areas under basic infrastructure are shown below:

- Fish seed farms & hatcheries
- Species specific feed
- Support for infrastructure development
- Proper storage, transportation and distribution
- Housing to fisherman
- Sanitation & Hygiene
- Drinking water facilities
- Electrification
- Roads & Culverts
- Investment on fishing implements
- Anganvadi

3.3.3: Livelihood Security and income

The focus areas are shown below

- Marine capture fisheries
- Conservation and Management measures
- Exploitation of oceanic fish resources
- Stock enhancement programme
- Climate change and fish behaviour
- Diversification of aquaculture species
- Development of ornamental fisheries
- Exploitation by the middle man
- Credit
- Saving habits
- Risk Management
- Value addition
- Social capital for livelihood
- HDI- education, health Education & Literacy
- Social security
- Risk & Vulnerability
3.3.4: Service delivery

The focus areas under service delivery are shown below

- Extension Support
- Capacity building & HRD
- Good Management for Disease control
3.3.1: Pillar 1: Aquaculture Productivity:

Presently, aquaculture is practised in 10,000 ha. of water bodies, but the average aquaculture productivity is only 2.8 ton/ha, but that of Tamil Nadu and Andhra Pradesh is 4.4 ton/ha. Productivity enhancement shall be the thrust activity for the enhancement of fish production. The present productivity shall be enhanced to 4.4 ton/ha.

Focus areas

3.3.1.1: Technology

Fisheries sector needs technology upgradation for innovative practices to increase fish production. Technologies available with countries like Japan, Taiwan, Vietnam, Philippines, and Australia etc in the field of selective breeding, seed production and feed manufacturing can be effectively made use for the development of Aquaculture sector of the State.

3.3.1.2: Stock enhancement in Reservoirs through culture based Fisheries

Kerala State has 53 reservoirs with a water spread area of more than 44,000 Ha. Based on the water spread area they are classified into small reservoirs (<1000Ha) medium reservoirs (1000Ha to 5000Ha) and large reservoirs (>5000Ha). Even though certain efforts were made during late 90s for the enhancement of fish production in reservoir through Indo-German project, it still remain as underutilized for fishery purposes. Reservoirs have been recognized as an important resource for fresh water fish production. With a view to enhance fish production, scientific fish culture practices are being adopted in the reservoirs. Reservoir productivity can be enhanced by supplementary stocking with the advanced fingerlings of indigenous fish varieties and farming of fish in floating cages. Fishing rights of reservoirs for conducting fish culture is a major hurdle for development. Reservoirs can be developed more effectively and productivity of reservoir can be increased from the present level of 53.5 kg/ha/year to 150kg/ha/year.
3.3.1.3: Mariculture

Considering the huge coastline of the State, there is great scope for Mariculture activities. Cage farming in open sea in participation with youth groups of fishermen can offer immense production.

3.3.1.4: Re-circulatory Aquaculture System

Culture of GIFT fish in re-circulatory aquaculture system integrated with the cultivation of leafy vegetables can be one of the pillar in blue revolution. It can be practised even in urban areas where the availability of the land is limited.

3.3.2: Pillar 2: Investment in basic infrastructure

Focus areas

3.3.2.1: Fish seed farms & hatcheries

The State has 12 Nos of hatcheries in Government/Public sector and 31 Nos in private sector. Annual requirement of fish seed of the State is 9 crore while the present level of production is only 1.55 crore. Presently the State procures fish seeds from Tamilnadu and Andhrapradesh. Fresh seed brought from distant places are often weak due to stress caused by long duration of transportation which drastically reduces the survival and adversely affects aquaculture productivity. It can be addressed by enhancing the production capacity of the existing hatcheries and also by establishing new hatcheries and seed farms for the seed production of indigenous fish varieties.

3.3.2.2: Species specific feed

Protein requirement of fish varies from species to species. Carnivores require feed with 45% protein while planktovorous & herbivorous require only 30% protein in their diet. Some fishes requires floating feed while some others requires sinking feed or slow sinking feed. Hence, there should be species specific feed to suit the nutritional requirement of each varieties. Presently the farmers are giving only a common feed without considering its requirement. Some farmers are not even giving supplementary feed. Hence, there should be provision for providing species specific feeds. A fish nutritional
support programme may be launched by establishing feed mills under Quasi Government sector and by providing subsidy to the farmers for procuring such type of feeds.

3.3.2.3: Support for infrastructure development

Aquaculture production of the existing farms can be enhanced by the development of infrastructure facilities. The additional facility includes Paddle wheel aerators, Pumps, etc. A provision may be given for providing interest free capital support from the financial institutions to the marginal farmers. All kind of financial support to the farmers can be made available through DBT.

3.3.2.4: Proper storage, transportation and distribution

It is estimated that 15-25% of fish catch is wasted as trash fish or spoilt fish. Prevention of fish spoilage and maximum utilization of harvested fish resources can be ensured by its proper storage, transportation and distribution. Steps for preserving the fish quality shall start from on-board and continue until it reaches in the hands of the final consumers. For that a “quality chain” has to be developed with on-board keeping of fish in insulated box/chambers in the fishing craft, on-shore storage of fish in the insulated rooms, distribution of fish through the vehicles with insulation facility and by adopting hygienic fish handling practices. At the landing centres supply of safe ice, chilling facilities, potable water availability and other sanitary requirements is to be ensured. Insulated truck and vehicles with insulated boxes can be given for fish transportation.

3.3.2.5: Housing to fisherman

Issues on housing in the coastal belt has certain specific features. Poverty is the critical reason for poor housing conditions prevalent in fishing villages. The survey conducted on 2010 reveals that 16,359 fishermen are dwelling in thatched hut/shed and 12,850 are both land less as well as homeless. The number of thatched huts has reduced from 48% (1981) to 18% (2009). Possession of land among the fisher folk is a critical problem. When new housing schemes are announced by the Government, the landless fisherman becomes unable to get the assistance. Regarding land holding, only 35% have more than 5 cents of land. In the coastal parts of the State, the density of population is around 2168 persons per square kilometre which resembles to the slum of urban area. The
attitudes of fishermen against migration to other areas due to occupational, religious and communal reasons have changed after Tsunami disaster. Considering the scarcity of land along the coastal area, multi storeyed residential complexes are suggested for 12,850 land less people.

The CRZ notification also adversely affects housing of fisherfolk. Fishermen household of 58.4% are residing within the area of 100 meters from sea coast where new construction or replacement of existing houses are restricted. It is more pronounced in Thiruvananthapuram and Malappuram districts where it is 84.6% and 79.8% respectively. In the area between 100M and 200M from shore where re-construction is only permitted, where 24.7% of total fishermen households are residing.

3.3.2.6: Sanitation & Hygiene

Occurrence of food poisoning and other contagious diseases are more outstanding in coastal areas. It is due to disposal of human excreta as carelessly as possible; defecation takes place in the open fields or surface waters including sea. In some areas, fishermen lack not only the means to provide such facilities, but also the very information on hygienic aspects. Around 31% of fishermen house hold has latrines with septic tank while 29% have pit latrines and the remaining 40% depends on public comfort station or perform open defecation. As per 2010 survey, there are 23,335 households without any type of toilet facilities. Financial assistance and awareness is required to alter this pathetic situation. In a few cases where the fishermen habitats are congested, community latrines can be considered.

The coastal environment gets polluted with the waste carried away from the upstream as well as that thrown into the sea shore. Nowadays, it is quite common to see that most of the beaches and coastal waters are heavily polluted with solid waste including plastic materials. In the coastal area, there is no effective functioning mechanism for management of the solid waste. Eco-friendly solid waste disposal system by biological means for degradable materials and disseminator for non-biodegradable materials can be opted.

Drainages play a multi-dimensional role in maintaining the hygiene and sanitary conditions in the fishing villages. They also prevent water logging during monsoons.
Absence of proper drainage system can result in aggravating the ill-effects of water logging, which will make the life of the fisher folk quite miserable. There are about 90 fishing villages which lack proper drainage facilities. Total sanitation program is essential for the entire fishing villages of the State to keep the fishing villages under good sanitary and hygienic conditions.

3.3.2.7: Drinking water facilities

Scarcity of safe drinking water is a critical natural problem in fishing villages as the proximity to saline water makes the ground water unsuitable for human consumption. In many fishing villages higher content of ferrous and higher count of coliforms makes the ground water unsuitable for human consumption. Water from open wells suitable for drinking purposes is available only in 38 fishing villages. Other fishing villages depend on public water distribution system which is available at a few corners but with erratic water supply. The survey report, 2009 revealed that there are 31,523 houses with no access to potable drinking water. There are about 117 fishing villages which are in urgent need of drinking water supply which have already been taken-up by the Government through Kerala Water Authority.

Most of the drinking water projects commissioned for coastal area is not functioning well. In some places, capacity of pumping station and overhead tank is seen as not compatible with respect to quantity of water demanded by the project area. In some cases, old pipe lines aren’t in a position to withstand higher water pressure. Lack of servicing the motor pumps is also a major reason for the failure of the project. Jalanidhi project failed in the coastal area, since the operation and maintenance has to be met by the user community. In a few fishing village, rain water harvesting project has been introduced, but due to mismanagement and people’s sceptic perception on its quality, it is not in working condition. These issues can be addressed by implementing a Comprehensive Drinking Water Supply Project including the establishment of de-salination plants under the ownership of KWA.
3.3.2.8: Electrification

There are remarkable changes in the proportion of electrified houses from a mere of 10% in 1981 to 93% in 2009. It is reported that there are about 12,562 houses still non-electrified in the fishing villages of the State. Low voltage and voltage fluctuations are the common problems faced by the inhabitants of the coastal area. Establishment of transformers along with line extension/conversion is required. Government has taken-up 65 projects to address the issues through KSEB.

3.3.2.9: Roads & Culverts

The primary survey 2009 indicated the need for construction of all weather roads to an extent of 583.48 kilo metres across nine coastal districts. Even though an amount of Rs. 50 Crore is being spent annually by the Government, the reflection in the coastal village is not promising. Formation of coastal roads shall be restricted within the boundaries of fishing villages with the nearby service road.

3.3.2.10 Investment on fishing implements

The unhealthy competition among the fishing units for the limited fish resources has resulted in over capitalization of the sector and made fishing a non-economic activity. Introduction of larger fishing vessels with high powered engines and larger fishing gears have enhanced the venture cost considerably. The per capita investment on fishing implements per active fisher folk in motorised sector escalated from Rs.26,000 in 2005 to Rs.98,000 in 2011. But, net annual labour earnings per active fisher man for the same sector came down from Rs.50,491 in 2005 to Rs.16,520 in 2013 (Source-CMFRI study report). Hence, over investment has to be controlled.

3.3.2.11: Anganvadi

Cases with birth weight less than 2.5 Kg is 26.7% among fisher folk against the state average of 16.1%. It indicates abysmally lower level of nutrition of pregnant mother. In the absence of proper functioning of anganvadi in the coastal areas, the elder child is forced to remain at home as baby sitters when their mothers go out for work. The anganvadi mainly aims at the comprehensive development of the child, right from parental period through infancy to childhood, by a series of co-ordinated activities of Nutrition, Health and
Education services. In order to effectively achieve the goal, the anganvadi should be child friendly and attractive. Most of them require toilet, drinking water, electricity, toys, teaching aids, construction of compound wall etc. From the survey reports 2010, it is noted that 810 anganvadi require new building. During the first phase, 58 anganvadi were selected by the State Government for providing new building.

3.3.3: Pillar 3: Livelihood security and income

3.3.3.1: Marine capture fisheries

Marine fish production was stagnant over last two decades till 2008 and now shows a declining trend from 5.86 lakh ton in 2008 to 5.22 lakh ton in 2014 due to increased fishing effort, overexploiting of selected stocks, and juvenile fishing. In this complex situation, only limited scope exists for further enhancement in marine fish production. Marine fish production can be enhanced by sustainable means of conservation and management measures, exploitation of oceanic fish resources and stock enhancement through the laying of artificial reef and ranching of fish seeds.

3.3.3.2: Conservation and Management measures

Over exploitation and juvenile fishing are the main threats existing in the marine fish resources. It can be controlled by regulating number, size and power of fishing units, notifying minimum legal size for fishing and imposing fishing ban both in certain area or specific period. Even though there are provisions to regulate marine fishing under Kerala Marine Fisheries Regulation Act, it is not implemented effectively due to various reasons. The Conservation and Management measures can be implemented more effectively by
awareness programmes, effective surveillance practices and ensuring the participation of local people in the form of Fisheries Management Councils (FMCs). Management of fish resource by the user community was existed in early days. Awareness programmes to fishermen may be given on the management of fishery resources, potential, sustainable use, and growth over fishing, recruitment overfishing and sustainable use of the resources. Effective surveillance can be ensured by establishing Automatic fishing vessel monitoring system.

3.3.3.3: Exploitation of oceanic fish resources

It is reported that there is enormous fish resources available in the oceanic waters. There are appropriate fishing equipments to tap the resources such as oceanic tuna, oceanic squid, and deep sea prawns etc. Suitable fishing equipments to exploit this resources are available in foreign countries like Australia and Japan. Instead of giving Letter of Permit (LOP) to the foreign fishing vessels for deep sea fishing, sophisticated fishing equipments can be given to the traditional fishermen groups. Mechanized fishing boats solely suitable for line fishing of oceanic fish resource can be chosen for the promotion of deep sea fishing.

3.3.3.4: Stock enhancement programme

Establishment of artificial reefs and ranching of fish seeds are widely accepted to be an effective method for the replenishment of depleting stock of commercially important fish species. The fish varieties dwelling with natural reef in coastal waters are alarmingly declined over the years mainly due to the destruction of natural reef. The reefs are highly productive ecosystem of great significance. This forms the breeding and nursery grounds of a large number of commercially as well as ecologically important species of fin fishes, shrimps, lobsters, crabs and molluscs. Reefs are the spawning and main feeding areas of many fishes. Ranching of quality fish seeds produced in the hatcheries in to the reef area shall enhance the fish stock.

3.3.3.5: Climate change and fish behaviour

Some fishes like yellow fin tuna are highly stenothermic. Even minute change in temperature by 0.1°C triggered the fish to migrate from its natural habitat.
3.3.3.6: Diversification of aquaculture species

At present, freshwater aquaculture in Kerala is more or less restricted to Carp culture. Catla, Rohu, Mrigal and Common carp are the principal fishes farmed. Grass carp and Silver carp are also farmed, though to a very limited extent. However, in Kerala people generally prefer sea fishes and demand for carps is limited. Carps generally fetch low price in the State. The selection of fish species for aquaculture production shall be driven by market demand. Once, the carp are the only species whose induced breeding technology was available and now seed production of a lot of varieties were standardised and commercial production is practicing in neighbouring States. Under these circumstances, a shift from the carp centric approach is very much required. Indigenous fresh water fishes like the Catfishes, Murrels, Giant freshwater prawn and the exotic fishes like GIFT and Pungasius are good alternative candidate species for farming in the freshwater areas. Regarding brackish water environment farming the present practice in now restricted to the tiger prawn and to a very limited extent to the Indian white prawn. Commercial farming of Milk fish, Mullet, Pearl spot, Sea bass, Silver pompano, Cobia, Groupers, and that of Vannamei Shrimp are not attempted to an appreciable level in the State.

3.3.3.7: Development of ornamental fisheries

Kerala has conclusive climatic condition for the development of ornamental fishes having rich and unique biodiversity with a variety of indigenous ornamental fishes and there exists huge potential in providing employment to the people from rural sector and foreign exchange earner. The low productivity cost and higher returns within a very short time causes growing demand for ornamental fishes both from domestic and international market.

