

STATE IRRIGATION PLAN

Pradhan Mantri Krishi Sinchayee Yojana
(PMKSY)

GOVERNMENT OF ARUNACHAL PRADESH

Prepared by



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State Irrigation Plan
Arunachal Pradesh

CREDIT CITATION

*NABCONS sincerely acknowledges that without the overall support provided by the top officials of the State Government, Arunachal Pradesh, especially the Departments of Agriculture, Horticulture, Water Resources Department, Rural Development Department, Soil & Water Conservation Department under RWD and Department of Environment & Forest as also the teams of District-level field functionaries of the participating Departments and agencies under the overall leadership of the concerned Deputy Commissioners, it would not have been possible to prepare this State Irrigation Plan (SIP) under “**Pradhan Mantri Krishi Sinchayee Yojana**” for the State of Arunachal Pradesh”.*

NABCONS hereby records its earnest thanks and gratitude for the same and trusts that this document shall be instrumental in bringing about a transformative progress in the lives of the farmers in Arunachal Pradesh.



Message from the Chief Secretary, Arunachal Pradesh

Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) has been unveiled by Hon'ble Prime Minister of India during July 2015 with the vision of extending the coverage of irrigation (**Har Khet ko Pani**), improving water use efficiency (**Per Drop More Crop**) and enhance recharge of aquifers and introduce sustainable water conservation practices (**PMKSY-Watershed**) in a focused manner with end to end solution on water resource creation, distribution, management, field application and extension activities. The strategies have been identified in the State Irrigation Plan (SIP). It is more significant in irrigation sector, for about 85-90% of water consumption is in this sector. The State has abundant water resources which could boost its economy by harnessing these resources. Efficient planning and management measures are needed for meeting growing requirements of the population with respect to irrigation, energy and other related sectors of environment, recreation and navigation. With the ever increasing demand for water w.r.t. population growth, urbanization and industrialization, making water available for multiple uses, planning and management of water resources and utilization of water economically, optimally and equitably assume greater significance.

Under PMKSY, an integrated planning and management of water resources, through estimation of water budget for each of the district and sub district and preparation of strategic action plan to address the water gap through District Irrigation Plans (DIPs) was envisaged. PMKSY will be implemented in area development mode only by adopting a 'decentralized State level planning and project based execution' structure that will allow States to draw up their own irrigation development plans based on DIPs and SIPs with a horizon of 5 years.

The State Irrigation Plan (SIP) which emanates from District Irrigation Plans of 18 Districts of the state with the coordinated efforts by different stakeholders and departments i.e., Water Resource Department, Tube well and Ground Water Division and other line departments at the State and district level. I trust and hope that the Water Resource Department, Govt. of Arunachal Pradesh, which is the nodal Department for implementation of PMKSY would ensure that this very important flagship programme is implemented as per the guidelines prescribed by the GoI in a time bound manner.

I further appreciate and put on record the sincere efforts made by the Deputy Commissioners, officers of the Departments of Agriculture, Horticulture, Rural Works Department (RWD), DRDA, Water Resource Department and Department of Environment and Forests for collection and analysis of relevant and requisite information.

I hope that the State Irrigation Plan (SIP) of Arunachal Pradesh, 2016-21 will fulfil the objectives of "**Har Khet Ko Pani**", "**Per Drop More Crop**" & "**PMKSY-Watershed**" and will go a long way in achieving the national goal of increasing the agriculture production in a sustainable manner in addressing the multiple challenges of water resource planning and management in the State.

Sr. No	Item	Particulars																											
1	Name of the Project	State Irrigation Plan under PMKSY – Arunachal Pradesh																											
2	Name of the Nodal Department of the State Government	Agriculture Department																											
3	Key Objectives	(i) Achieve convergence of investments in irrigation; (ii) Enhance physical access to water on farms; (iii) Expand cultivable area under assured irrigation; (iv) Improve on-farm water use efficiency to reduce wastage; (v) Enhance precision-irrigation (More crop per drop); (vi) Ensure integrated development of rain-fed areas; (vii) Promote water harvesting and water management; (viii) Attract greater private investments in irrigation.																											
4	Convergence with Other Programmes	MGNREGS, NABARD's RIDF, etc.																											
5	Total Proposed Outlay	Rs. 17,71,231.12 Lakhs																											
6	Phasing of the Project	5 Years (2016-17 to 2020-21)																											
7	Component-wise Share	(Rs. In Lakhs) <table border="1"> <thead> <tr> <th>Sl. No</th> <th>Component</th> <th>Planned Outlay</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Har Khet Ko Pani</td> <td>7,96,997.07</td> </tr> <tr> <td>2</td> <td>Per Drop More Crop</td> <td>4,06,311.26</td> </tr> <tr> <td>3</td> <td>Watershed</td> <td>4,83,578.45</td> </tr> <tr> <td>4</td> <td>Admin cost @ 5%</td> <td>84,344.34</td> </tr> <tr> <td colspan="2">GRAND TOTAL</td> <td>17,71,231.12</td> </tr> </tbody> </table>	Sl. No	Component	Planned Outlay	1	Har Khet Ko Pani	7,96,997.07	2	Per Drop More Crop	4,06,311.26	3	Watershed	4,83,578.45	4	Admin cost @ 5%	84,344.34	GRAND TOTAL		17,71,231.12									
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9	Top 3 Districts with highest budget projections	(i) Upper Subansiri ; (ii) Kurung Kumei; (iii) West Siang																											
10	3 Districts with the lowest budget projection	(i) Anjaw ; (ii) Tawang; (iii) Tirap																											

State Irrigation Plan (SIP) Dashboard

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Abbreviations Decoded

Abbreviations	Decoded Forms
AIBP	Accelerated Irrigation Benefit Programme
ATMA	Agricultural Technology Management Agency
BCM	Billion Cubic Meters
Bgl	Below ground Level
BPL	Below Poverty Line
C & RD Block	Community and Rural Development Block
CAD	Command Area Development
CADWM	Command Area Development and Water Management
CCA	Cultivable Command Area
C-DAP	Comprehensive District Agriculture Plan
C-SAP	Comprehensive State Agriculture Plan
CI	Cropping Intensity
SIP	State Irrigation Plan
DLIC	District Level Implementation Committee
DRDA	District Rural Development Agency
GCA	Gross Cropped Area
GIA	Gross Irrigated Area
GIS	Geographic Information System
Gol	Government of India
GoAP	Government of Arunachal Pradesh
HKKP	Har Khet Ko Pani
I&PH	Irrigation and Public Health Department
IWMP	Integrated Watershed Management Programme
Kg/ha	Kilogram per hectare
LPD	Litre Per Day
LULC	Land Use/Land Cover
MCM	Million Cubic Metres
MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
MI	Micro Irrigation
MIS	Management Information System
NABARD	National Bank for Agriculture and Rural Development
NHH	Number of Household
NITI Aayog	National Institution for Transforming India Aayog
NM	Number of Member
No.	Number
NRLM	National Rural Livelihoods Mission
NRM	Natural Resource Management
NSA	Net Sown Area
PRI	Panchayati Raj Institutions
Qtl/yr.	Quintal per year
RIDF	Rural Infrastructure Development Fund
RWD	Rural Work Department
SC/ST	Scheduled Caste/ Scheduled Tribe
SIP	State Irrigation Plan
SSI	Small Scale Industries
STP	Sewage Treatment Plant
SWMA	Supplementary Water Management Activities
TGA	Total Geographical Area
WRD	Water Resource Department

Executive Summary

In an agrarian economy like India, agriculture utilizes the major share of country's exploitable water resources. Though the sector utilizes the maximum share of exploitable water resources, availability of the same at different locations to different extent makes it vital to adopt effective utilization of water through storage, channelizing and judicial use. At some places like Punjab and Haryana, the environmental and socio-economic rationale for this capture by the sector is now being questioned. Accordingly, it is needed to challenge and change the fundamentals of the prevailing view of water resources exploitation. A new and more suitable approach to water resources allocation is necessary if the population is to be adequately fed, without further degradation and destruction of the critical ecosystem services. Water productivity needs to be enhanced considerably, and economic cost-benefit analysis and pricing regimes can play a significant role in such a process. However, these economic measures will not be sufficient on their own. They will need to be buttressed by technological innovation and institutional changes in order to encourage a more equitable distribution of resources and to mitigate potential international conflicts across 'shared' water basins.

Water has unique characteristics that determine both its allocation and use as a resource by agriculture. Agricultural use of water for irrigation is itself contingent on land resources. In a situation of growing water scarcity and rising demands for non-agricultural (household and industrial) use of water, reassessment of sectoral allocations of water are inevitable. In developing countries, irrigated agriculture plays a vital role in contributing towards domestic food security and poverty alleviation. Therefore, achievement of these objectives is dependent on adequate allocations of water to agriculture. Justification of such allocations requires that irrigated agriculture be a cost-effective means of achieving stated political or social objectives, such as food security or poverty alleviation, and that all externalities be taken into account in the pricing mechanism. Improved allocation of irrigation water is required within the agriculture sectors in order to achieve greater efficiency in the use of irrigation water and existing irrigation infrastructure. Reallocation is also required in order to reduce water logging and salinization of irrigated land, to decrease the negative environmental impacts and other externalities of irrigation (caused by over extraction of groundwater and depletion and pollution of surface water).

Government of India launched Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) to address the constraints in providing assured irrigation as well as increasing efficiency and productivity of current water use to bring more prosperity to the rural areas. Priorities of Government of India were reflected in

the Hon'ble President's address to the joint Session of the Parliament of 16th Lok Sabha where he indicated that "Each drop of water is precious. Government is committed to giving high priority to water security. It will complete the long pending irrigation projects on priority and launch the 'Pradhan Mantri Krishi Sinchayee Yojana' with the motto of 'Har Khet Ko Pani'. There is a need for seriously considering all options including linking of rivers, where feasible; for ensuring optimal use of our water resources to prevent the recurrence of floods and drought. By harnessing rain water through 'Jal Sanchay' and 'Jal Sinchan', we will nurture water conservation and ground water recharge. Micro irrigation will be popularized to ensure 'Per drop-More crop".

PMKSY has been approved with an indicative outlay of Rs.50, 000 crore over a period of five years from 2015-16 to 2019-20. The programme is an amalgamation of on-going schemes of Ministry of Water Resources, River Development and Ganga Rejuvenation, Ministry of Agriculture & Cooperation and Ministry of Rural Development. The existing schemes AIBP, CADWM, MI, SWMA, and Watershed & Convergence with MGNREGA were brought together under the umbrella program of PMKSY. Further the scheme seeks convergence with scheme like Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNRES), Rashtriya Krishi Vikas Yojana (RKVY), Jawaharlal Nehru National Solar Mission and Rural Electrification programme (JLNNSM&REP), Rural Infrastructure Development Fund (RIDF), Members of Parliament Local Area Development Scheme (MPLAD), Members of Legislative Assembly Local Area Development Fund (MLALAD), Local Body Funds (LBF), Working Plan of State Forest Department (WPSFD) etc. The PMKSY will be implemented in an area development mode only by adopting a decentralized state level planning and projected execution structure that will allow the state to draw up their own irrigation development plans based on DIPs and SIPs with a horizon of 5-7 years. The program will be supervised and coordinated utilizing the existing mechanism and structure available under Rashtriya Krishi Vikas Yojana (RKVY) program with state agriculture department acting as the State Nodal Agency for implementation of PMKSY. However, the implementing departments for the four components like AIBP, PMKSY (Har Khet KO Pani), PMKSY (Per drop more crop) and PMKSY (watershed development) will be decided by the respective program ministry/department.

The 05 chapters along with introduction chapter, explains the profile of state, its water requirement for agriculture and allied sector, water availability, assessment of water requirement for various sectors and strategic action plan for augmentation and effective management of available water resources.

Highlights of SIP

The aggregate size of the SIP projection, incorporating the share of all individual components of PMKSY, is **Rs. 17,71,231.12 lakhs** which would be implemented in 5 years (2016-17 to 2020-21) of the targeted plan period under the scheme. The District-wise allocation is as under: -

District-wise Command Area, Financial Outlay under PMKSY- Arunachal Pradesh

Sl. No.	District	Command Area (ha)	Total (Rs. In Lakhs)	Grand Total* (Rs. In Lakhs)
1	Anjaw	1319	10141.93	10649.03
2	Changlang	24924	62836.23	65978.04
3	Dibang Valley	14275	68761.38	72199.45
4	East Kameng	10273	118347.82	124265.21
5	East Siang	42317	107479.51	112853.49
6	Kurung Kumey	68971	230520.86	242046.90
7	Lohit	30283	83778.04	87966.94
8	Longding	10971	31487.74	33062.13
9	Lower Dibang	49892	101701.05	106786.10
10	Lower Subansiri	59519	91764.96	96353.21
11	Namsai	42390	104403.10	109623.26
12	Papum Pare	20595	120003.88	126004.07
13	Tawang	3128	11118.99	11674.94
14	Tirap	15596	19651.96	20634.56
16	Upper Siang	26818	79079.15	83033.11
17	Upper Subansiri	59885	260268.69	273282.12
18	West Kameng	12621	41668.38	43751.80
19	West Siang	34911	143873.11	151066.77
TOTAL		5,28,687	16,86,886.78	17,71,231.12

*Grand total includes administration cost taken as @5% of total cost

The key components of PMKSY are - Har Khet Ko Pani (HKKP), Per Drop More Crop (PDMC) and PMKSY Watershed (includes Convergence with MGNREGS). The component-wise share in the aggregate projection of **Rs. 17,71,231.12 lakhs** is as follows:

Total Component-wise Financial Outlay of PMKSY Arunachal Pradesh

Sl. No	Component	Planned Outlay (Rs. In Lakhs)
1	Har Khet Ko Pani	7,96,997.07
2	Per Drop More Crop	4,06,311.26
3	PMKSY Watershed	4,83,578.45
4	Admin cost @ 5%	84,344.34
Grand Total		17,71,231.12

The Departments implementing PMKSY in Arunachal Pradesh are Water Resources Department (WRD), Agriculture Department, Horticulture Department, Rural Development Department (RD), Soil & Water Conservation Department under RWD and Department of Environment & Forest. The Department-wise share in the total projected strategic action plan of **Rs. 17,71,231.12 lakhs** is as follows: -

Total Department-wise Financial Outlay of PMKSY Arunachal Pradesh		
Sl. No	Department	Planned Outlay* (Rs. In Lakhs)
1	Agriculture Department	2,54,349.96
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Introduction

Preparation of decentralized area specific state planning process visualized in various plans took concrete shape through the years and initiatives like specific guidelines on methodologies and processes for preparation of state plans; framework for preparation of perspective plan, medium term and annual plans by then planning commission in 1969 and the 73rd and 74th constitutional amendments conferring constitutional status to Panchayats at state and sub state level; local self-government in urban areas; constitution of state planning committee to consolidate the plans prepared at Panchayats and municipalities and prepare a draft development plan for the whole state.

The decentralized planning process was further strengthened through emphasis by planning commission on preparation of state level plans and making it an integral part of the process of preparation of the state's 11th five-year plan. The Planning commission issued guidelines in August 2006 for preparation of the state plans. The guidelines define the State Planning as 'the process of preparing an integrated plan for the local government sector in a state taking into account the resources (natural, human and financial) available and covering the sectorial activities and schemes assigned to the state level and below and those implemented through local governments in a state. The document that embodies this statement of resources and their allocation for various purposes is known as the State Plan'.

Government of India through a resolution in National Development Council on 29th May 2007 conceived a special Additional Central Assistance Scheme (ACAS) to address the slow growth of agriculture and allied sectors by incentivizing states to draw up plans for their agriculture sectors more comprehensively. The NDC resolution states "Govt will introduce a new Additional Central Assistance Scheme to incentivize states to draw up plans for their agriculture sector more comprehensively, taking agro-climatic conditions, natural resource issues and technology into account, and integrating livestock, poultry and fisheries, etc. This will involve a new scheme for Additional Central Assistance (ACA) to State Plans, administered by the Union Ministry of Agriculture over and above its existing Centrally Sponsored Schemes, to supplement the State-specific strategies including special schemes for beneficiaries of land reforms. The newly created National Rainfed Area Authority will, on request, assist States in planning for rainfed areas".

The NDC in its resolution advised the states to prepare a comprehensive state agriculture plans (C-SAP) that will fully utilize available resources and will include allied agriculture sectors. Further, GOI issued a manual on preparation of comprehensive state agriculture plans to help the states prepare C-SAP. As per these guidelines, the objective of state planning is 'to design an integrated and participatory action plan for the development of local area in general and agriculture and allied sectors in particular'. The objectives of Comprehensive State Agriculture Plan (C-SAP) are:

- To prepare a Comprehensive State Agriculture Plan (C-SAP) through participatory process involving various organizations and stakeholders.
- To enable optimum utilization of scarce natural, physical & financial resources.
- To assess and plan for the infrastructure required to support the agriculture development.
- To establish linkages with the required institutional support services, like credit, technology transfer, ICT, research etc.
- To evolve an action plan for achieving sustainable agricultural growth with food security and cropping system that will improve farmers' income.

The guidelines wanted the state/state authorities to (i) ensure that the agricultural plans are prepared for the state and then integrated into the agricultural plans of the State based on the agro-climatic conditions, availability of technology, trained manpower and natural resources; (ii) local needs / crops / feed and fodder / animal husbandry / dairying / fisheries / priorities are reflected in the plan; (iii) productivity gaps for important crops and livestock and fisheries are reduced; and (iv) the returns to the farmers from these are maximized.

The latest move in the process of strengthening of decentralized planning process was the Government of India guidelines issued in 2015 in the form of a template for the preparation of District Irrigation Plan (DIP) and State Irrigation Plan (SIP) as part of the Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) program and made the preparation of DIP and SIP mandatory for the states to receive funds from the program. The present report is a product of these long drawn efforts of Government of India to strengthen the decentralized planning process in the country focusing on the vital resource i.e., water.

Water is of vital importance for human & animal life, maintenance of ecological balance and promotion of developmental activities. Considering its vital importance and ever increasing demand for water, in the face of population growth, urbanization & industrialization and considerations of climatic change, making water, an increasingly a scarce resource, available to multiple uses, planning and management

of this vital resources, utilization of water economically, optimally and equitably assumes greater importance.

According to the 12th Five-year Plan, the water budget estimates of India by Ministry of Water Resources suggests an availability of 1123 Million Cubic Meters (MCM) against a current estimated demand of 710 MCM. The Standing Committee of the Ministry of Water Resources estimates that this water demand will rise to 1093 MCM by 2025. Though the existing water availability in the immediate future seems to be adequate, with the near constant supply of water resources in the face of increasing demand on account of population growth, urbanization and industrialization will strain the water supply-demand balance.

The per capita water availability which stood at 5,177 cubic meters in 1951 was reduced to 1820 cubic meters in 2001 while the international prescribed limit is 1800 cubic meters. The projected per capita availability of water is 1341 cubic meters in 2025 and 1140 cubic meters in 2050 suggesting shortage of water in the medium term¹. Further, the all India water balance estimates does not reflect the variations in water balance across time and space- certain areas having a positive water balance and the others facing acute shortage. The problem is further accentuated by water quality related issues.

With the abundant surface and ground water supply in the first five decades since independence, more than 80 percent of the total available water resources were allocated for irrigation purposes and the rest meeting the domestic and industrial demands. In a recent study², on the demand for water from agriculture, domestic and industrial uses in 2000, 2025 and 2050 seems to suggest that domestic demand (34 MCM in 2000, 66 MCM in 2025 and 101 MCM in 2050) and industrial demand (42 MCM in 2000, 92 MCM in 2025 and 161 MCM in 2050) for water will utilize the total balance water available while agriculture demand for water will be (605 MCM in 2000, 675 MCM in 2025 and 637 MCM in 2050). This change is partly because of the changing sectorial contributions of India's GDP and also partly because of dynamics of irrigation development in the country where the initial expansion in area under irrigation is propelled by the availability of abundant water resources and availability of good quality land. This is no longer the case in many of the states where the availability of land and water are serious constraints for further expansion of irrigation. Further, as per the erstwhile planning commission up to March 2012 out of 141 million hectares of net sown area in the country 114 (or 81%) million hectares is Irrigation Potential Created (IPC) and 88 (or 62%) million hectares is Irrigation Potential

¹Ministry of Water Resources (2011), Strategic Plan for Ministry of Water Resources, Government of India, New
² Amarasinghe, U.A., Shah T., Turrall, H. and Anand, B.K. 2007, *India's water future to 2025-2050: Business-as-usual scenario and deviations*. Research Report 123, International Water Management Institute, Colombo.

Utilized (IPU) leaving almost 20% of irrigated potential unutilized. This leaves 40 percent of the net sown area in the country dependent on rainfall which makes farming a high risk and less productive.

The competing demands for water resources and the emerging issues and concerns were to be addressed through certain basic principles and commonality in approaches in dealing with planning, development and management of water resources³ under an Integrated Water Resource Management framework. The main objectives of water resource management as delineated in National Water Policy 2012 are:

- a. Planning, development and management of water resources need to be governed by common integrated perspective considering local, regional, State and national context, having an environmentally sound basis, keeping in view the human, social and economic needs.
- b. Principle of equity and social justice must inform use and allocation of water.
- c. Good governance through transparent informed decision making is crucial to the objectives of equity, social justice and sustainability. Meaningful intensive participation, transparency and accountability should guide decision making and regulation of water resources.
- d. Water needs to be managed as a common pool community resource held, by the state, under public trust doctrine to achieve food security, support livelihood, and ensure equitable and sustainable development for all.
- e. Water is essential for sustenance of eco-system, and therefore, minimum ecological needs should be given due consideration.
- f. Safe Water for drinking and sanitation should be considered as pre-emptive needs, followed by high priority allocation for other basic domestic needs (including needs of animals), achieving food security, supporting sustenance agriculture and minimum eco-system needs. Available water, after meeting the above needs, should be allocated in a manner to promote its conservation and efficient use.
- g. All the elements of the water cycle, i.e., Evapo-transpiration, precipitation, runoff, river, lakes, soil moisture, and ground water, sea, etc., are interdependent and the basic hydrological unit is the river basin, which should be considered as the basic hydrological unit for planning.
- h. Given the limits on enhancing the availability of utilizable water resources and increased variability in supplies due to climate change, meeting the future needs will depend more on demand management, and hence, this needs to be given priority, especially through (a)

³ Ministry of Water Resources, National Water Policy, 2012 Government of India, New Delhi.

- evolving an agricultural system which economizes on water use and maximizes value from water, and (b) bringing in maximum efficiency in use of water and avoiding wastages.
- i. Water quality and quantity are interlinked and need to be managed in an integrated manner, consistent with broader environmental management approaches inter-alia including the use of economic incentives and penalties to reduce pollution and wastage.
 - j. The impact of climate change on water resources availability must be factored into water management related decisions. Water using activities need to be regulated keeping in mind the local geo climatic and hydrological situation.

The National Water Policy 2012 drives the water resource management program planning and management in the country. Government of India launched Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) to address the constraints in providing assured irrigation as well as increasing efficiency and productivity of current water use to bring more prosperity to the rural areas. Priorities of Government of India were reflected in the Hon'ble President's address to the joint Session of the Parliament of 16th Lok Sabha where he indicated that ***“Each drop of water is precious. Government is committed to giving high priority to water security. It will complete the long pending irrigation projects on priority and launch the ‘Pradhan Mantri Krishi Sinchayee Yojana’ with the motto of ‘Har Khet KO Pani’. There is a need for seriously considering all options including linking of rivers, where feasible; for ensuring optimal use of our water resources to prevent the recurrence of floods and drought. By harnessing rain water through ‘Jal Sanchay’ and ‘Jal Sinchan’, we will nurture water conservation and ground water recharge. Micro irrigation will be popularized to ensure ‘Per drop-More crop’.”***

PMKSY has been approved with an indicative outlay of Rs. 50,000 crore over a period of five years from 2015-16 to 2019-20. The programme is an amalgamation of on-going schemes of Ministry of Water Resources, River Development and Ganga Rejuvenation, Ministry of Agriculture & Cooperation and Ministry of Rural Development. The existing schemes AIBP, CADWM, MI, SWMA, Watershed and Convergence with MGNREGA were brought together under the umbrella program of PMKSY. Further the scheme seeks convergence with scheme like Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS), Rashtriya Krishi Vikas Yojana (RKVY), Jawaharlal Nehru National Solar Mission and Rural Electrification programmes (JLNNSM&REP), Rural Infrastructure development Fund (RIDF), Member of Parliament Local Area Development Scheme (MPLAD), Member of Legislative Assembly Local Area Development Scheme (MPLALAD), Local body funds (LBF), Working Plan of State Forest Department (WPSFD) etc.

The PMKSY will be implemented in an area development mode only by adopting a decentralized state level planning and projectised execution structure that will allow the state to draw up their own irrigation development plans based on DIPs and SIPs with a horizon of 5-7 years. The program will be supervised and coordinated utilizing the existing mechanism and structure available under Rashtriya Krishi Vikas Yojana (RKVY) program with state agriculture department acting as the State Nodal Agency for implementation of PMKSY. However, the implementing departments for the four components like AIBP, PMKSY (Har Khet Ko Pani), PMKSY (Per drop more crop) and PMKSY (watershed development) will be decided by the respective program ministry/department.

The funds under this program would be provided to the states as per the pattern of assistance of Centrally Sponsored Schemes (CSS) decided by the Ministry of Finance and NITI Aayog. During 2015-16, the existing pattern of assistance of on-going scheme was continued. An outlay of Rs. 50,000 crore has been approved for 2015-20. The financial assistance provided to the state governments from this centrally sponsored scheme is subject to fulfilment of certain conditions. Firstly, a state will become eligible to access PMKSY fund only if it has prepared the District Irrigation Plans (DIP) and State Irrigation Plan (SIP), except for the initial year, and the expenditure in water resource development for agriculture sector in the year under consideration is not less than the baseline expenditure, which is defined as the average of the expenditure in irrigation sector irrespective of the department in the state plan in three years prior to the year under consideration. Secondly, States will be given additional weightage for levying charges on water and electricity for irrigation purposes, so as to ensure sustainability of the programme. Thirdly, interstate allocation of PMKSY fund will be decided based on

- Share of percentage of unirrigated area in the state vis-à-vis national average including prominence of areas classified under Desert Development Programme (DDP) and Drought Prone Area Development Programme (DPAP)
- Increase in percentage share of expenditure on water resource development for agriculture sector in State Plan expenditure in the previous year over three years prior to it and
- Improvement in irrigation efficiency in the state.

Vision

The overreaching vision of Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) will be to ensure access to some means of protective irrigation to all agricultural farms in the country, to produce 'per drop more crop', thus bringing much desired rural prosperity.

Objective

The objectives of the PMKSY program are to:

- a. Achieve convergence of investments in irrigation at the field level (preparation of state level and, if required, sub state level water use plans).
- b. Enhance the physical access of water on the farm and expand cultivable area under assured irrigation (Har Khet ko Pani),
- c. Integration of water source, distribution and its efficient use, to make best use of water through appropriate technologies and practices.
- d. Improve on-farm water use efficiency to reduce wastage and increase availability both in duration and extent,
- e. Enhance the adoption of precision-irrigation and other water saving technologies (per drop more crop).
- f. Enhance recharge of aquifers and introduce sustainable water conservation practices
- g. Ensure the integrated development of rainfed areas using the watershed approach towards soil and water conservation, regeneration of ground water, arresting runoff, providing livelihood options and other NRM activities.
- h. Promote extension activities relating to water harvesting, water management and crop alignment for farmers and grass root level field functionaries.
- i. Explore the feasibility of reusing treated municipal waste water for peri-urban agriculture, and
- j. Attract greater private investments in irrigation.

Strategy/approach

To achieve these objectives PMKSY adopted strategies that include

- a. Creation of new water sources; repair, restoration and renovation of defunct water sources; construction of water harvesting structures, secondary & micro storage, groundwater development, enhancing potentials of traditional water bodies at village level like Jal Mandir (Gujarat); Khatri, Kuhl (H.P.); Zabo (Nagaland); Eri, Ooranis (T.N.); Dongs (Assam); Katas, Bandhas (Odisha and M.P.) etc.
- b. Developing/augmenting distribution network where irrigation sources (both assured and protective) are available or created;

- c. Promotion of scientific moisture conservation and run off control measures to improve ground water recharge so as to create opportunities for farmers to access recharged water through shallow tube/dug wells;
- d. Promoting efficient water conveyance and field application devices within the farm viz, underground piping system, Drip & Sprinklers, pivots, rain-guns and other application devices etc.;
- e. Encouraging community irrigation through registered user groups/farmer producers' organizations/NGOs; and
- f. Farmer oriented activities like capacity building, training and exposure visits, demonstrations, farm schools, skill development in efficient water and crop management practices (crop alignment) including large scale awareness on more crop per drop of water through mass media campaign, exhibitions, field days, and extension activities through short animation films etc.

Programme Components

PMKSY has following four programme components:

1. **Accelerated Irrigation Benefit Programme (AIBP)** to focus on faster completion of on-going Major and Medium Irrigation including National Projects.
2. **PMKSY (Har Khet ko Pani):** This component focuses on-
 - a. Creation of new water sources through Minor Irrigation (both surface and ground water)
 - b. Repair, restoration and renovation of water bodies; strengthening carrying capacity of traditional water sources, construction rain water harvesting structures (Jal Sanchay);
 - c. Command area development, strengthening and creation of distribution network from source to the farm;
 - d. Ground water development in the areas where it is abundant, so that sink is created to store runoff/ flood water during peak rainy season.
 - e. Improvement in water management and distribution system for water bodies to take advantage of the available source which is not tapped to its fullest capacity (deriving benefits from low hanging fruits). At least 10% of the command area to be covered under micro/precision irrigation.

- f. Diversion of water from source of different location where it is plenty to nearby water scarce areas, lift irrigation from water bodies/rivers at lower elevation to supplement requirements beyond IWMP and MGNREGS irrespective of irrigation command.
- g. Creating and rejuvenating traditional water storage systems like Khatri, Kuhl etc. at feasible locations.

3. PMKSY (Per Drop More Crop)

- a. Programme management, preparation of State/State Irrigation Plan, approval of annual action plan, Monitoring etc.
- b. Promoting efficient water conveyance and precision water application devices like drips, sprinklers, pivots, rain-guns in the farm (Jal Sinchan);
- c. Topping up of input cost particularly under civil construction beyond permissible limit (40%), under MGNREGS for activities like lining inlet, outlet, silt traps, distribution system etc.
- d. Construction of micro irrigation structures to supplement source creation activities including tube wells and dug wells (in areas where ground water is available and not under semi critical/ critical/ over exploited category of development) which are not supported under AIBP, PMKSY (Har Khet ko Pani), PMKSY (Watershed) and MGNREGS as per Block/state irrigation plan.
- e. Secondary storage structures at tail end of canal system to store water when available in abundance (rainy season) or from perennial sources like streams for use during dry periods through effective on-farm water management;
- f. Water lifting devices like diesel/ electric/ solar pump sets including water carriage pipes, underground piping system.
- g. Extension activities for promotion of scientific moisture conservation and agronomic measures including cropping alignment to maximize use of available water including rainfall and minimize irrigation requirement (Jal Sarankchan);
- h. Capacity building, training and awareness campaign including low cost publications, use of Pico projectors and low cost films for encouraging potential use water source through technological, agronomic and management practices including community irrigation.
- i. The extension workers will be empowered to disseminate relevant technologies under PMKSY only after requisite training is provided to them especially in the area of promotion of scientific moisture conservation and agronomic measures, improved/

innovative distribution system like pipe and box outlet system, etc. Appropriate Domain Experts will act as Master Trainers.

- j. Information Communication Technology (ICT) interventions through NeGP-A to be made use in the field of water use efficiency, precision irrigation technologies, on farm water management, crop alignment etc. and also to do intensive monitoring of the Scheme.

4. PMKSY (Watershed Development)

- a. Effective management of run-off water and improved soil & moisture conservation activities such as ridge area treatment, drainage line treatment, rain water harvesting, in-situ moisture conservation and other allied activities on watershed basis.
- b. Converging with MGNREGS for creation of water source to full potential in identified backward rainfed Blocks including renovation of traditional water bodies.

Rationale/ Justification

In reference to the status and need of irrigation, the water resource management including irrigation related priorities was identified for 'Arunachal Pradesh' state by the people representatives of state with support from administration and technical experts. For instance, the reports of Strategic Research and Extension Plan (SREP) prepared under ATMA program, Comprehensive State Agriculture Plan (C-SAP) prepared as part of Rashtriya Krishi Vikas Yojana (RKVY), Potential Linked Credit Plans (PLP) of NABARD and the Integrated State Development Plan etc. identified number of irrigation related issues for Arunachal Pradesh state including (i) promoting water use efficiency through sprinkler and drip irrigation; (iii) promoting protected polyhouse cultivation to minimize risk factors and enhance quality and productivity; (iv) Improvement of on-farm water delivery and efficiency of existing irrigation systems; (v) promotion of soil conservation of arable & non-arable land through engineering measures; (vi) creation of new water harvesting structures, check dams, ponds, tanks, etc. (vii) increase the forest cover in the state and (viii) land improvement measures.

Methodology

During the course of preparation of State Irrigation Plan (SIP), the team had visited all the districts to collect data and have interaction with all the stakeholders, which is compiled in the State Irrigation Plan. Methodology adopted to prepare SIP is outlined in brief as under:

- a. Collection of primary and secondary data from field from various sources including published documents and websites.
- b. Various meetings were held to obtain ground level realities and data from key personnel/stakeholders through structured, unstructured interviews, focused group discussions etc.
- c. Meetings with State Government departments and related institutions were held
- d. Meeting was also held with State Level authorities.
- e. GIS maps of the areas/clusters were studied to understand the land morphology, topography of the state.
- f. Focused group discussions and interaction with agriculture officers, horticulture officers, soil conservation officers, extension officers, rural development department, animal husbandry department, irrigation officers both at Blocks and state level for identifying the key issues and focus areas of the region.
- g. Discussion with NABARD officer of the state was also held during the visit.

On the basis of detailed discussion and analysis of data, the team arrived at the projections of various components of PMKSY and Department wise plan for five years from 2016-17 to 2020-21 was prepared.

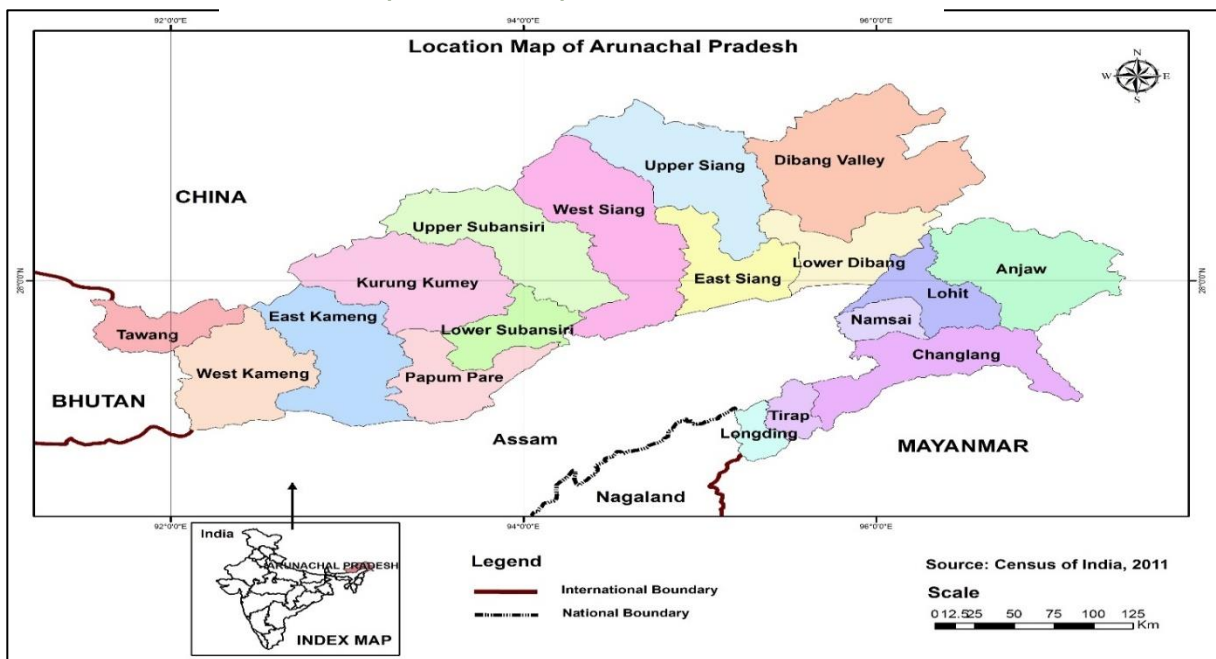
CHAPTER - 1

General Information of the State

1.1 State Profile

Arunachal Pradesh is situated in North Eastern Part of India stretching between longitude 91°30'E to 97°30'E and Latitude 26°30'N and 29°31'N. It spreads over an area of 83,743 Sq. km. touching the international boundaries with Bhutan (160 Km) in west, China (1080 Km) in the North, Myanmar (440 Km) in the South East and in the south it is linked with the state of Assam. At present it has 18 districts with population of 13, 83,727 of which 7, 13,912 males and 6, 69, 815 female and a literacy rate of 65.38% as per 2011 Population Census. There are over 20 major tribes and a large number of sub-tribes inhabiting the State. Though, most communities are ethnically similar, having descended from an originally common stock. But their geographical isolation from each other has brought amongst tribes certain distinctive characteristics in language, dress and customs. Nature has also provided the people with a deep sense of beauty which finds delightful expression in their songs, dances, crafts and festivals.

Map 1: Location Map of Arunachal Pradesh



The climate of Arunachal Pradesh varies from hot and humid to heavy rainfall in the Shivalik range. It became progressively cold as one moves northward higher altitudes. Trees of great size, plentiful climbers and abundance of cane and bamboo make Arunachal evergreen. The richness of flora and fauna that occur in these forests presents a panorama of biological diversity with over 5000 plant species, about 85 terrestrial mammals, over 500 birds and a large number of butterflies, insects and reptiles. Arunachal Pradesh also is considered to be a treasure home to orchids, known for their exquisitely beautiful blooms, with more than six hundred species occurring in varying elevations and climatic conditions throughout the state.

Till 1972, Arunachal Pradesh was known as the North-East Frontier Agency (NEFA). It gained the Union Territory status on January 20, 1972 and renamed as Arunachal Pradesh. On February 20, 1987, it became a full-fledged state. Its capital is located in Itanagar in the Papumpare district. Itanagar is named after Ita fort meaning fort of bricks, built in the 14th century AD.

Arunachal Pradesh constitutes 2.55 per cent of India's total geographical area and 31.94 per cent of that of the Northeast. The State is divided into five river valleys: the Kameng, the Subansiri, the Siang, the Lohit and the Tirap. Part of the Eastern Himalayan ranges, Arunachal Pradesh is one of the most picturesque tourist destinations in India.

There are about 20 major tribes in the State along with many sub-tribes. Broadly, the people are divided into three cultural groups on the basis of their socio-religious affinities. The Monpas and Sherdukpens of Tawang and West Kameng districts follow the lamaistic tradition of Mahayana Buddhism. The second group of the people are Adis, Akas, Apatanis, Bangnis, Nishis, Mishmis, Mijis, Thongsas etc., who worship Sun and Moon God namely, Donyi-Polo and Abo-Tani, the original ancestors for most of these tribes. The third group comprises Noctes and Wanchos, adjoining Nagaland in the Tirap District. These tribes speak their own native languages even though Hindi is the lingua franca in the State. 54.74 per cent of the State's population is literate. The State of Arunachal Pradesh is significantly rich in mineral resources, oil and natural gas. The State is also rich in forest products such as bamboo, cane and timber.

The State has witnessed peripheral insurgency movements occasionally. Further, the State's territory has been used by insurgent cadres of the Assam based United Liberation Front of Asom (ULFA) in transit. Districts of Tirap and Changlang have witnessed activities of the both factions of the Nagaland-based National Socialist Council of Nagaland-Isak-Muivah (NSCN-IM) as well as the Khaplang faction of the NSCN (NSCN-K).

According to final figures of the 2011 population census, the population of the state is 13.83 lakhs registering a population density of 17 per sq.km. The population has increased by 2.86 lakhs during the decade 2001 to 2011. There is apparent disparity in the level of income and consumption between the rich and the poor,

between the urban elite and the rural poor, between the haves and have-nots and between the public living in the hills and in the valley.

1.1.1 Administrative Units

Arunachal Pradesh is not a linguistic state. It is an ethnic state inhabited by colourful tribal people of diverse culture and lifestyle. All of them have their own unique culture and traditions. They also have customary laws and a time tested dispute resolution mechanism. The disputes in tribal societies are resolved by a system of administration of justice founded on customs and customary laws of each tribe by the Village Council.

It is most gratifying to remember that the inhabitants of this tribal state have the spirit of democracy inherent in their traditional laws, which further strengthen by the five fundamental principles for administration of tribal areas.

There were unwritten rules for administration of tribal villages. However, the customs and traditions were almost compatible with the modern concepts of jurisprudence. The tribal councils in NEFA were functioning on the lines of the system evolved for parliamentary democracy, which is in vogue now a days. This is well illustrated in the utterances of the leaders of the councils Kebang/ Buliang/ Mela/ Abela of different communities in their traditional speeches, which they recite at the beginning of their meeting. "Villagers and brethren, let us strengthen our custom and our council, let us improve our relations, let us make the laws straight and equal for all, let our laws be uniform, let our customs be the same for all, let us be guided by the reason and see that justice is done and the compromise reached that is acceptable to both parties. We have come together for a council meeting and let us speak in one voice and decide our verdict." The council derived their authority from the expression of the will and power of the people. They had the support of both social and supernatural. Thus, the concept of parliamentary democracy is not new to the tribal society.

1.1.2 Towns and Villages

The State is predominantly rural with around 77 percent of the population resides in rural areas of the State. The state has a total number of 5589 villages spreading over 59 Community and Rural Development Blocks of 18 districts. Out of 5589 villages, 5495 are inhabited while remaining 331 are uninhabited which means 94.07% rural population have basic amenities with better infrastructure and connectivity to nearby towns and cities. However, the number of towns in the state is 27 out of which 26 are statutory and 1 is census towns with least residing population. Dibang Valley is the largest district in the state with an area of 9129 sq. km. followed by West Siang (8325 sq. km.) and West Kameng (7422 sq. km.).

Although major share of the total population in Arunachal Pradesh is found in rural areas, the percentage of urban population has been increasing right from the beginning of the century.

1.2 Demography

Population of a country is its most important asset and demographic indicator. In terms of size of population, Arunachal Pradesh is the sixth largest State in the North Eastern Region of India. Population of Arunachal Pradesh constitutes 3.04 percent of the total population of 8 (eight) north eastern states including Sikkim where it comprises nearly 0.11 percent of the total population of India. Population pressure is found to be increasing day by day reducing the man-land ratio from about 1: 7.85 hectares in 1901 to 1: 0.78 hectares in 2011. With such population to land ratio and considering vast area Arunachal Pradesh, the State still finds itself in great difficulty in making any significant dent on its poverty and economic backwardness.

The population of Arunachal Pradesh as per 2011 census was 13.84 lakhs comprising 7.14 lakhs of males and 6.70 lakhs of females. Population of Arunachal Pradesh constitutes nearly 0.11 % of the total population of India.

The density of population of Arunachal Pradesh as per 2011 census was 17 persons per sq.km. The sex ratio for the state 938 females per 1000 males in 2011.

The population growth rate of Arunachal Pradesh is found to be higher than that of India. The population growth rate of Arunachal Pradesh in 2011 is 26.03 % as against All India growth rate of 17.64 %.

In terms of literacy, Arunachal Pradesh ranks eighth among the North Eastern States of India as per the final figures of the 2011 census. The literacy rate has increased from 54.34 % in 2001 to 65.38 % in 2011. Among the males, it has increased from 63.83% in 2001 to 72.55 % in 2011, whereas among females, it has increased from 43.53% in 2001 to 57.70 % in 2011.

The 18 districts in the state vary remarkably due to the differences in topography, geo-physical conditions and availability of resources. Also, there are wide variations in area and population of the states and the district-wise density varies from 1 persons per sq. kilometre in Dibang Valley to 51 persons in Papum Pare district. Papum Pare is the most populated district followed by Changlang and West Siang district. Dibang Valley is the least populated district followed by Anjaw and Upper Siang. In the inhabited villages and 27 towns of the state, the population of ST is 9,53,605 and the total number of literates are 7,66,005

Table Error! No text of specified style in document..1: District-wise demography of the State

Sl. No.	District	No. of Villages	Population (Nos.)				ST	General	Total
			Males	Females	Children (1-14 years)	Total	No. of Member	No. of Member	No. of Member
1	Anjaw	305	11507	9660	3472	21167	16934	4233	21167
2	Changlang	362	76948	71278	25869	148226	53878	94348	148226
3	Dibang Valley	142	4414	3590	1084	8004	5701	2303	8004
4	East Kameng	384	38775	39915	14626	78690	72400	6290	78690
5	East Siang	151	50116	49098	12955	99214	69979	29235	99214
6	Kurung Kumey	737	45318	46758	16988	92076	90764	1312	92076
7	Lohit	115	26365	23411	7095	49776	15920	33856	49776
8	Longding	72	28710	28243	11404	56953	48410	8543	56953
9	Lower Dibang Valley	264	28053	26027	7999	54080	25974	28106	54080
10	Lower Subansiri	538	41843	41187	10320	83030	72911	10119	83030
11	Namsai	178	49856	46094	16806	95950	31490	64460	95950
12	Papum Pare	485	89182	87391	25170	176573	117216	59357	176573
13	Tawang	235	29151	20826	5788	49977	34811	15166	49977
14	Tirap	118	28894	26128	8641	55022	49962	5060	55022
15	Upper Siang	112	18699	16621	4988	35320	28468	6852	35320
16	Upper Subansiri	553	41758	41690	12475	83448	78323	5125	83448
17	West Kameng	283	46155	37792	11643	83947	47681	36266	83947
18	West Siang	461	58168	54106	14855	112274	92783	19491	112274
Total		5495	7,13,912	6,69,815	2,12,178	13,83,727	9,53,605	4,30,122	13,83,727

Source: Census-2011

1.3 Biomass and Livestock

The Animal Husbandry and Veterinary department is the core sector of the state economy and has played a vital role in developing the livestock and poultry component by implementing certain development schemes both in rural and urban sector for increasing production and generating employment opportunities.

Agricultural operations in Arunachal Pradesh have limitations due to its topography, climatic situation and socio-economic conditions claiming only about 5-10% of the total land for cultivation, therefore, livestock and poultry plays a vital role in the economic growth of the state and provide the only alternative avocation the villagers fall upon for a subsidiary living.

A large number of small and marginal farmers, agricultural labourers and other economically weaker sections depend upon livestock for gainful employment. The primary objective of animal husbandry development activities is to augment animal based products like milk, meat, egg, wool, hide and skins etc.

The main categories of livestock reared in Arunachal Pradesh are cattle, buffalo, sheep, goat, yak, Mithun, dog, pig, etc. Cattles and buffaloes provide motive power in wet cultivation. Rearing of livestock and poultry helps in assuring income and nutritional security to the resource poor people of the State. It has emerged as a very popular supplementary vocation in homestead farms of the marginal and small farmers as about three fourth of the population own livestock for their livelihood. Poultry farming and Piggery are age old animal husbandry activities adopted by the tribal farmers of the state to supplement their income.

The per capita availability of milk is only 42 gm per day as against the national average of 258 gm as per the Draft Annual Plan of the State Govt. indicating substantial potential for development of dairy. Since the population is predominantly non-vegetarian there is a huge local demand for meat and eggs. Though meat production is substantial, egg production is lagging behind. Most of the livestock in the state are of indigenous stock. The State has a Livestock Policy for improving the local germplasm and enhance milk yield. The Poultry Breeding Policy of the State Govt. seeks to enhance egg production under backyard rearing system as well as large scale commercial egg production. The Breeding policy for Piggery provides for commercial farming of improved exotic purebred / crossbred pigs of proven potential.

As per information provided by the district animal husbandry and veterinary departments, cattle are the most reared livestock in the state in large animal category and account to 77% of the total livestock population of the state under large animals. The number of crossbred cattle (male and female) is lesser than total indigenous cattle population. However, poultry population is largest in the state which account to 40% (or 11.08 lakhs) of the total livestock population. The poultry population is followed by pigs, goats, ducks and sheep which account for 12.3% (or 3.38 lakhs), 10.7% (or 2.98 lakhs), 7.6% (or 2.11 lakhs) and 0.46% (or 12809) respectively, of the total livestock population of the state, as they provide milk, eggs and meat which is marketed and has commercial value. Changlang (12.4%), Papum Pare (12%) and East Siang (10%) have the highest poultry population of the state whereas West Siang (11.4%), Papum Pare (10.7%) and East Siang (10.5%) are the top three states in terms of pigs' population. Lower Subansiri (36.6%), Anjaw (33.6%) and Lohit (12.2%) have the highest Buffalo population while Papum Pare (16.4%), East Siang (12.2%) and Lower Subansiri (10.8%) have the highest cattle population.

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Sl. No.	District/ State	Small animal (Nos.)					Total Small Animal	Large Animals (Nos.)			Any other Milch or Meat Animal	Draft Animal (Buffalo/yak/bul ls/any other)	Total Large Animals
		Poultry	Ducks	Pigs	Goats	Sheep		Indigenous Cattle	Hybrid Cow	Buffalo/ Mithun			
1	Anjaw	35969	83	15211	5745	NA	57008	5234	457	9758	NA	NA	15449
2	Changlang	137439	14558	29812	35641	581	218031	59609	703	397	3	47	60759
3	Dibang Valley	8340	1049	2000	1526	54	12969	238	NA	28	5565	670	6501
4	East Kameng	NA	NA	31236	22165	NA	53401	28433	NA	NA	20471	NA	48904
5	East Siang	107586	116480	35624	18730	NA	278420	74704	4678	45	NA	NA	79427
6	Kurung Kumey	60690	25100	21400	18976	NA	126166	29672	2542	NA	NA	17069	49283
7	Lohit	40903	873	1308	13764	NA	56848	24827	2034	3553	2061	1735	34210
8	Longding	40092	NA	13479	11521	NA	65092	9273	51	47	5523	NA	14894
9	Lower Dibang Valley	68026	8636	15525	22257	NA	114444	26039	3060	2163	17186	3053	51501
10	Lower Subansiri	93818	7957	22526	11612	246	136159	66107	471	10646	NA	NA	77224
11	Namsai	91984	6248	15144	20001	NA	133377	53405	4911	2007	NA	136	60459
12	Papum Pare	133756	21345	36298	44382	NA	235781	100149	4052	398	NA	NA	104599
13	Tawang	12617	NA	5221	8590	8044	34472	24417	1260	NA	2939	9825	38441
14	Tirap	27674	NA	6151	4510	NA	38335	2455	347	NA	NA	NA	2802
15	Upper Siang	85789	8969	20891	7690	NA	123339	17336	45	NA	NA	5915	23296
16	Upper Subansiri	36875	NA	22958	19531	406	79770	38063	NA	NA	NA	NA	38063
17	West Kameng	28601	552	5453	11343	3478	49427	16158	145	11	4165	2969	23448
18	West Siang	98713	NA	38632	20032	NA	157377	35285	383	NA	NA	24151	59819
Total		1108872	211850	338869	298016	12809	1970416	611404	25139	29053	57913	65,570	789079

Source: District Animal Husbandry and Veterinary Department, Districts of Arunachal Pradesh

Note: The population of mithun has been added into Indigenous cattle category while yak is in draft animal category

1.4 Agro Ecology, Climate, Hydrology and Topography

The state is located in the extreme North-eastern corner of the country. It shares its border with the neighbouring countries of Bhutan in the West, China (Tibet) in the North and Northeast, Myanmar in the East and Southeast and the Indian states of Assam and Nagaland in the South.

Arunachal Pradesh is a hilly region. The elevation of the hills ranges from 60 meters to over 7300 meters (GORICHEN peak in West Kameng). The territory falls in the outer Himalayas and Patkoi Ranges. It is endowed with wide topographical variations, vegetation and wild life along the greater part of the length of the territory the characteristics Siwalik type formation of Himalayan Mountains is native. The definition of Siwalik ranges loses its typical character at the point of the valley head and is replaced by series of low hills with easier slopes. These hills gradually merge into the Patkoi hill ranges which separate India & Burma. The general tendency of the hills is found sloping towards the plains of Assam. These hill ridges of Arunachal Pradesh are situated in a very haphazard manner. As soon as one ridge ends, the other starts either in opposite direction or parallel. At these intervals the wide and narrow valleys come into existence. Because of these hill ridges and the valleys, the surface of Arunachal Pradesh is found variegated almost everywhere which also results into numerous geographical isolation of places caused by various rivers and streams traversing the region and depositing the flowing detritus enroute in valley and again at the foothills.

1.4.1 Agro-climatic Zones in Arunachal Pradesh

Arunachal Pradesh being essentially hilly with deep valley and high mountain peaks traversed by number of rivers and rivulets, has varying agro-climatic zones which can broadly be classified as:

Tropical Zone: With high rain-fall and humidity, warm temperature ranges from 22-36 degree C in summer and 10-25 degree in winter and elevation range 80-900 m MSL.

Sub-Tropical Zone: A. With moderate rain-fall and humidity, cool temperature is ranges from 15-30 degree C in summer and 14-21 in winter and elevation range 900-1800 m MSL.

Temperature Zone: With less rain-fall, cool temperature is ranges from 0-22 degree Centigrade and elevation ranging from 1800 m to 3500 m MSL.

Alpine Zone: Essentially cool temperature from 0-20 degree Centigrade with snow-fall and elevation above 3500 m MSL.

Table Error! No text of specified style in document..3: Agro climatic Feature of the Sub Regions

Sub Region	Rainfall (in mm)	Climate	Soil	Crop
Himalayan Hills	2441	Per humid to humid	Brown Hills	Rice, maize, ragi, potato
North-East Hills	3528	Per humid to humid	Red sandy laterite	Rice, rapeseed, maize
Upper Brahmaputra	2809	Humid to per humid	Alluvial, red loamy	Rice, jute, rapeseed, wheat
Southern Hills	2052	Per humid to humid	Acidic soils	Rice, maize, sesame, sugarcane
Lower Brahmaputra	1840	Per humid to humid	Alluvial, red loamy, tarai soils	Rice, rapeseed, wheat, jute, potato

Source: <http://dacnet.nic.in/farmer/new/dac/AgroClimaticZones>

1.4.2 Rainfall and Climate

North- East India falls within the sub-tropical monsoon rain forest belt which receives the heaviest rainfall in the country. In Arunachal Pradesh, the wide altitudinal difference along with physiography, contributes great climatic variations in the State. It is hot and humid in the Brahmaputra plain, the Sub-Himalayan and the Naga-Patkoi ranges, cooler in Lesser Himalayan and Alpine type in Higher and Tethyan Himalayan zones. The State has variegated climate due to wide altitudinal range. The climate varies from sub-tropical in the south temperate and alpine in the north with large areas experiencing snowfalls during winter. It becomes progressively cold as one move northwards to higher altitudes. Along the foothills, bordering the plains of Assam, the climate is humid and hot while along the international border towards China, the State has high and lofty mountains. All along the border with China, many of the high mountains are permanently snow-capped. Winter season sets in from October and continuous up to February, followed by summer season from March to Mid-June. Summer season is hot and humid but is less pronounced because of the early start of the pre-monsoon rains. The area receives rainfall under the influence of south-west monsoon which generally starts from the month of May to September/October.

The areas around the middle belt of Arunachal Pradesh are cooler. The middle belt in Arunachal Pradesh experiences micro thermal climate. Moreover, Arunachal Pradesh possesses alpine climate in the higher altitudes of the state. The higher regions of Arunachal Pradesh witnesses' snowfall during the winter. The snowfall and the alpine climate of Arunachal Pradesh largely draws tourists from the different parts of the world to tour within the territory of Arunachal Pradesh. Another distinct feature of the climate at Arunachal Pradesh is rainfall. In fact, Arunachal Pradesh experiences heavy rainfall during May to September. The average rainfall recorded in Arunachal Pradesh is 2822 mm while, the average monthly rainfall in the State is 235 mm and average number of rainy days in the year is 148.

Table Error! No text of specified style in document..4: District- wise rainfall and temperature

Sl. No.	District	Normal Annual Rainfall (mm)	Average Monthly Rainfall (mm)	No. of Rainy Days	Average Weekly Temperature (°C)								
					Period								
					Summer (April-May)			Winter (Oct-Mar)			Rainy (June-Sept.)		
					Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean
1	Anjaw	3398	283	130	19	24	22	15	19	17	22	26	24
2	Changlang	2510	209	144	19	26	23	17	23	20	24	29	27
3	Dibang Valley	4399	367	150	19	24	21	6	12	9	24	27	26
4	East Kameng	2680	223	120	14	29	22	10	22	16	20	30	25
5	East Siang	3748	312	156	19	33	26	13	32	23	23	37	30
6	Kurung Kumey	1200	100	90	17	30	23	12	27	20	22	32	27
7	Lohit	5266	439	170	17	26	22	15	26	20	26	31	28
8	Longding	2520	210	139	18	32	25	12	28	20	18	30	24
9	Lower Dibang Valley	2577	215	133	23	38	31	13	21	17	21	38	30
10	Lower Subansiri	1910	159	130	23	34	28	11	21	16	20	31	26
11	Namsai	2449	204	137	23	28	25	15	28	22	19	35	27
12	Papum Pare	2348	196	129	29	36	33	3	6	5	21	23	22
13	Tawang	2135	178	150	4	15	9	-4	18	7	11	19	15
14	Tirap	3479	290	170	16	32	24	3	16	10	13	18	16
15	Upper Siang	3240	270	180	13	39	26	4	21	13	14	23	18
16	Upper Subansiri	1356	113	234	20	38	29	10	20	15	20	30	25
17	West Kameng	1975	165	140	7	21	14	-1	12	6	13	23	18
18	West Siang	3607	301	160	16	26	21	13	21	17	21	30	25
Average		2822	235	148	18	29	23	9	21	15	19	28	24

Source: District Contingency Plans, District Agriculture Office

1.5 Soil Profile

In vast varied terrain with numerous rivers it is difficult to provide any generalization about the type of soils. However, considering the sand stone rocks the granite and genesis formation interspersed with calcareous limestone and slate and other minerals tempered largely by swift flowing hilly rivers the broad group could possibly be (1) Soils of the hills, (2) Soils in the valleys and mid hills and (3) soils in the foot hills. The soils in the valleys are rich in organic content and clayey-alluminous. It needs to be mentioned that soils in Arunachal Pradesh has high acidity which may be ascribed to the high rainfall and heavy run of soils. As regards the colour, the soils look red, black and white (Pure sand). It may be mentioned that red soils is considered to be fit for growing root crops like radish, carrot, turnip, potato, beet root, tapioca, yams, etc. in addition to crops like millets and maize. At the same time black soils with clay is recognized suitable for paddy and loamy soils are suited for wheat, barley, potato cultivation. Due to heterogeneity of basic rock and sedimentary formation of soils there is great variation in the nature and composition of soils found own at close intervals.

Table Error! No text of specified style in document..5: Soil Profile of Arunachal Pradesh

Sl. No.	District	Area (ha)	Land Slope			
			0-3% (ha)	3-8% (ha)	8-25% (ha)	>25% (ha)
1	Anjaw	619000	6190	12380	92850	507580
2	Changlang	466200	69930	69930	93240	233100
3	Dibang Valley	912900	18258	45645	118677	730320
4	East Kameng	413400	20670	41340	103350	248040
5	East Siang	360300	72060	126105	108090	54045
6	Kurung Kumey	604000	6040	12080	90600	495280
7	Lohit	362500	90625	126875	72500	72500
8	Longding	110200	2204	8816	27550	71630
9	Lower Dibang Valley	390000	97500	175500	58500	58500
10	Lower Subansiri	350800	10524	59636	70160	210480
11	Namsai	158700	55545	71415	31740	0
12	Papum Pare	346200	34620	69240	86550	155790
13	Tawang	217200	2172	4344	32580	178104
14	Tirap	126000	3780	8820	31500	81900
15	Upper Siang	659000	13180	46130	158160	441530
16	Upper Subansiri	703200	7032	63288	175800	457080
17	West Kameng	742200	7422	14844	148440	571494
18	West Siang	832500	16650	149850	166500	499500
Total		83,74,300	5,34,402	11,06,238	16,66,787	50,66,873

Source: District Agriculture Office, Districts of Arunachal Pradesh

1.6 Soil Erosion and Runoff Status

Land has an infinite life, if used sustainably. The use of land for agricultural purposes, using unsustainable practices would mean degradation of the land due to soil erosion in the form of the loss of nutrients from the topsoil, movement of soil (changes in soil depth). This is a common phenomenon in Arunachal Pradesh. Soil erosion is a natural process and only when it erodes beyond the tolerable rate, it has an impact. Under natural conditions, the soil lost is largely replenished. However, when the natural rate of replenishment is exceeded by erosion, a physical reduction of soil resources takes place. In the absence of other forces at play, any loss of soil erosion beyond a tolerable level can be considered as human induced. The most common approach for valuing the loss of soil and soil nutrients is the replacement cost method. This is based on the cost of replacing soil nutrients with artificial fertilizers.

Arunachal Pradesh is a hilly state and the agricultural practices are done mostly on the hilly slopes and only a small proportion is practiced in the plain. Soil erosion is a regular phenomenon in Arunachal Pradesh. The two main agents of soil erosion are wind and water.