3.3.3.8: Exploitation by the middle man

The exploitation of fisher folk by the middlemen during auctioning is attributed as a major reason for their meagre income. The fisherman could realize only 60% of the market value as the beach price. The significant difference in the prices of fish at the beach and market indicates the involvement of more intermediaries. Better prices can be ensured by reducing the intermediaries. The fisheries co-operatives can play a major role in this
The fisheries co-operatives affiliated with Matsyafed manage only 10-12% of the fish catch for primary sale with the participation of 44,906 fishermen (2012-13) of 252 fisheries co-operatives. It can be observed that the fishing groups which have not taken loan from fisheries co-operatives is not participating in the auction conducted by them. It may be due to the collection of 5% auction commission of which 1% each is contributed to the auctioneer, fisheries co-operative society and Matsyafed and the remaining 2% as savings of the fisherman. The 1% contribution to Matsyafed may be discontinued by compensating it with special grant by the State Government for meeting their administrative cost. Besides, production bonus can be given to attract more fishermen in the auction system practiced through the fisheries co-operatives.

3.3.3.9. Credit

Due to uncertainty and seasonal nature of occupation, poor income level and lack of money saving habits, fishermen are often obliged to borrow money for various purposes. Loan facilities are not availed to the illiterate fishermen from financial institutions due to lack of awareness, incapability of providing collateral security and inherent non-repayment characteristics. Hence, they depend on informal money lenders to meet day-to-day expenses at exorbitant rate of interest of 5-10% of daily catch. It leads them to lifelong indebtedness. Still, there is practise of bonded labour system for obtaining debt from the owner of the fishing vessel by pledging their labour. If the fisherman owns a fishing unit by taking informal credit and fails to repay the amount, they are forced to mortgage the fishing implements to the creditor, the middlemen or sell off. Both middle man and educated fisherman enjoy loan facilities from banks and Cooperatives societies. As per the primary survey 2008, it was reported that 69% of fishermen was indebted and the per capita debt was Rs.75,000. The cooperatives have to be strengthened to meet the credit needs of fisherman taking into account of the incapability of the fisher folk to find out collateral security because of landlessness. All the active fishermen shall be brought under the umbrella of fisheries cooperatives. There are 780 fisheries cooperatives functioning in the State but lion share of the active fishermen are outside the institutional mechanism of fisheries co-operatives. The remaining active fisherman shall be linked with the present cooperatives or organized by creating new cooperatives. Erosion of income as exorbitant
interest can be prevented by providing more credit support to the fisherman through the co-operative sector.

3.3.3.10: Saving habits

The fisher folk, by nature, don’t save money and spent it on the same day itself by mismanagement and over expenditure. In the days of no catch, fisherman demands cash for alcohol from their wife. This may further lead to miserable situations at home and their children especially the school going, are often the victims of this domestic violence. Erosion of income can be prevented by promoting money saving habit. Saving cum Relief scheme is being implemented to enhance saving habits of fisherman which would make them confident in repaying the loans and also serve as a reserve in the lean season. There were 183,917 fishermen who enrolled under the scheme for the year 2013-2014.

3.3.3.11: Risk Management

As aquaculture is more capital incentive and risk prone, there should be provision for crop insurance and measures to support market price for the produce.

3.3.3.12: Value addition

Wastage of catch as trash fish can be reduced by converting it into value added fish products. Value addition of fish catch in fresh form will lead to demand for processed and ready to eat fish products like breaded and battered fish items, fish burgers, sea food mix, fish fingers, fish sausage, etc. By establishing Solar fish drying units, the excess catch can be made into good quality dried products.

3.3.3.13. Social capital for livelihood

It is seen that large section of the fishermen belongs to the productive age groups, between 20 and 60. Even then the dependency ratio is 1:4, because, 41.43% of the work force remains unemployed. Contrary to the previous period, most of the new generation abstain from fishing even if they could not find a job outside fishery and tends to remain unemployed. Except in Thiruvananthapuram and Malappuram district, new generation of fisher folk is showing tendency for moving towards coolie works. This trend is initiated
after the hope emanated from the booming gulf migration. Regarding Gulf migrant fishermen, 33% is employed in fishing activities and 50% in coolie activities. Secondary level education and lack of vocational competency fetch them a very meagre salary of Rs. 10000/month. Effective fishing days of fishermen per week have been reduced from 6/7 days to 3/4 days. Most of the fishermen aren’t considering the NREGS as a means of alternate employment. Sea-wall repairing, cleaning of beaches, planting mangroves/trees for shore protection, reclamation of ponds and formation of bunds can be included under NREGS to provide supplementary income to fisher folk at least during the non-fishing days. Rather than remain idling during non-fishing days, the fishermen can be effectively deployed for other part time livelihood avocation, after providing skill training and capital support. Even though, they may face problem in other fields of occupation, it can supplement them with additional income. It can stabilize the already congested fishing sector and enhance their per capita income.

In a deprived community with meagre income, the role played by women member in securing the livelihood of their family members is quite significant. The trend noticed among a part of the fisher folk families is that the fishermen will generally squander the money they earn on the same day itself forcing the women to run the family. Among the total fisherwomen of 3,03,194, around 1.70 lakh fisherwomen are in the age group from 25-45 years. Out of this, around 50,000 fisherwomen are involved in fish vending and allied activities like auctioning, peeling, pre-processing etc. After the hazardous attack of tsunami on the Kerala coast on 26th December 2004, Government of Kerala has initiated many sustainable livelihood programmes under Tsunami Emergency Assistance programme (TEAP) and Tsunami Rehabilitation programme (TRP). An agency, Society for Assistance for Fisherwomen (SAF) was evolved specially for providing livelihood support to the youth fisherwomen of Kerala. The venture was a great success and 21,671 fisherwomen got assistance for alternate livelihood activities and 60% of them lead an average life today by earning an additional income. The average monthly net profit is calculated as Rs.3862. The remaining one lakh fisherwomen are presently idle and they would have been provided with alternate livelihood opportunities. The additional income realized by the woman member of the family will in turn accelerate the process of socio-economic development.
3.3.3.14: HDI- education, health Education & Literacy

Educating the new generation of the fisher folk is the fundamental solution for poverty reduction. Education makes a person more efficient in using the available financial resources. Educational rate of fishermen population enhanced from 23.2% (1980) to 72.80% (2005), but the rates of drop outs in primary classes remain in between 12-15%. They were forced to involve in fishing from a very early age of 12 years onwards for assisting their elders. Hence, it is highly important to provide awareness to the parents about the importance of education and its magical transformation role in moulding the future generations. It is reported in 2009 that only 34.21% of students from fisher folk having study facilities at home. Even though the general population of the State is attaining remarkable change in technical/professional education in the last decade, fishermen population stay aside without any interventions. Nonetheless, in higher education above the higher secondary level, and especially, in the post graduation, technical and professional education, the community depicts a more distracted situation. Hence, sufficient scaffolding has to be given to the students from fishermen family so that they may be able to compete with general population. In such a predicament, a concerted effort is to be made urgently to bring up the fisher folk into the educational standard of the general population. The children of fishermen may get better employment in other sector if better education facilities are given to them. The details of financial assistance on education provided by the State Government to them for the year 2014-15 are given below.

<table>
<thead>
<tr>
<th>Category</th>
<th>No. of students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower primary</td>
<td>19,237</td>
</tr>
<tr>
<td>Upper primary</td>
<td>21,778</td>
</tr>
<tr>
<td>High School</td>
<td>31,979</td>
</tr>
<tr>
<td>Higher secondary</td>
<td>11,099</td>
</tr>
<tr>
<td>Bachelor degree</td>
<td>5101</td>
</tr>
<tr>
<td>Professional degree</td>
<td>922</td>
</tr>
<tr>
<td>Post-graduate degree</td>
<td>640</td>
</tr>
<tr>
<td>Doctorate study</td>
<td>4</td>
</tr>
<tr>
<td>Others</td>
<td>706</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>91,466</strong></td>
</tr>
</tbody>
</table>
There are 246 lower primary schools, 122 upper primary schools, 58 high schools and 62 higher secondary schools existing in the fishing villages. It is pity to note that 123 marine fishing villages have no facility under Government or Aided sector for the high school education of fishermen children in and around 5 Kilometre radius. Despite several programmes for improving the educational infrastructure in the State, the coastal villages, particularly the fishermen habitations have not received adequate attention. Inadequate infrastructure, poor maintenance, lack of modern educational provision etc. are some of the deficiencies to provide quality education. The physical infrastructures of most of the coastal schools are abysmally poor.

In the year 2011, 93.92% of Kerala population were literate. However the fishermen community of Kerala is an outlier to this trend. Average literacy among the fisher folk is just 85.84%. But for active fishermen the literacy rate is still 60-70%. Regular reading habit continues with 18% of fishermen household and most of the subscription is only due to the compulsion by political parties or religious institutions. The pitiable level of reading habits makes the fishermen vulnerable to socio-political awareness and participation. It is more pitiable that more than 20% of fishermen population are unaware of various welfare schemes implemented by the State Govt. particularly fishermen of Thiruvananthapuram and Malappuram districts and northern parts of Kasargode districts.

Effective strategies should be taken to ensure 100% enrolment for education at the age of 5 plus and arrest dropouts at least up to the higher secondary level and the community should be made aware about chances of socio-economic development through education. Study centre for the students of fisher folk should be established so that proper and effective study habits are developed and educational interest maintained with the help of extension staff. Selected coastal schools may be adopted to provide more focused quality education. Promote regular reading habits among fisher folk by establishing libraries or reading rooms. Special coaching program can be imparted to the youth of fisher folk for various competitive examinations.

Poor housing conditions, non- availability of safe drinking water, lack of total sanitation coverage, improper waste disposal, unscientific drainage systems etc adversely affect the health of the fisher folk and 7.6% of them suffer serious health problems.
Incidence of water borne diseases, skin diseases, cancer, tuberculosis, stroke, paralysis, filariasis, mental disorder etc are considerably high in coastal area compared to the general population. The frequent occurrence of water borne diseases like diarrhoea, dysentery, cholera and typhoid are clear indicators of the poor health and sanitary conditions prevailing in the area. The fisher folk also succumb to their job oriented ailments like rheumatism, body pain and gynaecological problems. This situation reduces the number of effective working days and life span.

Many of fishermen are marginalised from the public health care systems. For meeting expenses connected with medical treatment and delivery, they rely on local money lenders with usurious interest rate. There are cases that people stop treating the disease, after sometime when they think that the expense exceeds their financial capacity. On an average, people spend Rs.500-3600 for acute diseases and Rs.7,000 to 15,999 for chronic diseases. Medical insurance is taken by only 35.82% of total households. The existing coastal health centres have poor infrastructure facilities and the doctors are often hesitating to work there. Recently the State Government has taken-up steps to provide adequate infrastructure facilities to 54 existing hospitals.

Excessive consumption of liquor and its addiction is quite widespread in the coastal area, which has also become a major health hazard and is the root cause of the socio–cultural impoverishment of the community. Persons of 60 and above just constitute only 6.19% indicating the lesser longevity of the fisher folk. Effective man days and longevity of fisherman can be enhanced by ensuring good health. Good health care to fisherman can be assured by providing sufficient man power and infrastructure facilities in the coastal hospitals. Conduct of extension programmes, medical camps with continuous follow-up and tie-up with super speciality hospitals may ensure good health care to fisherman.

3.3.3.15: Social security

Even though per capita income of fisherman is Rs 50,491, it is pitiful to note that 90% is that of total fishermen population has a per capita income of below Rs. 8280. This meagre income is neither proportionate to their hard work nor to the working hours of more than 12 hours. Their earnings are far short of their expenditure. Erosion of income as
interest is the most challenging area. Fishermen spend 60% of their income for food while, general population of Kerala spent 42% of earnings for food. The expenses for domestic goods are 15 times lower among the fisher folk. But the amount spent for alcohol is four times higher among fisher folk than rural Kerala. As a custom, each fishing unit diverts a portion of their earnings for alcohol consumption. More than 50% of fishermen in Thiruvananthapuram and Alappuzha districts are habitual drinkers, while it is only 27.1% for all fishing villages together. A change in attitude and behavioural pattern is necessary to reform the society. Programmes should be addressed at the grass root level to liberate the fishermen from the habit of alcoholism/un authorized drugs.

3.3.3.16: Risk & Vulnerability

The peculiar oceanographic and climatic conditions increase the casualties of lives and properties of fishermen particularly during monsoon. According to FAO, the marine fishing industry is one of the most accident prone occupations. The annual death rate while fishing is 20 times higher than the overall occupational fatality rate. In the year 2014, it is reported that 101 fishermen lost their life while fishing at sea. In this context the Government is giving greater attention for risk mitigation by providing sea safety equipments, conducting sea rescue operations and providing life and accident insurance coverage. There are no effective programmes to address the damage caused to fishing units due to adverse climatic factors. The present fishing craft insurance scheme seems to be not attractive to the fishermen. Most of the fisher folk settlements are not far from the sea shore which causes chances of damage to the houses and washing away of land during rough seasons.

3.3.4: Pillar 4: Service delivery

3.3.4.1: Extension Support

There have been improvements among fishermen from their respective previous levels, but still lag behind the general population. Even after implementing many schemes for the socio-economic development of fishermen, the achievements are not promising as we expected. It may be due to lack of proper planning, wrong selection of beneficiaries, non-participation of community and deviation from guideline during implementation. In
the fishing villages of Thiruvananthapuram and Malappuram districts, the very information about welfare programmes are not reaching to the real beneficiaries. Hence, a full-fledged extension support and awareness campaigns are required which are essential to ensure the outcome of the community development programme as a success. It can motivate and help to reduce the number of drop outs from school classes and in curing diseases. The educated youth of the same fishing village can be engaged to provide continuous extension support after giving intensive training.

Grass root level socio up-liftment programmes for a refined living and awareness about the need of money saving, alcohol de-addiction, parenting, family bond etc to fisherman; importance of self actualization and self earnings to fisherwomen and need of education, focus in life and human values to the children shall be conducted.

For the dissemination of innovative aquaculture technologies of aqua farming to the farmers, proper extension support is essential. The extension support includes establishment of demonstration ponds, farmers training at demonstration unit or learning with the aid of multimedia, sophisticated technical man power etc.

3.3.4.2: Capacity building & HRD

Capacity building is a basic pre-requisite for concerted and sustainable development and management of fisheries and ensuring food and livelihood security of the fisher community. Looking towards the future in fisheries management, it is essential to address the capacity building needs through demand-driven training and educational programmes for different stakeholders in the fisheries sector, revamping and restructuring training programmes in core and emerging areas of fisheries science, developing advanced research and development capabilities and arranging/organizing exposure visits, workshops, awareness creation, etc.

3.3.4.3: Good Management for Disease control

Fish health management of all farmed species and new entrants in aquaculture for thorough diagnosis, treatment, prevention and reporting is a necessity in achieving disease
free and sustainable aquaculture production systems. The economic losses and
environmental issues is the consequent of the outbreak of major epidemics in fin fishes.
Presently, there no system at all for the management of fish diseases in Kerala. Aqua clinic
may be established in all the districts with competent technical man power. Quality
certification of fish seeds, disease diagnosis, treatment, prevention, reporting and
meaningful quarantine, including establishment of an Aquatic Animal Health Centre is
needed. Service of Aquatic Animal Health Centre may include physio-chemical analysis,
disease diagnosing and suggest suitable remedial measures.

3.4: Irrigation

3.4.1: Pillar 1: Raise Productivity (Water Productivity)

Focus areas

3.4.1.1: Improvement of conveyance efficiency

CADWM deals with development of the command area of completed major and
medium irrigation schemes. The main objective of CAD Programme is to increase the
utilization of created potential by better water management and distribution techniques and
thereby achieving higher production and thus increasing the income of individual farmers.
By construction of field channels and by adopting proper water management methods for
distribution of water the wastage of water has been considerably reduced. The ayacut area
where water was not reaching previously are now getting sufficient water. Adaptive trials,
demonstrations, training to farmers etc play a key role in better water management and
agricultural practices. As a result, the agricultural production has gone up. The land
utilization and utilization of the created irrigation potential is also increased.
3.4.1.2: Micro Irrigation - More crop and income per drop of water

With population growth and rising affluence, the need for food and thus agricultural water for irrigation is increasing. At the same time the quantity of water with a sufficient quality is declining. Water use in agriculture is often highly inefficient with only a fraction of the water diverted for agriculture is effectively used for plant growth and the rest is drained or lost via evapotranspiration. An ideal irrigation effort aims to cover the deficit between a crop’s optimal water needs and what it can take up through natural means.

Climatic conditions, soil type and structure, plant type, and the irrigation techniques applied are among the main factors that influence the efficiency and effectiveness of irrigation practices. For a given location and climatic and soil conditions, the efficiency of water irrigation practices can be improved by making the right decisions regarding - Crop type, Irrigation scheduling, Irrigation method, Soil enhancement measures, source of water. Improving irrigation practices can reduce water and pumping costs, reduce costs for fertilizers and other agricultural chemicals, maintain a higher soil quality, increase crop yield by as much as 100%.
The Ministry of Water Resources had constituted a sub committee under the chairmanship of M.S. Swaminathan to prepare a report on “More crop and income per drop of water”. The report gives details of implementable action plans incorporating technologies along with their economics.

India is continuing to invest substantial amount of money for the extension and improvement of irrigation facility. All the five year plans have given considerable importance to the creation of additional irrigation potential. In spite of large investments, the performance of many irrigation and drainage systems is significantly below potential due to variety of shortcomings. These include inadequate design, use of inappropriate technology, system layouts that do not adequately reflect existing conditions, inappropriate governance arrangements, and poor management practices.

Scope to increase water use efficiency

Since land is a shrinking resource for agriculture, increased production can be achieved by higher productivity per unit of arable land and water. Factor productivity will have to be doubled, if the cost of production is to be reasonable and the prices of our farm products are to be globally competitive. Technological improvements in irrigation systems have also increased production opportunities. Modern irrigation technologies, particularly sprinkler and drip irrigation, increase water use efficiency. They have opened up opportunities to cultivate soils with low water-holding capacity (sandy and rock soils) and to farm low quality lands and steep slopes.

As per the report, it is estimated that with 10% increase in the present level of water use efficiency in irrigation projects, an additional 14 m.ha area can be brought under
irrigation from the existing irrigation capacities which would involve a very moderate investment as compared to the investment that would be required for creating equivalent potential through new schemes.

### 3.4.1.3 River Basin Management

*Adoption of integrated water resource management*

Kerala shall adopt an integrated regional water resource management strategy that accompanies its spatial strategy or is a part of it. Depending on the type of soil, water usage, availability, urbanisation rate and agricultural patterns, suitable water strategy needs to be adopted that caters to the needs of all sectors and stakeholders. Working Group report on Water Management and Watershed Management notes the case of two rivers- Periyar & Bharathapuzha and mentions plans to restore them which has to be done on a holistic basis.

**Box: Integrated Water Resources Management in Bharathapuzha River Basin**

After Periyar, Bharathapuzha has the largest area under one basin in the State. Of the total basin area of 6186 sq km of Bharathapuzha, 4400 sq km is within Kerala State. A study was undertaken in Bharathapuzha basin during 2005-07 by IWMI-Tata Water Policy Program of International Water Management Institute for preparing a basin management plan aimed to boost up agricultural development. Some of the recommendations suggested for improving the productivity of rice in Bharathapuzha basin are :-

- a) Improving water utilization capacity of schemes through regulatory reservoirs and watershed management.
- b) Lining the canal systems
- c) Investment in water control devices
- d) Creation of intermediate storage system in command areas
- e) Advancing crop transplanting
- f) Building institutional capacity for irrigation management
3.4.2: Pillar 2: Investment in Infrastructure

Focus Areas

3.4.2.1: Minor Irrigation

The strategy should be to focus on developing minor irrigation systems in Kerala as they conserve water while achieving results.

Construction of Check Dams

This is a small dam built across a minor channel or drainage ditch and caters to the temporary or permanent needs of a few hectares of land. Their major advantages are that they reduce erosion and gully in the channel, slow the speed of the water flow, allow sediment and pollutants to settle and facilitate groundwater recharge. Since Kerala has a number of rivulets, this technique can be widely adopted. This will help to sustain water flow in the rivers as well as the biotic wealth.

Lift Irrigation

Lifting of water is required for irrigating fertile land at a higher elevation where gravity flow of stored water is not possible. Lift irrigation schemes involve lifting of water by mechanical means for irrigating mostly for paddy fields having a command area of not
less than 40 Ha. Although mechanical lifting is required, these schemes are very useful and serve the marginal farmers of the State. The sources of water are usually canals and rivers. There are about 442 lift Irrigation schemes which are in operation for supply of water to agriculture under the Water Resources Department. An ayacut of around 42,000 hectares (42848.07) has been achieved by the various Lift irrigation schemes in the state.

3.4.2.2: Traditional water sources

There are many local – level traditional rainwater harvesting and conserving structures/ systems prevalent in Kerala, like check dams of various types (katta in Kasargod, anicut in Palakkad & brushwood check dams in Wayanad), ponds/small reservoirs (mathakkam in Kasargod, pallam in Kasargod and Thiruvananthapuram, chirakandam in Palakkad), small wells/pits (keni in Wayanad, oli in different parts), silt traps (muttana in Palakkad).

Working Group Report on Water Management & Water shed Management explains how kattas (check dams) and surangams (water tunnels) in Kasargode district enhance water status and contribute to agricultural production. Surangams are basically horizontal wells/tunnels dug through the laterite hill slopes, from the periphery of which water flows out by gravity usually into open pit/tank/pond. Water from surangam is used both for domestic and irrigation purposes. Agriculture and groundwater departments need to work together to limit bore wells and instead encourage traditional water systems as they boost the use of water in a sustainable fashion. Kerala should explore, on a pilot basis, ways to revive kulams in Palakkad district. In general, the tanks and ponds in Kerala should be revived for irrigation given their positive economic and ecological benefits.

3.4.2.3: Restoration of Tanks & Ponds

Though ponds play an important role in the development of an area, over a period of time the pond system has failed due to its poor upkeep and maintenance. As part of reviving the defunct water bodies, a scheme viz “Repair, Renovation and Restoration of water bodies” was launched by Ministry of Water Resources, GOI. In compliance to this, Kerala Irrigation Department has also initiated steps to furnish a reliable data on the number of tanks and ponds in the state of Kerala.
Considering the importance of ponds especially in times of drought, and understanding the necessity to rejuvenate them, it is essential to identify the number of such structures prevalent in the State. Accordingly, IDRB has prepared a database on the existing ponds in Kerala.

As an initial step, site inspection was carried out by a team consisting of 49 Assistant Engineers and their subordinates. Executive Engineers of Minor Irrigation Divisions acted as Nodal Officers for coordinating the activities. As part of preparing the database, various hydraulic structures like ponds, vented cross bars, check dams, lift irrigation schemes, salt water extruder cum bridge, lakes, dams etc were identified. Various locations of these structures were identified using GPS instruments in which features such as name, length, breadth, depth, altitude, storage capacity, full supply level, pump capacity, ayacut area etc were recorded. Details were created as a database in Geographical Information System (GIS) platform as well as spatially represented as a map. Hence the chance of duplication is eliminated.

Data are prepared river basin wise. Each structure is given an identification number which facilitates easy assimilation. Ponds are given a 10 digit Unique Identification number in which first two digit indicates name of State, second two digit the name of river basin, third two digit represent sub basin and last four digit the serial number of the pond. Since Bharathapuzha basin contains larger number of ponds, this is divided into 5 sub basins.

Taking into account public, private & unidentified ponds, this database includes 40976 ponds covering 32 basins. This includes public and private ponds numbering 7677 & 22491 respectively.

3.4.2.4: Completion of long pending infrastructure projects

Major Irrigation projects such as Karapuzha, Muvattupuzha, Idamalayar and Banasurasagar are long pending for more than three decades. Huge amounts are set apart on these projects each year under annual plan. A proactive action is required to complete these pending projects.
3.4.2.5: Flood management for Agriculture

Though it may not be possible to change certain factors contributing to frequent floods and droughts, like spatial and temporal distribution of rainfall, geology, geomorphology etc, it is definitely possible to have a planned land use as well as development and conservation activities. If proper planning is done with regard to land use, soil conservation and developmental activities in a river basin, it may be possible to a great extent to control floods, droughts and high rate of sediment transport. Hence, flood management aims at providing a reasonable degree of protection against flood damage at economic costs.

Kuttanad Package

The total outlay of the Kuttanad Package as per MSSRF report is Rs 1840.40 crore. Out of this, Rs 1517.90 crore is set apart for the Irrigation sector (82.5%). Projects worth Rs. 771.11 crore have been sanctioned under Flood management programme. Central and State release comes to Rs. 164.32 crore. There was no central release during 2013-14 & 2014-15. The major issues regarding the implementation of Kuttanad package is slow pace of progress, tender excess, cost escalation etc. Time bound completion of the project is required to avail maximum assistance from Government of India and to develop the Kuttanad wetland ecosystem.

3.4.2.6: Ground water management

National Water Policy of Government of India states that traditional water conservation practices such as rainwater harvesting and non-conventional methods such as artificial recharge of ground water need to be practiced to increase the utilizable water resources. The best method of rainwater harvesting is ground water storage, because it not only involves filtration of surface water, but is also safe from evaporation losses, natural catastrophes and so on. Artificial recharge of groundwater is the process of diverting surface water into suitable geological formations. The common structures are percolation tanks, khadins, check dams/ anicuts, sub surface dams and injection walls. Hence, investment in Groundwater storage and utilization structures should be concentrated.
### 3.4.2.7: Integrated Watershed Management

The watershed development approach proposed for the State can be oriented to prepare master plan through a four step activity.

1. Preparation of Block level watershed appraisal report
2. Preparation of micro water shed development report
3. Preparation of micro watershed action plan
4. Preparation of Block level master watershed development plan

Watershed management can be considered as a three dimensional activity in which management process, management activities and management system elements provide the analytical frame. A comprehensive watershed management programme should address issues like drinking water, agricultural productivity, irrigation, poverty, deforestation, sedimentation, biomass generation, perenniality of river & flooding.
3.4.2.8: Rain water Harvesting for Irrigation

It is generally used for irrigation or other grey water uses, though it can also be used for drinking water if it is adequately treated. Rainwater harvesting for agriculture generally involves creation of structures such as check-dams, ponds, and percolation tanks at a planned set of places along the flow path. This increases the percolation of the water into the ground and recharges the groundwater table. It increases the supply of water in the wells and the duration of availability. Decentralized small harvesting structures present a major alternative to conventional river basin water resource development. Some of the benefits of rain water harvesting are reduced run off, healthier plants and water savings.

3.4.2.9: Irrigation support in Urban agriculture

Water use and Reuse for Urban Agriculture

The use of water in urban agriculture is a relevant issue both in terms of competition with other uses and in terms of safety for human health. In regions where the freshwater resources are scarce, wastewater can become a valuable resource in irrigated agriculture. In rapid growing urban centres, water has become a fragile and scarce resource in a competing environment.

Management of water resources has become an urgent issue as urban and peri-urban farmers often apply water from municipal sewage, mostly in its untreated form, increasing the risk for illnesses to farmers and consumers. In urban and peri-urban agriculture, locally adapted small scale irrigation and plant production methods and schemes are possible solutions to save water. Low cost water-savings technologies such as underground and drip irrigation can increase water efficiency as well as allowing safe use of low quality water resources. Treated domestic waste water can be used for irrigating trees, crops and even gardens in households.

Drip irrigation infrastructure can be manufactured from existing local products, such as using porous ceramic containers or pipes with holes in which water is dripped onto the soil above the root zone only. Drip irrigation practices offer the opportunity of spot irrigating and fertilizing when using wastewater, often utilizing a third of the water used in conventional irrigation practices. Drip irrigation also offers the added benefit of
minimizing the contact of the wastewater and the crop, decreasing the likelihood of contamination. In cases of salt-tolerant crops, brackish water can be used in localized irrigation schemes. Simple hydroponics (SH) promotes water savings in recycling and decontamination of water and will facilitate growing of plants in areas with marginal conditions for crop production, such as adverse climate, soil, space limitations in cities, water scarcity, and pest occurrences.

3.4.3: Pillar 3: Service Delivery

3.4.3.1: Effective Functioning of institutions for water distribution

Role of Project Advisory Committee

For the implementation of any project, a Project Advisory Committee is formed at the District level, in which the District Collector is the Chairman and Executive Engineer of the project is the convenor. Members of Legislative Assembly are also representatives of the committee. The committee should be convened twice in a year.

This committee takes decisions regarding the time to start the distribution of water, water distribution turn and takes initiative to solve any issues relating the canal system. Thus, anything and everything regarding the water distribution system will be decided by this committee.

Role of Canal Committee

The canal committee is formed in the respective local body which is benefitted (ayacut area) out of this project. The members of this committee are Panchayat members, Karshska sanghams, Agricultural Officers etc. Asst Executive Engineer will be the convenor of the committee and an elected farmer will be the chairman. One member of this committee will be nominated for attending the Participatory Advisory Committee. This committee controls and takes decision on canals and water distribution systems of that particular local body.

Beneficiary Farmers Association

Regarding the implementation of CADA canals, Beneficiary Farmers Association is constituted in which Engineers and officers of Agricultural Department are also members.
Around 722 BFA’s have been formed, but only some are functional. For undertaking maintenance works of completed CADA canals, funds are given to the farmers, but it is not carried out resourcefully.

3.4.3.2: Motivating maintenance of field channels by beneficiaries

Though funds are being given to the farmers for maintenance of CADA canals, to make it effective, properly and timely intervention by the Department is very essential.

Padasekharasamithies

The State Government has initiated a pilot project linking Padasekharasamithies and the field for the effective functioning of field channels and drains of CADA projects. Department of Agriculture is providing support for padasekharasamithies for institutional building, crop management as well as for other promotional activities of paddy at padasekharasamithy level. Padasekharasamithy based intervention will be an ideal institutional support for the effective functioning of field channels and drains. During 2015-16, pilot project is extended to more areas. We are envisaging effective service delivery by the convergence of irrigation and agricultural department through this institutional mechanism. Further institutional support may be worked out on convergence mode to increase income of the farmers through effective utilization of water.

3.4.3.3: IT application for service delivery

Outstanding contribution to water use efficiency was achieved mainly in countries that are exposed to strict water scarcity and benefit of high technology development. Information and Communication Technology (ICT) is one of the most effective means in upgrading of land and water management and increasing food production. ICT and automation facilitated optimization of pressure regime in delivery networks, savings of water and energy and the invoicing of consumers according to their actual water consumption. Adoption of ICT & automation enhanced water use efficiency in irrigation by 10%-50%, increase yield per land and water unit by 20%-100%.

One beneficial by-product of automation and ICT in irrigation management is the adoption of volumetric approach in water application. Volumetric automation and
scheduling commits volumetric definition of the preset water amount to be delivered, independently from time designation.

Automation and ICT can be implemented independently from each other. Automation in irrigation is classified in two categories:

1. Automation on time basis – using timers for opening and shut down of valves
2. Automation on volumetric basis – automatic shut down of valves after a preset volume of water had been delivered.

Almost every system (drip, sprinkler, surface) can be automated with the help of timers, sensors or computers or mechanical appliances. A pilot project could be initiated in Bharathapuzha basin for ICT application in irrigation.