However, it is more of an agricultural problem which creates forest and soil erosion problems. Soil erosion takes place due to dynamic processes of nature and other natural factors. This has been further aggravated by human interference by way of jhum cultivation, indiscriminate cutting and felling of trees for fuel and timber, free grazing of cattles, unscientific cultivation of crops on the steep slopes, etc. leading to destruction of flora and fauna and finally eco-degradation.

The pernicious effects of jhuming have been increasing and have now assumed a devastating proportion. Several hill sides of Arunachal Pradesh have become barren-slopes with rills and gullies without vegetation. The eroded soil from the upper reaches fills up the streams and reservoirs where siltation takes place. Due to decrease in the water depth in the lakes/ reservoirs, life of hydro-electric projects is going to be shortened. Drying of many of the perennial sources of water also takes place. On the other hand, floods occur more often now than before and the quality of environment is being seriously affected. Ecological balance of the whole region is being endangered.

1.7 Land Use Pattern in the State

Land Utilisation statistics for the entire State of Arunachal Pradesh are not available because hill areas are not cadastrally surveyed. The land-based enterprises support a large segment of population in the State. The land based enterprises particularly the cultivation of field crops as well as horticulture crops

is considered a critical determinant of the pace of overall economic development of the State. The efficient use of land resource, therefore, assumes singular significance with respect to planning of economic activities. Understanding of dependence and different land uses is essential for proper development on any region. At places the forest areas are over exploited either for community needs or developmental purposes and, therefore, considerable area is under degraded forests. The Gross Cropped Area of the district is 3,52,876 hectares. Out of total Gross Cropped Area of the State, Lower Dibang Valley and Lohit shares the maximum area of 39,127 hectares i.e., 11%, and 37,075 hectares i.e., 11% of the total Gross Cropped Area of the State respectively. While, Tawang and Dibang Valley contribute only 3% (8969 Hectare) and 2% (8448 Hectares) of the Total Gross Cropped Area of the State respectively.

Further, the State has total Net Sown Area of 2,46,651 Hectares with average cropping intensity of the State is 119%. However, Dibang Valley district has maximum cropping intensity of 147% and Lower Dibang Valley district has minimum cropping intensity of 104%.

For a hilly State like Arunachal Pradesh, forest products are the most important natural resources for environmental protection and maintaining ecological balance. The total area under forest in the State is 62,74,588 hectares.

The potential net sown area could be increased if and when the fallow lands are utilised for cultivation purposes. The cultivable waste land of the state is a part which might be progressively utilised for cultivation purpose in the long run. The land use pattern in the State is shown in Table – 1.6.

Table Error! No text of specified style in document..6: Land use Pattern in Arunachal Pradesh

Sl. No.	Name of District	Total Geographical Area (Ha)	Area under Cultivation					Area under Forest (Ha)	Area under Waste Land (Ha)	Area under Other Uses (Ha)
			Gross Agriculture Area (Ha)	Net Sown Area-Agri (Ha)	Cropping Intensity (%)	Net Area under Horticulture (Ha)	Gross Cropped Area (Ha)			
1	Anjaw	619000	9714	8467	115%	1482	11196	524300	12074	72677
2	Changlang	466200	31540	27640	114%	2085	33625	430600	3830	2045
3	Dibang Valley	912900	5572	3788	147%	2876	8448	890003	11042	5191
4	East Kameng	413400	14580	12060	121%	342	14922	368568	2348	30082
5	East Siang	360300	24992	19564	128%	1000	25992	287200	13369	39167
6	Kurung Kumey	604000	13305	11466	116%	649	13954	362400	55123	174362
7	Lohit	362500	18485	17285	107%	18590	37075	235732	3004	87888
8	Longding	110200	8500	7876	108%	756	9256	71014	470	30085
9	Lower Dibang Valley	390000	35805	34355	104%	3322	39127	292996	34324	25003
10	Lower Subansiri	350800	16940	12571	135%	4024	20964	311494	6876	15835
11	Namsai	158700	28321	21414	132%	2411	30732	68244	6250	60381
12	Papum Pare	346200	17219	13829	125%	3191	20410	304649	1370	23160
13	Tawang	217200	5709	4148	138%	3260	8969	125300	5000	79492
14	Tirap	126000	9041	8450	107%	817	9858	79100	2120	35514
15	Upper Siang	659000	10192	8634	118%	1776	11968	479254	5718	163618
16	Upper Subansiri	703200	9037	6763	134%	4291	13328	580700	25940	85506
17	West Kameng	742200	8539	7176	119%	5458	13997	323583	165660	240323
18	West Siang	832500	25011	21165	118%	4044	29055	539451	22874	244966
Total		83,74,300	2,92,502	2,46,651	119%	60,374	3,52,876	62,74,588	3,77,392	14,15,295

Source: District Agriculture Office, Districts of Arunachal Pradesh



CHAPTER - 2

State Water Profile

Agriculture is the mainstay of the economy of Arunachal Pradesh. It involves both permanent settled cultivation as well as 'jhum' cultivation. The state's agriculture and allied sectors have growth rates that are three times the national average. Major agro and forest based industries in the state are related to tea, fruit, non-timber and plywood industries. Around two-thirds of the state's population is dependent on climate sensitive natural resources such as agriculture, forest, bio-diversity and water availability. The state government aims to achieve higher economic growth and create job opportunities for the unemployed in rural areas. The state government is focusing on improving farmer income through higher productivity, use of suitable farm techniques, upgrading technical competency, marketing support and availability of a cooperative credit network. Non-timber based industries include bamboo, cane, rubber and medicinal plants. The industry is characterised by many regional players; several units have been set up by the Arunachal Pradesh Forest Corporation (APFC), a government organisation. Horticulture has a vast potential, owing to good agro climatic conditions and topography, for the development of varied varieties of fruits and vegetables.

Under Rashtriya Krishi Vikas Yojana, US\$4.82 million was allocated to the state during 2015-16, out of which US\$2.41 million has been released and US\$ 2.12 million has been utilized by the state. As on October 2016, edible oil maker, Ruchi Soya Industries, signed a memorandum of understanding (MoU) with Government of Arunachal Pradesh to boost palm oil production in the state, through development of quality palm plantations and human capacity building on 25,000 hectares of land in four districts of the state viz, West Siang, East Kameng, Lower Subansiri and Papumpare.

2.1 Area-wise, Crop-wise Irrigation status

Agriculture sector contributes 27% of the GSDP and employs around 63% of the total workers. However, factors, like low availability of permanently cultivable land, unsatisfactory yield and yield growth, stagnation of area under HYV crops, ill-defined property rights, lack of access to institutional credit, poor marketing infrastructure facilities hamper development of the sector. The state has

undulating topography and the plain below 5 degrees slope is limited to 12434 sq. km including the river beds. Soils of the state are mostly shallow and recently formed and have low fertility.

While scope for area expansion for cultivation of field crops is limited to plains of East Siang, Lower Dibang Valley and Lohit districts due to physiographic factors, there is tremendous potential for producing a variety of horticultural crops such as apple, pear, orange, pineapple, kiwi, walnut, ginger, turmeric, medicinal plants and vegetables. Despite rich biodiversity and immense scope for development of sectors like plantation and horticulture, the state has not been able to realize much of the potential in these areas. The following interventions for promotion of agriculture are required from the state government:

- Strengthening the extension mechanism to facilitate the farmers with technical knowhow and supply of quality planting materials
- Promoting agro-climatic zone specific commercial cultivation of horticulture crops and medicinal plants
- Facilitating creation of marketing channels and market infrastructure for collection, grading, standardization, processing, certification, etc. especially through producers' cooperatives, producer organizations or state promoted to ensure remunerative prices to the farmers
- Introducing a Crop Insurance Scheme for risk mitigation in agriculture
- Removing ambiguity with respect to the land ownership by conducting cadastral surveys and preparing ownership documents so that land can be used as collateral for loans from financial institutions
- Strengthening a contract enforcement mechanism

Table Error! No text of specified style in document..7: Area-wise, Crop-wise Irrigation Status

Sl. No.	District	Kharif (Area in Ha)			Rabi (Area in Ha)			Total (Area in Ha)			Horticulture Area (Ha)
		Irrigated	Rainfed	Total	Irrigated	Rainfed	Total	Irrigated	Rainfed	Total	
1	Anjaw	1097	7370	8467	53	1194	1247	1150	8564	9714	1482
2	Changlang	3642	22067	25709	16	5815	5831	3658	27882	31540	2085
3	Dibang Valley	595	3441	4036	NA	1536	1536	595	4977	5572	2876
4	East Kameng	1600	11054	12654	162	1764	1926	1762	12818	14580	342
5	East Siang	6356	14001	20357	1660	2975	4635	8016	16976	24992	1000
6	Kurung	3034	4950	7984	639	4682	5321	3673	9632	13305	649

Sl. No.	District	Kharif (Area in Ha)			Rabi (Area in Ha)			Total (Area in Ha)			Horticulture Area (Ha)
		Irrigated	Rainfed	Total	Irrigated	Rainfed	Total	Irrigated	Rainfed	Total	
	Kumey										
7	Lohit	2225	4663	6888	NA	11597	11597	2225	16260	18485	18590
8	Longding	200	7618	7818	NA	682	682	200	8300	8500	756
9	Lower Dibang Valley	3319	8307	11626	NA	24179	24179	3319	32486	35805	3322
10	Lower Subansiri	6430	10450	16880	NA	60	60	6430	10510	16940	4024
11	Namsai	4152	9786	13938	NA	14383	14383	4152	24169	28321	2411
12	Papum Pare	5030	8247	13277	133	3809	3942	5163	12056	17219	3191
13	Tawang	1122	1390	2512	NA	3197	3197	1122	4587	5709	3260
14	Tirap	894	6553	7447	191	1403	1594	1085	7956	9041	817
15	Upper Siang	1571	7063	8634	284	1274	1558	1855	8337	10192	1776
16	Upper Subansiri	1881	5312	7193	394	1450	1844	2275	6762	9037	4291
17	West Kameng	2353	2270	4623	NA	3916	3916	2353	6186	8539	5458
18	West Siang	4810	15463	20273	1594	3144	4738	6404	18607	25011	4044
Total		50311	150005	200316	5126	87060	92186	55437	237065	292502	60374

Source: Agriculture Department and Horticulture Department, 2015-16

2.1.1 Status of Horticulture and Plantation crops

Horticulture is an important sector in Arunachal Pradesh having tremendous potential for alleviation of rural poverty. Total area suitable for horticulture is 1.8 Mha. However, the present total area under horticulture is only 60,374 ha. Horticultural crops comprises of cultivation of fruits such as orange, apple, kiwi, walnut, pine apple and banana. Popular spices in the state are large cardamom and ginger. Among plantation crops, arecanut is the most widely cultivated crop in the state.

Table Error! No text of specified style in document..8: Area-wise Status of Horticulture and Plantation Crops

Sl. No	District	Area (in ha)
1	Anjaw	1482
2	Changlang	2085
3	Dibang Valley	2876
4	East Kameng	342
5	East Siang	1000

Sl. No	District	Area (in ha)
6	Kurung Kumey	649
7	Lohit	18590
8	Longding	756
9	Lower Dibang Valley	3322
10	Lower Subansiri	4024
11	Namsai	2411
12	Papum Pare	3191
13	Tawang	3260
14	Tirap	817
15	Upper Siang	1776
16	Upper Subansiri	4291
17	West Kameng	5458
18	West Siang	4044
TOTAL		60,374

Source: Horticulture Department, Arunachal Pradesh

As shown in Table – 2.2, the total area under horticultural crops is 60,374 Ha. The area under horticultural crops in Lohit district is maximum with 18,590 Ha while the minimum area is in East Kameng district with 342 Ha.

2.2 Production and Productivity of major Crop

Agriculture is the main occupation of the people of Arunachal Pradesh on which the economy of the State entirely depends. Agriculture in the State was traditionally organic that contributed to preventive health care and wellbeing in olden days. Jhum cultivation was the most prominent farming system in earlier days. It provided and continues to provide a way of life for most of the ethnic group of the State. Due to varied physiographic and agro-climatic condition, the agricultural practice and prospect of area differs in some extent from one district to other district of the State. Diverse of physiographic and agro-climatic feature of the State is congenial for commercial cultivation of both tropical & temperate fruits, Orchid species, Potato, Ginger, Species, Medicinal and Aromatic plants etc.

At the instance of the Government of India, the major emphasis has been given on effective extension services to wean away the farming community from traditional practice of slash and burn shifting cultivation to settle cultivation in Arunachal Pradesh. The main efforts of the Agriculture department are towards increasing permanent cultivation, land preparation, supply of improved varieties of seeds, grafts, fertilizers, pesticides and insecticide etc. The programme has been succeeded to a great extent in this area. Government is committed to achieve food security and raise income of farmers through

commercialisation of agriculture. Also, encouraging the farmers to increase productivity of land and production of agricultural crops for graduating from Subsistence Agriculture to commercial farming. With persistent efforts made in this direction, it has been possible to reach a production level of food crops from a very negligible level of the time of Independence. Even then, there is still a shortfall of required staple food crops annually in this district. The agriculture and allied sectors have been identified as key area of economic development of the district. To generate higher income of cultivators, the Government is providing subsidy to the progressive farmers for purchase of machineries, fertilizers and variety of high yielding seeds etc.

Different crops are grown in the region depending on the seasons. However, in warmer areas, the production process continues throughout the year. Among food grain crops, highest area is under paddy, followed by maize, millet, pulses and wheat. In terms of production, paddy accounts 70% of the total food grain production followed by maize, millet, pulses and wheat.

The other food crops which are grown in the State are vegetables, Chili and Pulses. Among the horticulture crops, the most significant are Apple, orange, walnut, pineapple, banana, orange and kiwi. Under National Mission on Medicinal Plants low altitude plants like *Aqualaria agallocha*, *Emblica Officinallis*, etc. and high altitude plants such as *Picrorhiza kurroa*, *Aconitum heterophyllum*, etc. are being propagated. The state has high scope for promoting High Altitude Medicinal Plants having high demands in Chinese and Tibetan Medicines, which can be cultivated in Tawang, West Kameng, upper reaches of West Siang, Upper Subansiri, Anini, Kurung Kumey, Upper Subansiri and Anjaw districts. The season-wise area, production and productivity of major agricultural crops in state is given in Table– 2.3.

Table Error! No text of specified style in document.:9: Production and Productivity of field crops in Arunachal Pradesh

Sl. No.	District	Rainfed			Irrigated			Total		
		Area (ha)	Production (Qtl/yr)	Yield (Kg/Ha)	Area (ha)	Production (Qtl/yr)	Yield (Kg/Ha)	Area (ha)	Production (Qtl/yr)	Yield (Kg/Ha)
1	Anjaw	8564	96340	1125	1150	15709	1366	9714	112049	1153
2	Changlang	27882	452156	1622	3658	76624	2094	31540	528780	1677
3	Dibang Valley	4977	64383	1294	595	8092	1360	5572	72475	1301
4	East Kameng	12818	192275	1500	1762	39832	2261	14580	232107	1592
5	East Siang	16976	279265	1645	8016	153510	1915	24992	432776	1732
6	Kurung Kumey	9632	135346	1405	3673	62658	1706	13305	198004	1488

Sl. No.	District	Rainfed			Irrigated			Total		
		Area (ha)	Production (Qtl/yr)	Yield (Kg/Ha)	Area (ha)	Production (Qtl/yr)	Yield (Kg/Ha)	Area (ha)	Production (Qtl/yr)	Yield (Kg/Ha)
7	Lohit	16260	235277	1447	2225	46414	2086	18485	281690	1524
8	Longding	8300	153646	1851	200	4006	2003	8500	157652	1855
9	Lower Dibang Valley	32486	742352	2285	3319	81316	2450	35805	823667	2300
10	Lower Subansiri	10510	128100	1219	6430	108805	1692	16940	236905	1399
11	Namsai	24169	564970	2338	4152	103782	2500	28321	668752	2361
12	Papum Pare	12056	184647	1532	5163	85909	1664	17219	270556	1571
13	Tawang	4587	105867	2308	1122	26599	2371	5709	132446	2320
14	Tirap	7956	112732	1417	1085	17680	1630	9041	130412	1442
15	Upper Siang	8337	104189	1250	1855	35521	1915	10192	139710	1371
16	Upper Subansiri	6762	86082	1273	2275	31259	1374	9037	117341	1298
17	West Kameng	6186	127456	2060	2353	52968	2251	8539	180279	2111
18	West Siang	18607	220447	1185	6404	101156	1579	25011	321603	1286
Total		237065	3985530	1445	55437	1051840	1741	292502	5037204	1593

Source: Agriculture Department 2015-16, Arunachal Pradesh

The average productivity of agricultural crops was found to be higher in irrigated condition as compared to rainfed condition by 20%. The average productivity of agricultural crops in the state was found to be 1593 Kg/ha.

2.3 Irrigation based classification

The State is blessed with immense water resources. It has two major basins within which it has 6 sub-basins, 19 catchments, 108 sub-catchments and 335 watersheds. Many rivers and streams crisscross the State uniformly and there is ample scope for using the available water resources for irrigation purposes as the industrial demand for water is very less. Farming with assured irrigation is one of the critical inputs for weaning away the primitive shifting cultivation practices of the tribal farmers. It would also help in making agriculture a sustainable economy of the State by enhancing productivity and maintaining the ecological balance.

The undulating topography of the State limits the scope for major and medium irrigation projects. Even the irrigation infrastructure created so far is prone to damages due to geological fragility and extreme

rainfall pattern of the region requiring additional funds for special repair and maintenance of these assets. Thus, the prudent way to improve irrigation facility is to create minor irrigation structures.

The Net Irrigated Area forms 49,333 Ha out of the total Gross Cropped Area of 3,52,876 Ha of the State as per the data provided by the district agriculture officers in the districts of Arunachal Pradesh.

The State is availing benefits of the minor irrigation and flood control measures. The irrigation projects once completed are handed over to the beneficiary farmers, who manage the normal operation and maintenance works.

There is immense opportunity for exploitation of Ground water for irrigation, as the Ground water level in the State is in the safe zone. As per the estimates, about 50000 Ha area can be brought under irrigation through ground water development. The State is promoting deep tube wells for irrigation with the assistance from the Central Sponsored Scheme for Strengthening of Surface and Ground Water for minor Irrigation.

The State encounters problems of landslides in upper altitude belt, landslides coupled with bank erosion of valley regions in the middle belt and bank erosion together with flooding problems in the foothill belt.

Table Error! No text of specified style in document..10: Irrigation based Classification

Sl. No.	Districts	Gross Irrigated Area (Ha)	Net Irrigated Area (Ha)	Un- Irrigated Area (Ha)	Gross Cropped Area (Ha)
1	Anjaw	1150	1097	10046	11196
2	Changlang	3658	3642	29967	33625
3	Dibang Valley	595	595	7853	8448
4	East Kameng	1762	1600	13160	14922
5	East Siang	8016	6356	17976	25992
6	Kurung Kumey	3673	3034	10281	13954
7	Lohit	2225	2225	34850	37075
8	Longding	200	180	9056	9256
9	Lower Dibang Valley	3319	3319	35808	39127
10	Lower Subansiri	6430	6430	14534	20964
11	Namsai	4152	3194	26580	30732
12	Papum Pare	5163	5030	15247	20410
13	Tawang	1122	1122	7847	8969
14	Tirap	1085	894	8773	9858
15	Upper Siang	1855	1571	10113	11968
16	Upper Subansiri	2275	1881	11053	13328

17	West Kameng	2353	2353	11644	13997
18	West Siang	6404	4810	22651	29055
Total		55437	49333	297439	352876

Source: District Agriculture Office, WRD

As shown in Table – 2.4, the gross irrigated area in the State for field crops is 55,437 Hectares out of which 90% i.e. 49,333 Hectares is net irrigated area and total rainfed area for field crops is 2,97,439 Hectare. Maximum gross irrigated area of agricultural crops is covered by East Siang district, i.e., 8016 Hectare while, Lower Dibang Valley district has maximum rain-fed area of 35,808 Hectare. Longding district has minimum irrigated area of 200 Hectare and Tawang has minimum rainfed area of 7847 Hectare.

CHAPTER - 3

Water Availability in the State

Irrigation and Water Resources Development provides the basic infrastructure for the growth of economy of the country and large investment has been made for the purpose in our country. Irrigation is an artificial application of water to the soil for crop production by constructing headworks (weir) across a river in case of flow irrigation system. In lift irrigation system water required for irrigation purpose has been lifted from the river as the situation commands by diesel operated or electricity power operated barge mounted pump. In third case where these two systems are not feasible required water are extracted from the water bearing aquifer beneath the ground level by means of deep tube well assembly. Besides these popular system of irrigation there are sprinkler system and drip irrigation system. In a world of explosive population growth, particularly in developing nations, it is the need of the time to enhance the growth of food grain production keeping in conformity with the increase in population. The increase in agricultural production in general and food grain production in particular has not kept pace with the growth of the population by ushering the traditional cultivation system. Every means must therefore be sought to increase agricultural production. In the arid and semi-arid zones of the world one of the principal means to achieve this is development of irrigation. Our country, India also needs irrigation to keep pace with the growth of its huge population, which has crossed one billion marks in this millennium.

3.1 Status of Water Availability

Overview of Water Resources in Arunachal Pradesh

There are five major rivers in Arunachal Pradesh namely, Kameng, Subansiri, Siang (Brahmaputra), Lohit and Tirap. All of these rivers go on to form the Brahmaputra, one of the biggest rivers in the world. The entire state is dotted with numerous river, small streams, spring, etc. and receives good rainfall over eight to nine months. Perennial rivers and high rainfall make Arunachal Pradesh a water rich state.

The State is blessed with immense water resources. It has two major basins within which it has 6 sub-basins, 19 catchments, 108 sub-catchments and 335 watersheds. Many rivers and streams crisscross the State uniformly and there is ample scope for using the available water resources for irrigation

purposes as the industrial demand for water is very less. Farming with assured irrigation is one of the critical inputs for weaning away the primitive shifting cultivation practices of the tribal farmers.

It would also help in making agriculture a sustainable economy of the State by enhancing productivity and maintaining the ecological balance. The undulating topography of the State limits the scope for major and medium irrigation projects. Even the irrigation infrastructure created so far is prone to damages due to geological fragility and extreme rainfall pattern of the region requiring additional funds for special repair and maintenance of these assets. Thus, the prudent way to improve irrigation facility is to create minor irrigation structures.

Issues

- There is a necessity to promote Water Harvesting Structures in the regions receiving adequate rain where storage of rain water for irrigation purpose is feasible.
- Adequate supply of uninterrupted power as well as availability of diesel is necessary for energization of pump sets. Similarly, awareness about the solar energy operated pump sets can be created to circumvent the problems of energy availability.
- The State has good potential for cultivation of various vegetables and horticultural crops in some pockets. Thus, there is a necessity for popularization of Drip / Sprinkler irrigation systems. Agencies like Jain Irrigation System already have presence in the State, who supply cost effective drip & sprinkler irrigation systems even for smaller landholdings. Subsidy for irrigation is available under Macro Management in Agriculture
- There is also a need for acquisition and deployment of pump sets, drilling machines, rigs for irrigation purposes.
- The Water Users Association (WUA) are being formed under Society's Registration Act in recent years. The schemes under Command Area Development & Water Management (CADWM) are being implemented through the participation of these WUAs. However, the State is yet to have Water Policy, Irrigation Policy / Participatory Irrigation Management (PIM).

Table 3.1 below shows the district-wise water availability. It shows the surface water that is presently being utilised for irrigation. 3487.84 MCM of water is being presently utilised through surface irrigation in the state. However, Arunachal Pradesh is abundant in water resources and the absolute water availability in the state is 3,05,205 MCM. This is the amount of water that can be harnessed in future for irrigation as well as other purposes.

In terms of surface water that is presently being utilised, East Siang district is presently able to utilise maximum quantity with 658.93 MCM. East Siang district also has the maximum absolute surface water availability of 70,000 MCM.

Table Error! No text of specified style in document..11: Status of Water Availability in Arunachal Pradesh

Sl. No.	Districts	Surface Water Availability for Irrigation (MCM)	*Absolute Surface Water Availability (MCM)
1	Anjaw	88.69	19405
2	Changlang	205.89	5000
3	Dibang Valley	99.45	22500
4	East Kameng	136.97	8000
5	East Siang	658.93	70000
6	Kurung Kumey	72.1	8000
7	Lohit	184.25	21000
8	Longding	104.16	2000
9	Lower Dibang Valley	51.7	27500
10	Lower Subansiri	308	10000
11	Namsai	119.71	6300
12	Papum Pare	373	4000
13	Tawang	153.76	2500
14	Tirap	132.24	3000
15	Upper Siang	167.67	60000
16	Upper Subansiri	170.52	13500
17	West Kameng	150.57	2500
18	West Siang	310.19	20000
Total		3487.84	305205

Source: Water Resource Department, Arunachal Pradesh

*Absolute Water Availability: It is the total unutilised water available in the State through large number of rivers, rivulets and streams.

The above table shows that the total surface water availability in the State is 3487.84 MCM which is only 1% to the total absolute water available. It states that the even though the State has large volume of water but it has not been able to tap it for economic utilization due to constraints such as low fund availability, lack of manpower and geographical constraints in many districts.

3.2 Status of Ground Water Availability

Hydrogeology

The entire foothill belt running along the Himalayan front can be correlated to the “Bhabar belt” of Ganga basin with exception of some areas of Lohit and Tirap districts. Ground water occurs under unconfined to semi-confined conditions. In Namsai and Mino sub-divisions, the depth to water levels is essentially governed by topography. Sediments down to 106 meters below ground level (m.bgl) are predominantly sandy and discharge of tube wells ranges up to 160 m³/hr. Open wells in Namsai and Mino sub-division tap 3 to 5 m of saturated sand and yield up to 100 m³/day.

Diverse geological formation, lithological variations, geomorphological and hydro meteorological dissimilarities exist in the state and which result in various ground water situations.

The modes of groundwater occurrence are:

- a) Porous formations comprising unconsolidated and semi-consolidated sediments. Aquifers are generally interconnected and often extensive both continuous and discontinuous having moderate to very high yield potentials.
- b) Fissured formations consisting of consolidated hard rocks rendered porous by weathering and fracturing. Aquifers are discontinuous in nature having limited yield potentials.

Table Error! No text of specified style in document..12: Status of ground water availability in Arunachal Pradesh

Sl. No	District	Net Annual ground Water Availability (MCM)	Existing Ground Water for Irrigation (MCM)	Existing Ground Water for Domestic & Industrial Supply (MCM)	Existing Ground Water for all Uses (MCM)	Surplus (MCM)	Stages of Ground Water Development (%)
1	Anjaw	NA	NA	NA	NA	NA	NA
2	Changlang	249.42	0.26	0.98	1.24	248.18	0.50%
3	Dibang Valley	NA	NA	NA	NA	NA	NA
4	East Kameng	147.55	0.15	0.03	0.18	147.37	0.12%
5	East Siang	677.46	0.69	1.79	2.48	674.98	0.37%
6	Kurung Kumey	NA	NA	NA	NA	NA	NA
7	Lohit	1756.77	0.05	2.52	2.57	1754.2	0.15%
8	Longding	NA	NA	NA	NA	NA	NA

Sl. No	District	Net Annual ground Water Availability (MCM)	Existing Ground Water for Irrigation (MCM)	Existing Ground Water for Domestic & Industrial Supply (MCM)	Existing Ground Water for all Uses (MCM)	Surplus (MCM)	Stages of Ground Water Development (%)
9	Lower Dibang Valley	858.18	0.34	0.48	0.82	857.36	0.10%
10	Lower Subansiri	23.08	0.05	0	0.05	23.03	0.22%
11	Namsai	NA	NA	NA	NA	NA	NA
12	Papum Pare	119.08	0.58	0.84	1.42	117.66	1.19%
13	Tawang	NA	NA	NA	NA	NA	0.00%
14	Tirap	83.27	0.03	0.18	0.21	83.06	0.25%
15	Upper Siang	NA	NA	NA	NA	NA	NA
16	Upper Subansiri	3	NA	NA	NA	3	0.00%
17	West Kameng	15.76	NA	NA	NA	15.76	0.00%
18	West Siang	56.01	NA	0.25	0.25	55.76	0.45%
Total		3989.58	2.15	7.07	9.22	3980.36	

Source: Tube-well and Ground Water Division under WRD, Arunachal Pradesh

The total ground water availability in the State is 3989.58 MCM out of which only 0.23% is being currently utilized i.e., 9.22 MCM under domestic, industrial and agriculture sector. The total ground water being utilized under crop production is 2.15 MCM which also states that there is an ample opportunity to tap ground water for irrigation purposes in future.

3.3 Status of Command Area

The state has a total command area of 90,557 hectares. Within the state, Namsai district has the largest command area with 12,625 hectares constituting 14% of the total command area of the state followed by East Siang district with 12,431 hectares (14%) and Lohit with 9150 (10%) hectares.

Out of 90,557 hectares of the state's command area, nearly 49,333 hectares (54%) is developed and 41,224 hectares (46%) of the area is undeveloped command. Among the districts, East Siang district has the largest developed area with 13,241 hectares constituting 23% of the total developed area of the

state followed by Namsai district with 10,152 hectares (17%) and Lower Dibang Valley with 5,319 (9%) hectares. The districts of Longding, Dibang Valley and Anjaw have the lowest developed command area in the state.



Irrigation Structures in Changlang district of Arunachal Pradesh

Table Error! No text of specified style in document..13: Status of command area in Arunachal Pradesh

Sl. No.	District	Information on the other services command		
		Total Area (Ha)	Developed Area(Ha)	Undeveloped Area(Ha)
1	Anjaw	1298	1097	201
2	Changlang	5369	3642	1727
3	Dibang Valley	732	595	137
4	East Kameng	2711	1600	1111
5	East Siang	12431	6356	6075
6	Kurung Kumey	3234	3034	200
7	Lohit	9150	2225	6925
8	Longding	1184	180	1004
9	Lower Dibang Valley	6539	3319	3220
10	Lower Subansiri	6783	6430	353
11	Namsai	12625	3194	9431
12	Papum Pare	6234	5030	1204
13	Tawang	1682	1122	560
14	Tirap	2087	894	1193
15	Upper Siang	4641	1571	3070
16	Upper Subansiri	4626	1881	2745
17	West Kameng	2715	2353	362
18	West Siang	6515	4810	1705
Total		90557	49333	41224

Source: Water Resource Department, Arunachal Pradesh

3.4 Existing type of Irrigation

Irrigation Infrastructure in the State

The state is keen to use its natural resources, water and land in particular for overall economic development in the state. Creation and maintenance of necessary developmental infrastructure would necessitate strong policy interventions backed by operational plans, most importantly, including efficient management and sustainable utilization of state's water resources. Expansion of irrigation accessibility for increased agriculture acreage and productivity, State's remoteness and lack of communication (road) infrastructure will be the biggest barrier for such large scale development.

Though the state has abundant rainfall and perennial rivers, it also faces constraints particularly in terms of high cost of construction and maintenance of irrigation infrastructure. This is especially from the point of view of difficult hilly terrain, inaccessible villages, difficulty in movement of rigs and other equipment, and importantly recurring flash floods that destroy irrigation infrastructure.

However, the terrain offers considerable scope for development of gravity water supply schemes, adoption of rainwater harvesting and other traditional water harvesting methods in this region.

Irrigation Status

The State is availing benefits of the Accelerated Irrigation Benefit Programme (AIBP) for minor irrigation and flood control measures. The irrigation projects once completed are handed over to the beneficiary farmers, who manage the normal operation and maintenance works. There is immense opportunity for exploitation of Ground water for irrigation, as the Ground water level in the State is in the safe zone. As per the estimates, about 50000 Ha area can be brought under irrigation through ground water development. The State is promoting deep tube wells for irrigation with the assistance from the Central Sponsored Scheme for Strengthening of Surface and Ground Water for minor Irrigation. The State encounters problems of landslides in upper altitude belt, landslides coupled with bank erosion of valley regions in the middle belt and bank erosion together with flooding problems in the foothill belt.

Table Error! No text of specified style in document..14: Existing type of irrigation in Arunachal Pradesh

Sl. No.	District	Surface Irrigation (in No.)					Total (Nos.)
		Canal Based		Tanks/Ponds/ reservoirs			
		Govt. Canal-Minor Irrigation	Community/Private Canal	Community Ponds	Individual /Pvt. Ponds	Govt. Reservoir/Dams	
1	Anjaw	45	NA	NA	NA	NA	45
2	Changlang	NA	NA	NA	NA	NA	NA
3	Dibang Valley	63	NA	NA	NA	NA	63
4	East Kameng	47	NA	NA	NA	NA	47
5	East Siang	632	NA	NA	43	NA	675
6	Kurung Kumey	NA	NA	NA	NA	NA	NA
7	Lohit	3	NA	NA	NA	NA	3
8	Longding	NA	NA	NA	NA	NA	NA
9	Lower Dibang Valley	184	NA	NA	NA	NA	184
10	Lower Subansiri	221	890	98	121	2	1332
11	Namsai	12	NA	NA	NA	NA	12
12	Papum Pare	322	61	NA	NA	7	390
13	Tawang	87	NA	NA	NA	NA	87
14	Tirap	32	NA	NA	NA	NA	32

Sl. No.	District	Surface Irrigation (in No.)					Total (Nos.)
		Canal Based		Tanks/Ponds/ reservoirs			
		Govt. Canal-Minor Irrigation	Community/Private Canal	Community Ponds	Individual /Pvt. Ponds	Govt. Reservoir/Dams	
15	Upper Siang	197	54	NA	NA	NA	251
16	Upper Subansiri	496	NA	NA	NA	33	529
17	West Kameng	59	13	NA	26	NA	98
18	West Siang	15	200	68	NA	NA	283
Total		2415	1218	166	190	42	4031

Source: Water Resource Department and Tube well & Groundwater Division, Arunachal Pradesh



CHAPTER - 4

Water Requirement / Demand

The earlier Chapters dealt with the general profile, water profile and water availability in the State of Arunachal Pradesh. This Chapter now deals with the current (2016) and projected (2020) demand for water from various sectors. The demand has been worked out on the basis of the data collected from different departments which has already been presented in previous Chapters. For practical considerations, the unit for volume of water has been chosen as Million Cubic Meters (MCM) instead of Billion Cubic Meters (BCM) as suggested in the PMKSY Guidelines. MCM would denote the volume of water that would fill up an imaginary cube with edges one meter in length (about 1000 litres) and then multiplied a million times. With conversion, one MCM of water would also be equal to 100 hectare meters.

4.1 Domestic Water Demand – State

This includes the water requirement by the households for the purposes such as drinking, cooking, bathing, lawn sprinkling, gardening, sanitary purposes, etc. The amount of domestic water consumption per person shall vary according to the living conditions.

The total domestic water demand shall be equal to the total population multiplied by the desirable level of per capita domestic consumption. It has been assumed that per capita daily water requirement of people residing in urban areas of the State is 140 LPCD (litres per capita per day) and for population in rural areas, the daily per capita water requirement is 120 litres. As the last population census was done in 2011, the actual population of the State in 2016 is not readily available. Considering the base population of the State as per the Census 2011, the projected population in 2021 can be assessed by applying the last decadal growth rate of 26.03%. Using the above norms, the annual gross domestic water demand for 2021 for the projected level of population in Arunachal Pradesh would be **78.08 MCM**. This estimation is shown in Table - 4.1.

Table Error! No text of specified style in document..15: Annual Domestic Water Demand (Projected)

State	Population as per census 2011	Population in 2016	Present Water Requirement (2016) (MCM)	Projected population in 2021 (MCM)	Annual Water Requirement in 2021 (MCM)
Arunachal Pradesh	1383727	1596645	67.85	1856254	78.08

4.1.1 Domestic Water Demand – District-wise

Table - 4.2 indicates the district-wise projection of water demand in the year 2021 for which the actual decadal growth rate of each district in 2011 Census has been reckoned. In the hilly catchments of the upstream of Arunachal Pradesh plains, natural springs and dug wells are generally the preferred means of fulfilling the needs of freshwater for the present population. In hilly areas, most of the drinking water is harnessed from springs, streams, rivers, ponds and natural water bodies. However, major portion of the domestic water is harnessed from ground water, predominantly through shallow tube wells and dug wells. Although there is abundant surface water in Arunachal Pradesh, ground water continues to play a significant role in meeting the water demands of most communities in the State, especially those in the rural areas, with tube wells and dug wells as the most common means to access water.

Table Error! No text of specified style in document..16: Domestic Water Demand – District-wise

Sl. No.	District	Population as per census 2011	Population in 2016	Present Water Requirement (2016) (MCM)	Projected population in 2021 (MCM)	Annual Water Requirement in 2021 (MCM)
1	Anjaw	21167	22972	0.11	24173	0.22
2	Changlang	148226	161700	7.97	173459	8.55
3	Dibang Valley	8004	8407	0.38	9254	0.42
4	East Kameng	78690	90531	4.63	105333	5.38
5	East Siang	99214	104689	4.2	111960	4.49
6	Kurung Kumey	92076	144329	7.11	196582	9.69
7	Lohit	49776	53905	2.5	58376	2.71
8	Longding	56953	60259	1.57	62904	1.64
9	Lower Dibang Valley	54080	56027	2.54	60285	2.73
10	Lower	83030	105466	3.53	133965	4.48

Sl. No.	District	Population as per census 2011	Population in 2016	Present Water Requirement (2016) (MCM)	Projected population in 2021 (MCM)	Annual Water Requirement in 2021 (MCM)
	Subansiri					
11	Namsai	95950	103909	4.66	112528	5.05
12	Papum Pare	176573	219758	9.79	273505	12.18
13	Tawang	49977	57074	2.57	65178	2.97
14	Tirap	55022	58291	2.93	61754	3.01
15	Upper Siang	35320	36362	1.86	37195	1.9
16	Upper Subansiri	83448	106899	3.23	136941	4.14
17	West Kameng	83947	89206	4.03	94795	4.11
18	West Siang	112274	116861	4.23	138067	4.41
Total		1383727	1596645	67.85	1856254	78.08

Source: Census-2011

4.2 Crop Water Requirement

Water requirement of a crop denotes the total quantity and the way in which a crop requires water, from the time it is sown to the time it is harvested (“**crop period**”). Different crops will have different water requirements and the same crop may have different water requirements at different places of the same country depending upon the climate, type of soil, method of cultivation, rainfall, etc. The total quantity of water required by the crop for its full growth may be expressed in Hectare-m or in Million Cubic Meter or simply as a depth to which the total supplied irrigation water would stand above the surface without percolation or evaporation. Water is needed mainly to meet the demands of evaporation (E), transpiration (T) and metabolic needs of the plants, which is together known as consumptive use (CU). Since water used in the metabolic activities of plant is negligible, being only less than one percent of quantity of water passing through the plant, evaporation (E) and transpiration (T), i.e. ET is directly considered as equal to consumptive use (CU). In addition to ET, water requirement (WR) includes losses during the application of irrigation water to field (percolation, seepage and runoff) and water required for special operation such as land preparation, transplanting, leaching, etc.

WR = CU + application losses + water needed for special operations

Water requirement (WR) is, therefore, **demand** and the supply would consist of contribution from irrigation (I), effective rainfall (ER) and soil profile contribution including that from shallow water tables (S)

$$WR = IR + ER + S$$

Under field conditions, it is difficult to determine evaporation and transpiration separately. They are estimated together as evapotranspiration (ET). It is, thus clear that **Irrigation Water Need = Crop water need — available rain fall.**

Water requirement of crop is the quantity of water regardless of source, needed for normal crop growth and yield in a period of time at a place and may be supplied by precipitation or irrigation or both. The crop water need always refers to a crop grown under optimal conditions, i.e. a uniform crop, actively growing, completely shading the ground, free of diseases, and favourable soil conditions (including fertility and water). The crop, thus, reaches its full production potential under the given environment. The crop water need mainly depends on:

- The climate - in a sunny and hot climate, crops need more water per day than in a cloudy and cool climate;
- The crop type - crops like maize or sugarcane need more water than crops like millet or sorghum;
- The growth stage of the crop - fully grown crops need more water than crops that have just been planted.

4.2.1 Technical Concepts

An understanding of the following technical aspects would give a better perspective:-

a. “Base Period”

It represents the whole period of cultivation from the time when irrigation water is first provided for ground preparation to the time when it is provided last just before the harvesting.

b. “Duty”

“Duty” represents the irrigating capacity of a unit of water. Duty of a water simply expresses the number of hectares of land that can be irrigated for the full growth of the given crop by supplying 1 cumec water (cubic meter per second, as a unit of rate of flow of water) continuously during the entire “base period” of that crop. It is the relationship between the area of the crop irrigated and the quantity of the irrigation water required during the entire crop period. For example, if 3 cumec of water is required for a crop sown in an area of 5100 hectares, the “duty” of the irrigation water would be $5100 / 3 = 1700$ hectares/cumec and the discharge of 3 cumecs will be required throughout the “base period”.

c. “Delta”

On the other hand, “Delta” is the total quantity of water required for any crop during its base period for its full-fledged nourishment when expressed in depth of water (i.e. in 'cm' or in 'inches'). The total quantity of water (volume of water) is divided by the total irrigated area to obtain Delta of crop of the irrigated area. Thus, Delta is the total depth of water required by a crop during the entire period when the said crop is in the field (denoted by symbol Δ).

d. “Consumptive Water Requirement”

Consumptive water requirement is the amount of water potentially required to meet the evapo-transpiration needs of the plant so that the plant does not suffer in its growth through short supply of water. It is, thus, the depth of water needed to meet the water loss through evapo-transpiration of a disease-free crop, growing in large fields under non-restricting soil conditions including soil water and fertility and achieving full production under the given growing environment.

e. “Consumptive Water Use” (Evapo-transpiration)

Consumptive use or evapo-transpiration is the amount of water used by the growing plant in transpiration (building of plant tissues, etc.) and that evaporated from adjacent soil or from the plant foliage in any specified time. It is expressed as mm or cm or inches. Consumptive use or evapo-transpiration depends upon all those factors on which evaporation/transpiration depend such as temperature, sunlight, wind movement, etc.

f. “Consumptive Irrigation Requirement”

Consumptive irrigation requirement is the depth of irrigation water, exclusive of precipitation, stored moisture, or groundwater that is required to meet evapo-transpiration during the crop period.

g. “Net Irrigation Requirement”

Net irrigation requirement is the depth of irrigation water, exclusive of precipitation, stored moisture, or groundwater that is required consumptively for crop production as also for other purposes such as leaching, etc.

h. “Effective Rainfall”

Effective rainfall is the precipitation falling during the growing period of the crop that is available to meet the evapo-transpiration requirement of crops. It does not include precipitation lost through deep percolation below the root zone or through surface runoff.

i. “Irrigation Efficiency”

Irrigation efficiency is the percentage of applied irrigation water stored in the soil and available for consumptive use by the crop.

j. “Irrigation Water Requirement”

The net irrigation water requirement divided by the irrigation efficiency is termed as irrigation water requirement.

4.2.2 Crops & Water Requirement

Broadly, the crops can be categorized into 3 groups – crops whose water requirement is low, crops with mid-level water requirement and crops where the water requirement is very high.

I. Low Water Requirement Plants

Plants that require low levels of water are often called drought-tolerant. Drought-tolerant plants can thrive in hot, dry conditions with very little water. They include both perennials and annuals. Most drought-tolerant plants only have to be hand-watered when they are planted and while they are establishing themselves. After that, they can be left to the natural cycle of the elements. All citrus trees are also drought-tolerant. Popular drought-tolerant annuals include marigold.

II. Mid-Level Water Requirement Crops

Most plants land in this range when it comes to water requirements. These plants do not need to be watered every day, but they need to be watered when the soil has been dry for over a week or two. Sometimes these plants are classified as plants lying in the "occasional water zone". Rice, wheat, pulses and oilseeds are mainly covered under this category in Arunachal Pradesh.

III. High Water Requirement Plants

Some plants require large amounts of water. The soil for these plants should always be kept moist. Standing water is not a concern for these plants, so you don't have to worry about root rot. Perennials are especially good for wet areas because they do not have to be replanted year after year, which can be difficult in marshy areas. Most annual flowering plants also do well in constantly moist soil. Some water-thirsty crops are (litres/Kg of crop) Cotton (7000-29000 litres), Rice (3000-5000 litres), Sugarcane (1500-3000), Soya (2000 litres), etc.

4.2.3 District-wise crop water requirement in Arunachal Pradesh

As discussed in Chapter 2, cereals and horticultural crops are cultivated on major part of the gross cropped area in the State. The assumptions used are as under: For paddy: 0.03 m per ha, for Maize: 0.045 m per ha, for Millet: 0.15 m per ha, Vegetables: 0.18 m per Ha and for Horticulture crops: 0.015

m per ha. The small portion of area under other crops has been taken in category of vegetables and same assumption has been made for calculation of water requirement of both agriculture and horticulture crops.

Water potential required has been derived from water required by crops cultivated under rainfed conditions. Therefore, the existing water potential represents the water requirement of crops cultivated in irrigated areas. Currently, the total crop water requirement for the State is 16254.75 MCM which is projected to increase to 20073.76 MCM by 2021. The present crop water potential created in the State is 3697.99 MCM. Thus, it can be concluded from the table that a total water potential of 16375.77 MCM is to be created in the State to fulfil the requirement of crops and to provide assured irrigation facilities to farmers of the State. The district-wise crop water demand and also the total water potential to be created is shown in Table - 4.3.

Table Error! No text of specified style in document..17: District-wise Crop Water Demand in Arunachal Pradesh

Sl. No.	District/State	Gross Cropped Area (Ha)	Net Irrigated area (ha)	Projected Area (Ha)	Existing Water Requirement (MCM)	Existing Water Potential (MCM)	Water Potential Required in 2021 (MCM)	Water Potential to be created (MCM)
1	Anjaw	11196	1097	10046	556.29	75.56	660.01	584.46
2	Changlang	33625	3642	29967	1815.94	240.336	1968.82	1728.49
3	Dibang Valley	8448	595	7853	248.88	39.07	515.96	476.89
4	East Kameng	14922	1600	13160	792.342	115.769	864.623	748.85
5	East Siang	25992	6356	23466	1285.34	526.62	1541.7	1015.08
6	Kurung Kumey	13954	3034	13365	753.332	241.375	878.088	636.71
7	Lohit	37075	2225	34850	1135.71	146.17	2289.64	2143.47
8	Longding	9256	180	9056	567.11	13.15	594.99	581.84
9	Lower Dibang Valley	39127	3319	35641	2257.16	218.07	2341.64	2123.57
10	Lower Subansiri	20964	6430	13525	825.9	422.49	888.59	466.10
11	Namsai	30732	3194	27332	1406.88	272.79	1795.72	1522.93
12	Papum Pare	20410	5030	14142	908.58	339.23	929.11	589.88
13	Tawang	8969	1122	7847	272.53	73.668	504.64	430.97
14	Tirap	9858	894	8773	555.13	71.27	576.35	505.08
15	Upper Siang	11968	1571	10113	567.24	121.89	664.43	542.54
16	Upper	13328	1881	10393	444.34	205.17	682.82	477.65

Sl. No.	District/State	Gross Cropped Area (Ha)	Net Irrigated area (ha)	Projected Area (Ha)	Existing Water Requirement (MCM)	Existing Water Potential (MCM)	Water Potential Required in 2021 (MCM)	Water Potential to be created (MCM)
	Subansiri							
17	West Kameng	13997	2353	12085	471.46	154.59	793.95	639.36
18	West Siang	29055	4810	24090	1390.58	420.78	1582.67	1161.89
	Total	3,52,876	49,333	3,05,704	16,254.75	3697.99	20,073.76	16,375.77

4.3 Livestock Water Demand

The 19th Livestock Census, the last full census exercise, was undertaken in 2012. However, in the year 2016 there were 2759494 numbers of livestock in Arunachal Pradesh. It has been assumed that the existing water potential is equal to present water demand of livestock. Thus, the water potential to be created implies the quantum of water availability to be created to meet the water demand by the livestock in 2021. The livestock water requirement of the State has been assessed district wise considering per capita daily water requirement for cows/buffaloes and other large animals as 65 L, goats/pigs 6 L and Poultry 0.25 L. Thus, water demand for livestock of the State during 2021 is expected to be 31.53 MCM as compared to the present demand of 23.41 MCM and, hence, the estimated water potential to be created in the State for its livestock population is 11.75 MCM in addition to the present created potential of 19.78 MCM. The district-wise livestock water demand for the State has been assessed in Table - 4.4

Table Error! No text of specified style in document..18: District-wise Livestock Water Requirement

Sl. No.	District/State	Total number of livestock (2016)	Present Water demand (MCM)	Projected Livestock Population (2021)	Water demand in 2021 (MCM)	Existing Water potential (MCM)	Water potential to be created (MCM)
1	Anjaw	72457	0.04	79703	0.08	0.03	0.05
2	Changlang	278790	1.18	244332	1.04	1.04	0
3	Dibang Valley	19470	0.16	23169	0.19	0.16	0.03
4	East Kameng	102305	1.65	117806	1.9	1.65	0.25
5	East Siang	357847	1.41	397210	1.72	0.31	1.41
6	Kurung Kumey	175449	2.56	201766	3.07	2.56	0.51
7	Lohit	91058	0.84	97432	0.9	0.84	0.06
8	Longding	79986	0.42	83985	0.44	0.42	0.02
9	Lower Dibang Valley	165945	1.29	176234	1.39	1	0.39

Sl. No.	District/State	Total number of livestock (2016)	Present Water demand (MCM)	Projected Livestock Population (2021)	Water demand in 2021 (MCM)	Existing Water potential (MCM)	Water potential to be created (MCM)
10	Lower Subansiri	213383	2.28	717660	3.28	1.85	1.43
11	Namsai	193836	1.5	279125	2.19	1.34	0.85
12	Papum Pare	340380	3.61	783519	6.76	2.4	4.36
13	Tawang	72912	0.97	80204	1.05	0.97	0.08
14	Tirap	41137	0.02	42372	0.05	0.02	0.03
15	Upper Siang	146635	2.14	190626	3.64	2.14	1.5
16	Upper Subansiri	117833	0.87	128801	0.95	0.86	0.09
17	West Kameng	72875	0.63	78414	0.65	0.63	0.02
18	West Siang	217196	1.83	499963	2.23	1.56	0.67
Total		2759494	23.41	4222321	31.53	19.78	11.75

4.4 Industrial Water Demand

Arunachal Pradesh is rich in natural resources but due to difficult terrain, inadequate infrastructural facilities and varying climatic conditions, the state could not develop much in the industrial sector of its economy. However, the resources, policy incentives & climate in state support investments in mining & mineral products (including cement), tissue culture & floriculture, plantation crops (tea, rubber, etc.) & agro-based industries. North Eastern Development Finance Corporation Ltd is engaged in catalysing industrial growth of the North-eastern states (including Arunachal Pradesh) by providing counselling, timely advice & assistance for building quality enterprises. The central government also approved the North East Industrial and Investment Promotion Policy (NEIIPP), 2007.

The policy provides several incentives: incentive on business expansion, 100% excise duty & income tax exemption, capital investment subsidy, interest subsidy and insurance premium reimbursement. In addition, the Department of Industries has set up District Industries Centres (DICs) & Sub-District Industries Centres (Sub- DICs) for the industrial development of small scale, tiny & village industries.

The Department of Industries, Government of Arunachal Pradesh, may also be responsible for promoting industrial activities in the state to provide employment opportunities to the rural and urban people. The DICs also help the local entrepreneurs in identifying suitable schemes, preparing feasibility reports, arranging supply of tools and equipment, providing credit facilities, etc.

Based on the available information collected during the preparation of DIPs in each of the 18 districts in Arunachal Pradesh, the total requirement of water by the industries has been assessed and shown, District-wise, in Table - 4.5.

Table Error! No text of specified style in document..19: Industrial Water Demand

Sl. No.	District/State	Present Water demand (MCM)	Water demand in 2021 (MCM)	Existing water potential (MCM)	Water potential to be created (MCM)
1	Anjaw	NA	4.27	0.00	4.27
2	Changlang	0.02	0.03	0.02	0.0043
3	Dibang Valley	NA	NA	NA	NA
4	East Kameng	NA	NA	NA	NA
5	East Siang	0.57	0.62	0.57	0.05
6	Kurung Kumey	NA	NA	NA	NA
7	Lohit	NA	NA	NA	NA
8	Longding	0.0015	0.0015	0.0015	0.0001
9	Lower Dibang Valley	0.03	0.06	0.00	0.06
10	Lower Subansiri	NA	NA	NA	NA
11	Namsai	0.33	0.38	0.33	0.06
12	Papum Pare	NA	NA	NA	NA
13	Tawang	0.12	0.13	0.12	0.02
14	Tirap	NA	NA	NA	NA
15	Upper Siang	NA	NA	NA	NA
16	Upper Subansiri	NA	NA	NA	NA
17	West Kameng	NA	NA	NA	NA
18	West Siang	NA	NA	NA	NA
Total		1.07	5.49	1.03	4.46

Source: District Agriculture Office, Districts of Arunachal Pradesh / "0" indicates non-availability of the figures from the source.

4.5 Water Demand for Power Generation

Power or electricity is the most convenient and versatile form of energy. It plays a key role in the industrial, agricultural and commercial sectors of the economy and is also the most crucial source of supplying domestic energy requirements. The demand has, therefore, been growing at a rate faster than other forms of energy. The demand of power met mainly from Grid Power, diesel and hydro generation. As of June 2016, Arunachal Pradesh had a total installed power generation capacity of 257.86 MW. Hydro energy (97.57 MW) accounted for around 37.84% of Arunachal Pradesh's installed power generation capacity. The Department of Hydropower Development, Arunachal Pradesh, is wholly entrusted with the design, construction, operation and maintenance of hydropower projects in the state. After renewable energy and hydropower, thermal power is the prime source of electricity generation in the state.

Further, as of June 2016, the state accounted for an installed capacity of power generation of 55.41 MW from thermal power plants out of which 43.06 MW is contributed by gas power plants and 12.35 MW from coal power plants. On account of its hilly terrain and abundant rivers, Arunachal Pradesh is estimated to have hydropower potential of 60,000 MW (through mega projects). Key regions for tapping hydropower include Dibang, Tawang, Subansiri Upper, Subansiri Middle, Kameng and Lohit. The Government has invited domestic power companies in the region to develop hydropower plants. For the installation of 40,000 MWp grid connected solar rooftop system in the country by 2022, the target allocated for the state is 50 MWp. Four of the biggest projects under construction include the 2,000 MW Subansiri Lower, 600 MW Kameng, 110 MW Pare and 1,750 MW Demwa Lower hydroelectric projects. These projects are expected to be completed by the end of 2017. A 2x30 KW Ashapani micro hydel project has been commissioned in Anjaw district of the state, with an objective of electrification of Chaglagam circle and its adjoining villages. The Ministry of Environment and Forests (MoEF) granted preconstruction scoping clearances to over 50 projects under the EIA notification 2006. Final environmental clearance has been awarded to 13 projects. These projects are expected to be operational by 2019.

Though power plays a vital role in the development of the state, Arunachal Pradesh is facing the problem of power shortage. The state continues to be deficit in electric energy.

Water demand for power generation is zero in the state as there are no thermal power plants in the state

Table Error! No text of specified style in document..20: Water Demand for Power Generation

Sl. No.	State	Power Requirement (MW)	Water Demand (MCM)	Water Demand in 2021 (MCM)	Existing Water Potential (MCM)	Water Potential to be created (MCM)
1	Arunachal Pradesh	NA	NA	NA	NA	NA

Source: District Agriculture Office, Districts of Arunachal Pradesh

4.6 Total Water Demand for Various Sectors

The total water demand of the Arunachal Pradesh for all the sectors described earlier has been assessed as the aggregation of share of each sector. The current water demand has been indicated in Table - 4.7 and the projected water demand has been depicted in Table – 4.8.

Table Error! No text of specified style in document..21: District-wise Present Water Demand for Various sectors

Sl. No.	District	Sector-wise water demand (2016)				Total (MCM)
		Domestic (MCM)	Crop (MCM)	Livestock (MCM)	Industries (MCM)	
1	Anjaw	0.11	556.30	0.04	NA	556.45
2	Changlang	7.97	1815.94	1.18	0.02	1825.11
3	Dibang Valley	0.38	248.88	0.16	NA	249.42
4	East Kameng	4.63	792.34	1.65	NA	798.62
5	East Siang	4.20	1285.34	1.41	0.57	1291.52
6	Kurung Kumey	7.11	753.33	2.56	NA	763.00
7	Lohit	2.50	1135.71	0.84	NA	1139.05
8	Longding	1.57	567.11	0.42	NA	569.11
9	Lower Dibang Valley	2.54	2257.16	1.29	0.03	2261.02
10	Lower Subansiri	3.53	825.90	2.28	NA	831.71
11	Namsai	4.66	1406.88	1.50	0.33	1413.37
12	Papum Pare	9.79	908.58	3.61	NA	921.98
13	Tawang	2.57	272.53	0.97	0.12	276.19
14	Tirap	2.93	555.13	0.02	NA	558.08
15	Upper Siang	1.86	567.24	2.14	NA	571.24
16	Upper Subansiri	3.23	444.34	0.87	NA	448.44
17	West Kameng	4.03	471.46	0.63	NA	476.12
18	West Siang	4.23	1390.58	1.83	NA	1396.64
Total		67.85	16,254.75	23.41	1.07	16,347.06

Table Error! No text of specified style in document..22: District-wise Future Water Demand for Various sectors

Sl. No.	District	Sector-wise water demand (2021)				Total (MCM)
		Domestic (MCM)	Crop (MCM)	Livestock (MCM)	Industries (MCM)	
1	Anjaw	0.22	660.02	0.08	4.27	664.59
2	Changlang	8.55	1968.82	1.04	0.03	1978.44
3	Dibang Valley	0.42	515.96	0.19	0.00	516.57
4	East Kameng	5.38	864.62	1.90	0.00	871.90
5	East Siang	4.49	1541.70	1.72	0.62	1548.53
6	Kurung Kumey	9.69	878.09	3.07	0.00	890.85

Sl. No.	District	Sector-wise water demand (2021)				Total (MCM)
		Domestic (MCM)	Crop (MCM)	Livestock (MCM)	Industries (MCM)	
7	Lohit	2.71	2289.64	0.90	0.00	2293.25
8	Longding	1.64	594.99	0.44	0.00	597.07
9	Lower Dibang Valley	2.73	2341.64	1.39	0.06	2345.82
10	Lower Subansiri	4.48	888.59	3.28	0.00	896.35
11	Namsai	5.05	1795.72	2.19	0.38	1803.34
12	Papum Pare	12.18	929.11	6.76	0.00	948.05
13	Tawang	2.97	504.64	1.05	0.13	508.79
14	Tirap	3.01	576.35	0.05	0.00	579.41
15	Upper Siang	1.90	664.43	3.64	0.00	669.97
16	Upper Subansiri	4.14	682.82	0.95	0.00	687.91
17	West Kameng	4.11	793.95	0.65	0.00	798.71
18	West Siang	4.41	1582.67	2.23	0.00	1589.31
Total		78.08	20,073.76	31.53	5.49	20,188.87

4.7 Water Budget

Water budget reflects the relationship between input and output of water through a region. Thus, it shows the gap between water availability and requirement. The negative gap indicates that there are sufficient water resources for irrigation, domestic and the industrial uses. The District-wise position is given in Table – 4.9. It is seen from this Table that Arunachal Pradesh has adequate availability of water to fulfill the demand by creating efficient technologies of irrigation through various schemes.