### 3.5: Towards a convergence in Green Growth

With the increasing emphasis on need for development, coupled with increasing urbanization, it is becoming apparent that the natural resources are to be used judiciously and sustainably. Natural resources play a vital role in providing livelihood and securing life sufficient – ecological services. There is need to design programmes to improve the quality of natural capital.

Development of agriculture continues to remain critical for Kerala’s economic growth and poverty reduction. The nature of agriculture has been changing rapidly during the last two decades and farmers currently need a range of support including organizational, marketing, technological, financial and entrepreneurial support. Addressing this involves interventions from several agencies at different levels which need to be converged and effectively delivered.

To give recognition and status to the farmer youth, they should be trained, tested and certified in farm skills on modular basis through systematic capacity building to enable them to engage in agribusiness activities and to take up employment in various farm related services. To attract and retain youth in farming, the farming itself needs to be redefined to meet their expectations and leverage their strengths.
Decentralised planning adopted in Kerala for more than 15 years has enhanced local capacity in understanding issues, identification of strategies and project formulation. It has succeeded in motivating several experiments and contributing significant investment in agriculture sector. Further strengthening of decentralized planning is essential for agriculture and allied sectors as the local level resources, convergence and leadership, climate and agroecological features dictate success of any intervention. Local level planning at agroecological unit basis in each district helps to arrive at an integrated, participatory and co-ordinated initiative for agricultural development. The convergence will help to identify a resource envelope at the district and agroecological unit basis.

Expansion of organic agriculture, safe to eat mode of production, safe to environment mode of production, ecological agriculture, popularization of good agricultural practices (variants of green agriculture) and development of healthy soils focusing more on managing fertility and biological fertility are critical for moving towards agriculture green growth.

A strong and vibrant agriculture sector with an expanded outlook is a prerequisite for achieving a faster, sustainable and more inclusive growth. A mission mode approach is also critical for bringing about convergence and synergy among the different departments and agencies. The challenges facing agriculture are complex. Issues such as food insecurity, weather variability and climate change, water availability, biodiversity and associated ecosystem service loss need to be addressed simultaneously. Innovation in agriculture is a key element in meeting these challenges. Increased productivity needs to balance immediate demands for feeding the world against future concerns for environmental stability.

The Food and Agriculture organization (FAO) has estimated the gross investment requirements for primary agriculture in developing countries at US$125 billion per year to 2030, to increase agricultural productivity to double current levels. Agricultural growth needs to be more inclusive, supporting the equitable reduction of poverty and hunger and balanced with preserving existing high value ecosystem. The productivity revolution in the sector could require additional costs beyond current spending but no estimate exists of the incremental cost for greening the agriculture sector.

WEF - Green Investment Report 2013
Chapter 4: Support from Government of India

4.1: Measures/assistance expected from GoI/NITI Aayog

Support for State specific Centrally Sponsored Schemes

State Government has provided possible plan support from State plan as well as from the plans of the local governments for the development of agriculture over the plan periods. The outlay has been increased to about 12.07 percent of state plan to agriculture and allied sectors including irrigation, out of the total state plan outlay of Rs.20000 crores in 2014-15. Over and above this, the outlay provided by the local self governments during 2014-15 was about Rs.215 crores adding to 13.4 per cent of outlay for agriculture sector in the state. In spite of all committed public investments, the performance of agriculture is not encouraging. The growth rate in agriculture was negative during 2013-14 at -2.88 percent leading to a looming livelihood crisis in the coming years. The low price of natural rubber due to low international prices of natural rubber owing largely due to low prices of crude oil being an ingredient of synthetic rubber which is adding another crisis in Kerala agriculture. About 21 per cent of net cropped area in the state is under natural rubber and farmers have started neglecting management of the crop.

The agriculture sector needs special projects for addressing issues in perennial and plantations crops. Systematic replanting programmes of tree crops like coconut, cashew, rubber and other perennial crops are required. Apart from this, the state is a chronic food deficit State which depends heavily on neighbouring states. The success of massive vegetable development programme implemented by the state in the 12th five year plan with the support of State plan is an example of how flexible fund added to the improvement of production of vegetables in the state by addressing state specific issues. State government has substantially hiked budget provision by more than twelve times for vegetable development during 12th plan period.

In order to take up such other massive programmes in agriculture to supplement the resources of the state, untied umbrella programme in CSS seems to be better for the state. The suggested umbrella schemes are shown below.
4.1.1: Umbrella schemes for CSS in agriculture and allied sectors

Assistance from GoI under CSS may be limited to the following umbrella schemes with flexibility for the state to implement and design sub schemes relevant to the state.

i. Krishonnati Yojana

ii. Pradhan Mantri Krishi Sinchai Yojana

iii. Livestock Mission

iv. Coastal social Infrastructure and Livelihood Management

All existing schemes could be clubbed in the umbrella scheme with a lumpsum allocation. No separate allocation is needed for each scheme under the umbrella scheme. Norm based state allocation for each umbrella, based on transparent criteria should be included in the budget document. Allocations may be pooled department wise under each umbrella. The RKVY model formula may be evolved for different Departments/Umbrellas by NITI Aayog in consultation with states. The unit cost may vary depending on local conditions, not only between states, but even intra state. States should be given freedom to fix unit cost based on transparent criteria evolved in consultation with NITI Aayog.

Role of NITI Aayog in CSS

i. The NITI Aayog may organize annual, bi-annual or quarterly meetings of states on methodology of allocation, issues in spending, outcomes and exchange of views/experiences.

ii. To approve frameworks designed by each state to align the deliverables under CSS with national priorities.

iii. While states should be given the flexibility to modify and design schemes under each CSS umbrella, this should be done in consultation with and approval of, the NITI Aayog.

4.1.2: Consultancy support

A mechanism to be evolved in NITI Aayog to avail consultancy support of experts in various sectors in project preparation in some selected areas like packaging, supply
chain management, E commerce, value addition, new technologies, spatial technology , information technology etc.

4.1.3: Facilitate technology transfer from reputed institutions within the country and support for new development models

It is desirable to have a mechanism in NITI Aayog to facilitate technology support. New technologies available in reputed research institutions and new development models from other states could be facilitated to discuss in NITI Aayog. Support of Government of India is required for the identification of successful development models from other states for state level adaptation. Funding for pilot testing of successful models could substantially enhance the implementation under a National guidance framework.

4.1.4: Facilitate International collaboration

The development professionals may be facilitated to visit various leading international technology centres as well as in countries with good development models relevant to the state. Hand holding and funding support from NITI Aayog will facilitate the process.

A mechanism for interaction of state level officers with foreign countries focusing on development projects, international exposure visit, as well as collaboration for investment in development projects also to be developed at Government of India level with the involvement of Ministry of External Affairs. A separate wing may be developed in NITI Aayog / MEA for this process.

4.1.5: Support for Risk Management in Agriculture

The agriculture sector is exposed to a variety of risks which occur with high frequency. These include climate and weather risks, pests and diseases, natural catastrophes which cause highly variable production outcomes. Production risks are exacerbated by price risks, credit risks, technology risks and institutional risks. Risk management in agriculture ranges from informal mechanism like avoidance of highly risky
crops, diversification across crops and across income sources to formal mechanisms like agriculture insurance, minimum support price, price stabilization fund and future’s markets. The frequency and severity of risks in agriculture in the State particularly in the last few years has increased due to globalization and liberalization policies as well as due to weather fluctuations. A paradigm shift is needed in the post WTO regime where market forces play a greater role in price discovery and price realization. An efficient risk management system for agriculture will pressure the standard of living of those who depend on farming, strengthen the variability to farm business and provide an environment which supports investment in the farming sector.

The suggested support for risk management in agriculture is shown below.

4.1.5.1: Design of effective Risk Management Instrument in Agriculture for price stabilization

Price volatility has increased with sharp swings in product and input prices. Markets have been affected by macroeconomic disturbances, disease outbreaks and adverse weather events such as floods and droughts. With agriculture policies that are more decoupled from production and prices, farmers are now more exposed to market forces than the past. Risk management in agriculture is now an essential tool for farmers to anticipate, avoid and react to shocks.

There is a wide range of market based price risk management instruments available including futures. None of these instruments fundamentally alters the risky character of the markets. There are many obstacles hindering the use of market based risk management tools.

The Price Stabilization Fund operated by the Ministry of Commerce for plantation crops is not effective in addressing the price volatility. The price stabilization fund was established by the Ministry of Commerce based on a report of the NCAER for four plantation crops – Tea, rubber, coffee and tobacco, based on a price spectrum band by taking into account a seven year moving average of international prices. A restructuring of the scheme is required to make it useful for the farmers.
The recently introduced Price Stabilization Fund scheme of the Ministry of Agriculture in 2015 is simply a interest free working capital advance for the procurement of onion and potato. A comprehensive scheme for addressing price instability of perennial crops like coconut, rubber, spices, vegetables etc needs to be designed and financially supported from Government of India to improve livelihood security of farmers and agriculture development of the State.

4.1.5.2: Effective Crop Insurance

Crop insurance is used to share production risks. National Agricultural Insurance Scheme, modified National Agricultural Insurance and weather based insurance are the insurance schemes implemented with the support of Government of India. Crop insurance is a financial mechanism in which the uncertainty of loss in crop yields is minimized by pooling most uncertainties that impact crop yields, so that the burden of loss can be distributed. However in order to benefit the farmers more, a restructuring of insurance schemes are required. The limited expansion in the scope and content of crop insurance did not measure up to the expectations of the farming community.

Weather based crop insurance scheme has been under implementation from 2007 onwards including the pilot phase. The density of automatic weather stations and IMD observatories need to augmented. The requirement of a high density weather station networks needs to be supported by Government of India to make the scheme effective. The technical parameters of the scheme also to be re examined to make it more farmer friendly.

4.1.5.3: Agriculture Credit Risk Guarantee Fund

Due to vulnerabilities of small and marginal farmers to vagaries of nature and several other external factors, there is relatively high degree of risk associated in lending to agriculture sector and more specifically to small and marginal farmers, oral lessees, tenant farmers and landless labourers. The Financial Stability Report (RBI, June 2011) states, the asset quality under priority sector lending, especially agriculture deteriorated at a faster pace as compared to overall asset quality, which was a concern. The gross non-performing asset ratio (NPA) in respect of credit to the agriculture segment rose to 3.3% in March 2011 as against 2.4% in March 2010. The deterioration in the ratio was attributable to a rise to 60 percent in agriculture NPAs as against a growth of 19 percent in agriculture credit.
Establishment of credit guarantee fund to deal with the cause of distressed small and marginal farmers appears as efficient mechanisms to address the risk in agriculture sector. This will also protect lending institutions against perceived risks in lending to small and marginal farmers. Government of India may create a Credit Risk Guarantee Fund for Agriculture. Such mechanisms will encourage banks to extend loans liberally to small and marginal farmers leading to hassle-free credit to vulnerable groups in agriculture.

4.1.5.4: Income guarantee programme

The agrarian crisis could be effectively addressed through the introduction of income guarantee scheme. Income guarantee has been proposed as an effective instrument for safeguarding farmers, in the Kerala Agricultural development policy approved in 2015 also. The National Farmers Commission stated- progress in agriculture should be measured by the growth rate in the net income of the farm families…moving away from an attitude which measures progress only in millions of tons of food grains and other farm commodities – quoted in the policy document. The policy recommended the formulation and enactment of Farmer’s Income Guarantee Act which assures all farming households a dignified living income to meet the basic living expenses. A lead role by Government of India is required to design an Income Guarantee Programme for the farmers with significant financial contribution.

4.1.6: Interest subvention for short term and investment credit

Government of India provided 2% interest subvention scheme from 2006-07 onwards which was revised to 3 percent from 2009-10 onwards. Additional 1% interest subvention was extended to farmers who will repay loans on or before the due date fixed by the bank, subject to a maximum period of one year. Even though Government of India has allocated Rs.13000 crore in the budget 2015-16 for implementation of the interest subvention scheme for short term crop loans during 2015-16, it has been communicated to continue the scheme till 30th June 2015. It is reported that various alternative approaches for improving the efficiently of the scheme are being examined. Support for low cost credit is essential to improve livelihood of the farmers.

Currently at the All India level, private sector constitutes almost 85% of the capital formation in agriculture (Nabard 2014) Investment credit has emerged as the major driver
in private capital formation. However, the recent declining trend in investment credit vis-à-vis crop loan has serious implication for sustaining capital formation in agriculture. Investment made by farm households on farm equipment, machinery, livestock, irrigation, land reclamation, land improvements etc are included. Household investment would constitute around 90% share in private investment. The ratio of capital formation in agriculture to overall GDP has stagnated at a level below 3 percent. The average was 2.69% for the period 1990-95 to 2011-‘12 (Nabard 2014) at national level. A new interest subvention scheme for investment credit needs to be supported by Government of India for facilitating capital formation as well as to improve livelihood of small and marginal farmers.

4.1.7: Support for effective Monitoring and Evaluation

Effective monitoring and evaluation is vital for tracking and measuring results and throwing light on the impact of development interventions, remain challenging. Monitoring and evaluation requires selecting indicators of outputs and outcomes. Given the increasing demand for development accountability and impact, support of professional institutions and identified experts are required for conducting monitoring and evaluation analysis. Support of Govt of India in both will enhance the quality of the outputs of M&E works.

Capacity building programme is required for conducting quality monitoring and evaluation studies with the support of Government of India. Appropriate institutional tie up could be developed for capacity building of development professionals under the leadership of Government of India.

4.1.8: Support for Start Ups – TBIs

Start- ups have played and continue to play significant roles in the growth, development and industrialization of many economies of the world over. Globally technology based startup companies are registering in higher number than non-high-tech companies because of their growing importance in the new knowledge economy. Since the rate of generation and innovation in knowledge has become very fast, the rate of obsolescence of technology has also become fast and consequently the rate of mortality of startup companies have also gone up. Hence it is important that appropriate strategies are
framed for their long term survival. The startup sub sector must be vibrant in order to play a crucial role in economic and technological developments in the country. The Government should readily and freely assist startups to have access to necessary information relating to business opportunities, markets and services which would enable them to enter in new markets and expand their operation. Government should establish business information centers and business support center for offering advisory and mentoring services to entrepreneurs. There is a need to promote effective communication mechanisms between startups and technology producers in order to create awareness of newer technology available and transfer of technology and easier access to them. The existing relationship between Research and Development institutes and startups need to be strengthened. There is need to promote the establishment of startups coordinating units in research and development institutions in order to facilitate assistance to these firms. The creation of frameworks for joint research projects that addresses sectoral needs of startups such as technology support needs and technology information infrastructure is imperative. There is a need to support technology acquisitions and upgrading by startups through a number of arrangements such as technical assistance, joint ventures, franchising etc. The understanding, application and use of patenting among startups should be encouraged and promoted. There is a need to promote the creation of integrated networks of startups. The functioning of S&T parks & TBIs needs to be expanded.

4.1.9: Minimum support price for Horticulture Commodities

Horticulture commodities are not covered under the Minimum Support Prices (MSP) mechanism and therefore, the farmers, at times, don’t even recover their cost of cultivation, being fully dependent upon the market for disposal of their produce. The farmers suffer the most on account of steep fall in prices. At present GoI announces MSP for 25 major agricultural communities, covering important cereals as well as pulses, oil seeds, cotton, jute, sugarcane and tobacco. Horticulture crops like vegetables may be covered under the scheme.
4.1.10: Linkage and support of Technology Information, Forecasting and Assessment Council (TIFFAC)

Technology Information, Forecasting and Assessment Council is involved to look ahead in technologies, assess the technology trajectories and support technology innovation by network action in selected technology areas. Support of TIFFAC at state level will help to locate technologies suited for the State as well as to conduct studies on technologies related areas relevant to Kerala.