Table Error! No text of specified style in document..23: District-wise Water Budget

Sl. No.	Block	Total Existing water availability (MCM)		Total (MCM)	Water Demand (MCM)		Present Water Gap/ Surplus(MCM)	Projected Water Gap/ Surplus (MCM)
		Surface Water	Ground Water		Present (2016)	Projected (2021)		
1	Anjaw	88.69	NA	88.69	556.45	664.59	467.75	575.90
2	Changlang	205.89	1.24	207.13	1825.11	1978.44	1617.98	1771.31
3	Dibang Valley	99.45	NA	99.45	249.42	516.57	149.97	417.12
4	East Kameng	136.97	0.18	137.15	798.62	871.90	661.47	734.75
5	East Siang	658.93	2.48	661.41	1291.52	1548.53	630.11	887.12

Sl. No.	Block	Total Existing water availability (MCM)		Total (MCM)	Water Demand (MCM)		Present Water Gap/ Surplus(MCM)	Projected Water Gap/ Surplus (MCM)
		Surface Water	Ground Water		Present (2016)	Projected (2021)		
6	Kurung Kumey	72.10	NA	72.10	763.00	890.85	690.90	818.74
7	Lohit	184.25	1.03	185.28	1139.05	2293.25	953.77	2107.97
8	Longding	104.16	NA	104.16	569.11	597.07	464.94	492.91
9	Lower Dibang Valley	51.70	0.82	52.52	2261.02	2345.82	2208.50	2293.30
10	Lower Subansiri	308.00	0.05	308.05	831.71	896.35	523.66	588.30
11	Namsai	119.71	1.54	121.25	1413.37	1803.34	1292.12	1682.09
12	Papum Pare	373.00	1.42	374.42	921.98	948.05	547.56	573.62
13	Tawang	153.76	NA	153.76	276.19	508.79	122.43	355.03
14	Tirap	132.24	0.21	132.45	558.08	579.41	425.63	446.96
15	Upper Siang	167.67	NA	167.67	571.24	669.97	403.57	502.30
16	Upper Subansiri	170.52	NA	170.52	448.44	687.91	277.92	517.39
17	West Kameng	150.57	NA	150.57	476.12	798.71	325.55	648.14
18	West Siang	310.19	0.25	310.44	1396.64	1589.31	1086.20	1278.87
Total		3487.84	9.22	3497.06	16,347.06	20,188.87	12,850.00	16,691.81

Table Error! No text of specified style in document..24: Water Budget for Crop Production

Sl. No.	Block	Total Existing water availability for Irrigation (MCM)		Total (MCM)	Crop Water Demand (MCM)		Present Water Gap/ Surplus(MCM)	Projected Water Gap/ Surplus (MCM)
		Surface Water	Ground Water		Present (2016)	Projected (2021)		
1	Anjaw	88.69	NA	88.69	556.29	660.017	467.60	571.32
2	Changlang	205.89	0.26	206.15	1815.94	1968.824	1609.78	1762.67
3	Dibang Valley	99.45	NA	99.45	248.88	515.96	149.43	416.51
4	East Kameng	136.97	0.15	137.12	792.34	864.623	655.22	727.50

Sl. No.	Block	Total Existing water availability for Irrigation (MCM)		Total (MCM)	Crop Water Demand (MCM)		Present Water Gap/ Surplus(MCM)	Projected Water Gap/ Surplus (MCM)
		Surface Water	Ground Water		Present (2016)	Projected (2021)		
5	East Siang	658.93	0.69	659.62	1285.34	1541.7	625.72	882.08
6	Kurung Kumey	72.10	NA	72.10	753.33	878.088	681.23	805.98
7	Lohit	184.25	0.02	184.27	1135.71	2289.64	951.44	2105.37
8	Longding	104.16	NA	104.16	567.11	594.99	462.95	490.83
9	Lower Dibang Valley	51.70	0.34	52.04	2257.16	2341.64	2205.12	2289.60
10	Lower Subansiri	308.00	0.05	308.05	825.90	888.59	517.85	580.54
11	Namsai	119.71	0.03	119.74	1406.88	1795.72	1287.14	1675.98
12	Papum Pare	373.00	0.58	373.58	908.58	929.11	535.00	555.53
13	Tawang	153.76	NA	153.76	272.53	504.64	118.77	350.88
14	Tirap	132.24	0.03	132.27	555.13	576.35	422.86	444.08
15	Upper Siang	167.67	NA	167.67	567.24	664.43	399.57	496.76
16	Upper Subansiri	170.52	NA	170.52	444.34	682.82	273.82	512.30
17	West Kameng	150.57	NA	150.57	471.46	793.95	320.89	643.38
18	West Siang	310.19	NA	310.19	1390.58	1582.67	1080.39	1272.48
Total		3487.84	2.15	3489.99	16,254.75	20,073.76	12,764.76	16,583.77

The present demand from various sector is 16347.06 MCM out of which 16254.75 MCM is from agriculture sector whereas, the projected water demand in the State is 20188.87 MCM out of which 20073.76 MCM is from agriculture sector. The present water gap amounts to 12850 MCM while it has been projected to be 16691.81 MCM by 2021. It can be stated from the above table that the State's present and projected water demand is more than the water available through various sources currently. There exists a gap in the demand and supply of water in the State but it is not due to unavailability of water sources or deficit of water in the State. Arunachal Pradesh is one of the most water surplus State in the country and the absolute water availability in the State amounts for 3,05,205 MCM through different rivers, rivulets, streams, etc. At present, the State is only utilizing 1% of the total absolute water available through different water harvesting and irrigation infrastructure. There exists a

gap in the economic utilization of available water due to unavailability of infrastructure to tap the source, lack of required fund to develop such infrastructures and lack of capacity building and awareness at various levels.

In view of it, the State has proposed a Strategic Action Plan which is discussed in Chapter 5. The objective of this five-year action plan is to provide water to every farm land by creating irrigation infrastructures, increasing the irrigated area and impeding soil and water conservation for increasing the irrigation efficiency. It also proposes various extension activities that need to be conducted to promote awareness among the farmers for better agronomic practices and scientific method of cultivation.

Further, the action plan also includes activities which will help in promoting farm and non-farm livelihood opportunities to the people of the State and the concentrated efforts of all these activities will lead to growth in crop production, farmers' income and the State's economy.

CHAPTER - 5

Strategic Action Plan

5.1 Background

PMKSY has been formulated with the objective of enhancing physical access of water on farm and expand cultivable area under assured irrigation, improving farm water use efficiency, introducing sustainable water conservation practices, etc. It seeks to bring about a new era of water for every farm land via assured irrigation in the country, more so for a State like Arunachal Pradesh where the existing irrigation backbone is minimal. In spite of receiving heavy rainfall during the monsoon season, the scarcity of water is an endemic problem. Ushering a new phase of secure irrigation through coordinated efforts of all action departments is the main aim of PMKSY. For this to happen, a strategic action plan is of utmost importance. It will give a Department-wise / component-wise / year-wise prospective plan for enhancing the irrigation outreach in the State. For a vision with a scale like PMKSY's, a bottom-up, not top-down, planning will be of supreme significance so as to have a realistic, implementable content. Accordingly, the State's Strategic Action Plan under PMKSY would logically base itself in the similar action plans prepared for each of the 18 districts as a part of the respective District Irrigation Plans (DIPs). The strategic action plan for the State thus reflects an effective aggregation of various schemes proposed by the line departments in each District and its blocks based on the ground need of the concerned areas and villages. Since the emphasis in the DIPs has been on inclusion of irrigation scheme for such villages as are devoid of any irrigation facilities currently, the same shall continue to be reflected in SIP.

5.2 Areas of Focus

The State's strategic action plan has been formulated for an initial period of five years with focus on covering the unirrigated areas. Due emphasis is woven in on better and more effective use of the available water resources of the State for better irrigation efficiency. Apart from implementing schemes for enhancing the irrigation potential of the available sources as also for creation of new irrigation potential, a concurrent prominence has also been accorded to increasing the moisture content of the soil through appropriate water conservation measures in all districts of Arunachal Pradesh.

5.3 Key Departments and Agencies

The main Departments across the State that have proposed schemes under PMKSY are:-

- Agriculture Department
- Horticulture Department
- Water Resource Department
- Soil & Water Conservation Department under Rural Works Department (RWD)
- Rural Development Department (RD)
- Agricultural Technology Management Agency (ATMA under Agriculture Department)
- Tube-well and Ground Water Division (under WRD)
- Department of Environment & Forests

These schemes are phased for implementation over a period of five years and they cover blocks and villages of each district. The strategic action plan also provides for area-specific approaches and planning based on regional variation in topography so that the most appropriate solutions to the conditions of irrigation stress are adopted. For example, in the hilly districts of Arunachal Pradesh, conventional irrigation structures like STWs would have limited utilities in such terrain. Instead, water harvesting structures like check dams and storage tanks collecting runoff water will be more useful. Besides, within the focus of PMKSY are also measures to promote in situ percolation of rain water which, otherwise, runs off causing damage to the surrounding ecology by way of washing away the top soil and causing increased denudation. Completion of ongoing major and medium irrigation/multipurpose irrigation projects under PMKSY have been projected under PMKSY-AIBP while Repair, Renovation and Restoration (RRR) of Water Bodies, Surface Minor Irrigation (SMI) projects and Command Area Development & Water Management (CADWM) projects have been included under PMKSY- Har Khet Ko Pani (HKKP). Clearly, the strategic action plan has to ensure an effective congruence of various components and sub-activities of various line departments in a coordinated approach so that the core objectives of PMKSY are achieved most optimally.

Based on the above exercise undertaken, the aggregate financial outlay projected under the strategic action plan for the State of Arunachal Pradesh is **Rs 17,71,231.12 lakhs**. This outlay reflects the aggregation of the District-wise outlays arrived in the respective DIPs approved by the concerned DLICs in respect of all the 18 Districts of Arunachal Pradesh.

5.4 Component-wise Allocation of Financial Outlay

The component-wise allocation of estimated costs under PMKSY in Arunachal Pradesh is as shown below.

Table Error! No text of specified style in document..25: Component-wise Allocation of Financial Outlay

Component	Planned Outlay (Rs. In Lakhs)
Har Khet Ko Pani	7,96,997.07
Per Drop More Crop	4,06,311.26
Watershed	4,83,578.45
Admin cost @ 5%	84,344.34
GRAND TOTAL	17,71,231.12

Table Error! No text of specified style in document..26: Component-wise Strategic Action Plan**Rs. In Lakhs**

Sl. No.	District	HKKP	PDMC	Watershed	Total	Admin cost @ 5%	Grand Total
1	Anjaw	4541.60	2225.00	3375.33	10141.93	507.10	10649.03
2	Changlang	46610.40	13768.00	2457.83	62836.23	3141.81	65978.04
3	Dibang Valley	3531.50	46438.48	18791.40	68761.38	3438.07	72199.45
4	East Kameng	32439.30	2296.50	83612.02	118347.82	5917.39	124265.21
5	East Siang	54928.12	6576.74	45974.65	107479.51	5373.98	112853.49
6	Kurung Kumey	91939.00	65616.29	72965.57	230520.86	11526.04	242046.90
7	Lohit	23108.22	51560.32	9109.50	83778.04	4188.90	87966.94
8	Longding	12384.45	18878.29	225.00	31487.74	1574.39	33062.13
9	Lower Dibang	58158.74	26530.97	17011.34	101701.05	5085.05	106786.10
10	Lower Subansiri	41930.85	27138.83	22695.28	91764.96	4588.25	96353.21
11	Namsai	85646.33	7726.77	11030.00	104403.10	5220.16	109623.26
12	Papum Pare	64591.83	24489.89	30922.16	120003.88	6000.19	126004.07
13	Tawang	6363.94	2444.30	2310.75	11118.99	555.95	11674.94
14	Tirap	11822.41	1881.00	5948.55	19651.96	982.60	20634.56
15	Upper Siang	60358.31	9492.14	9228.70	79079.15	3953.96	83033.11
16	Upper Subansiri	104996.49	58752.90	96519.30	260268.69	13013.43	273282.12
17	West Kameng	23490.88	9151.35	9026.15	41668.38	2083.42	43751.80
18	West Siang	70154.70	31343.49	42374.92	143873.11	7193.66	151066.77
Total		7,96,997.07	4,06,311.26	4,83,578.45	16,86,886.78	84,344.34	17,71,231.12

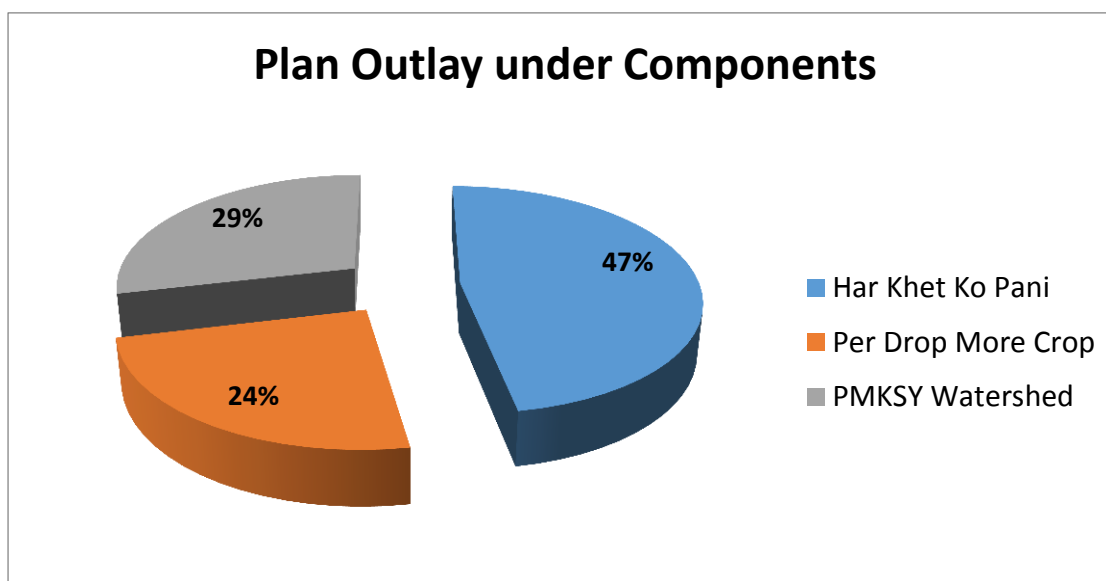


Figure Error! No text of specified style in document..1: Share of components under PMKSY in Arunachal Pradesh

(a) PMKSY –“Har Khet Ko Pani”

This component of PMKSY seeks to provide proper and sustainable irrigation to every farm field in the country. It is called “Har Khet Ko Pani” as it would signify “all fields getting water”. The focus would be on such activities as creating new water resources, repairing/renovating the existing water resources and promoting better solutions for improving water management and distribution for irrigation. The following major activities will be taken up under “Har Khet Ko Pani” component: -

- Creation of new water sources through Minor Irrigation (both surface and ground water);
- Repair, restoration and renovation of water bodies; strengthening carrying capacity of traditional water sources, construction of rain water harvesting structures (“*Jal Sanchay*”);
- Command area development, strengthening and creation of distribution network from source to the farm;
- Ground water development in the areas where it is abundant, so that sink is created to store runoff/ flood water during peak rainy season;
- Improvement in water management and distribution system for water bodies to take advantage of the available sources which are not tapped to its fullest capacity (deriving benefits from low hanging fruits). At least 10% of the command area is to be covered under micro/precision irrigation.

- Diversion of water from source of different water-surplus locations to nearby water scarce areas, lift irrigation from water bodies/ivers at lower elevation to supplement requirements beyond IWMP and MGNREGS irrespective of irrigation command; and
- Creating and rejuvenating traditional water storage systems like *Dongs* at feasible locations.

Under this component of PMKSY, the target is to reach each village in the State through assured irrigation. Schemes under this component have been proposed mainly by Water Resources Department, Agriculture / Horticulture Departments that have the responsibility of promoting irrigation in the State.

Table Error! No text of specified style in document..27: District-wise Planned Outlay under Har Khet Ko Pani

Sr No.	District	Planned Outlay (Rs.in Lakhs)
1	Anjaw	4541.60
2	Changlang	46610.40
3	Dibang Valley	3531.50
4	East Kameng	32439.30
5	East Siang	54928.12
6	Kurung Kumey	91939.00
7	Lohit	23108.22
8	Longding	12384.45
9	Lower Dibang	58158.74
10	Lower Subansiri	41930.85
11	Namsai	85646.33
12	Papum Pare	64591.83
13	Tawang	6363.94
14	Tirap	11822.41
15	Upper Siang	60358.31
16	Upper Subansiri	104996.49
17	West Kameng	23490.88
18	West Siang	70154.70
Total		7,96,997.07

(b) PMKSY –“Per Drop More Crop”

The primary objective of this component is to promote efficient water conveyance and precision water application devices like drips, sprinklers, pivots, rain-guns in the farm (Jal Sinchan) so as to improve the water use efficiency and, thereby, crop productivity. This component also covers programme management, preparation of State/District Irrigation Plans, approval of annual action plan, monitoring, etc. The following major activities will be taken up under “PMKSY-Per Drop More Crop” component: -

- Promoting efficient water conveyance and precision water application devices like drips, sprinklers, pivots, rain-guns in the farm (Jal Sinchan);
- Topping-up of input cost, particularly under civil construction, beyond the permissible limit (40%) under MGNREGS for activities like lining inlet, outlet, silt traps, distribution system, etc.;
- Construction of micro irrigation structures to supplement source creation activities like tube wells and dug wells (in areas where ground water is available) which are not supported under AIBP, PMKSY (Har Khet ko Pani), PMKSY (Watershed) and MGNREGS as per DIPs;
- Secondary storage structures at tail-end of canal system to store water when available in abundance (rainy season) or from perennial sources like streams for use during dry periods through effective on-farm water management;
- Water lifting devices like diesel / electric / solar pump sets, including water carriage pipes, underground piping system, etc.
- Extension activities for promotion of scientific moisture conservation and agronomic measures including cropping alignment to maximize use of available water including rainfall and minimize irrigation requirement (“**Jal Sarankchhan**”);
- Capacity building, training and awareness campaign for encouraging better use of water source through technological, agronomic and management practices including community irrigation;
- Adoption of Information Communication Technology (ICT) interventions in the field of water use efficiency, precision irrigation technologies, on-farm water management, crop alignment, etc.

The expected output for the interventions under PMKSY-HKPP include increase in production, productivity and quality of farm produce, conservation and sustainable use of water, higher energy efficiency in agriculture sector, improved water use efficiency and higher fertilizer use efficiency

Table Error! No text of specified style in document..28:District-wise Planned Outlay under Per Drop More Crop

Sr No.	District	Planned Outlay (Rs.in Lakhs)
1	Anjaw	2225.00
2	Changlang	13768.00
3	Dibang Valley	46438.48
4	East Kameng	2296.50
5	East Siang	6576.74
6	Kurung Kumey	65616.29
7	Lohit	51560.32
8	Longding	18878.29
9	Lower Dibang	26530.97
10	Lower Subansiri	27138.83
11	Namsai	7726.77

Sr No.	District	Planned Outlay (Rs.in Lakhs)
12	Papum Pare	24489.89
13	Tawang	2444.30
14	Tirap	1881.00
15	Upper Siang	9492.14
16	Upper Subansiri	58752.90
17	West Kameng	9151.35
18	West Siang	31343.49
Total		4,06,311.26

(d) Watershed Development

Rapid increase in population and entailing pressure on natural resources like land and water by human habitations in general, cattle and other domestic animals included, are compounding the degradation of these resources, threatening the stability and resilience of our ecosystem and the environment as a whole. The expansion of human settlement and infrastructure, intensification of agriculture, expansion of agriculture into marginal areas and fragile ecosystem emphasizes the need for integrated planning and proper management of resources. The urgent need is to prevent further degradation of these resources with multi-dimensional approaches and its development via a scientific, holistic and innovative approach.

One of the principal reasons for low productivity in agriculture in the country is the progressive deterioration of soil due to erosion. The factors responsible for soil erosion are excessive deforestation, overgrazing and faulty agricultural practices. Consequently, valuable top soil is lost and its fertility depleted, resulting in poor crop yields. Forest and grass land products have also become deficient. The deterioration of natural resources in an area can be contained and properly developed by adopting watershed approach. A watershed is an area demarcated by a common drainage point. In this approach, development is not confined to agricultural land alone, but covers the whole area- starting from the highest point of area (ridge line) to the outlet of the natural stream (river). This will involve implementation of ameliorative measures on barren hill slopes, marginal land, *nullahs*, river courses, etc.

Soil and water conservation planning is best done on a watershed basis. Soil conservation works should start at the head/highest point of such topographical units and proceed in the same way the water flows downstream. One of the first principles in a watershed programme is to manage the land so as to ensure that the maximum possible quantity of rain water is absorbed by the land *in situ* while the rest is collected downstream for storage and use for irrigation.

The focus of watershed-based development is on conservation of natural resources viz., soil, water and vegetation, through holistic participatory approaches for a better eco-system and higher productivity. These objectives can be realized by developing natural resources and by preventing soil erosion, degradation of top soil cover, regeneration of natural vegetation, rain water harvesting and recharging of the ground water table. The approach also gives specific importance to the productivity enhancement of agriculture / horticulture / animal husbandry activities and innovative sustainable livelihood development.

Launched in 2009-10 as a modified programme after subsuming of the erstwhile Drought Prone Areas Programme (DPAP) and Desert Development Programme (DDP), IWMP primarily seeks to restore the ecological balance by harnessing, conserving and developing degraded natural resources such as soil vegetative cover and water. The outcomes are prevention of soil runoff, regeneration of natural vegetation, rain water harvesting and recharging of the ground water table. This enables multi-cropping and the introduction of diverse agro-based activities, which help to provide sustainable livelihoods to the people residing in the watershed areas. IWMP is planned with an aim to integrate sustainable eco-friendly development of the rural areas of the country. The objective is to attach locally available natural resources in an optimum manner to achieve the overall goal of sustainable development in an area. The natural resources management becomes more important for economic development of the rural people.

Major activities undertaken under IWMP are –

- Soil & moisture conservation measures like terracing, *bunding*, trenching, veg-barriers, etc.
- Rain water harvesting activities like farm ponds, percolation tanks, check dams, etc.
- Planting & sowing of multi-purpose trees/shrubs/grasses/legumes & pasture land development;
- Encouraging natural regeneration;
- Promotion of agro-forestry and horticulture;
- Measures needed to disseminate technology;
- Training, extension and creation of a greater degree of awareness among the participants;
- Encouraging peoples' participation;
- Livelihood activities for asset-less people through micro-enterprise

With the launch of PMKSY, IWMP has now been subsumed under it. This also includes converging with MGNREGS for creation of full potential of water sources in identified backward rain-fed blocks including renovation of traditional water bodies. The illustrative range of eligible activities under PMKSY-

Watershed include creation of water harvesting structures such as check dams, *nullah* bund, farm ponds, tanks, etc., capacity building, entry point activities, ridge area treatment, drainage line treatment, soil and moisture conservation, nursery raising, afforestation, horticulture, pasture development, livelihood activities for the asset-less persons and production system and micro enterprises for small and marginal farmers, effective rainwater management like field bunding, contour bunding/trenching, staggered trenching, land levelling, mulching, etc. In Arunachal Pradesh, DRDA is entrusted with the responsibility of implementing watershed development programmes, including IWMP.

Watershed component also includes convergence with MGNREGA component.

- PMKSY seeks convergence with all rural assets / infrastructure-based programmes related to water conservation and management programmes/schemes like Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS), Rashtriya Krishi Vikash Yojana (RKVY), Jawaharlal Nehru National Solar Mission and Rural Electrification Programmes, Rural Infrastructure Development Fund (RIDF), Member of Parliament Local Area Development (MPLAD) Scheme, Member of Legislative Assembly Local Area Development (MLALAD) Scheme, Local Body funds, Working Plan of State Forest Department, etc. In most cases, labour-intensive works like earth works for source creation are taken up under MGNREGS. Emphasis is also given for utilizing MGNREGS fund for de-silting of ponds, canals, defunct water bodies like old ponds, *kuhls*, tanks, etc. to improve storage capacity and creating scopes for water availability for irrigation purposes. PMKSY (Per Drop More Crop) fund is also used for topping up of material cost beyond the specified limit, i.e., 40% in the MGNREGS, for lining, inlet, outlet, silt trap, adjustable gates, etc. PMKSY guidelines prescribe that wherever irrigation potential has been created, but is lying unutilized for want of field channels, works for creating such supporting infrastructure shall be taken up under MGNREGS on priority and such works should also be part of the District Irrigation Plan. Under PMKSY, focus is on convergence of the MGNREGS schemes to enhance the irrigation facilities in the district. The activities under MGNREGS considered eligible for such convergence are –
- Water harvesting structures on individual lands of vulnerable sections, creation of new irrigation sources, upgradation/de-silting of traditional water bodies, water conservation works, etc.;
- Supplementing soil and water conservation works in the identified backward rain-fed by overlaying of the plans with that of watershed projects for development to full potential;
- De-siltation of canal and distribution system, deepening and de-siltation of existing water bodies, strengthening of bunds/embankments, etc.;

- Restoring the potential of traditional water storage systems, like *Jal Mandir, Khatri, Kuhls, Zabo, Ooranis, Dongs, Katas, Bandhas*, etc. through de-siltation.

Table Error! No text of specified style in document..29: District-wise Planned Outlay under Watershed component

Sr No.	District	Planned Outlay (Rs.in Lakhs)
1	Anjaw	3375.33
2	Changlang	2457.83
3	Dibang Valley	18791.40
4	East Kameng	83612.02
5	East Siang	45974.65
6	Kurung Kumey	72965.57
7	Lohit	9109.50
8	Longding	225.00
9	Lower Dibang	17011.34
10	Lower Subansiri	22695.28
11	Namsai	11030.00
12	Papum Pare	30922.16
13	Tawang	2310.75
14	Tirap	5948.55
15	Upper Siang	9228.70
16	Upper Subansiri	96519.30
17	West Kameng	9026.15
18	West Siang	42374.92
Total		4,83,578.45

**Watershed component includes Convergence with MGNREGS part also*

5.5 Department-Wise Financial Outlay

PMKSY is a coordinated effort from various departments that have been playing a role in creating, utilizing and promoting irrigation in a State. Irrigation is a natural focus area for a State like Arunachal Pradesh where minimum area of total cropped area is under utilizable assured irrigation. Clearly, there is a need for a huge investment in creation of irrigation potential in various districts across Arunachal Pradesh. Under the current scheme of organization set-up, Agriculture Department is the nodal department for implementation of PMKSY in the State while the Water Resource Department with the responsibility of creating irrigation potential in the State is an equally key player. Besides, the Watershed component of the PMKSY will be implemented by Rural Development Department (RD) and Soil & Water Conservation Department under RWD. RD Department is the nodal agency for implementing the schemes for convergence. Detailed discussion had taken place during conduct of DLICs in each district while finalizing DIPs on the role and projection of different departments and agencies associated with PMKSY. The Department-wise financial outlays in Arunachal Pradesh under SIP of PMKSY are presented in table below.

Table Error! No text of specified style in document..30: Department-wise Financial Outlay

Sl. No	Department	Planned Outlay* (Rs. In Lakhs)
1	Agriculture Department	2,54,349.96
2	Horticulture Department	1,51,961.29
3	Water Resource Department (WRD)	7,96,997.07
4	Rural Development Department (RD)	3,78,798.08
5	Soil & Water Conservation Department under RWD	1,04,473.80
7	Department of Environment & Forest	306.58
8	Admin Cost@5%	84,344.34
GRAND TOTAL		17,71,231.12

*In West Kameng district, Soil & Water Conservation under RWD and RD Department schemes were given together. Planned outlay is divided equally between them.

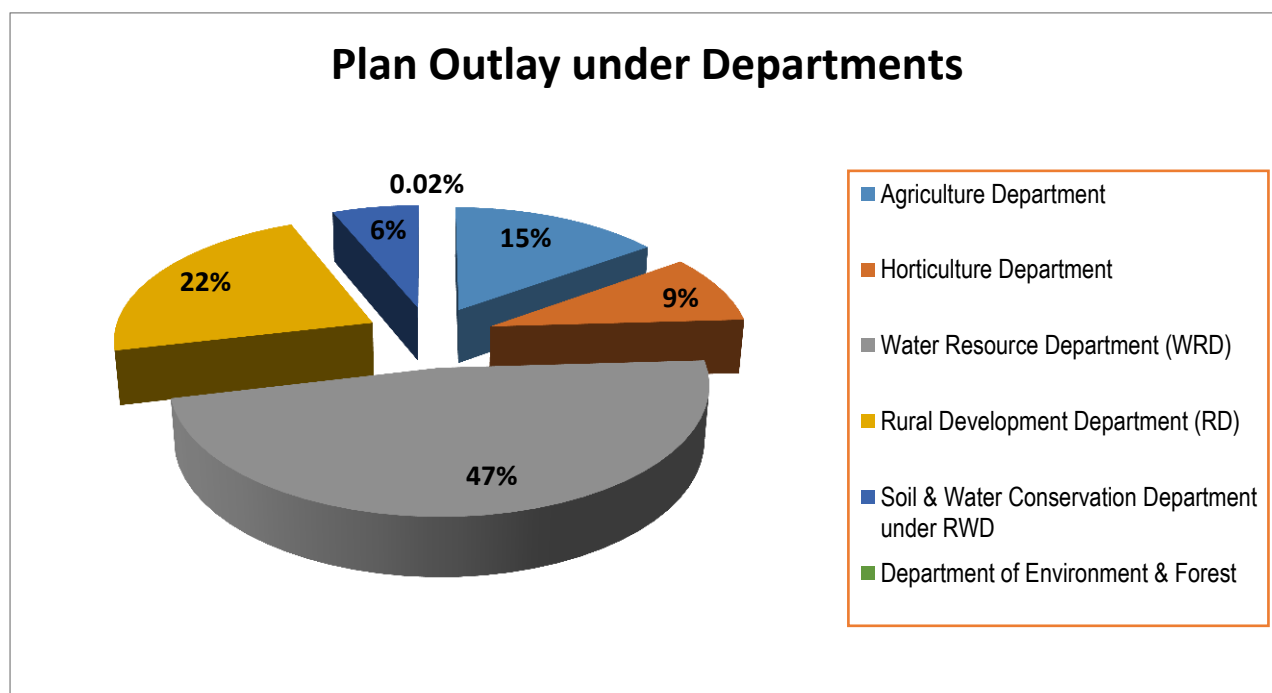


Figure Error! No text of specified style in document..2: Share of Departments in Planned Outlay under PMKSY in Arunachal Pradesh

Table Error! No text of specified style in document..31: Department-wise Strategic Action Plan

Rs. in Lakhs

Sl. No.	Name of the District	Agriculture	Horticulture	WRD	Tube-well and Ground Water Division under WRD	RD Department	Soil & Water Conservation under RWD	ATMA under Agriculture Department	Department of Environment & Forests	Total	Admin Cost@5%	Grand Total
1	Anjaw	1300.00	925.00	4541.60	NA	3375.33	NA	NA	NA	10141.93	507.10	10649.03
2	Changlang	4042.50	9725.50	42016.40	4594.00	1613.29	831.96	NA	12.58	62836.23	3141.81	65978.04
3	Dibang Valley	39256.50	6965.98	3531.50	NA	6446.40	12345.00	216.00	NA	68761.38	3438.07	72199.45
4	East Kameng	1533.96	762.54	32439.30	NA	83612.02	NA	NA	NA	118347.82	5917.39	124265.21
5	East Siang	4055.44	1977.00	54928.12	NA	10239.89	35734.76	544.30	NA	107479.51	5373.98	112853.49
6	Kurung Kumey	54289.48	11326.81	91939.00	NA	72965.57	NA	NA	NA	230520.86	11526.04	242046.90
7	Lohit	5394.57	46165.75	13208.22	9900.00	7008.23	2101.27	NA	NA	83778.04	4188.90	87966.94
8	Longding	17365.44	1512.85	12384.45	NA	225.00	NA	NA	NA	31487.74	1574.39	33062.13
9	Lower Dibang	17315.52	8540.45	55440.24	2718.50	7216.34	9795.00	675.00	NA	101701.05	5085.05	106786.10
10	Lower Subansiri	14432.60	12385.68	41930.85	NA	11314.17	11087.11	320.55	294.00	91764.96	4588.25	96353.21
11	Namsai	7045.50	525.17	61946.33	23700.00	7440.00	3590.00	156.10	NA	104403.10	5220.16	109623.26
12	Papum Pare	20853.55	216.00	64591.83	NA	30053.03	869.13	3420.34	NA	120003.88	6000.19	126004.07
13	Tawang	1743.70	494.30	6363.94	NA	1254.38	1056.37	206.30	NA	11118.99	555.95	11674.94
14	Tirap	1881.00	0.00	11822.41	NA	815.74	5132.81	NA	NA	19651.96	982.60	20634.56

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Sl. No.	Name of the District	Agriculture	Horticulture	WRD	Tube-well and Ground Water Division under WRD	RD Department	Soil & Water Conservation under RWD	ATMA under Agriculture Department	Department of Environment & Forests	Total	Admin Cost@5%	Grand Total
15	Upper Siang	8896.94	595.20	60358.31	NA	9228.70	NA	NA	NA	79079.15	3953.96	83033.11
16	Upper Subansiri	14509.37	43948.53	104996.49	NA	85867.33	10651.97	295.00	NA	260268.69	13013.43	273282.12
17	West Kameng*	8705.00	333.90	23490.88	NA	5368.77	3657.39	112.45	NA	41668.38	2083.42	43751.80
18	West Siang	23382.86	5560.63	70154.70	NA	34753.89	7621.03	2400.00	NA	143873.11	7193.66	151066.77
Total		2,46,003.93	1,51,961.29	7,56,084.57	40,912.50	3,78,798.08	1,04,473.80	8,346.04	306.58	16,86,886.78	84,344.34	17,71,231.12

*In West Kameng district, schemes by Soil & Water Conservation under RWD and RD Department were given together. Planned outlay is divided equally between them.

5.5.1 Department-Year-wise Total Plan of the state

The total plan of PMKSY for the period 2016-17 to 2020-21 works out to be **Rs. 16, 86,886.78** lakhs (excluding administration costs). The Water Resources Department (WRD) has the maximum share of and constitutes about 47% followed by Rural Development Department (RD) which constitutes about 22% to the total plan outlay of the State. The WRD also constitutes an outlay of Rs.40, 912.50 Lakhs under Tube-Well and Ground Water Division. The plan outlay under Rural Development Department (RD) is Rs.3,78,798.08 lakhs which constitutes about 22% of the total plan outlay. The Agriculture Department has a total plan outlay of Rs.2,54,349.96 lakhs which is 15% of the total plan outlay followed by the Horticulture Department which constitutes about 9% to the total plan outlay with a total outlay of Rs.1,51,961.29. Soil & Water Conservation Department under RWD shares about 6% of the total plan outlay with a total plan of Rs. 1, 04,473.80 lakhs, while the rest is under Department of Environment & Forest which constitutes about 0.02% of the total outlay. While working out the plan, phasing of ongoing irrigation projects has been considered. Agriculture Technology Management Agency (ATMA) will focus on awareness generation, capacity building, extension and training of the beneficiary farmers on water distribution, efficient use of water and water saving technologies. These are vital activities for the successful execution of the plan and therefore ATMA has a planned outlay of **Rs. 8,346.04** lakhs and it will be covered under Agriculture Department.

Table Error! No text of specified style in document..32: Year-wise Financial Outlay of Departments

Rs. In lakhs

Sl. No	Department	2016-17	2017-18	2018-19	2019-20	2020-21	Grand Total*
1	Agriculture Department	30521.99	33065.50	89022.49	63587.49	38152.49	2,54,349.96
2	Horticulture Department	18235.35	19754.97	53186.45	37990.32	22794.19	1,51,961.29
3	Water Resource Department (WRD)	95639.65	103609.62	278948.98	199249.27	119549.56	7,96,997.07
4	Rural Development Department (RD)	45455.77	49243.75	132579.33	94699.52	56819.71	3,78,798.08
5	Soil & Water Conservation Department under RWD	12536.86	13581.59	36565.83	26118.45	15671.07	1,04,473.80
7	Department of Environment & Forest	36.79	39.86	107.30	76.65	45.99	306.58
Grand Total*		2,02,426.41	2,19,295.28	5,90,410.37	4,21,721.70	2,53,033.02	16,86,886.78

*Excludes administration cost @5% of total

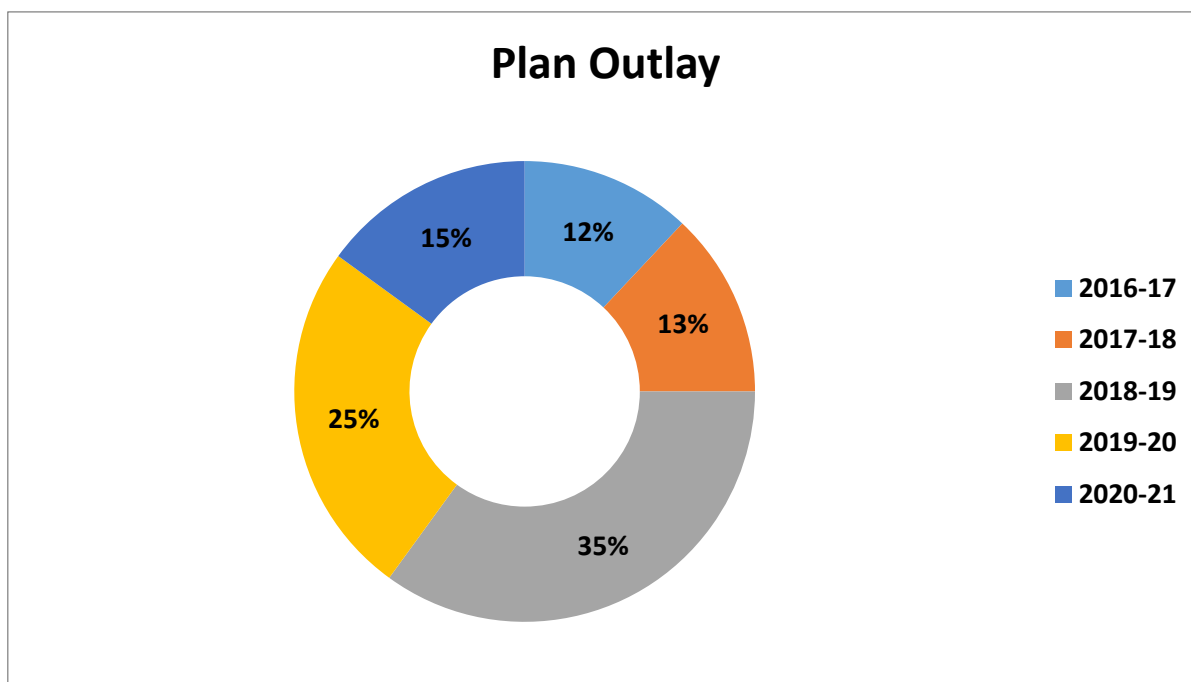


Figure Error! No text of specified style in document..3: Year-wise phasing under PMKSY in Arunachal Pradesh

5.5.2 Department-wise Planned Outlay

(a) Agriculture Department

Agriculture Department, which is also the overall nodal department for formulation of DIPs and SIP and their ground execution, has proposed schemes and activities under 2 PMKSY components - Har Khet Ko Pani (HKKP) and Per Drop More Crop (PDMC). One of the important functions of this department is creating assured irrigation facilities to the farmers through Minor irrigation schemes so as to obtain maximum returns from their land. Towards this objective, many irrigation related schemes are implemented by the Agriculture Department. The main projection by the department is under PDMC where drip and sprinkler systems have been proposed. The use of drip and sprinkler irrigation is very limited in Arunachal Pradesh due to its high terrain and cost and through its projection in the State's strategic action plan under PMKSY, Agriculture Department seeks to give a new thrust to these measures. Taking cues from progressive States like Gujarat where drip and sprinkler irrigation have been widely adopted even in non-protective, field agriculture, Arunachal Pradesh, too, would move in that direction in coming years through PMKSY projection under PDMC. The share of Agriculture Department in the aggregate financial projection is **Rs. 2,46,003.93 lakhs** and is shown below.

Table Error! No text of specified style in document..33: Planned outlay under Agriculture Department

Sr No.	District	Planned Outlay (Rs.in Lakhs)
1	Anjaw	1300.00
2	Changlang	4042.50
3	Dibang Valley	39256.50
4	East Kameng	1533.96
5	East Siang	4055.44
6	Kurung Kumey	54289.48
7	Lohit	5394.57
8	Longding	17365.44
9	Lower Dibang	17315.52
10	Lower Subansiri	14432.60
11	Namsai	7045.50
12	Papum Pare	20853.55
13	Tawang	1743.70
14	Tirap	1881.00
15	Upper Siang	8896.94
16	Upper Subansiri	14509.37
17	West Kameng	8705.00
18	West Siang	23382.86
Total		2,46,003.93

**Excludes administration cost taken @5% of total*

(b) Water Resource Department

In due cognisance of the criticality of irrigated agriculture in ensuring adequate production, which results both in food security and economic growth, the department is playing a vital role in the development of irrigation potential of Arunachal Pradesh by harnessing the rich surface and ground water resources of the State. Its main objectives / roles include increasing agricultural production of the State by providing assured irrigation supply to the field in close coordination with Agriculture Department to assure food security, providing assured irrigation during all seasons to the cultivators, creation of irrigation potential through irrigation schemes, utilizing the created irrigation potential by equitable distribution of water through command area development and water management, creation of additional potential through Major, Medium and Minor Irrigation schemes, etc.

The Department deals with two main PMKSY Components - AIBP and Har Khet Ko Pani (HKKP). The share of the Water Resource Department under PMKSY is **Rs. 7,56,084.57 lakhs**, the highest among all. The District-wise distribution of this share is given in table below.

Table Error! No text of specified style in document..34: Planned outlay under WRD

Sr No.	District	Planned Outlay (Rs.in Lakhs)
1	Anjaw	4541.60
2	Changlang	42016.40
3	Dibang Valley	3531.50
4	East Kameng	32439.30
5	East Siang	54928.12
6	Kurung Kumey	91939.00
7	Lohit	13208.22
8	Longding	12384.45
9	Lower Dibang	55440.24
10	Lower Subansiri	41930.85
11	Namsai	61946.33
12	Papum Pare	64591.83
13	Tawang	6363.94
14	Tirap	11822.41
15	Upper Siang	60358.31
16	Upper Subansiri	104996.49
17	West Kameng	23490.88
18	West Siang	70154.70
Total		7,56,084.57

*Excludes administration cost taken @5% of total

(c) Soil & Water Conservation Department under (RWD)

The Rural Works Department is the nodal agency for soil and water conservation activities in the state. The department has taken up a number of schemes under this sector. The different measures undertaken by the department includes construction of contour and graded bunds, levelling of land and improvement of soil, adoption of appropriate farming and tillage methods, afforestation of degraded forests and non-agricultural lands, development of grasslands and fuel cum fodder reserves in the wastelands, raising of utility tree plants on private/ community/ wastelands and controlling and establishing torrents, landslides, cattle path erosions etc. by biological and engineering measures. Besides these measures to control soil and water erosions, the department also undertakes activities such as construction of storage structures for increasing depression in the catchment, measures for controlling water logging, development and reclamation of lands and maintenance and repair of work conducive to soil and water conservation. The problem of erosion is also very acute in Arunachal Pradesh. The extensive practice of shifting cultivation has affected the soil quality of the land. In view of it, the various activities covered under Soil & Water Conservation Department becomes essential for enhancing the soil productivity of the agricultural land. The Soil & Water Conservation Department

under RWD therefore has projected a plan of **Rs. 1,04,473.80 lakhs** under PMKSY. The district wise allocation is shown in table below.

Table Error! No text of specified style in document..35: Planned outlay under RWD

Sl. No.	Name of the District	Planned Outlay* (Rs. In lakhs)
1	Anjaw	NA
2	Changlang	831.96
3	Dibang Valley	12345
4	East Kameng	NA
5	East Siang	35734.76
6	Kurung Kumey	NA
7	Lohit	2101.27
8	Longding	NA
9	Lower Dibang	9795
10	Lower Subansiri	11087.11
11	Namsai	3590
12	Papum Pare	869.13
13	Tawang	1056.37
14	Tirap	5132.81
15	Upper Siang	NA
16	Upper Subansiri	10651.97
17	West Kameng	3657.39
18	West Siang	7621.03
Total		1,04,473.80

*Excludes administration cost taken @5% of total

(d) Rural Development Department (RD)

District Rural Development Agency (DRDA) or the RD of Arunachal Pradesh has traditionally been the principal organ at the district level to oversee the implementation of different rural development and anti-poverty programmes and it is but natural that the implementation for Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) related works has been entrusted to it in Arunachal Pradesh, like elsewhere. RD is responsible for implementation of IWMP in the district before the introduction of PMKSY. The share of RD under the strategic action plan for Arunachal Pradesh under PMKSY is **Rs. 3,78,798.08 lakhs**. Out of the total plan outlay under RD, about **Rs. 47,349.94 lakhs** constitutes for ongoing schemes for 156 projects and **Rs. 8,985 lakhs** for 44 new schemes under IWMP. The district-wise allocation is shown in table below.

Table Error! No text of specified style in document..36: Planned outlay under RD

Sl. No.	Name of the District	Planned Outlay* (Rs. In lakhs)
1	Anjaw	3375.33
2	Changlang	1613.29

3	Dibang Valley	6446.40
4	East Kameng	83612.02
5	East Siang	10239.89
6	Kurung Kumey	72965.57
7	Lohit	7008.23
8	Longding	225.00
9	Lower Dibang	7216.34
10	Lower Subansiri	11314.17
11	Namsai	7440.00
12	Papum Pare	30053.03
13	Tawang	1254.38
14	Tirap	815.74
15	Upper Siang	9228.70
16	Upper Subansiri	85867.33
17	West Kameng	5368.77
18	West Siang	34753.89
Total		3,78,798.08

**Excludes administration cost taken @5% of total*

(e) ATMA

ATMA is a registered society of key stakeholders involved in agricultural activities for sustainable development in the district by integrating research-extension activities. ATMA is, thus, responsible for coordination and management of agricultural extension related work in the District. It would have linkage with all the line departments, research organizations, non-governmental organizations and agencies associated with agricultural development in the district. Research and Extension units within the project districts such as ZRS or substations, KVKs and the key line Departments of Agriculture, Animal Husbandry, Horticulture, Fisheries, etc. would become constituent members of ATMA. Each Research Extension (R-E) unit would retain its institutional identity and affiliation but programmes and procedures concerning district-wise R-E activities would be determined by ATMA Governing Board to be implemented by its Management Committee (MC). The "Revised ATMA Scheme" has now been notified and strengthened with a strong manpower, infrastructure and activity as summarized below: -

- Provision of specialist and functionary support at different levels, viz., State Coordinator and Faculty / supporting staff for State Agricultural Management & Extension Training Institutes (SAMETI) at State levels, Project Director, Deputy Project Directors and supporting staff at District levels and Block Technology Manager and Subject Matter Specialists at the levels;
- Innovative support through a 'Farmer Friend' at Village Level @ 1 Farmer Friend per two villages;

- Revision in “ATMA Cafeteria” (i.e. list of extension related activities to choose from) to include some additional activities and to provide for enhanced unit costs for some of the activities;
- Farmers Advisory Committees at State, District and Block levels comprising a group of farmers to advise and provide inputs to the administrative bodies at each level; and
- Support to SAMETIs for creating essential infrastructure.

Under PMKSY Guidelines, SIP would also enumerate on extension & ICT-related activities to be undertaken under supervision of Agriculture Technology Management Agency (ATMA). The following shall be the focus areas of ATMA in the implementation of PMKSY in Arunachal Pradesh –

For ensuring efficient use of water, extension services will focus on making the best use of available water through crops/cropping system aligned to agro-ecological conditions and suitable agronomic practices to ensure larger coverage and equity to farmers;

- (i) In selected areas, a few progressive farmers will be sensitized towards this subject and incentivized to experiment with changes in cropping pattern with available irrigation facilities. Farm school component of ATMA scheme would be suitably used to take up this activity;
- (ii) Cluster of 8 - 10 villages will be taken up in districts for saturating them as per the plan for showcasing potential augmentation of water and its efficient use. The success of these clusters in promoting such activities will then be replicated in other parts of the district;
- (iii) The Project Director, ATMA will make use of the existing infrastructure and staff under ATMA in districts and blocks for discharging duties under PMKSY;
- (iv) The Project Director, Agricultural Technology Management Agency (ATMA) will be the Member Secretary of DLIC;
- (v) ATMA Management Committee will assist DLIC in coordinating and executing extension related activities under PMKSY.

Although the role of ATMA is only supportive under PMKSY and it would not execute any irrigation enhancing project and scheme, a projection of **Rs.8346.04 lakhs** has been made by it in the strategic action plan under PMKSY for Arunachal Pradesh.

Table Error! No text of specified style in document..37: Planned outlay under ATMA

SI. No.	Name of the District	Planned Outlay* (Rs. In lakhs)
1	Anjaw	NA
2	Changlang	NA
3	Dibang Valley	216
4	East Kameng	NA
5	East Siang	544.3
6	Kurung Kumey	NA

7	Lohit	NA
8	Longding	NA
9	Lower Dibang	675
10	Lower Subansiri	320.55
11	Namsai	156.1
12	Papum Pare	3420.34
13	Tawang	206.3
14	Tirap	NA
15	Upper Siang	NA
16	Upper Subansiri	295
17	West Kameng	112.45
18	West Siang	2400
Total		8346.04

**Excludes administration cost taken @5% of total*

(f) Horticulture Department

Undulating topography and varied agro-climatic conditions offer vast potential for the development of Horticulture for growing varieties of tropical, sub-tropical and temperate fruits, vegetable including off season vegetables), spices, aromatic and medicinal plants flowers and mushroom. The fruits being perennial in nature help in checking soil erosion and provide high density green cover to the soil. These tree can also be planted to retrieve soil which provide potential alternative for control of shifting cultivation.

Horticulture is the backbone and future of rural economy. The practice of shifting cultivation is also prevalent and it has various adverse effect on ecology and poses silting problems in the plains as millions of tonnes of soil is eroded and washed down through rain water depleting the nutrient status of soils of the hills every year. To check the erosion it is essential to cover such area by perennial and other suitable crops of economic importance so that rural people may get employment and generate income through such ventures.

The Horticulture Department in the State is engaging itself in overall development of Horticulture through various socio - economical need based activities viz, cultivation and production of various fruit crops, spices and condiments, medicinal crops, vegetable crops etc. through state and centrally sponsored programme like, area expansion, rejuvenation of old and sick gardens, training and education, method demonstration, post-harvest management, marketing etc.

Under PMKSY, Horticulture department is mainly responsible for micro irrigation and drip and sprinkler irrigation in particular. The coverage of MI system in North Eastern and hilly region is much low due to poor infrastructure and difficult terrain. Arunachal Pradesh, is considered under category “C” by the

central government. Following points need to be kept in mind while designing a drip irrigation system by the department, keeping in view the sloppy and terraced land:

- It is difficult to lay PVC main and sub-main lines below the ground surface and therefore HDPE pipes are required in place of PVC.
- The undulating and vertical slopes would lead to comparatively larger length of pipes.
- To maintain uniform pressure and to irrigate upper most terrace of land, control valve should be provided at sub-main/main lines at 4m vertical drop. Accordingly, the number of flush valves will also increase.

The cost of drip system is likely to be higher in North Eastern & Himalayan states because of the terrain, higher transport cost, lesser presence of manufacturing companies etc. Therefore, unit cost of micro irrigation systems is taken 25% higher in these states for the purpose of subsidy calculations.

For sprinkler irrigation financial assistance would be restricted as per the cost of High Density Poly Ethylene (HDPE) pipes used in sprinkler irrigation systems, even though, the beneficiaries may use aluminium pipes as well. The sprinkler irrigation systems may be portable, mini sprinklers, micro sprinklers, semi-permanent sprinklers or large volume sprinkler systems (Rain-guns). Additional 25% and 15% on the indicated unit cost may be considered for calculation of subsidy for a state with difficult terrain like Arunachal Pradesh.

The share of Horticulture Department under the strategic action plan for Arunachal Pradesh under PMKSY is **Rs.1, 51,961.29 lakhs**. The district-wise allocation is shown in table below.

Table Error! No text of specified style in document..38: Planned outlay under Horticulture Department

Sl. No.	Name of the District	Planned Outlay* (Rs. In lakhs)
1	Anjaw	925.00
2	Changlang	9725.50
3	Dibang Valley	6965.98
4	East Kameng	762.54
5	East Siang	1977.00
6	Kurung Kumey	11326.81
7	Lohit	46165.75
8	Longding	1512.85
9	Lower Dibang	8540.45
10	Lower Subansiri	12385.68
11	Namsai	525.17
12	Papum Pare	216.00
13	Tawang	494.30
14	Tirap	0.00
15	Upper Siang	595.20

Sl. No.	Name of the District	Planned Outlay* (Rs. In lakhs)
16	Upper Subansiri	43948.53
17	West Kameng	333.90
18	West Siang	5560.63
Total		1,51,961.29

*Excludes administration cost taken @5% of total

(g) Tube-well and Ground Water Division under WRD

There two Sub-Divisions under this division.

1) WR (TW & GW) Sub-Division, Roing

a) The Tube Well & Ground-Water Sub-Division, Roing has been executing Schemes under Lohit, Lower Dibang Valley, Upper Dibang Valley and Anjaw districts.

2) WR (TW & GW) Sub-Division, Miao

b) The Tube Well & Ground-Water Sub-Division, Miao has been executing Schemes under Tirap, Changlang and Longding districts.

The department has provided schemes in Namsai, Lohit, Lower Dibang and Changlang districts. The share of Tube-Well and Ground Water Division under the strategic action plan for Arunachal Pradesh under PMKSY is **Rs.40,912.50 lakhs**. The district-wise allocation is shown in table below.

Table Error! No text of specified style in document..39: Planned outlay under Tube-well & Ground Water Division

Sl. No.	Name of the District	Planned Outlay* (Rs. In lakhs)
1	Anjaw	NA
2	Changlang	4594.00
3	Dibang Valley	NA
4	East Kameng	NA
5	East Siang	NA
6	Kurung Kumey	NA
7	Lohit	9900.00
8	Longding	NA
9	Lower Dibang	2718.50
10	Lower Subansiri	NA
11	Namsai	23700.00
12	Papum Pare	NA
13	Tawang	NA
14	Tirap	NA

Sl. No.	Name of the District	Planned Outlay* (Rs. In lakhs)
15	Upper Siang	NA
16	Upper Subansiri	NA
17	West Kameng	NA
18	West Siang	NA
Total		40,912.50

*Excludes administration cost taken @5% of total

(h) Department of Environment & Forests

Department of Environment & Forests have provided schemes in the two districts of Lower Subansiri and Changlang under PMKSY. The share of Department of Environment & Forests under the strategic action plan for Arunachal Pradesh under PMKSY is **Rs.306.58 lakhs**.

Table Error! No text of specified style in document..40: Planned outlay under Department of Environment & Forests

Sl. No.	Name of the District	Planned Outlay* (Rs. In lakhs)
1	Anjaw	NA
2	Changlang	12.58
3	Dibang Valley	NA
4	East Kameng	NA
5	East Siang	NA
6	Kurung Kumey	NA
7	Lohit	NA
8	Longding	NA
9	Lower Dibang	NA
10	Lower Subansiri	294.00
11	Namsai	NA
12	Papum Pare	NA
13	Tawang	NA
14	Tirap	NA
15	Upper Siang	NA
16	Upper Subansiri	NA
17	West Kameng	NA
18	West Siang	NA
Total		306.58

*Excludes administration cost taken @5% of total

(i) Project Administration Costs/Others

Apart from the proposed plan forwarded by the district, a separate budget has been kept for the administrative expenses for project management and other related expenses. 5% of the total financial allocations for the district has been taken as administrative expenses for the implementation of this

strategic action plan through the District Irrigation Plans for Districts. This is in sync with the guidelines under PMKSY issued by the Govt. of India. The total administration cost comes out to **Rs. 84,344.34 lakhs** under PMKSY for Arunachal Pradesh.

Table Error! No text of specified style in document..41: Project Administration Costs

Sl. No.	Name of the District	Planned Outlay (Rs. In lakhs)
1	Anjaw	507.10
2	Changlang	3141.81
3	Dibang Valley	3438.07
4	East Kameng	5917.39
5	East Siang	5373.98
6	Kurung Kumey	11526.04
7	Lohit	4188.90
8	Longding	1574.39
9	Lower Dibang	5085.05
10	Lower Subansiri	4588.25
11	Namsai	5220.16
12	Papum Pare	6000.19
13	Tawang	555.95
14	Tirap	982.60
15	Upper Siang	3953.96
16	Upper Subansiri	13013.43
17	West Kameng	2083.42
18	West Siang	7193.66
Total		84,344.34

5.6 Expected Output

The total command area to be developed under the various activities proposed under different departments in the State is 5,28,687 Ha. The total rainfed area in the district is 2,37,065 Ha which is 84% of the total agriculture area. The activity proposed by various departments will cover the rainfed area which is to be brought under the purview of irrigation along with the development of new area for agriculture purpose. Keeping in view the various constraints prevailing in the State such as geographical constraints, lack of man-power, delay in funding, lack of training and capacity building, etc. it has been assumed that the proposed plan outlay under various department will help in developing atleast 45% of the total command area proposed which is 2,37,909 Ha. The district wise command area to be developed under irrigation is mentioned in the table below:

**Table Error! No text of specified style in document..42: District-wise
command area
(Area in Ha)**

Sl. No.	District	Command Area (Ha)	2016-17	2017-18	2018-19	2019-20	2020-21
1	Anjaw	1319	158	171	462	330	198
2	Changlang	24924	2991	3240	8723	6231	3739
3	Dibang Valley	14275	1713	1856	4996	3569	2141
4	East Kameng	10273	1233	1336	3596	2568	1541
5	East Siang	42317	5078	5501	14811	10579	6348
6	Kurung Kumey	68971	8277	8966	24140	17243	10346
7	Lohit	30283	3634	3937	10599	7571	4542
8	Longding	10971	1316	1426	3840	2743	1646
9	Lower Dibang	49892	5987	6486	17462	12473	7484
10	Lower Subansiri	59519	7142	7737	20832	14880	8928
11	Namsai	42390	5087	5511	14837	10598	6358
12	Papum Pare	20595	2471	2677	7208	5149	3089
13	Tawang	3128	375	407	1095	782	469
14	Tirap	15596	1872	2027	5459	3899	2339
16	Upper Siang	26818	3218	3486	9386	6705	4023
17	Upper Subansiri	59885	7186	7785	20960	14971	8983
18	West Kameng	12621	1515	1641	4417	3155	1893
19	West Siang	34911	4189	4538	12219	8728	5237
Grand Total		5,28,687	63,442	68,729	1,85,040	1,32,172	79,303

Besides the command area development, there are activities which have also been proposed under Watershed development which will augment the area for irrigation. The total treatment area proposed under the planned outlay constitutes about 6,63,846 Ha. Hence, the total area proposed under the plan outlay to be developed is 11,92,533 Ha.

The activities proposed under various components such as Har Khet Ko Pani, Per Drop More Crop and Watershed will help in development of 5,28,687 Ha which will come in direct purview of various irrigation infrastructures. Further, an area of 6,63,846 Ha has been proposed as treatment area to augment the area for irrigation in the State i.e., the area that doesn't come directly under the purview of irrigation. This has been assumed on the fact that about 74% of the area lies under forest and the hilly terrain which makes it difficult in providing direct irrigation facilities. Hence, the various activities such as land development, soil and water conservation activities, pasture development and development of

fishery/ cattle ponds will supplement irrigation or other livelihood activities in such areas. The component wise area to be developed has been discussed in the table below:

Table Error! No text of specified style in document..19: Component-wise command area

Sl. No.	Component	Command Area	2016-17	2017-18	2018-19	2019-20	2020-21
1	Har Khet Ko Pani	221403	26568	28782	77491	55351	33210
2	Per Drop More Crop	157470	18896	20471	55115	39368	23621
3	PMKSY Watershed	149814	17978	19476	52435	37453	22472
	Grand Total	5,28,687	63,442	68,729	1,85,040	1,32,172	79,303

The department wise command area to be developed under various activity includes:

Table Error! No text of specified style in document..20: Department-wise command area

Sl. No	Department	Command Area	2016-17	2017-18	2018-19	2019-20	2020-21
1	Agriculture Department	94482	11338	12283	33069	23621	14172
2	Horticulture Department	62988	7559	8188	22046	15747	9448
3	Water Resource Department (WRD)	221403	26568	28782	77491	55351	33210
4	Rural Development Department (RD)	112175	13461	14583	39261	28044	16826
5	Soil & Water Conservation Department under RWD	37453	4494	4869	13109	9363	5618
7	Department of Environment & Forest	185	22	24	65	46	28
	Grand Total	5,28,687	63,442	68,729	1,85,040	1,32,172	79,303

5.7 Expected Outcome

As the water requirement of crops for the existing cropping pattern works out to be 16254.75 MCM and if the rainfed area is to be brought under irrigation, an additional 12764.76 MCM of water is required after considering the present water availability for crop production. Though the water (surface and ground water) is available in the district yet it will not be feasible to create irrigation potential to the extent of 100% as the construction of irrigation project may not be economically viable even if it is technically feasible. In hilly area due to tough terrain, high head, small and fragmented land holdings, per hectare cost may be very high. Moreover, it may not be feasible to develop all the sources within a short span of five years for which the plan is being prepared. So keeping in view of these constraints it is being assumed that atleast 45% of the total command area i.e., 2,37,909 Ha will be developed. The expected outcome on the successful implementation of PMKSY will result in:

A. Development of Irrigation Infrastructure:

- i. About 81% of the total fund under Water Resource Department will create surface minor irrigation structures which will act as a connecting link between source and the sink and provide water to every farm land through Har Khet Kp Pani initiative.
- ii. The supplementary water management activities which amounts to 57% to the total outlay under Per Drop More Crop (39% under Horticulture Department and 68% under Agriculture Department) will help in construction of structures such as tube wells, ug-wells, farm development to supplement the micro irrigation structures.
- iii. The creation of farm ponds and check dams which accounts for 35% to the total outlay under PMKSY Watershed will help in providing on-farm water storage and conserving soil from run-off.

B. Year round availability of water: The above infrastructures created will help in providing water for crop production throughout the year. The crop cycle and number of crop per agriculture year will also increase in the State. About 33.35% of the total outlay under Soil & Water Conservation Department under RWD will provide the soil and water conservation in the area which will in turn result in boosting the moisture content of the soil. It will reduce the soil erosion and also benefit the crop during the lean season. It will also help in creating pasture land for livestock which are also an important source of livelihood in the State. About 19% of the total outlay under Per Drop More Crop constitutes the Drip Irrigation and 21% of the total outlay under Per Drop More Crop constitutes the Sprinkler Irrigation, which are the water saving techniques being utilized all over the world. The Drip and Sprinkler will help in promoting water saving on the farm land which will increase the irrigation efficiency. If Irrigation efficiency is increased to 45% the irrigation demand decreases by 22%. If currently developed water supply is properly managed, only a part of these water savings is adequate for meeting future irrigation demand. (Source: Proceedings of the National Conference on Water, Food Security, and Climate)

C. Increase in Irrigation Potential: The creation of irrigation infrastructure and adopting of water saving techniques will not help in providing water to all at whole the year round but also it will enhance the irrigation potential in the State. The current irrigation potential in the State 90557 Ha⁴ will increase

⁴ WRD 2015-16

to 135193 Ha in five years proposed under the plan and this increase will be atleast 45% to the current situation. (Percentage assumption is based on the command area development under plan)

D. **Increase in Irrigated Area:** The current irrigated area in the district is 55437 Ha (16% to the total area under field crops) while the rainfed area is 237065 Ha (84% to the total area under field crops). The creation of irrigation infrastructures, water savings, increasing irrigation efficiency and creating additional irrigation potential will boost the irrigated area in the district and it has been assumed that the in five years (as proposed under the plan) the rainfed area will be covered under irrigation.