4.1.11: Trade Information Support

Additional Support is required for providing value added trade information. Monitoring of input/output data at State level, interstate trade information, import/export etc are important for framing policies for crops relevant to Kerala. The growing Regional Trade Agreements and bilateral trade agreements signed by Government of India without consulting States seems to have significant adverse impact at state level in some areas. Often details are not available at state level about the likely benefits, likely consequences, details of the agreements etc. In order to monitor the trade flows, a mechanism is required. The efficiency with which information services can be disseminated could be improved with the support of the State Govt agencies. The monitoring of domestic and international prices, assessment of future trends/forecasts, short-term forecasts of various commodities etc are important in decision making. This is more important for States like Kerala where long duration crops are cultivated. Support of Government of India is crucial for developing such an information base and monitoring on continuing basis.

4.1.12: Support for innovations

Farmers are addressing livelihood constraints and exploring new opportunities by experimenting with unique combinations of indigenous knowledge and new ideas. The local innovations include both hard technologies such as tools and implements as well as new ways of communication, application of electronics, management practices, other technology innovations, new varieties or marketing.

The government plays a fundamental role, supplying the economic, social and institutional conditions that faster innovation. The capacity for technological innovations
needs to be greatly enhanced in order to strengthen innovations and research and development capacity. Locally controlled innovation support funds that would allow farmers to invest in their non-research needs to be provided. A significant support is expected from the Government of India to foster innovation.

4.1.13: Support for agro ecological unit project

On the basis of climate, geomorphology, land use and soil variability, the state has been divided into five Agro Ecological Zones (AEZ) and 23 Agro Ecological Units (AEU) with the help of the National Bureau of Soil Survey and Land Use Planning, Bangalore. Out of 23, 5 are identified for the special soil and hydrological conditions in the coastal zone requiring unique management strategies. The districts have been divided into separate Agro Ecological Units on Panchayat wise. Each AEU is a homogenous agricultural region in the district characterized by distinct ecological responses to the macro-elements which are reflected in the vegetation, soils and agricultural land use.

The core approach in agricultural planning is driven by recognition that growth to a new plateau of performance cannot be achieved by continuing existing approaches and practices in the State. It is essential to prepare strategies and action plan for each AEZ and AEU for the development of agriculture and allied sectors. Each district has been divided into agro ecological units on Panchayat basis within the overall framework of technical parameters. The yield gaps as well as the potential and issues in AEZ/AEU have to be addressed separately considering the socio economic setting. There are several region specific gaps which limit the opportunity of realising higher yield of the crops/livestock/fish potential. Future crop yields and food security may hinge on the ability of farmers to narrow the gap between the current yields and yield potential ceilings. The Agro Ecological Unit wise and consolidated district level yield gaps for various crops, technology adoption index for various practices, occurrence of pests and diseases, soil fertility, constraints like labour availability, marketing, mechanization, irrigation and researchable issues are to be addressed on AEZ/AEU wise for the growth and development of agriculture in the state. The state desires to implement pilot projects for the revitalization of agriculture based on the agroecological delineation of the state. Support from the Government of India is highly essential for the implementation of the project.
Fig. Agro Ecological units of Palakkad District
4.1.14: Implementation of Lead Farmer Centred Extension Advisory and Delivery services (LEADS) project for innovative extension

Farmer led innovation in the Agriculture is the process which individuals or groups develop and apply improved ways of management or technologies. A number of outstanding and innovative farmers were available in the system and effective use of them in technology dissemination were not utilised. A pilot project on mainstreaming lead farmers in technology dissemination was initiated in two districts where in three most innovative farmers from each panchayat were selected and around them three satellite groups were constituted- Lead farmer centered extension advisory and delivery services-LEADS- For two panchayats one vocational Higher secondary trained personal was appointed on contract basis for regular field visit to the lead farmers. Support for disseminating new technologies was also provided to the farmers. Mobile phone was provided to lead farmers, contractual staff, regular staff, and convener of satellite groups for regular mobile phone based communication. Monthly Technology Advice (MTA) was prepared with the support of multidisciplinary team from universities, research stations, KVKs as well as retired professionals in advance for regular dissemination to lead farmers, groups, officers, farm schools etc. The project was extended to two more districts in 12th plan. Setting up of plant clinics at Panchayat level is another extension of the project where diagnosis and advisories for the management of pests and diseases was extended to help the farmers. Agroservice centres established at block level is supporting the labour requirement and other service requirement of farmers. Farmer innovations are promoted with a small financial assistance for further refinement. The pilot project needs to be scaled up for implementation to all districts for the revitalisation of agriculture. Financial support for the innovative extension system is essential to scale it up to all districts for the revitalisation of agriculture.

4.1.15: Marketing support

APMC Act is not implemented in the state. Private trade is predominant in agriculture for various commodities and exploitation of farmers by the middle men are widely reported. Setting up of farmers market is an alternative option tried for fruits and vegetables and the result is encouraging and the farmers share in the consumers rupee is more in those markets. The setting up of these markets was pioneered through the Fruits
and Vegetable Council of Kerala. Expansion of farmers markets, setting of cold storage facilities as well as local cool chambers and other infrastructure support for the markets are highly essential to support the marginal and vulnerable farmers. A major support from government of India is expected to set up a network of farmers market in the state.

4.1.16: Food processing and value addition

It is well demonstrated that secondary agriculture can add two to three fold value to the primary agriculture and can thus invigorate the agricultural economy. The fact that farm size itself has dwindled to below a level that can provide subsistence to a farmer is a matter of serious concern. Secondary agriculture is highly complex as it involves old as well as new technologies, capital investment, investments in rural infrastructure, technology, marketing etc. Agro commodity based high end processing industries are at an embryonic stage of development. It is capital intensive and highly competitive. Additional support in terms of funds, technical as well as institutional tie ups are highly essential to nurture the nascent sector. The State government has recently started the production of NEERA drink from coconut for improving the income of coconut farmers. A number of pilot projects have been established in the State with the initiative of growers associations for the production of NEERA. A major support from Government of India for agro processing and value addition can go a long way in revitalisation of agriculture in the State.

4.1.17: Support for expansion of Mechanisation and new trends in technology

Mechanisation has played an important role in the development of modern agriculture. Several innovative machines are being introduced in agriculture sector both from within the country as well as from other countries. The spread of mechanisation will to a great extent improve the viability of farming. Similar to mechanisation a number of new technologies are being developed in the public sector as well as in private sector. Another set of new technologies are available in other countries. A major support from Government of India is required for the introduction and expansion of new technologies in agriculture.
Support required for Fisheries sector from Government of India

4.1.18: Regulation on Juvenile fishing

The juvenile fishes are over exploited for the production of poultry/ cattle feed. It creates serious problem to the management of marine fishery. At present Kerala is regulating minimum legal size of commercial fishes for capture and marketing. It can be disseminated to other States. A National policy to prevent juvenile fishing is to be evolved.

4.1.19: Regulation on Aquaculture

Farming of fast growing varieties like GIFT, Nattor, Vannamei etc shall be promoted after observing all bio-security measures. The State has enforced an Act for ensuring the quality of fish seed. It can be taken-up by GoI to have consensus of other States and framing a national policy for the same.

Forest & Wild life Act is a hurdle against the development of reservoir fisheries in stocking and capturing fish. Regarding fish varieties, the right to fishing include a species in the purview of Forest & Wild life protection Act shall be vested with the Fisheries Department. Stocking and capturing of indigenous fishes which are not threatened/ endangered, shall be allowed in the reservoirs even comes under notified area.

4.1.20: Apprehension of the State with the Expert Committee on Sea fishing

The Expert Committee has made 19 major recommendations out of which many of them are harmful to the fishermen of the coastal State of Kerala. The committee has formulated its recommendations without taking into consideration of the views of the fishermen especially the traditional fishermen as well as Department of Fisheries of the State of Kerala and the concerns of the other stake holders or concerned officials. The following recommendations are specifically harmful to the traditional fishermen of our State.

4.1.20.1: The Committee's recommendation is to keep the area from 200 to 500 meter depth as Buffer Zone. This area falls within the active fishing area of the traditional fishermen. Keeping buffer zone in the guise to augment the resources and to diversify
existing fish fleet will of course affects our fishermen adversely especially the traditional fishermen and the benefits out of this will be favorable to the foreign vessels. At present the LOP (Letter of Permit) vessels which are conducting fishing in the said area themselves exploit the resources on a large scale. Even now the fishermen in the State are not getting sufficient catch because of the large scale exploitation of the fishes by the LOP Vessels.

4.1.20.2: The recommendation to consider 1178 Deep Sea Fishing Vessels by incorporating additional 270 vessels in the Exclusive Economic Zone is also a recommendation which is harmful to the fishermen in the above said background. The State strongly feel that the existing vessels themselves collect the resources fully, part of which is deserving to the traditional sector. Introducing more Deep sea vessels in the Indian EEZ will adversely affect the interest of traditional fishermen.

4.1.20.3: Another recommendation which causes strong protest is to acquire foreign vessels and foreign technology by joint ventures or leasing. This recommendation is also against the interests of the fishermen of our State. Without giving adequate training to our people and without strengthening the field by sophisticated vessels having sufficient facilities, if we go for the acquisition of foreign vessels and foreign technology, the Indian sector will never become self sufficient. It may be noted that in the committee report there is no effective suggestion to strengthen the Indian fisheries sector and without trying for that the committee recommend to liberalize the security clearance of foreign fishermen and foreign vessels.

4.1.20.4: The recommendation to re-consider the prohibition for fishing now being imposed to the LOP vessels in certain designated areas in the sea will also lead to over exploitation of sea wealth.

4.1.20.5: The traditional fishermen in Kerala are conducting fishing in the Exclusive Economic Zone also for their livelihood. At present in the State of Kerala, trawl ban is being implemented for 47 days and the period is from June 15th to July 31st of every year. This period coincides with monsoon. The traditional fishermen fishing by using traditional methods are exempted from trawl ban. The committee's main recommendation is to extend the ban period from 47 to 61 days in the west coast, ie from Jun 1 to July 31 of every year
and to make applicable the ban period to all types of fishermen including traditional fishermen. It will adversely affect more than 10 lakh of fishermen population of Kerala State.
Chapter 5: Best Practices

Given the renewed interest in agriculture, there is a need to take stock of promising initiatives and opportunities and promote mechanism for upscaling of successful models.

5.1: Best Practice I:

Direct Benefit Transfer to all beneficiary farmers in Kerala by the Department of Agriculture – Towards a complete coverage

Creation of India’s first Farmer’s Database and the most transparent system of disbursing agricultural subsidies using e-payment bring a transformation of governance in the Agricultural scenario of Kerala. The adoption of Online Farmer Registration Database and e-payment using Electronic Benefit Transfer during 2012-13, facilitated faster service delivery in Agricultural Subsidy Administration by Department of Agriculture. Lack of Online Farmer Database prevented Agricultural Department in the delivery of services effectively to farmers in time and resulted in excess paper work and several visits to Krishibhavans by the farmers. The system of subsidy transfer needed to change to give farmer more time for concentrating in farming and Department staff more time to visit farmers field and transfer modern agricultural technology to farmers for enhancing crop production, productivity and profitability. Adoption of Online Farmer Registration Database and e-payment using EBT software resulted in more emphasis on the finer points of Governance, such as farmer centricity, service orientation and transparency. Agricultural Department of Kerala as a pioneer in the application of IT for the benefit of the farmers views ICT as vehicle for transforming Kerala’s agriculture in to a knowledge-based, economically vibrant, democratic and inclusive activity for the benefit of farmers.

The project was implemented from the year 2012-2013 as per the decision taken by Government of Kerala. The project was envisaged for e-Payment of subsidies to farmers with an IT-enabled e-Governance System, in view of the huge amount of subsidy spent by the Department and lakhs of farmers on the receiving end.

The project is supported by the comprehensive and user friendly portal developed by the National Informatics Center (NIC) for Farmer Registration and the software for Electronic Benefit Transfer for Government of Kerala developed by NIC, Thiruvananthapuram for the use of various Government Departments of the State.
Purpose and priorities

The main purpose of the project was to create an online farmer database and the direct transfer of subsidies to the farmers’ accounts within the shortest possible time and with the following priorities:

1. Creation of an Online Farmer Database for effectively delivering services to genuine needy farmers. Farmer data like contact details, bank details, family member details, identity details, land details, farming and harvesting details, irrigation details, equipment details, membership details, insurance details, fertilizer and pesticide details, seed procurement details, loan details, loan repayment details and Krishi bhavan details etc are captured in farmer database for effective service delivery.

2. Directly credit Agricultural subsidies to Bank account of farmers which is secure, faster, efficient and transparent. Use of claim processing and e-payment software to reduce delay and avoid errors in e-payment.

3. Provide field level officers more time for filed visit and transfer of technology resulting in better adoption of technology and increasing production, productivity and profitability of farming. Find more time to the Agricultural officers in discharging their agricultural extension activities.

4. Minimize the burden to farmers to be in contact with the Panchayath level offices (Krishi Bhavans) for getting their benefits in time. Cut short the procedures to the minimum for the farmers

Strategies adopted

Technology intervention by e-Government, brings about large-scale changes in all parts and components of soft and hard systems, namely the organization, people, technology, procedures, and rules and regulations.

The strategy adopted was to concentrate at the following levels

1. Technology Level: Emphasis given for speed, functionality, user-friendliness, sophistication of delivery of service etc. Online Farmer Registration Database created with the help of the technology developed by the NIC and e-payment software
technology developed by NIC Kerala on behalf of the Government of Kerala were adopted, tested and customized for the Department of Agriculture.

2. **Process Level**: At the Process level, procedures, Rules and Regulations were concentrated. Necessary Government level and Department level orders and Circulars were framed and issued for streamlining the process.

3. **People level**: The main strategy at this level was to make the people aware about the change and prepare them to take the challenges so as to influence their working habits and attitudes and also help them to acquire the skills required for the new job. Multi-level Training programs were arranged for Department officials at various levels who are part of this project.

   A “Help Desk” facility has been initiated at the IT Division of Agriculture Directorate under the leadership of the Project leader for immediate redressel of complaints and for help and guidance to all Department officials. A detailed and illustrated “Hand Book” on e-Payment was also prepared and distributed with a view to empower the Department officials on this project.

4. **Organizational level**: The strategy was to keep in touch with all the stakeholders through meeting, Video Conferencing, evaluation meetings and making necessary interventions like execution of Service Level Agreements with the participating banks to ensure and enforce service quality standards.

   The stakeholders include the farmers, Department, participating Banks and the National Informatics Centre (NIC) Kerala, Kerala State IT Mission and AKSHAYA.

**Outcomes**

A data base of 18.77 lakhs of farmers have been created through the online software developed and maintained by the NIC. Subsidies worth Rs. 912.33 crores has been successfully transferred to thousands of farmers during 2012-13 to 2014-15.

**Creation of India’s first Farmer’s Database (http://kisan.gov.in/)**

- Data of 17,52,003 farmers already entered in Farmer Database.
- 18,77,749 applications collected from farmers.
Farmer data including contact details, bank details, family member details, identity details, land details, farming and harvesting details, irrigation details, equipment details, membership details, insurance details, fertilizer and pesticide details, seed procurement details, loan details, loan repayment details and krishibhavan details etc are captured in farmer database.

- Correct targeting of genuine farmers for agricultural subsidy distribution.
- Continuous updation of valuable statistics of individual farmers.
- Good source of information for planning, implementation and monitoring of agricultural development schemes.
- Simplification of procedures in application form.
- Real farmers getting agricultural loan and interest subsidy.
- Recognising farmers by issuing Agricard in association with Canara Bank.

**e-payment**

(www.ebt.kerala.gov.in)

- one of the most transparent system of disbursing agricultural subsidies in India.
- Subsidies directly paid to the bank account of the farmers.
- Farmers are informed about success or failure of fund transfer through SMS free of cost to the farmers.
- Subsidy paid to the farmers are published in website to ensure transparency.
- Delay in payment of subsidy can be avoided.
- Farmers need not visits to Krishi Bhavan to enquire about passing of subsidy/collection of subsidy amount.
- Paper work in subsidy disbursement can be avoided.
- Together with farmer registration software entire subsidy administration of Agricultural Department can be automated saving time, money and energy of farmers and officers.
- Right to information becomes easy due to publishing of beneficiaries list in website.
- Service Level Agreement obtained from participating banks to ensure service quality.
Digital signature and official email id given to all block level ADAs to ensure safety and security of data.

**Highlights of the initiative:**

- **Transparency and stakeholder participation:**
  
  The Software, Electronics Benefit Transfer for Government of Kerala has been conceived, developed and customized and improved for user-friendliness, transparency, accountability and reliability. This has been made possible by the overwhelming feedback and ideas of the Agricultural Department officials and other stakeholders like the participating Banks.

- **Innovativeness of the initiative and its replicability/ scalability:**
  
  The project is innovative in terms of the following grounds:
  
  - No database of the beneficiaries initially
  - This data are to be created for every season/year
  - Huge amount of subsidy
  - Multiplicity of schemes
  - Decentralized operations at block and krishibhavan levels
  - Insufficient supporting staff
  - This can be replicated for e-payment of subsidies in any Government Department including Local Self Government Institutions.

- **Increased efficiency and effectiveness in outcomes**
  
  The project was helpful in disbursing huge amounts of subsidies to lakhs of farmers within the shortest possible time with more accountability, transparency and less errors.

- **Sustainability of the initiative:**
  
  The success of the project has been proved that the model is sustainable and feasible in the coming years with the development of technology and innovative ideas. As a part of
continuous improvement efforts due to dynamic changes in technology the following activities are proposed to make world class services to Kerala farmers.

**Proposed Activities**

1) Aadhar Seeding and updation of all farmer data in database
2) Development of Android application of farmer database
3) GIS mapping and survey no based mapping of fields
4) Online application processing for agricultural subsidy.
5) Subsidy claim processing from farmer database.
6) Enabling e-payment subsidies through Post Offices using pincode and EMO code in place of IFSC code.
7) Enabling online fund transfer to farmers having account in Service co-operative Banks.
8) Simplification of process of transfer of e-payment file to bank and status file to ADA through web service.
9) Automation of the entire process and online auditing.

❖ **Facets of good governance demonstrated by the initiative**

- Simplification of application procedures and process
- Saving of time, travel, money and effort of farmer
- Subsidy to genuine farmers as per database and directly credited to the bank account
  - SMS sent to farmers to inform them about the status of the transaction.
  - As part of transparency, entire list of farmers who have received subsidy are published in website with details of schemes and amount of subsidy disbursed.

❖ **Systematic improvement of service**: For the preparation of claims and preparation of e-Payment list compared to the manual system and the procedures are much simplified. Application form was simplified and system of vouchers discontinued, resulting in saving of time, travel, money and effort of farmers. Transparency help to remove corruption.
- **Improved accountability and responsiveness:** Error in the data related to the details of beneficiaries may lead to mis-credit of the amount of subsidy. The accountability has also been ensured with the execution of the Service Level Agreement between the Department and the Participating banks. Registration of farmers ensure genuine beneficiaries and ease of operations make this much responsive among officials.

- **Public accessibility:** As the subsidy directly credited to the bank account of the farmer it will save time, travel, money and effort of farmers and help them to concentrate more on their core competency ‘farming’.

  ‘SMS’ alerts will be send to the farmers free of cost, intimating them about the credit or non-credit of subsidies to their Bank Accounts. This will enable them to collect their cash or to approach the concerned for rectification defects if any.

5.2. Best practice II

**Paddy production to direct benefit transfer: E Governance initiatives**

**Introduction:**

Kerala State Civil Supplies Corporation known as Supplyco is the implementing agency for paddy procurement, Processing and Marketing scheme. The main features of the scheme are De Centralized Procurement (DCP) and Minimum Statutory Price (MSP). DCP ensures that food grains grown and consumed locally are procured, processed and distributed within the region benefitting both farmers and consumers. MSP guarantees a minimum price for the food grains which is declared ahead of cropping season based on quality standards which instill confidence among farmers to undertake cultivation. Paddy procurement scheme is a blessing to strengthen the local economy. Supplyco has been the leading pioneer in integrating ICT -Information and Communication Technology in paddy procurement scheme to create accurate and reliable database, exchange information, and simplifying accounting procedures with increased accuracy.
Status:

Supplyco has successfully completed 9 years of scheme implementation. Harvest from August – September to December 31st is classified under first season and the harvest from January 1st to May 31st is under the second season. During 2014 August to -2015 May the gross cropped area registered was 140477 hectares, by 167327 farmers. Total quantity of paddy procured was 549421 MT. During this period Government declared procurement price of Rs.19 per kg which include Rs.13.60 per kg as MSP and Rs.5.40 per kg as SIB-State Incentive Bonus; which is the highest in the country.

IT application in Supply Chain: Supplyco has developed a web based platform to document the entire activities in the supply chain of paddy procurement scheme. The online website www.supplycopaddy.com collects data and exchanges information between the stakeholders involved in the supply chain. Supplyco’s information system has improved continually with a view to help the farmers, millers and consumers. Supplyco strives to ensure transparency, reliability and efficiency through out the chain.

Feature-1: Online farmer registration.

Online farmer registration process of paddy procurement scheme is the first and unique facility for paddy farmers in Kerala. Farmer registration module enables farmers to create descriptive profile of their cultivation. A structured and definitive database of padasekharams in the state has been developed. Farmers can access the website during the cropping season from any region without any time constraints. Nearly 90% of the farmers complete online registration process within 45 days of sowing. Subject to verification of cultivation the applicant will be provided an unique number by which the future transactions are monitored. Farmer can access the website any time to know the status of activities related to the scheme. The real time information based on spatial and temporal parameters about paddy cultivation is valuable for development and sustainability of its supply chain. Clear and precise data about crop acreage, yield and the profile of farmer is the advantage of such system. When paddy is procured the database will be updated with production figures.
Figure : 1-Screen shot of the website.

Feature -2: PRS computerization.

PRS- Paddy Receipt Sheets are issued to farmers to acknowledge the receipt of paddy by Supplyco. The conventional practice of writing quadruplicate copies consisting of farmers details which were submitted at the time of registration were replaced with more technologically advanced and efficient transfer of data using hand held device with GPRS facility. The quantity of paddy collected and the destination of storage is recorded through the hand held device which communicates with website server real-time. When paddy arrives at storage point the data is cross verified and stock is taken into account. The payment process is then initiated so that the amount due to farmers are transferred directly to their bank account. Farmers save their valuable time, money and energy when compared to the conventional method as the payment process is electronically managed. Error free data transfer between field, mill and to office has not only simplified payment process but also reduced time taken for effecting payments.
Figure: 2- Poster depicting E PRS Method

The website cum database and its features are hailed as best e governance initiative by Supplyco. Officials and millers rely on the information system to streamline their routine works. It helps planners to forecast the production and analyze the yield pattern. A decision support system is being developed to help scientists to improve the quality of paddy correlating the information to the soil conditions, variety, season, cropping pattern, and cultivation practices. Inventory management of 5.5 LMT paddy and fund management of Rs.950 crore within a span of nine months is precisely carried out with the help of web based information system. Supplyco has directly benefited from saving valuable human resources; otherwise could have been a herculean task implementing the scheme within time frame. Customized versions of the above mentioned features for other crops will surely herald new dimensions in agricultural development.

5.3: Best Practices III

ATMA plus model of extension - Innovations First

Realising the fact that public extension services need to be geared up particularly in addressing the emerging technological and knowledge needs. The extension support to farmers under support to state extension programme for extension reforms is provided
through a basket of activities called ATMA Cafeteria, which covers activities that are to be implemented at both state & district levels. District level activities are further categorized in to four groups viz, (a) Farmer oriented activities (b) farm information dissemination activities (c) Research extension-farmer activities (d) Innovative activities based on SREP and the block action plan jointly firmed up by the Block Technology team (BTT) and BFAC. Additional managerial and contractual manpower were provided for implementing the work plan. However the weakness include absence of regular field visit, regular technical advisory system, mainstreaming farmers innovation, inadequate support of specialists, service support, inadequate focus on farming system approach and natural resource management, dedicated manpower at lower level for regular field visit.

There is an emergent need to restructure and strengthen the extension system to meet the challenges highlighted above. This restructuring and strengthening has to be a judicious mix of extensive physical outreach of personal, enhancement in quality through domain experts, regular capacity building, interactive methods of information dissemination, and innovative use of ICT. The extension approach therefore has to be a combination of strategies for augmenting the workforce to support the delivery of extension services to farmers with innovative approaches for managing the extension system.

It has been widely documented that farmers learn best from their peers. Setting up farmer led arrangements is a major challenge. Farmer led innovation in Agriculture is the process which individuals or groups develop and apply improved ways of management or technologies. A number of outstanding and innovative farmers are available in the system and effective use of them in technology dissemination were not utilised. A pilot project on mainstreaming lead farmers in technology dissemination was initiated in two districts where in three most innovative farmers from each panchayat were selected and around them three satellite groups were constituted- Lead farmer centered extension advisory and delivery services - LEADS. For two panchayats one vocational Higher secondary trained personal was appointed on contract basis for regular field visit to the lead farmers. An assistance of Rs.4000/- was extended to lead farmers for setting up demonstration units. Mobile phone was provided to lead farmers, contractual staff, regular staff, and convener of satellite groups for regular mobile phone based communication. Monthly Technology
Advice (MTA) was prepared with the support of multidisciplinary team from universities, research stations, KVKs as well as retired professionals in advance for regular dissemination to lead farmers, groups, officers, farm schools etc. The project was extended to two more districts in 12th plan.

In order to further mainstream the lead farmers as well as other critical gaps in ATMA, ATMA plus by integrating MTA for regular dissemination was extended to all districts during 2012-13 based on a revised SREP prepared in all districts simultaneously. Other components introduced include support for integrated farming system for diversification of income source, specific farmer field schools for IPM, support for precision farm schools, technology fund for introduction of any new technology, organizing technology meet along with KVK, specific initiatives on soil testing, model panchayat extension plan, organizing farmer groups as apex Farmer Extension Organization (FEO) at block level with specially trained farmers for training, needs of farmers, inputs, extension and services (TIES) for the group of farmers, documenting success stories, specialist contractual support at district level in agriculture, animal husbandry and fisheries and untied fund for district specific activities. In order to mainstream farmers innovation, a component on Farmer Technology Development (FTD) was introduced on competitive grant basis. For selecting technologies for support, Farmer Research Committee (FRC) was constituted at district level. Formal researchers are not included in FRC to avoid bias in technology development, by the innovative farmers.

**Farmers Innovation Fund**

Farmer innovation fund is designed to provide direct, fairly simple competitive access to small grants for individual farmers who wish to adapt, develop or adopt innovation on topics and of their own choosing. Access to such funding allows a wide range of innovations to be tackled and expand innovative capacity among small holders. They are designed to solve problems and to test innovations.
Towards service delivery

Increasing concern about the effectiveness of public extension systems means that Government and the development partners are grappling with the question of how to deliver extension which not only addresses information and technology need of farmers but also provides service delivery.

A network of agro service centers at Block level on self-sustainable basis was also established to provide labour support, planting materials, biopharmacy etc to support extension services. Each center is having a labour force attached to it. Initial equipments, partial operational funds and expert training were given while income and wages were on self-support basis. It is planned that the Agroservice center will be mainly concerned with extension and input related services.
The success of modified extension approach will depend on how it enhances the information flow along the agriculture value chain and whether this is done sustainably and effectively along with service delivery.

5.4: Best Practice IV

PLANT HEALTH CLINIC towards revolutionalising agriculture

Introduction

Plant Health Clinics were established under the scheme on crop health management for providing with adequate diagnostic and advisory facilities to farmers on time and also to facilitate ecofriendly and scientific pest management strategies to increase production and productivity.

Concept of Plant Health Clinic

The concept of Plant Health Clinic has been evolved to encourage comprehensive diagnostic and advisory services for plant health and pest control. Plant Clinics help to provide timely diagnosis of a wide range of ailments and recommend remedies to reduce losses, increase crop productivity and boost food security and food safety. A well-developed, multispecialty, farmer-centric Plant Health Clinic on lines of human clinic in rural areas helps farmers to get right diagnostic and mitigatory advice in time. An ideal Clinic is aimed at improving people’s lives by providing information and applying scientific expertise to solve problems in agriculture and saving their crops from ravages of pests and diseases through timely diagnosis and remedial measures, thereby improving crop productivity and their well-being. The activities of Plant Clinic extend beyond Plant Clinic, with emphasis on extension, keeping a vigil on invasive pathogen, promoting integrated pest management, monitoring pest/diseases distribution, their outbreak, issuing pest alerts, organising plant health camps for creating awareness regarding likely appearance of pests/diseases, strengthening mobile clinic approach during disease/pest outbreak, etc.
Functions of a Plant Health Clinic:

The major functions of a Plant Health Clinic are Diagnosis of samples brought by farmers, Provide proper management strategy based on actual observation and examination of the specimen., Play vital role in promoting locally relevant, affordable and environmentally friendly practices and technologies, Serve as an information hub for farmers to solve location specific field problems, Act as a centre for providing early warning of pest and diseases., Function as a centre to provide information regarding changing behaviour of already existing pests., Act as an exhibition centre of pest, diseases, weeds, plant protection chemicals, beneficial insects etc., Provide basic information regarding soil health status of the village ,Conduct field level work to prepare nutrient management plan so as to reduce excessive/unbalance fertiliser applications., Exhibit newer agriculture implements and other latest inputs., Clinic data also provide information on changing status of pests/diseases, Providing early warning of emerging threats., To act as a centre for collecting and preserving Indigenous Technology Knowledge. Release pest/crop advisory bulletins giving emphasis to the local problems and projecting latest technologies which could be of use to the local farmers., Conduct regular trainings, both theory and practical’s pertaining on latest technologies. To serve as a place where success stories can be projected among other farmers so as to enthuse them to adopt the newer models. ,To conduct plant health camps so as to contain the emerging field problems., To serve as a training and production hub of bio inputs such as On farm production of Trichoderma, Panchagavya, multiplication of beneficial insects etc.

Plant Health Clinic at Vadakkenchery, Palakkad district

A Plant Health Clinic was established at Krishibhavan, Vadakkenchery in Alathur Block of Palakkad district, Kerala State during 2013-14. In the initial phase the functioning of the Plant Health Clinic was mainly on pest and diseases diagnosis but during when the pest surveillance was progressed the functions of the Clinic extended beyond diagnosis to advisories and various field activities for the benefit of farming community. The Clinic is acting as a valuable addition to the extension services as Plant health advice opened up to many more people in a convenient and accessible way. The Plant Health Clinic at Vadakkenchery is now promoting various sustainable technologies such as Ecological
Engineering, Agro Ecosystem Analysis, Onfarm production of biocontrol agents etc along with regular pest and diseases diagnosis and surveillance based advisories. The activities and outreach activities of the Plant Health Clinic is acting as a total solution which strengthens the whole plant health system.