E. **Income generation:** The increase in the irrigation potential and the irrigated area in the district will help in increasing the crop production and productivity in the State. This is likely to generate an additional income of Rs.47,582 lakhs to the farmers of the district. This is based on the assumption of atleast 45% of potential utilised and Rs.20,000 per Ha incremental income from rainfed to irrigated farming. This is also likely to create 1471.38 lakh mandays of non-recurring employment and 264343 jobs annually on recurring basis.

These concentrated efforts will help not only in boosting the agricultural economy of the State but it will also help in realising the mission of doubling of farmer's income by 2022.

5.8 Road Map of Agriculture Development by 2030

5.8.1 Agricultural Scenario of Arunachal Pradesh vis-à-vis Other States

Arunachal Pradesh is the largest north-eastern state of India, sharing its boundaries with Myanmar in east, Bhutan in west, China on the north and the states of Assam and Nagaland on the south. Agriculture and livestock rearing is the major occupation in the State that contributes about 31.60% to the state's GDP. About 75% of the state's total workforce is engaged in agriculture and allied services and it constitutes the backbone of State's economy.

Paddy is the major crop grown in the State and it covers about 58% of the total area grown under field crops⁵. The average production of Paddy in the State was found to be 2.42 lakh ton⁶ from 2009-10 to 2013-14 while under the 4th advance estimate for the year 2014-15, it was found to be 2.85 lakh ton. The state has also been compared with other major paddy growing states in the eastern India such as, Assam, Bihar, Chhatisgarh, Jharkhand, Odhisa, Uttar Pradesh and West Bengal. The average production of paddy of all seven states from 2009-10 to 2013-14 was found to be 75.61 lakh tons while the average production of these seven states in 2014-15 under 4th advance estimate was 79.71 lakh

⁵ Statistical Abstract of Arunachal Pradesh, 2015-16

⁶ Directorate of Economics and Statistics, Ministry of Agriculture, 2009-10 to 2014-15

tons. However, in terms of productivity, the State's average productivity under rice cultivation was found to be 2240 Kg/Ha while the average productivity in other seven states was 2105 Kg/Ha. This indicates that the yield of rice in Arunachal Pradesh was 6% higher as compared to other seven states.

Sl. No.	State	Production of Rice (Lakh Tonnes)						
		2009-10	2010-11	2011-12	2012-13	2013-14 (Final)	Average 2009-10 to 2013-14	2014-15 (4th Advance Estimate)
1	Assam	43.36	47.37	45.16	51.28	49.27	47.29	48.63
2	Bihar	35.99	31.02	71.63	75.29	55.06	53.8	63.77
3	Chhatisgarh	41.1	61.59	60.28	66.09	67.16	59.24	60.21
4	Jharkhand	15.38	11.1	31.31	31.65	28.11	23.51	33.2
5	Odisha	69.18	68.28	58.07	72.96	76.13	68.92	82.86
6	Uttar Pradesh	108.07	119.92	140.22	144.16	146.36	131.75	122.21
7	West Bengal	143.41	130.46	146.06	150.24	153.71	144.78	147.11
Total of Seven States		456.49	469.74	552.73	591.67	575.8		557.99
Average Production of Seven states		65.21	67.11	78.96	84.52	82.26	75.61	79.71
Per Cent Share to All India for seven states (%)		51.24	48.95	52.49	56.23	53.99	0.00	53.24
8	Arunachal Pradesh	2.16	2.34	2.55	2.63	NA	2.50	2.85
Per Cent Share to All India for Arunachal Pradesh (%)		0.24	0.24	0.24	0.25	NA	0.25	0.27
All India		890.83	959.7	1053.01	1052.32	1,066.46	1,004.46	1,047.98

Source: Directorate of Economics and Statistics, Ministry of Agriculture, 2009-10 to 2014-15

The other major produce in the State includes maize, pulses and potatoes. The production data of these crops were also taken for the same period i.e., from 2009-10 to 2014-15 to draw a comparison with the other seven states i.e., Assam, Bihar, Chhatisgarh, Jharkhand, Odisha, Uttar Pradesh and West Bengal. It was found that the average production of maize from 2009-10 to 2014-15 was 0.71 lakh tons in Arunachal Pradesh while it was 6.61 lakh tons in the other seven states. The yield of maize in Arunachal Pradesh was found to be 1562 Kg/Ha while it was 1602 Kg/Ha in other seven states, showing a percentage difference of 3.

Sl. No.	State	Production of Maize (Lakh Tonnes)						
		2009-10	2010-11	2011-12	2012-13	2013-14 (Final)	Average 2009-10 to 2013-14	2014-15 (4th Advance Estimate)
1	Assam	0.14	0.14	0.15	0.21	0.21	0.17	0.38
2	Bihar	14.79	14.4	16.11	24.76	21.12	18.236	21.78

Sl. No.	State	Production of Maize (Lakh Tonnes)						
		2009-10	2010-11	2011-12	2012-13	2013-14 (Final)	Average 2009-10 to 2013-14	2014-15 (4th Advance Estimate)
3	Chhatisgarh	1.43	1.86	1.72	2.08	2.29	1.876	2.3
4	Jharkhand	1.91	2.62	3.22	4.52	5.17	3.488	4.76
5	Odisha	1.75	2.99	2.12	2.28	2.63	2.354	1.89
6	Uttar Pradesh	10.39	11.14	13.08	12.34	13.06	12.002	12.75
7	West Bengal	3.85	3.52	3.64	4.17	5.22	4.08	6.52
Total of Seven States		34.26	36.67	40.04	50.36	49.7		50.38
Average Production of Seven states		4.89	5.24	5.72	7.19	7.10	6.03	7.20
Per Cent Share to All India		20.49%	16.88%	18.41%	22.63%	20.49%	0.00%	21.28%
8	Arunachal Pradesh	0.60	0.65	0.69	0.68	0.71	0.67	0.75
Per Cent Share to All India		0.36%	0.30%	0.32%	0.31%	0.29%	0.31%	0.32%
All India		167.19	217.29	217.54	222.58	242.60	213.44	236.73

Source: Agricultural Statistics at a glance 2016

The production of pulses in Arunachal Pradesh was found to be very low as compared to other seven states. The average production of pulses in the State was 0.42 lakh tons during 2009-10 to 2014-15 while it was 5.74 lakh tons in other seven states. On the other hand, the average productivity in Arunachal Pradesh was 1200 Kg/Ha, which was 51% higher than that of other states; the average productivity in other seven states was 795 Kg/ha.

Sl. No.	State	Production of Pulses (Lakh Tonnes)						
		2009-10	2010-11	2011-12	2012-13	2013-14 (Final)	Average 2009-10 to 2013-14	2014-15 (4th Advance Estimate)
1	Assam	0.65	0.7	0.69	0.84	1.04	0.784	1.12
2	Bihar	4.72	5.38	5.11	5.43	5.22	5.172	4.2
3	Chhatisgarh	4.89	5.38	4.99	6.49	4.82	5.314	6.55
4	Jharkhand	2.24	3.3	4.12	6.09	5.78	4.306	5.97
5	Odisha	3.99	4.27	3.43	4.24	4.19	4.024	4.4
6	UP	19.01	20.37	24.03	22.32	16.97	20.54	14.47
7	West Bengal	1.5	1.76	1.31	1.92	2.41	1.78	1.76
Total of Seven States		37	41.16	43.68	47.33	40.43		38.47
Average Production of Seven states		5.29	5.88	6.24	6.76	5.78	5.99	5.50
Per Cent Share to All India		25.24%	22.56%	25.56%	25.80%	21.00%	0.00%	22.38%
8	Arunachal Pradesh	0.10	0.09	0.11	0.11	0.00	0.08	0.75
Per Cent Share to All India		0.07%	0.05%	0.06%	0.06%	0.00%	0.05%	0.44%
All India		146.62	182.41	170.90	183.43	192.54	175.18	171.91

Source: Agricultural Statistics at a glance 2016

Potato is one of the staple foods and a major crop in Arunachal Pradesh. The average production of potato in the state was found to be 38.33 ('000) MT from 2009-10 to 2014-15 with an average productivity of 8.25 MT/Ha while the yield of potatoes in other seven states was found to be 17 MT/Ha.

Sl. No.	State	Production of Potatoes ('000 MTonnes)						Average 2009-10 to 2013-14	2014-15 (4th Advance Estimate)
		2009-10	2010-11	2011-12	2012-13	2013-14 (Final)			
1	Assam	590	738	783	975	700.14	757.228	1706	
2	Bihar	5387.2	NA	6101.7	6640.6	6536	6166.375	6345.6	
3	Chhatisgarh	449.8	526.3	579.2	648.6	556.4	552.06	542.8	
4	Jharkhand	573.1	655.5	652.8	659.6	653.1	638.82	659.6	
5	Odisha	178.8	191.4	201.1	201.1	249.8	204.44	268.9	
6	Uttar Pradesh	13447.3	13576.6	14125.1	14430.3	13808.8	13877.62	13137.5	
7	West Bengal	8880	13391.2	9693.3	11591.3	9030	10517.16	12027	
	Total of Seven States	29506.2	29079	32136.2	35146.5	31534.24		34687.4	
	Average Production of Seven states	4215.17	4846.50	4590.89	5020.93	4504.89	4673.39	4955.34	
	Per Cent Share to All India	80.67%	68.68%	77.47%	77.51%	75.88%	0.00%	75.49%	
8	Arunachal Pradesh	32.00	32.00	40.00	NA	NA	34.67	42.00	
	Per Cent Share to All India	0.09%	0.08%	0.10%	NA	NA	0.08%	0.09%	
	All India	36577.3	42339.4	41482.8	45343.6	41555.4	41459.7	45950.9	

Source: Agricultural Statistics at a glance 2016

The livestock sector is the second major livelihood option for the population of Arunachal Pradesh. The poultry farming and the livestock rearing can be observed in almost every household of the rural area in the State. Meat, milk and egg production are the major products obtained under livestock and poultry farming. The total meat production in the State in 2013-14 was 18,000 tons which grew to 19,000 tons in 2015-16 (P), showing an increase of 6%. The milk production is low in the state but has increased considerably from the estimates of 2013-14. The total milk production in 2013-14 was 43000 tons which grew by 16% from 2013-14. The total number of egg production during 2013-14 was 43 lakh and increased to 50 lakh in 2015-16 (P), showing an increase of 16%.

State	Production of Meat (000 Tonnes)		
	2013-14	2014-15	2015-16
Arunachal Pradesh	18	19	19

Source: Agricultural Statistics at a glance 2016

State	Production of Milk (000 Tonnes)		
	2013-14	2014-15	2015-16
Arunachal Pradesh	43	46	50

Source: Agricultural Statistics at a glance 2016

State	Production of Eggs (Lakhs Nos.)		
	2013-14	2014-15	2015-16
Arunachal Pradesh	43	46	50

Source: Agricultural Statistics at a glance 2016

The State has a number of rivers, rivulets and streams that provides ample opportunities for fish production. Fishery is also one of the major non-agricultural livelihood opportunities for the rural population in the State of Arunachal Pradesh. The fish production in the State has also shown an increase by 22%, from 3625 tons to 4410 tons during 2013-14–2015-16. (Source: Agricultural Statistics at a glance 2016)

The population in the State has been growing since 2001. The population has grown by 26% from 2001 to 2011 and is estimated to further grow by 46% by the year 2030. The population projected for the year 2030 will be 1975000 (Source: Population Foundation of India under Population Reference Bureau). This will require an additional food grain by 2030 and hence the agricultural production will have to increase continuously to feed this growing population. Thus, the major challenge for the State is to increase productivity, production, and profitability while minimizing environmental impact for sustainability and provide economic opportunities.

The agriculture scenario of the state in terms of productivity of major crops such as paddy, maize, pulses and potatoes rightly fits into the proverb – ‘Scarcity amidst Plenty’. The allied sectors of agriculture such as livestock rearing, poultry farming and fishery also contributes majorly in creating livelihood opportunities for the population of Arunachal Pradesh. The State is slowly developing its economy with the aim of improving the quality of life of its people. The task ahead is in full swing, the resources available are plentiful, but the ways and means to achieve the goal through the profitable and efficient use of resources are not well defined. Taking into account all these factors and the need to achieve greater economic growth and create employment opportunities for the rural unemployed through agriculture and the related sector, it is necessary for the state to have a well-defined policy in a long term.

The State Irrigation Plan of Arunachal Pradesh under PMKSY has prepared strategies and framework to address these issues in timely manner. This 'Road Map of Agriculture Development by 2030' documents key challenges and opportunities that are likely to appear in the next decade, strategies and framework to address these issues and provides a roadmap to articulate role of all the line departments of State i.e., Agriculture Department, Horticulture Department, WRD, RD and Soil & Water Conservation Department under RWD, in shaping the future of agricultural research for growth, development and livelihood security in the state of Arunachal Pradesh.

5.8.2 Possible Areas of Intervention for Agriculture Development in the State

In view of the plan proposed under PMKSY, the State Irrigation Plan provides a comprehensive approach for the development of Agriculture sector in the State in a time bound manner. The plan has been proposed till 2020-21 with a broad perspective to bring positive changes in the current agricultural scenario of the State by the year 2030 and make Arunachal Pradesh as one of the leading States in the country in the field of Agriculture and allied activities. The possible areas of interventions would be:

A. Creation of Irrigation Infrastructure

The State has ample sources of surface water with the absolute water availability of 305205 MCM through various rivers, rivulets and streams whereas the State has been able to utilize only 1% through available infrastructure. Currently, the State is utilizing irrigation infrastructures in the form of minor irrigation canals, community-based or private canals, ponds and government reservoirs. The total number of canals in the State is 2415, private canals is 1218 and ponds 398. Besides, the number of check dams constituted under watershed activity in the state is 261. The present State Irrigation Plan (SIP) of the State proposes to develop irrigation infrastructure with 81% of the fund under Har Khet Ko Pani for the creation of minor irrigation canals, 57% of the fund under Per Drop More Crop for the development of supplementary water management activities and 35% of the fund under Watershed for the creation of farm ponds and check dams. Assuming the physical constraints prevailing in the state and the delay in fund release or fund disbursement, an assumption of 60% has been taken as percentage increase in the number of irrigation infrastructure, the total number of canals under minor irrigation projects will increase to 3,864, number of ponds and check dams will increase to 1046 and 986, respectively, by the year 2030. This will enable the State to tap at least 5%-7% of the absolute water available through created irrigation infrastructures.

B. Increase in irrigation Potential

The current irrigation potential created in the State is 90557 Ha but with the wider perspective of agriculture development under PMKSY, it is assumed that the creation of irrigation infrastructure will develop a command area of 11,92,533 Ha by 2030 in a time bound manner. However, after assuming the constraints prevailing in the State such as geographical situation of the State, lack of fund and lack of manpower, it will lead to longer gestation period than the projected and hence the total command area to be developed has been assumed to spill over till year 2030.

C. Enhancing productivity, profitability, and sustainability of crop production systems through better agronomic practices

The creation of irrigation infrastructure and development of irrigation potential in the State will lead to a rise in agricultural production and productivity levels. But it needs to be implemented with the application of scientific cultivation. Majority of the crop production in the State is under Jhum Cultivation which has resulted not only in poor productivity but has also degraded the land, caused loss of soil nutrients and increased instances of soil erosion. This has necessitated the development and adoption of better agronomic practices of cultivation in the State such as:

i. Use of Bio-fertilizers for rice cultivation

Bio-fertilizers provides nutrient supply like nitrogen and phosphorous through their activities in the soil or rhizosphere and makes them available to the plants on the soil and also maintaining the health of the soil and are reducing pollutions in the environment by cutting down the use of chemicals. A study conducted by ICAR North Eastern Hill (NEH) region on the effects of bio-fertilizers and crop residue for sustainable rice production found that the productivity of rice increased by 13.20% to 44.89% from the current yield, depending upon the metho and application of dosage.

Azospirillum and Phosphatica increased the rice grain yield by 15.21 % and 12.22%, respectively over control (30.12 q/ ha). Ramkrishna et al. (1992) also found that Azospirillum increased yield by 13.20%. Azospirillum and Phosphatica when used together increased rice yield by 18.43%. However, paddy straw incorporated treatment increased yield by 16.87% over control. Azospirillum and Phosphatica along with full dose of NPK (60-40-30 Kg/ha) and half dose of NPK (30-20-15 Kg/ha) significantly increased the yield by 52.39% and 34.23%, respectively over control. Paddy straw incorporation in soil along with full dose and half dose of NPK also significantly increased the yield by 44.89% and 31.37%, respectively over control. However, Azospirillum + Phosphatica along with K(30 kg/ha) significantly increased the rice yield by 22.34% over control. The increase in rice yield may be due to improving the nutrients supply and their continuous availability to the crop through microbial activities of Azospirillum and Phosphatica. Rice straw incorporation had an important role in improving the continuous nutrients supply and availability to the crops.

The application of bio-fertilizer can boost the rice productivity in the state. It is assumed that the yield of rice in the state which is currently 2240 Kg/Ha can increase by at least 28% to 2890 Kg/Ha by the end of 2021-22, and further to 3248 Kg/Ha by the year 2030.

ii. Technology adoption in Horticulture

The total area under horticulture in the State was found to be 60374 Ha out of which 56196 Ha is under fruit production, 512 Ha is under plantation crops and 3666 Ha is under vegetable production. The horticulture area occupies 17% of the gross cropped area in the State. The State is blessed with rich climatic conditions and water availability for the cultivation of various horticultural crops but due to lack of resources, knowledge and unscientific method of cultivation, the sector has not been able to make a potential impact on the State's economy. Thus, for the development of this sector, the following interventions may be required -

- a. Incorporation of micro-irrigation techniques at the farm level will help in the year round availability of water, essential to mitigate the effects of uneven water application which can cause plant stress.
- b. Availability of quality planting material can boost the production of horticultural crops.
- c. Technologies such as high-density planting, use of plastics, precision farming, mulching, integrated nutrient management and integrated pest management can help in increasing the yield.

- d. Availability of post-harvest infrastructure for sorting, grading, storing and packing will reduce the post-harvest losses and enhance value addition of the horticultural crops.

The above arrangements can help in structuring the horticulture sector in the state. With the help of micro-irrigation techniques and better agronomic practices, the yield would increase by 21% to 60% under fruit cultivation, 25% to 33% in vegetable crops and 58% in sugarcane. (Source: Field test of drip irrigation under APMIP Scheme of Andhra Pradesh). A workshop on the analysis of crop productivity potential and drip irrigation system in India under International Commission on Irrigation & Drainage (ICID) had concluded that due to adoption of micro irrigation projects in Himachal Pradesh, there was 24% higher target achievement in case of sprinkler and 8% higher in case of drip system. Keeping this growth percentage in view, it can be assumed that with the adoption of better technologies in horticulture sector in the State of Arunachal Pradesh by the year 2030, the fruit productivity would increase to 5.16 MT/Ha from 2.79 MT/ha, productivity of plantation crops would increase from 16.34 MT/Ha to 30.23 MT/ha and productivity of vegetable crops would increase from 10.72 MT/Ha to 19.83 MT/ha.

D. Diversification towards high value crops

Diversification towards High Value Crops (HVCs) offers a great scope to improve farmers' income. As per the all India assessment presented by Niti Aayog, the staple crops occupy only 77% of the gross cropped area but contribute only 41% of total output of the crop sector. While the same value of output was contributed by HVC (fruits, vegetables, spices, condiments) which just occupied 19% of the gross cropped area in 2013-14. The average value of these HVC was estimated to be Rs.1,41,777 per hectare as compared to Rs. 41,169 per hectare for the staple crops. With this difference in productivity, shifting one hectare area from staple crops to commercial HVC has the potential to increase gross returns up to Rs.1,01,608 per hectare. The State has ample opportunities to develop HVC and enhance farm production and thus the farm income by 2030.

E. Enhancing productivity, profitability, and sustainability of livestock production systems

Livestock sector is one of the major contributors providing non-agricultural income to the rural population of Arunachal Pradesh. Meat, milk and egg are the major products of this sector. The different strategies to develop the livestock production system in the state are:

- i. Evolve a comprehensive livestock development policy
- ii. Genetic improvement of the indigenous non-descript animals and selective breeding of some indigenous breeds of livestock
- iii. Utilization of straws/crop of cereals and food crops with suitable treatment

- iv. Introduction of urea molasses blocks in rural areas
- v. Cultivation of green fodder in the fallow land

It is assumed that the adoption of better practices of livestock rearing will help in increasing the yield of meat and egg by 5%-10% by the year 2030.

With about 90% of the population being fish eaters (assumption), the demand of fish will increase steadily in the State. The different practices that should be adopted in increasing the fish production are:

- i. Development of large number of small size fish ponds. (The productivity of small size pond was found to be 506.14 Kg/acre/year followed by medium size (422.13 Kg/acre/year) and large size (304.54 Kg/acre/year)
- ii. Better quality fish seeds, fish feeds, manure, fertilizer, lime, etc. and labour inputs can play a significant role in enhancing fish production.

It is assumed that with these practices there will be three to four fold increase in the fish production and the total production may increase by 110% from present 22%.

F. Ground Water Development

The State has untapped 3989.58 MCM of ground water out of which only 0.23% is being economically utilized for domestic and industrial purposes. The State falls under the under-exploited stage of ground water development which opens a broad opportunity for ground water development, especially for agriculture purposes. It can help in availing water even during the off-monsoon period. The water availability can therefore increase the production and productivity of various agricultural and horticultural crops.

G. Reducing post-harvest losses

The State is currently dealing with 50% of post harvest losses in agriculture and horticulture sector which is much higher than the national average. It is also a limiting factor in generating higher production and productivity of crops. Various new initiatives that can be undertaken to improve the post harvest losses include:

- i. Developing packing stations in the growing areas with the facilities of sorting, washing, grading, packing and labeling facilities in addition to pre-cooling.
- ii. Availability of better transportation facilities to transfer the produce from farm to market in less possible time.

- iii. Availability of cold storage at cluster or block and at a district level to preserve fruits and vegetables in natural condition.
- iv. Promotion of agriculture processing industry in the State.

The above practices can help in bringing down the post-harvest losses at least by 15%-20% by the year 2030 depending upon the development of infrastructure in the State.

H. Development of marketing infrastructure in the State

The increase in production and productivity alone can meet the objective of prosperous farmer and State, it needs to be further materialized into terms of trade. Currently, the State lacks marketing infrastructure for agricultural produce and farmers depend on the local traders for selling of their produce. Thus, the State needs a comprehensive and state specific policy for agriculture market development. Besides that, the State needs to follow the model of public-private partnership in the view that the State Government alone cannot bridge the gap in agriculture infrastructure due to limited resources and organizational structure. The Government has also been providing financial assistance through various central sector and centrally sponsored schemes which include inter-alia the schemes of Department of Agriculture & Cooperation (DAC) such as the Integrated Scheme for Agricultural Marketing (ISAM) and its sub-schemes of Agricultural Marketing Infrastructure (AMI), Marketing Research and Information Network (MRIN) and Venture Capital Assistance (VCA), the Rashtriya Krishi Vikas Yojana (RKVY) and the Mission for Integrated Development of Horticulture (MIDH) as well as the scheme of Ministry of Food Processing Industries (MoFPI) on Cold Chain, Value Addition and Preservation Infrastructure. The integration of policy, availability of finance and capacity of existing manpower toward the use of better technology can reap better future in terms of high income and growth of State GDP.

The roadmap of agriculture development in the State by 2030 gives a comprehensive approach to achieve not only the vision of doubling farmer income but also to make the State more self-dependent and developed in the agriculture sector. The various initiatives as mentioned above may result in increase in the farm income by 4 times from the present income. It has been assumed that by 2030 the farmers' income will increase to Rs. 80,000 per hectare from the current Rs. 20,000 per hectare. It may further increase depending upon the implementation of various schemes and judicious use of resources. These initiatives may result in employment generation in the farm and non-farm sector. It is assumed that even if 80% of the total funds as projected in the SIP are utilized, it will result in creation of 6030 lakh mandays of non-recurring employment while an additional 5,96,267 number of people, both in rural and urban areas, will get employment on recurring basis. Furthermore, if 60% of the total

command area out of proposed 11,92,533 Ha is developed by 2030, the total additional income generated by the year 2030 will be Rs. 2,86,208 lakhs in the State, considering the average income to be Rs.40,000 per ha. It will result in an increase in the contribution of agriculture and allied sector towards State GDP. Currently, agriculture and allied sector contributes about Rs.7,98,888 lakhs to Gross State Value (Statistical Abstract, Arunachal Pradesh 2015-16) in 2015-16 at current prices and it showed a jump of 75% from 2011-12 gross state value. The various interventions will further result in the enhancement of gross state value under agriculture and allied activities. It has been assumed that with the growth of 15% per annum in gross state value under agriculture and allied activities at present, the total gross value added by the year 2030 will be Rs 12,18,304 lakhs, indicating a rise of 53% at current price. While at constant price, the total contribution of agriculture and allied activities in the year 2015-16 is Rs.5,27,545 lakh (Statistical Abstract, Arunachal Pradesh 2015-16) which showed an increase of 16% from the year 2011-12 and annual growth of 3% in the gross state value in last five years. The proposed interventions will further add to the gross state value under agriculture at constant price and by the year 2030 it will be Rs.6,16,173 lakh, depicting an increase of 17% from the present value at constant price. It will also lead to an increase in the contribution of agriculture and allied sector to the state's GDP which is currently 30% (approx.). Whereas, the State's GDP contribution to the country's total GDP will also increase, which is presently 0.13% at current price.

The above interventions and positive benefits will only be achieved if it is combined with proper capacity building and training of stakeholders at all the levels i.e., at farmers level and the institutional level. The farmers need to be made aware of the benefits of various interventions in the agriculture sector by which they can enhance their farm production. The manpower should be strengthened at the block, district and the state level for this Herculean task. There should be proper flow of fund and communication for better implementation of various schemes and programs.

5.9 Suggestions

Doubling real income of farmers till 2022-23 over the base year of 2015-16, requires annual growth of 10.41% in farmers' income. This implies that the ongoing and the proposed initiative for increase in the farmers income needs to be sharply accelerated. Therefore, strong measures will be needed to harness all possible sources of growth in farmers' income within and outside agriculture sector. The major sources of growth operating within the agriculture sector are: improvement in productivity, resource use efficiency, increase in cropping intensity and diversification towards high value crops. The different sources outside agriculture that can boost the farmers' income are: shifting cultivators to non-farm livelihood opportunities and improvement in terms of trade for farmers. The present initiatives taken

under PMKSY in the State will help in enhancing the crop production and productivity level but it needs to be further connected with the agriculture marketing system in the State so that the farmers gets the maximum benefits of the produce. It will also help in increasing the marketable surplus in the State.

Research Institutes should come with technological breakthroughs for shifting production frontiers and raising efficiency in the use of inputs. The use of scientific agronomical practices like precision farming to raise production and income of farmers substantially can easily be observed in many parts of the country. Similarly, modern machinery such as laser land leveller, precision seeder and planter, and practices like SRI (system of rice intensification), zero tillage, raised bed plantation, and ridge plantation allow technically highly efficient farming. These technologies requires strong extension for the adoption by farmers. The KVKs, Agriculture Institutes and R&D Institutions should also include in their packages grassroots level innovation and traditional practices which are resilient, sustainable and income enhancing.

Therefore, for successful implementation of PMKSY plan it is suggested that:

- All the stakeholders should convene meeting of Panchayat samities and then finalise the village plan and prepare DPR.
- There should not be duplicity of project.
- The Department should supplement each other so that the maximum irrigation efficiency is achieved.
- Agriculture and Horticulture Department should take micro irrigation projects in the command of minor irrigation projects completed or likely to be completed in near future.
- All the irrigation projects should have a component of water conveyance so that the each drop of water is judiciously utilized.
- All the structures planned should be geo tagged and marked on map, so that social monitoring of the projects can be conducted. This will also avoid the duplicity.
- Priority should be given to projects minimize the gap in potential created and potential utilized.
 - i. The prioritization should be given based on the projects which are directly linked to development of irrigation infrastructure and enhancing the irrigation potential.
 - ii. The criteria for project prioritization of funds should be:
 - Creation and development of Irrigation Infrastructure
 - Increase in Irrigation Potential
 - Increase in irrigation efficiency
 - Soil and water conservation
 - Extension Activities; and,

- Livelihood/ Enterprise development
- iii. In the view of the above criteria, the fund allocated at the district level or the block level can be prioritized among the various departments. It is suggested that the project prioritization of fund between various departments should be:

Sl. No.	Department	Project Prioritisation of Fund	Ranking
1	Water Resource Department (WRD)	28%	I
2	Agriculture Department	21%	II
3	Horticulture Department	19%	III
4	Soil & Water Conservation Department under RWD	17%	IV
5	Rural Development Department (RD)	15%	V

- iv. As per the table shown above, the first priority of allocating the fund should be given to creation of Irrigation infrastructure in the State which will further lead to creation of additional irrigation potential. The micro-irrigation techniques will further add to increase of irrigation efficiency at the farm level which will ultimately boost the production level in the State. It should then further followed by soil and water conservation measures to prevent soil erosion, to bolster the ground water recharge and to invigorate the agriculture sector by enhancing the soil fertility status which will result in augmentation of agricultural productivity. The farmers should undertake capacity building and training for adoption of better agronomic practices. It should be further accompanied with livelihood generation activities which can be farm or non-farm. The linking of these initiatives under prioritization will not help in economic utilization of resources but it will better coordination between various departments.
- Execution of the scheme should be expeditiously completed.
 - There should be smooth fund flow to timely complete the project.

Remote Sensing with GIS for Irrigation Management

GIS technology such as ARC/INFO software was efficiently and effectively used in many water resources planning and management worldwide. It can help to establish agricultural water rights, support the application for drilling permits for irrigation purposes, and track water rights information. It can also be used to evaluate the loss of water from soil drainage and unlined canals, as well as help determine the suitability, cost-effectiveness, and prioritisation of canal projects in planning stages.

Use of GIS especially for analysing spatial water and irrigation requirements with their large volumes of spatially and temporally distributed data is widely adopted. The GIS capability to integrate spatial data, integrating remote sensing data and handling large volume of data has been popular among the

irrigation experts. The integration and use of geo-referenced data in irrigation management certainly requires the use of GIS technologies. GIS offer a spatial representation of irrigation systems. GIS has capabilities to integrate database, statistics, remote sensing, maps with advance graphics for visualization and analysis. Spatial database of soil, rainfall, geology, land use, transportation, topography, demography and socio-economic can be implemented for better decisions in irrigation planning and management (Pant *et al.*, 1997) with its powerful capacity for management and analysis of spatial data, GIS has becomes an important tool in irrigation management.