Plant Health Clinic Established at Krishibhavan, Vadakkenchery, Alathur Block in Palakkad District

Activities conducted at Plant Health Clinic

Pest surveillance and advisories

Pest surveillance is the systematic monitoring of biotic and abiotic factors of the crop ecosystem in order to predict the pest outbreak, study of ecology of pest, population dynamics, key mortality factors which in turn helps in devising the appropriate management strategies. Surveillance units were established in farmers fields for five crops such as Paddy, Coconut, Banana, Vegetables and Pepper and plant health information were collected from field on a regular basis for reporting the pests and diseases and its management Based on the plant health information received from fixed plot and rapid roving survey, advisories were prepared and pest and diseases were forecast on biweekly interval and disseminated through local newspaper which includes need based management
strategies. The advisories and recommendations were compiled every month and released to farmers as Vila NireekshanaPathrika (Pest News Bulletin) named “Susthira”. During the year 2014-15, 8 nos of Susthira were published and distributed to farmers. The Susthira Printing charges were met from the fund Plant health Clinic under Crop Health Management Scheme of Department of Agriculture.

The farmers brought plant parts or report the problems of their crops at the plant health clinic. Cause of the problems was investigated and determined using diagnostic tools at Plant Health Clinic. In some cases field visits were also done to analyse field situations to ensure proper diagnosis. Proper diagnosis helps in selection of appropriate management practices so as to minimize pest and diseases and put them under control.

A museum of pest and diseases of crops was set apart at Plant Health Clinic including herbaria and insect box. Herbaria are the collections of biological specimens which are dead, dried, pressed, preserved and stored along with the information about the specimens. The diseased plant parts were preserved using preservation techniques either wet or dry in the Plant Health Clinic and causal organisms were isolated and slides were prepared and kept at Clinic for further use. The insect pests were pinned in insect box with proper labels. Herbariums of weeds species were also prepared and preserved at Clinic with proper label. Insect zoo studies were also conducted at regular intervals and when new pests were noticed in the field and when farmers wanted to see different stages of the pest. Live insects, caterpillars, pupae etc collected from field were reared at Clinic using polythene covers and plastic containers. This would help to study the stage and life cycle of insect pest and its feeding habits. The parasitoids were emerged from infected larvae and pupae of insects which explained about the parasitisation. Predators were also reared at clinic to explain about predatory nature of them. The knowledge bank is a collection of various information regarding cultivation of crops, pest and diseases and its management practices as well as on-line resource for diagnosis and to identify pests. It contains simple fact sheets which give specific practical advice on individual pests. Fact sheets were also prepared in local languages for extension staff and farmers. A library was established for this purpose at Plant Health Clinic. The library contains Magazines, Journals, Books, CDs, DVDs, Fact sheets and Field cards of pests for reference.
**Agro Bio Pharmacy**

An array of products ranging from tobacco decoction to pheromone traps and many of the new generation products are displayed here at the clinic. Safe use of insecticides is just one of the numerous tools of Integrated Pest Management recommended by agricultural scientists to safeguard soil and human health. At this Agro pharmacy farmers were able to get first hand information on various botanicals, bio control agents and new generation pesticides so as to adopt safe to use agricultural practices.

Farmers, however, usually depend solely on chemical insecticides as they think that this is the only practical control measure to obtain quick results. The Agro Bio pharmacy offers organic and safe to use substitutes to toxic chemicals.

**Capacity building on pest management and pest surveillance**

Trainings were given on Ecological engineering in various crops and Paddy was very effectively demonstrated in field with the technological support from NIPHM, Hyderabad. Trainings on scientific and eco friendly pest and diseases management of major crops such as Paddy, Vegetables, Banana etc were provided at Plant Health Clinic to farmers utilising funds of ATMA, ATMA PLUS and Department schemes. The importance and method of application of various biocontrol agents such as Pseudomonas, Trichoderma, Azospirillum, Trichocards were popularised at Plant health Clinic. These bio control agents were supplied at 50% subsidized price using the funds of LSGD and department of agriculture schemes. Awareness campaigns on pest surveillance, eco-friendly management practices, reduced use of pesticides, use of biocontrol agents, safe and judicious use of pesticides including new generation pesticides were given to farmers at Plant Health Clinic using various ATMA and Department of Agriculture schemes. ATMA pest surveillance groups were established for the reporting of pest and diseases at Plant Health Clinic. The groups were also collected specimens and insects for display at Plant Health Clinic. Plant health camps were organised at Plant Health Clinic on every 4th Saturday with the support from KVK, Pattambi.
On farm Production units of bio control agents and botanicals

Training on On farm production of Pseudomonas and Trichoderma were initiated at Plant health clinic using the technology from NIPHM, Hyderabad. Production units were established in the field by the farmers. On farm production and use of various growth promoters, bio pesticides, bio control agents, botanicals were demonstrated to farmers under various schemes at Plant Health Clinic.

Conservation of natural enemies in Paddy Ecosystem

Major thrust was given to conservation of natural enemies in paddy ecosystem thereby avoiding pesticides application. The pest surveillance and Farmers Filed Schools were effective tools used at Plant Health Clinic for the conservation of natural enemies in the field. The pest: defender ratio was better informed by framers through pest surveillance and Farmers field schools. The ricker mounts of natural enemies were prepared and exhibited at Plant Health Clinic so as to identify them by the farmers.

Farmer Field Schools

Farmers were effectively empowered through FFS based on Agro Ecosystem Analysis (AESA) so as to promote environmentally sustainable plant health management with the participation of farmers. An FFS was organised in Paddy crop during 2nd crop season at Kuruvai Padasekharam (Collective of paddy fields) with 18ha of area. The outcome was non pesticide management in paddy with 30% increase in yield and a reduction of 25% in cost of cultivation of paddy.

Promotion of nutrient management plan

The nutrient management plan based on soil test data was published for Vadakkenchery Panchayat by the Department. The nutrient management based on soil test data is being popularised here. There is a rapid soil testing facility using soil testing kits at Plant Health Clinic. During trainings the importance of application of soil ameliorants were demonstrated to farmers at the clinic. Soil testing was also undertaken using the Mobile Soil Testing facilities of the Department of Agriculture.
Outcomes/Benefits accrued to farming community

Farmers from various part of the panchayat, block and districts visited Plant health clinic for various queries and ecofriendly management practices were recommended to them. The timely advisories through newspapers helped the farmers in taking up prophylactic management measures at the earliest. The farmers were convinced about the effectiveness of adoption of ecofriendly crop and pest management in crops. The increasing shift towards safe to eat food products following the growing awareness about the ill-effects of chemical fertilisers and pesticides has encouraged people to experiment with cultivation and consumption of safe to eat food products. The farmers are now selling their organic products under the brand name “Safe to eat products” which gave them an attractive price.

Comparative Analysis of the Scheme on Crop Health Management

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Key result areas</th>
<th>Deliverables from Plant Health Clinic</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bi-weekly plant health advisories</td>
<td>Nil</td>
<td>Biweekly advisories released through newspapers</td>
</tr>
<tr>
<td>2</td>
<td>Monthly Vila NireekshanaPathrika (Pest News Bulletin) “Susthira”</td>
<td>Nil</td>
<td>Released 8 editions of Susthira and distributed among 8000 farmers in Alathur Block</td>
</tr>
<tr>
<td>3</td>
<td>Field guides for identification of pest and diseases</td>
<td>Nil</td>
<td>Field guide of pest and diseases of Paddy, Vegetables, Banana, Pepper and natural enemies of paddy were prepared</td>
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<td></td>
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</tr>
<tr>
<td>4</td>
<td>Library</td>
<td>Nil</td>
<td>A library was established at Plant Health Clinic with books, magazines, journals, digital materials, leaf lets and other publications by various institutions.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Creation of knowledge bank with all available information which can be used by extension staff as well as farmers for the proper identification and diagnosis of problems and selection of remedial measures.</td>
</tr>
<tr>
<td>5</td>
<td>Agro BioPharmacy</td>
<td>Nil</td>
<td>Information and display of biocontrol agents, botanicals and method of preparation, traps, pheromone traps, new generation pesticides etc.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Farmers are getting first hand information on agro bio inputs and products and how to produce it and use it in their fields for the better adoption of technologies based on the principles of “seeing is believing.”</td>
</tr>
<tr>
<td>6</td>
<td>Live specimens and insect zoo studies</td>
<td>Nil</td>
<td>Herbarium of affected plant parts, live insects, ricker mounts and insect zoo studies</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>First hand information on pests, their biology, life cycle, mode of attack, behaviour for the better understanding of pests</td>
</tr>
<tr>
<td>7</td>
<td>Awareness on plant health management</td>
<td>Yes</td>
<td>Now more effective awareness through plant health clinic</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Adoption of ecofriendly and sustainable practices and Reduction in use of pesticides their by reduction in cost of cultivation and sustainability in production</td>
</tr>
<tr>
<td>8</td>
<td>Trainings</td>
<td>Yes</td>
<td>Now more effective trainings with newer technology from NIPHM, Hyderabad</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Improvement in cultivation, increase in yield, and income of farmers.</td>
</tr>
<tr>
<td>9</td>
<td>Farmer Field Schools</td>
<td>Yes</td>
<td>Agro Eco System Analysis was gainfully employed during the Farmer Field School to analyse field situations with regard to pests, defenders, soil conditions, plant health, influence of climatic factors and their interrelationships on paddy.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Critical analysis of the field situation every week helped the famers take appropriate decision on management practices. Reduction in pest resurgence and conservation of natural enemies are other outcomes their by reduction in pesticide usage.</td>
</tr>
<tr>
<td>10</td>
<td>Community empowerment</td>
<td>Yes</td>
<td>Now thrust was given to empower farmer groups for better plant health management</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Farmer to farmer extension can be possible. Rapid spread of technologies among farmers.</td>
</tr>
</tbody>
</table>
Conclusion

The plant health clinic can become an extension tool for providing quality services through various activities at clinic level and at field level. The farmers are very much convinced about the need of plant health clinic which provides them a sustainable solution to their farming activities. The activities and outreach activities should be more strengthened to extend the plant health clinic as a total solution to our plant health system.

5.5: Best Practice V:

Farmer Markets of Vegetable and Fruit Promotion Council of Kerala

5.5.1: Introduction

VFPCK has conceived and implemented the concept of group marketing with broad objective of equipping the SHG farmers to take better marketing decisions by improving their skills and knowledge and by analyzing market situations. The council has taken all efforts to make marketing system suitable and to be an economically viable and a socially responsible venture.

The concept of group marketing is developed with the goal to ensure remunerative and stable prices to the farmers in their respective areas. Marketing activities envisaged more of independence and security to the farmers based on the group-marketing concept. It also aims to develop their bargaining capacity by organizing them both at SHG and FC level. Farmers pool the produce at a predetermined place and time through mutual co-operation. The large volumes induce traders to visit the farmers at these sites. On the other hand the farmers are in a better position to trade and negotiate with the traders in order to optimize their returns. This process where in farmers collectively negotiate with the traders at a
A predetermined place and time is called group marketing. This place is now familiarly called SWASRAYA KARSHAKA SAMITHI (FIELD CENTRE)

5.5.2: Advantages of farmer markets of VFPCK

- Bargaining power of the farmers will increase.
- Transparent weighment (weights and measures stamped)
- Prompt payment from traders with in the prescribed period.
- Reduce time spend by farmers in taking produce to markets and selling it.
- Better price realization for the produce.
- Intermediaries are avoided. Direct trading between farmers and traders.
- Clear-cut grading criteria.
- Reduce cost of marketing and transportation.
- Post-harvest handling losses are reduced to the minimum.

5.5.3: Activities of VFPCK farmer markets in brief

Under group marketing, 10-15 Self Help Groups (SHGs), numbering about 150-200 farmers, come together under the banner of Swasarya Karshaka Samithi (SKS), bulk and trade their produce collectively. This helps the farmers to have a good volume thereby being in a better position to negotiate with the wholesalers in order to 'optimise their returns'. There are 3 stages in the formation of a market

In the initiation stage, the samithi starts off as an unregistered organisation. During this period farmers bulk their produce at a central location and negotiate collectively with traders. The SKS pass through this stage and attain a certain pre-fixed benchmarks then the samithi is upgraded to implement various management systems. During this phase, referred to as the stabilisation stage, the samithi secures a legal identity and is registered under the Indian Societies Act (1860) / Travancore-Cochin Literary Cultural Scientific Charitable Societies Act (1955). The next phase is a self-sustaining stage where the samithi grows and improves upon its market and financial position to become a self-sustaining organisation. The farmer markets in a district are networked to form a district level farmer market apex body called Consortium.
There are 270 farmer markets functioning across the 14 districts of Kerala and an additional 6 more new farmer markets will be initiated during this year. The farmer markets have been instrumental in helping the farmers realize increased returns. During the year 2014-15, the farmer markets undertook trading of fruits and vegetables worth Rs. 259 crores.
The activities of Markets are coordinated and headed by the president. There are two stages in the formation of a market

- Stage I – Bulking point
- Stage II – Field center (Swasrya Karshaka Samithy)

5.5.4: Market Management

Marketing master farmers of the SHG’s join together to form a committee to manage the field President and Treasurer. These elected master farmers will hold their positions as per the centre. The committee members conduct Meeting to elect the President, Vice bye law. The committee should elect governing members for the next term before the annual general body meeting. The FC management team consists of the elected master farmers from the committee and VFPCK officials. The no: of VFPCK officials should not be more than three. The VFPCK officials do not have any voting rights and they are not eligible to hold any positions like president, vice president and treasurer in the committee. The management team can appoint a paid secretary to look after the day-to-day activities and the FC management team should monitor him.

5.5.5: Other activities of farmer markets to support marketing of the produces

- Analysis of market volumes and price to help them take marketing decisions (data collected through VFPCK Market Information Centre)
- Training for Marketing Master Farmers to help them negotiate with the traders, post harvest handling and grading
- Trade linkages to ensure traders reach the other markets nearby
- Help for the markets to open a retail counter in the nearby towns
- Production Planning to grow produce when its price is likely to be highest and
- Management support through VFPCK field team in order to assist the samithis in conflict management, marketing planning, office management etc.,
- Market Intervention supports

For providing remuneration price to grower during peak harvesting season market Intervention support will be arranged to stabilise the price of fruits and vegetables. VFPCK markets resort to distress sale when there is glut and have to settle for un-remunerative prices. In this context VFPCK has established fruit
and vegetable retail outlets viz, “SASYA” By sourcing the produce from farmer markets the benefits of better price realization can be passed down to the farmers.

5.5.6: Salient achievements of VFPCK markets

- Total no of markets- 270
- Total quantity traded- 259 crores/year
- Total farmers benefitted- 125000
- No of markets with permanent land and building- 120
- No of markets where input supplying centres are working- 135
- No of Sasya retail markets attached to SKS - 130

5.6: Best practice VI

PROJECT ON SOIL BASED PLANT NUTRIENT MANAGEMENT PLAN FOR AGRO-ECOSYSTEMS OF KERALA – Soil Health Cards to District Nutrient Management Plan

The Kerala State Planning Board had initiated a Project on ‘Soil based plant nutrient management plan for agro-ecosystems of Kerala’ in August 2010. The project was implemented by the Department of Agriculture in association with various Central and State government research institutes and the Kerala Agricultural University under the leadership of National Bureau of Soil Survey and Land Use Planning (NBSS & LUP), Bengaluru. Over 1.75 lakh soil samples had been collected from farmer’s fields of around
900 panchayats, municipalities and corporations, representing the major land use systems covering all the agro-ecological zones of the State.

**Soil analysis**

Soil samples were analyzed for 13 parameters (pH, electrical conductivity, organic carbon, available phosphorus, potassium, calcium, magnesium, sulphur, copper, zinc, boron, iron and manganese) with the support of 27 laboratories under the State and Central government institutions. For standardization of soil analysis, a laboratory manual outlining the procedures and protocols for sample collection and chemical analysis was issued to all the participating labs.

The data sheet of 1,74,305 soil samples covering 13 parameters mentioned above were thoroughly scrutinized for errors in chemical analysis/ data entry. Based on the scrutiny, meetings were convened with the concerned scientists/project associates and corrective measures suggested for quality checks in chemical analysis, data entry and uploading of analytical data.