A GIS technique allows modelling of water demand with different scenario for soil, crop, and weather and irrigation data. Recent advances in Remote Sensing technology offers potential improvement in various disciplines along with water resources management through important water resource-related information. GIS and Remote sense data have many similar attribute are concerned with the digital representation of geographic phenomena and often both employ the same spatial analytical techniques to manipulate the data. The remotely sense data in conjunction with other traditional data provides valuable information on topography, land use/cover, geological feature useful in irrigation planning and management. The space and time based earth observation in remote sensing provides unique opportunity in handling spatial and temporal irrigation data for better irrigation management. Remotely sense data can be used by two ways regarding irrigation management, first accessing land cover in different cover and other is through estimation of water requirement parameters (Bastiaanssen and Makin, 2000). When we deal with relatively large area/surface, remote sensing is more useful and there is always large area when dealing with irrigation management. Remote Sensing could be important future technology for better irrigation water management.

Remote sensing has been able to provide information with varying degrees of success and accuracy on; irrigated area, crop type, biomass development, crop yield, crop water requirements, crop evapo-transpiration, performance diagnosis, salinity and water logging.

Remote Sensing techniques and its data use in India for irrigation management has been suggested by previous researchers (Ray *et al.*, 2002). Remote sensing technique can be used for assessment of water availability in reservoir for optimal management of water to meet the irrigation demand. It can also be used in determination of irrigation water demand over space and time, water logging and salinity problems in irrigated land.

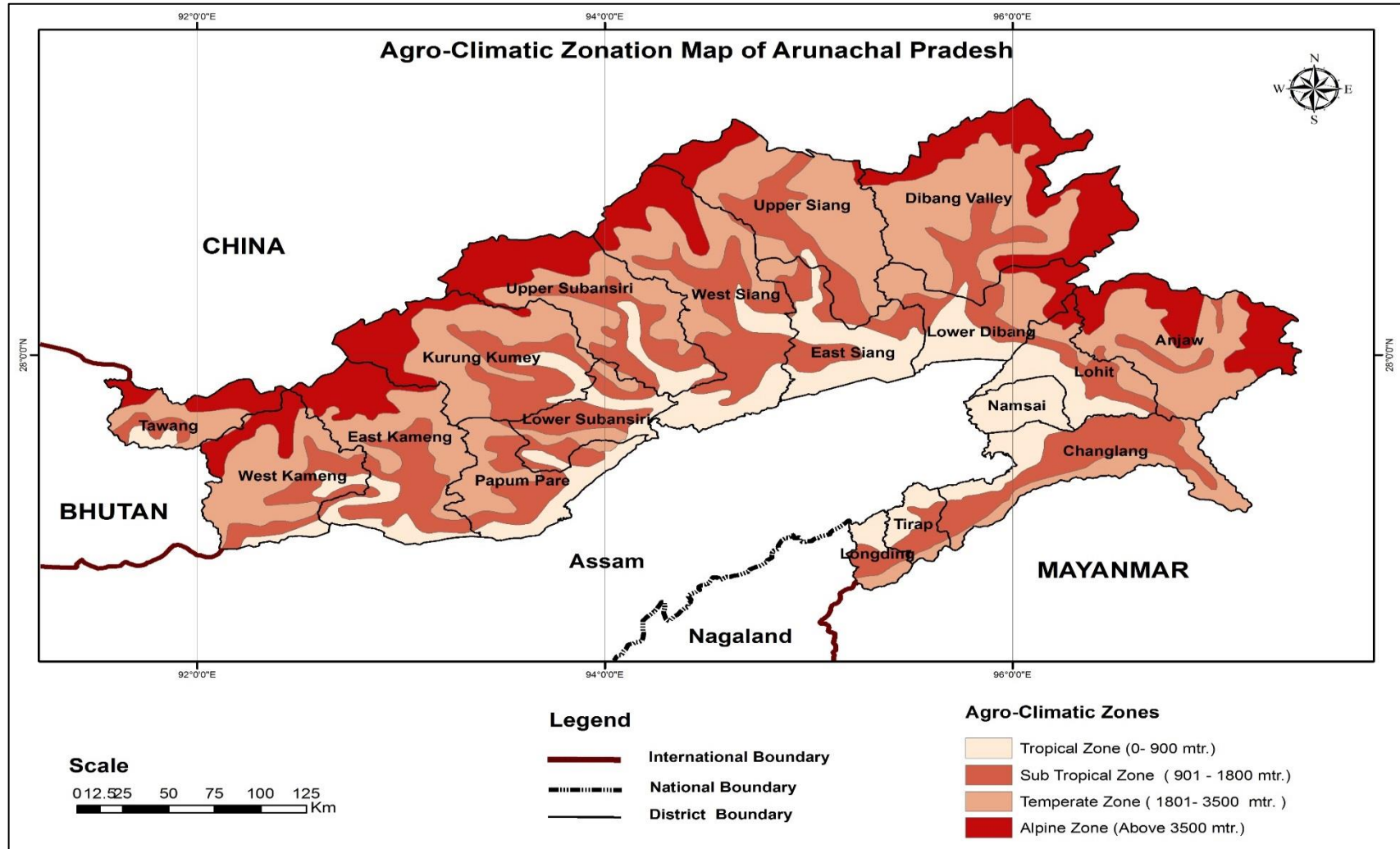
In this regard, it may be mentioned that the water sector has very strong linkages with all other developmental activities. In view of fast changing development scenario, it is emphasized that the key priorities and identified strategies cannot be considered as static and firm. These need to be reviewed and improved upon from time to time.



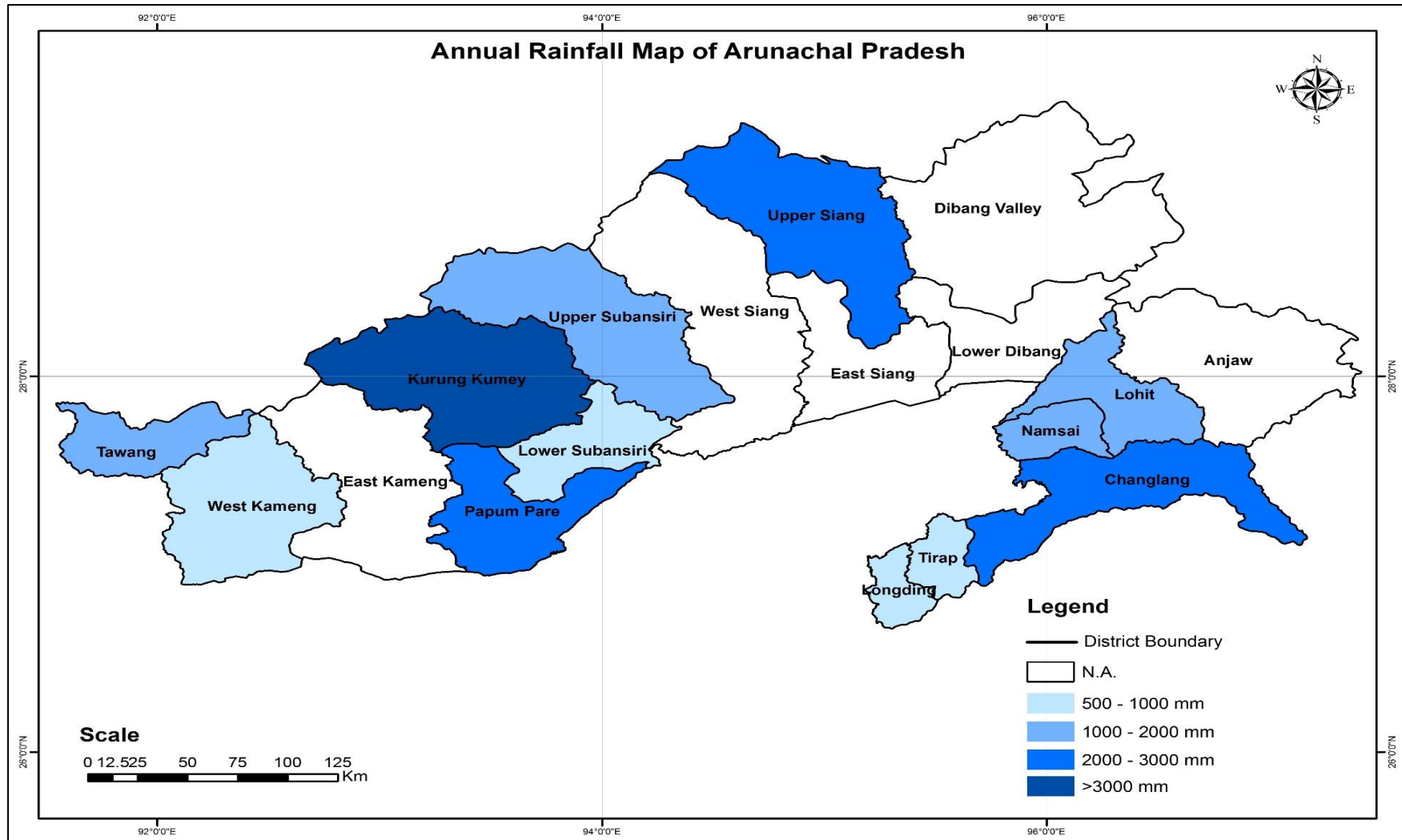


MAPS

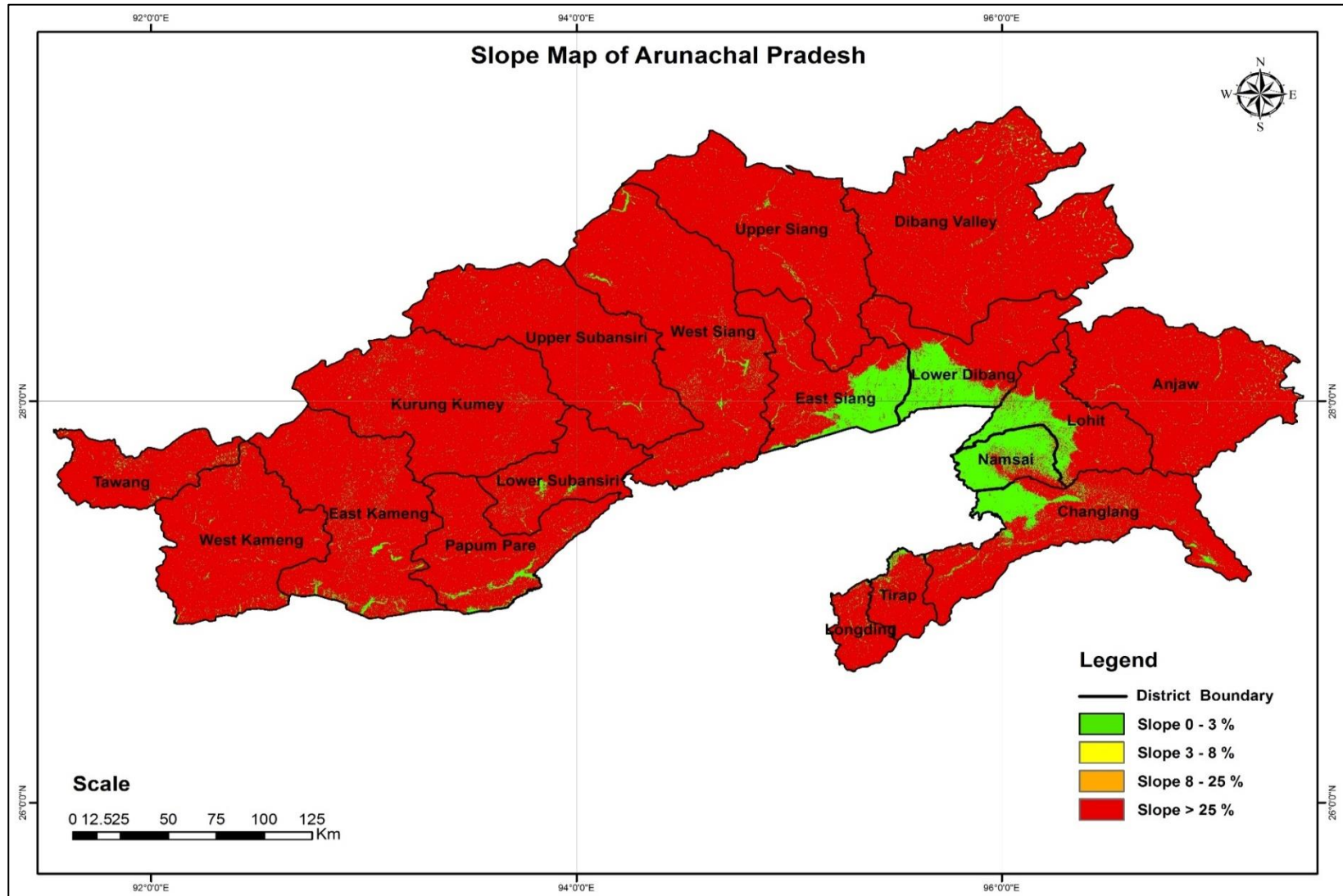
Agro-climatic Zones in Arunachal Pradesh



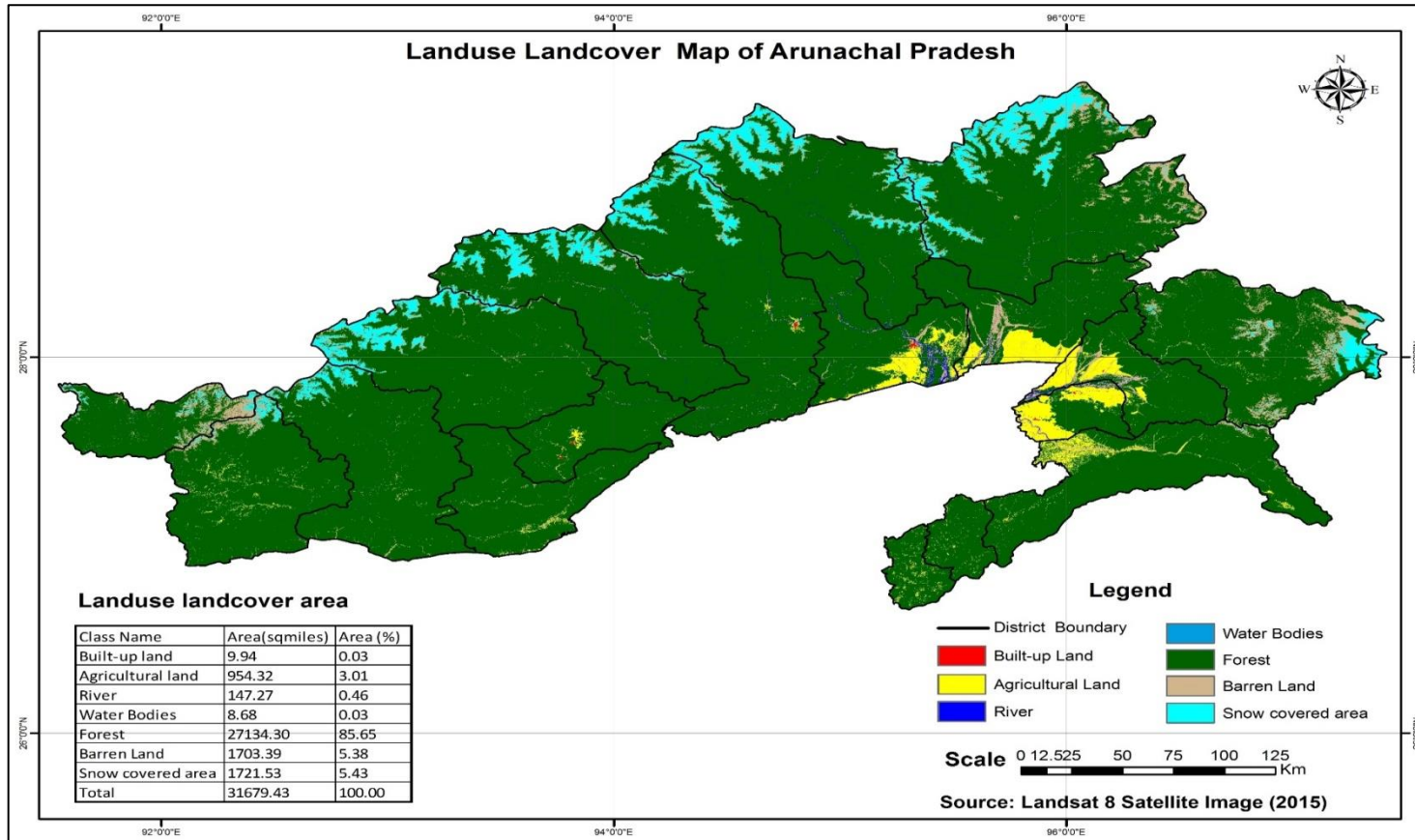
Annual Rainfall Map of Arunachal Pradesh



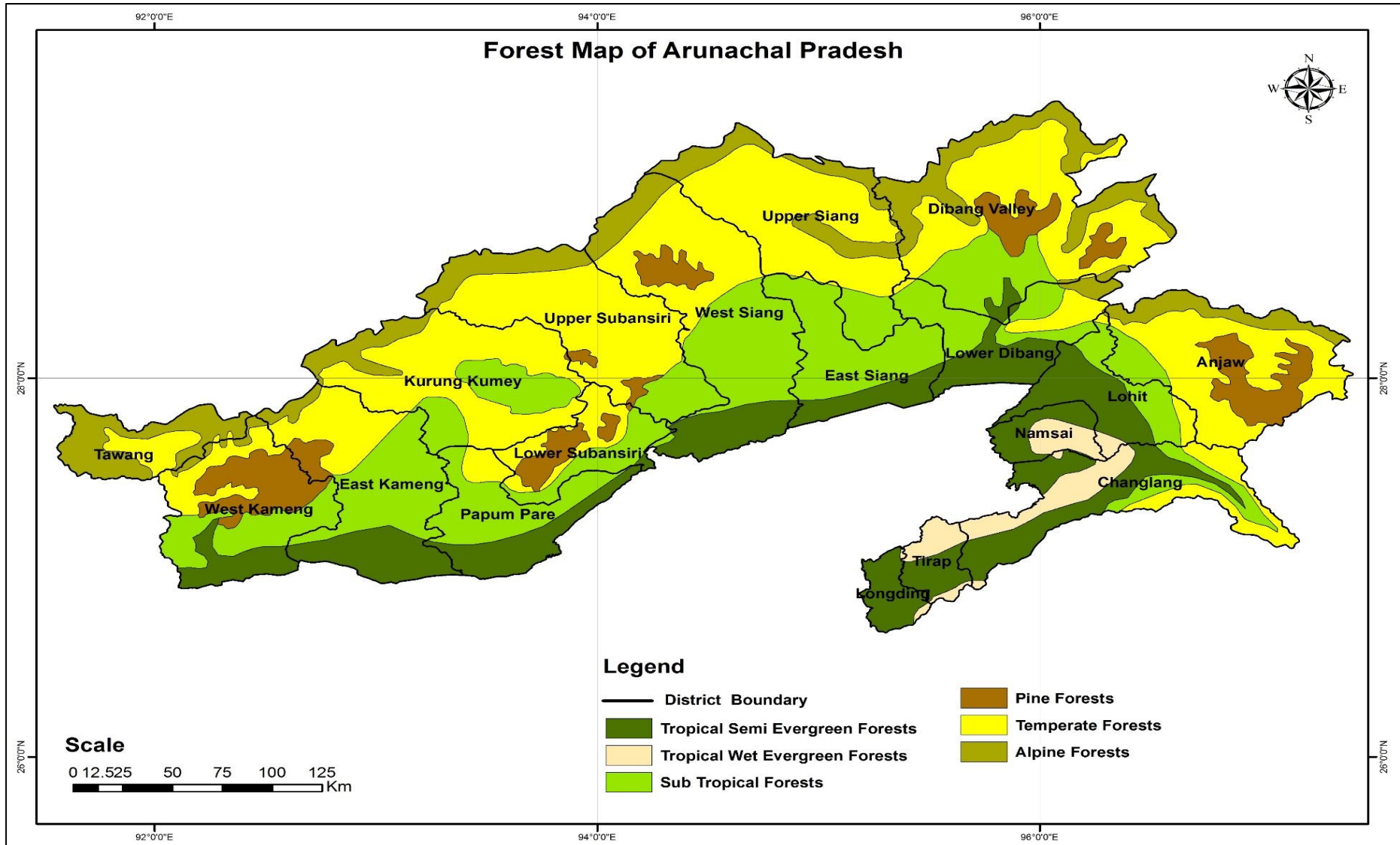
Slope Map of Arunachal Pradesh



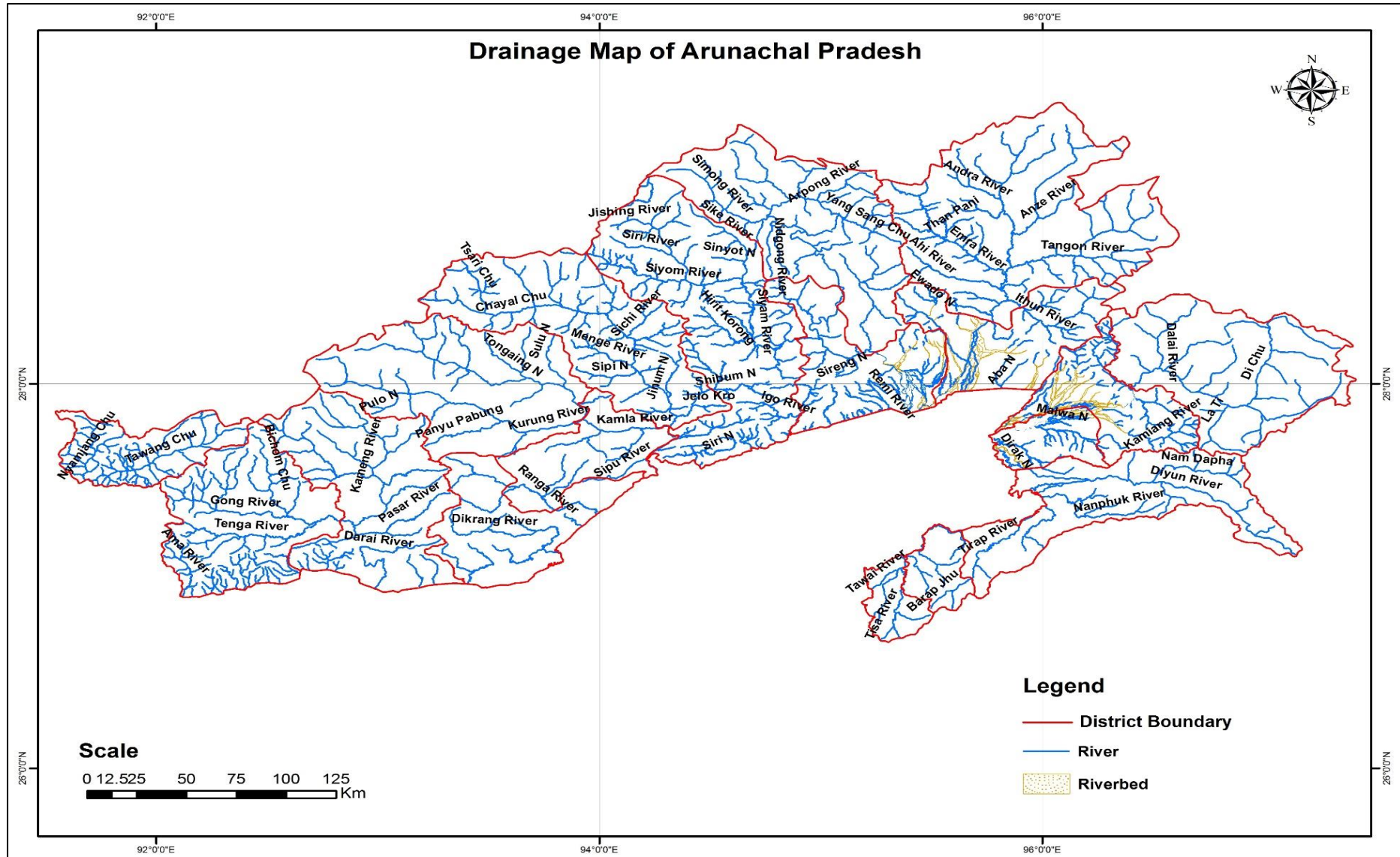
Land Use & Land Cover Map of Arunachal Pradesh



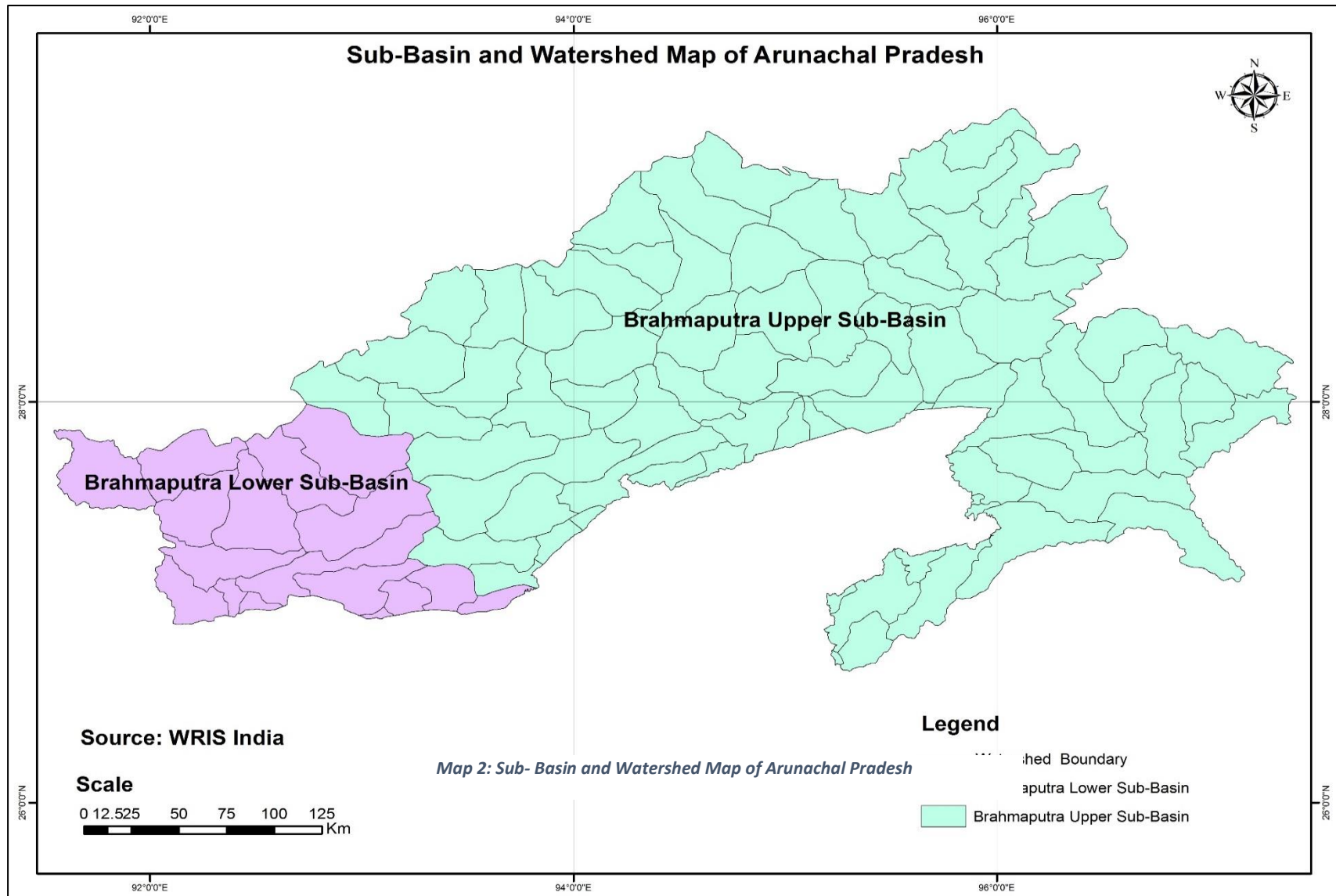
Forest Map of Arunachal Pradesh



Drainage Map of Arunachal Pradesh



Sub-Basin and Watershed Map of Arunachal Pradesh



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 - Monitoring and Evaluation
 - Impact Assessment Studies
 - Third Party Monitoring of Infrastructural Projects
 - Skills for Livelihood
 - Capacity Building
 - Accreditation of Rural Godowns
 - Climate Change Issues
 - CSR Facilitation
 - IT in Rural Banks

Pro-Services Rendered by NABCONS

No.	Name of Services	Description
1	Project Management Consultancy (PMC)	Entails provision of end-to-end solution, including assistance in statutory approvals, bid process management, issuing and evaluating tender documents and supervision over infrastructure projects like Mega Food Park, Rural Godowns, Cold Storage, etc. funded by Govt. or private entities.
2	Preparation of Detailed Project Report / Conduct / Techno-economic Feasibility	For various activities under agriculture, horticulture, forestry, fisheries, irrigation, animal husbandry, food processing activities, agri-infrastructure, climate issues, etc.
3	Third Party Monitoring (TPM) of Infrastructure Projects	TPM of various Govt.-funded infra projects to assess the level of compliance followed in execution. This also covers socio-economic impact evaluation.
4	Monitoring and Evaluation (M&E)	M & E is undertaken for various developmental schemes of Govt. of India and State Govts in the areas of agriculture, animal husbandry and all other socio-development sectors.
5	Training and Capacity Building	Training is imparted on forward markets, agriculture market infrastructure, rural godown, agri-financing, treasury and investment management for banks, etc.
6	Studies / Baseline Surveys	Baseline surveys are taken up for measuring impact of community investment made by public and private sector Companies. Studies are conduct on women, children, disadvantaged groups / regions, etc.
7	Livelihood Mapping	Livelihood mapping and analysis is done for identification of potential activities to be taken up by SHGs
8	International Visitors' Programme / International Exposure Visits	Entails organizing study tours / exposure for the visiting foreign delegates to their areas of interest such as watershed, micro-finance, fin-inclusion, cooperatives, projects appraisal, agro-processing, post-harvest technologies, farmers' clubs, etc.
9	Consultancy on Banking and Finance	Designing and execution of priority sector strategies, advisory services on Treasury and Investment Management for Banks, preparation of IT Policy, etc.
10	Transaction advisory	Transaction Advisory for setting up of Agri-mall, Silos & Cold Storages
11	Skills for Livelihood	Skilling of rural BPL youth and placement in the formal sector, monitoring skill initiatives of MORD, Govt. of India, facilitating access to credit for trainees, etc.
12	Accreditation of Godowns	Engaged by WDRA as Accreditation Agency for accrediting rural godowns.