**Development of software for generation of soil health cards**

As part of the project, software for online data capturing, processing and generation of soil health cards was developed by IIITM-K, Thiruvananthapuram. Three stages are involved in the process. The initial process was to capture the relevant data (farmer, crop, soil sample number and other details) through an online interface for all the 27 participating laboratories and generate a unique sample code and farmer ID. The basic details of farmer with address, land and crop details are entered in the first stage. In the second stage, soil analytical data (pH, EC, major, secondary and micro nutrients) are entered and updated to the system. The captured data have been validated through a systematic validation mechanism involving expert soil scientists and domain experts in the project. In the final stage, the processed data have been passed into the data analysis interpretation process to generate soil health cards for each crop to be distributed to the farmers. The software can generate recommendations of lime and fertilizers containing major, secondary and micro nutrients for all the crops cultivated in Kerala.
The entire processed data have been archived into a centralized environment in district/block/panchayat/crop/laboratory wise for easy retrieval and access. A web portal (www.keralasoilfertility.net) has also been developed for retrieval of data and access of soil test results and fertilizer recommendations (soil health cards) by scientists, agricultural officers and farmers through necessary authentication. The data have been used to prepare nutrient management plans (NMP) for panchayat, block and district.

Generation of unique sample code and farmer ID is one of the key elements in the system. The unique sample code is generated through a systematic approach by adopting a combination of alpha numeric characters. It is structured by integrating a combination of 3 letter character of the district, taluk, panchayat and survey number of the plot, followed by the serial number of the soil sample collected from the field. Based on the data entered in the above sequence, the system dynamically generates a unique sample code for the particular farmer. For example, in the farmer ID ‘TVM/NYK/CKL/368/29-2/106587’ the first three letters represents the district code, followed by the taluk, panchayat, survey number of the plot and serial number of the soil sample. Farmers can access the soil health cards by using the unique farmer code.

**Soil Health Cards**

Soil test based Health cards were generated using the software developed by IIITM-K and issued to all the farmers through the District level Agricultural Officers. The soil health cards provide detailed information on soil analysis data, soil fertility ratings and recommendations for lime, organic manure and chemical fertilizers supplying major, secondary and micro nutrients as per the Packages of Practices (2012), Kerala Agricultural University.

**Panchayat Level Nutrient Management Plan**

Nutrient Management Plan (NMP) was prepared based on the soil analysis data from each panchayat, municipality and corporation. The NMP provides information on the general description of the area in respect of soil, landform, climate and crops cultivated. It also provides the detailed soil test summaries and fertility ratings of major, secondary and micro nutrients. Soil test based recommendations for lime, organic manure and chemical
fertilizers supplying major, secondary and micro nutrients for major crops cultivated in the local bodies are also detailed in the NMP. Guidelines for maximizing fertilizer use efficiency are also suggested in the above document. The NMP provides useful guidelines to field and extension personnel involved in agricultural development in the formulation of meaningful nutrient management strategies to enhance crop performance and sustain soil health. A total of 900 NMPs have been prepared for various panchayats/municipalities/corporations and distributed to Krishi Bhavans.

Block level Nutrient Management Plan

The database generated for each panchayat in the Block formed the basis for the preparation of the Block level Nutrient Management Plan (BNP). The soil analytical data from all the panchayats of the Block has been used for the preparation of the BNP. This document is prepared as a reference material for guiding the Block level Agricultural Officers on crop based nutrient management strategies for the Block. The BNP is useful for discussions at the farmer level, farm advisory committees, block level federated organizations and farmer extension organizations on nutrient management. It will also be helpful in computation of fertiliser requirement at the Block level, discussions with
fertilizer dealers and in the preparation of advisories under Agriculture Technology Management Agency (ATMA) and Crop Health Management programs. Out of the total 152 Block panchayats in the State, 88 Block level dataset on soil analysis are only complete in Phase I and 60 BNPs have been released. The BNPs will be distributed to the respective District and Block level Officers.

**District level Nutrient Management Plan**

The database generated for all the Blocks in the District formed the basis for the preparation of the District level Nutrient Management Plan (DNP). The soil analytical data from all the panchayats and Blocks of the District has been used for the preparation of the DNP. This document is prepared as a reference material for guiding the District level Agricultural Officers on crop based nutrient management strategies for the District. Nutrient Management Plan for Wayanad, Kozhikode and Kasaragod District have been released and will serve as guidelines to the Block/district level officers of the Agricultural Department.

**Poster format of NMP**

Nutrient Management Plan in poster format (printed in Flex having size: 120 x 90 cm) for display in the Krishi Bhavans of the State has also been prepared. So far, 400 posters have been printed and dispatched to the concerned Assistant Director (Ag) for display in the Krishi Bhavans.

**Soil Fertility of Rice Eco-System**

A book on “Rice Eco-Systems of Kerala” is proposed to be released by the Kerala State Planning Board. One of the chapters is on ‘Soils and Soil Health in Rice Eco-systems of Kerala. This chapter has been prepared by utilizing the dataset from 18,500 soil samples covering the major rice growing areas under different Agro-Ecological Units. The data were extracted from the database of the above project.

**Project- Phase II**

During the first Phase of the project which concluded in December 2013, some of panchayats from various districts could not be sampled due to some field level problems. Considering the importance of the findings of the project in Phase I, it was decided to
collect 21,000 soil samples in the second phase. Based on the soil test data of these samples, Soil health cards will be distributed to the farmers. Panchayat level NMP including posters and Block/District level nutrient management plan (BNP & DNP) will be prepared for the entire State.

**Key achievements of the project**

- Analyzed 1.75 lakhs soil samples for macro, secondary and micro nutrients
- Prepared nutrient management plan (NMP) for 900 panchayats and preparation under progress for the remaining panchayats
- Soil Health Cards issued to farmers
- Developed online data input and transfer linkages to soil testing laboratories and Software for automated plant nutrient recommendations and generation of soil health card
- Released ad hoc recommendations for micro-nutrients by Kerala Agricultural University
- Developed a portal [www.keralasoilfertility.net](http://www.keralasoilfertility.net)
- Printed NMP in a poster format for display in Krishi Bhavans
- Revised Laboratory Manual of Soil testing for the State soil testing laboratories
- Adoption of panchayats, two each in a district for popularizing soil testing and demonstration of crop productivity improvement achievable through soil fertility management
- Introduced soil fertility as part of Agriculture Technology Management Agency (ATMA) Plus programme of extension activities
- Special soil testing component for vegetable and banana growing areas by Vegetable and Fruit Promotion Council Kerala (VFPCK)
- Micro-nutrient demonstrations in vegetables initiated in about 450 clusters
- Vegetable clusters were entrusted with campaign on soil testing so as to build ownership of the project at panchayat level
- Human resource development and capacity building programmes initiated for technical staff in soil testing labs under the Department of Agriculture
- Modernization of soil testing laboratories under Department of Agriculture is being initiated
Scheme for Monitoring the Utilization of Soil health cards

Book on ‘Soil fertility assessment and information management for enhancing crop productivity in Kerala’ (published in October, 2013)

A number of follow up initiatives are under implementation from 2014-15 onwards for the implementation of the findings of the analysis. A comprehensive soil acidity management programme, support for secondary nutrients, demonstration and assistance for micro nutrients, awareness programmes for farmers and officers and capacity building programmes are being implemented. The soil health card scheme has been expanded. The modernization of soil testing labs is also under implementation.

5.7: Best Practice VII

Agro Service Centres and Service Delivery

Agro service centres (ASC) established at block level to facilitate integration of services like mechanisation, ATMA based extension, credit support, weather advisory services, soil testing support and other technology based services. In order to provide full-fledged service to the farmers at a single point for various requirements of farmers such as agricultural inputs, farms related information like credit, marketing etc. are brought under a common service centre. The agro service centres established at the block level in the first phase is to support transfer of technology and service delivery. A mobile farm clinic is also established at the block level to provide solution to the field problems equipped with audio-visual and online support. The Agro service centres support the ATMA activities service support on various aspects, construction of rain shelters, setting up of micro irrigation units, production of planting materials, supply of bio inputs and mechanization. The mobile farm clinic and agro service centres established in the four districts where LEADS is under implementation for convergence and improved service delivery. The Farmers Service centers under the Cooperation Department was linked with the agro service centres for input delivery. The objective of the farmers service centers and agro service centres are
1. Act as a nodal agency at Block level to co-ordinate agriculture services in all Gramapanchayat within the block level to improve the agricultural productivity.

2. To manage the labour shortage problem faced in the agriculture sector of Kerala by agro machinery operation services and making data bank of Agricultural labours to form a “Green Army” for helping the farmers.

3. To provide quality seeds, pesticides, manure, growing substrates and other agricultural inputs.

4. Provide market intelligent services and help the farmers to operate the agricultural markets to sale their products.

5. Hiring farm machinery such as tractor, power tiller, sprayer etc to the farmers.

6. To undertake Farm machinery repair services, fabrication, procurement and supply of spare parts services and manufacturing of equipment at block level.

7. To give training to the unemployed youths.

8. To improve farm clinical services by the provision of mobility equipped with fertilizers for soil problem diagnosis, pest and disease management etc.

9. To work as an agency to provide the knowledge about Agricultural loans, subsidy etc using information technology in co-ordination with the organisations like NABARD, NCDC, State Horticultural Mission.

During 2012-13 to 2014-15, 49 Agro Service centres were established through Agriculture Department and 60 Farmers Service Centres through Co-operative department for improved service delivery to farmers.
During 2012-13 to 2014-15, 49 Agro Service centres were established through Agriculture Department and 60 Farmers Service Centres through Co-operative department for improved service delivery to farmers.

5.8: Best practice VIII

EMERGENCY VETERINARY CARE SERVICE DURING ODD HOURS AT BLOCK LEVEL – 6 pm to 6 am

Working hours of the Veterinary hospital / dispensary is from 9.00 am to 3.00 pm. Except the District Veterinary Centre; all the clinical institutions are functioning in a single shift. During day time the service of a Veterinary doctor will be freely available for a dairy farmer. But during night time if some emergency situation arises, the farmer will find it very difficult to get the service of a qualified veterinary surgeon. They will be forced to get the assistance of some quacks, there by destroying their valuable animals. The farmer will even be forced even to quit the Animal Husbandry sector. Hence Veterinary support at odd hour is a must. The project was initiated to provide emergency Veterinary care, during the odd hours of a day, ie 6.00 pm to 6.00 am. The service is concentrated at Block level. The farmer has to pay for the service.
**Facilities provided**

A registered Veterinary practitioner is in charge of the Emergency Veterinary Service Provider on contract basis at odd hours from 6PM to 6 AM.

The contract Veterinary doctor will function under the direct supervision of one Senior Veterinary surgeon of that Block. He will work as per his direction and must report all the activities undertaken in the odd hours. He has to send the client to the local Veterinary surgeon of that Panchayat for follow up work if required. Daily and monthly reports as to the requirement are to be submitted to the supervising officer.

Lifesaving and essential drugs will be provided by the department. The designated Senior Veterinary Surgeon will issue medicines. The cell phone number is to be given to all Veterinary institutions under the Block, milk societies, to Panchayat notice boards etc. He should never switch off the phone especially in the odd hours when his service is needed. The instruments and equipments required for the practice should be provided by the contract veterinarian himself. He can charge Rs 100/ (Rupees One hundred only) per visit from the farmer as incentive. No other amount should be collected from the farmer. In case of death of ailing animal / outbreak of any contagious diseases it must be reported to the local Government Veterinary officer immediately.

**Functioning:**

1. Area of service will be all the Panchayats of one block area. If the Government Veterinary doctor of the neighboring area demands his service for a case, the contract veterinarian is at liberty to render his service for that particular case without hindrance to his jurisdiction duty.

2. The District Animal husbandry Officer will purchase essential and lifesaving drugs for each block, as per the intend placed by the designated Senior Veterinary Surgeon of the identified institution of the block. The medicines will be purchased from the Neethi / Maveli/ other Government agencies/ or by observing SPR. The
Government Veterinary officer of the block will release the medicines to the contract veterinarian.

Status of scheme

The scheme is being implemented in the State since from 2012-13 with identified twenty Blocks where scope for dairying is more. During 2014-15 the service was extended in 21 Blocks and 4 Corporations. Now in 2015-16 the number of Blocks under the scheme will be 50 numbers.

Services provided

- A contract Veterinary surgeon is provided in the Block with provision for having essential drugs to tackle major emergency conditions. The medicines are provided at free of cost.
- The contract Veterinarian will be provided facility for communication and his contact number will be made available at contact points like Veterinary institutions of the Block, milk societies, Panchayats offices etc.
- The contract Veterinarian will have the support of an Attendant to tackle cases like dystocia, uterine prolapse, and uterine torsion, to tackle surgical cases of emergent nature.

5.9: Best practice in Fisheries IX

Artificial reef

As an age old practice, traditional fishermen know that any object immersed in the sea can attract fishes and provide habitat to them. Based on that, traditional fishermen used to dump coconut fronts fastened with rocks in to sea bottom to attracted fish closer to the shore. In this background, concept of artificial reef was emerged. Artificial reefs that established in the sea bed act as a fish congregating ground as it provide food and shelter to the fish. It also help some of the fish groups to deposit their eggs on the reef, thus act as breeding as well as nursery ground for them.
Artificial reefs are manmade objects placed in the sea to provide an artificial fish habitat and thereby to attract, aggregate and regenerate fish resources. Reefs when properly located and structured, not only concentrate fishes, but also increase the biological productivity of the area. The reef material increases the surface area necessary for fish food organisms. To revitalize the aquatic environment, the artificial reef can play a significant role. Artificial reefs constructed on a large scale covering a vast area with scientifically designed structures can increase fish production significantly by creating fertile ecosystem in such areas.

Artificial reef can also act as a tool to enhance the fish productivity from inshore waters which had been already disrupted due to unscientific interventions. In this view, certain efforts were already been taken to install artificial reef made up of concrete structures. The study on this structures using underwater camera revealed that it can definitely enhance aquatic environment. It results in the enhancement of the fishery of high quality fishes like Perches, Carangids, Rachycentron, Cephalopods, Lobsters, Rays, and Skates etc. It directly provides livelihood for artisanal fishermen who involved in hook and line fishing from a catamaran.

Artificial reef is based on eco-friendly technologies. Ecologically, a rich succession of marine life as encrusting bio-foulers on the concrete substratum takes place. Subsequently a succession of periphyton, fish fry, fingerlings and adult fish colonize in the reef for shelter, feeding and breeding. As the reef ecosystem provides favorable habitat for the young ones, adult fish take it as a protective site for breeding. Reefs are highly productive ecosystem of great significance. This forms the breeding and nursery grounds of a large number of commercially as well as ecologically important species of fin fishes, shrimps, lobsters, crabs and molluscs. Reefs are the spawning and main feeding areas of many fishes.

The artificial reef unit in each fishing villages is constructed by placing 120 trapezoidal RCC modules and enrichment materials in the sea. The enrichment material includes concrete rings, concrete pipes etc. The critical factor in the establishment of artificial reef is its transportation and placement in to the sea. The modules will be placed as 4-5 rows and the distance between each module will be 10-15 Meters.
Artificial reef that has already established off the coast of Southern part of Thiruvananthapuram district became a good habitat for the fishes and other aquatic organisms and enhanced the productivity of that area. Fishermen of these fishing villages are getting benefitted of this as they are getting good catch. It has helped even the aged and sick people, as they could do fishing in the near shore areas. It has played a major role in the improvement of socio-economic status of the fishermen in these fishing villages. The study revealed that artificial reefs can increase fish catches by 100%. Underwater camera study revealed the presence of a good ecosystem with a variety of fish species in and around the reef.