

## ANNEXURE II

(To be typed on Rs. 100/- stamp paper and executed before Executive Magistrate OR Notary public)

I, the undersigned \_\_\_\_\_ son of \_\_\_\_\_, major in age \_\_\_\_\_ years, Indian National, resident of \_\_\_\_\_, do hereby on solemn affirmation state as under:-

1. I say that I am not registered as contractor in individual capacity in Goa Water Resources Department.
2. I further state that my name has not been black-listed or removed from the approved list of contractors or demoted to a lower class or banned/suspended business with WRD/any other department in the past.
3. I say that I am Civil Engineer (Degree/Diploma) passed in the year \_\_\_\_\_ from \_\_\_\_\_ University/Technical board.
4. I say that I am not a member of Indian Parliament or State Legislature.
5. I say that I am not a Partner/Director of any other Firm/Company registered with WRD, Goa as contractor.
6. I say that no close relatives of mine are working in Water Resources Department, Goa except Shri \_\_\_\_\_ working as \_\_\_\_\_ in \_\_\_\_\_ office.
7. I say that I have no civil or criminal case pending in any Court in India.
8. I say that if any of the information furnished by me is found wrong, I am liable to be debarred from the list of contractor under CMRY 2020, scheme.
9. I am permanent resident of the State of Goa for the last fifteen years.
10. I am not a defaulter to any Nationalized Bank/ Financial Institution/Co-operative Bank etc.
11. I have not availed assistance to any other subsidy linked scheme of the Government.
12. The income of the undersigned along with spouse, dependents and children of minor age does not exceed Rs. 10,00,000/- per annum.

13. I say that what is stated herein above is true to my own knowledge.

Solemnly affirmed at \_\_\_\_\_ Goa,

On this \_\_\_\_\_ day \_\_\_\_\_.

DEPONENT

\_\_\_\_\_  
**Notification**

4/4/CE-WRD/EO/2021-22/156

The Goa State Water Policy, 2021, adopted by the Government is hereby published for the information of the general public.

By order and in the name of Governor of Goa.

*P. B. Badami*, Chief Engineer & ex officio Addl. Secretary (WRD).

Porvorim, 23rd August, 2021.

\_\_\_\_\_  
Goa State Water Policy, 2021  
Index

1. Preamble
  - 1.1 Water Sector.
  - 1.2 SWP 2000.
  - 1.3 SWP 2021.
2. Goa
  - 2.1 The State.
  - 2.2 The Land.
  - 2.3 Climate.
  - 2.4 Land Use.
  - 2.5 Economy and Livelihoods.
3. Water Resources
  - 3.1 River Basins.
  - 3.2 Surface Water.
  - 3.3 Ground Water Resources.
  - 3.4 Per capita water availability.
  - 3.5 Constraints on water resources development.
  - 3.6 Water Quality Assessment.

4. Present Development and Utilisation
  - 4.1 Major, Medium and Minor Schemes.
  - 4.2 Ground Water use and Artificial Recharge.
  - 4.3 Storage Created.
  - 4.4 Waste Water Treatment.
5. Future Requirements
6. Policy Recommendations
  - 6.1 Water Security.
  - 6.2 Not merely subsistence.
  - 6.3 Achieving Balance between Environmental Concerns and Economic Concerns.
  - 6.4 Determination of Requirements.
  - 6.5 Estimation of Resource.
  - 6.6 Data.
  - 6.7 RTDAS and SCADA.
  - 6.8 Water Allocation Priorities
  - 6.9 Basin as a Unit.
  - 6.10 IWRM.
  - 6.11 Rain Water Harvesting.
  - 6.12 Arresting Salinity Ingress.
  - 6.13 Desalination of seawater.
  - 6.14 Water Quality.
  - 6.15 Recycle and Reuse of waste water.
  - 6.16 Installation of STPs.
  - 6.17 Water Charges.
  - 6.18 Enumeration of Water Bodies.
  - 6.19 Public Education.
  - 6.20 Irrigation Potential Utilization
  - 6.21 Master Plans.
  - 6.22 Legislation.
  - 6.23 Research and Development.
  - 6.24 Human Resource Management (HRM).
7. Miscellaneous
  - 7.1 Hydropower.
  - 7.2 Inland Waterways.

- 7.3 Floodplain Management.
- 7.4 Khazan Land Management.
- 7.5 Mining.
- 7.6 Anti-sea erosion works.
- 7.7 Pisciculture.

#### 8. Action Plan and Review

##### 1. Preamble.—

##### 1.1 Water Sector:

The water sector spans several departments. The main users of water are agriculture, urban and rural water supply, industries, and environment. The Water Resources Department (WRD) has the jurisdiction for overall development and management of water at source. But WRD has no control on regulating the demand and use. Scarcity of water results in conflicts between different users of water, viz. upstream versus downstream, agricultural versus domestic and industrial; and uses of water for any human activity vis-à-vis environmental requirements.

Most users of water add pollutants in the water bodies. Various agro-chemicals enter the water bodies as non-point source pollution; domestic sewage treatment capacity is often inadequate and untreated sewage enters rivers or aquifer; industries are often deficient in treating the industrial effluent to required standards. But the WRD has no authority to initiating corrective action against the defaulters.

Certain peculiar aspects of water sector are:

- It takes a long time to plan and execute an intervention, such as a dam or a barrage etc.;
- Water infrastructure also costs a lot of money;
- The resource availability is variable and unpredictable within the year, and can also have long term trends due to climate change and land use changes;

- At the time of planning an intervention it is not possible to precisely foresee all the consequences of the intervention;
- And the interventions once executed are irreversible.

Therefore, compared to other sectors, interventions in water sector have to be planned with far more care.

Thus, water sector presents a complex matrix of different objectives, administered by different departments, and suffers from internal conflicts amongst the users. A stated Water Policy helps in bringing a commonality to decisions and actions, and in reducing the internal conflicts.

India first adopted a written National Water Policy (NWP) in 1987, which was revised in 2002 and then again in 2012. However, India is a very large country, with a very wide range of climates, land use, and topography. A common National Water Policy cannot serve the intended objectives across the country. Therefore, the NWP 2002 and also the NWP 2012 have provided for a State Water Policy (SWP) in consonance with the national perspective.

#### 1.2 SWP 2000:

Goa first adopted a SWP in the year 2000. The said policy served well the needs of the State of Goa as perceived at that time. However more than twenty years have passed since then and several factors have changed, viz.:

- Twenty years of additional hydro-meteorological data, ground water data, and water quality data has become available.
- In the year 2000, global warming and climate change were emerging sciences with many doubts. In 2021, these are accepted sciences and in certain ways the impacts are already being felt.
- There have been many advances in the awareness and understanding of the

environment, and its interaction with water cycle.

- Understanding of institutional issues in water sector has undergone a change.

These are some of the more important factors and there are others too. For all these reasons it has become necessary to revise the SWP.

#### 1.3 SWP 2021:

Water is a very emotive subject, with strong social, cultural and religious facets. Therefore, water policies run the risk of being lofty statements of how the policy makers ideally wish the things to be, without much regard to what is realistic and achievable. Further, when the objectives are not quantified and no time frame is specified to achieve the stated objectives, an illusion gets created that these will be achieved at some future time, which never comes. Such policies remain only “feel good” exercises that have no impact on actual water management.

This SWP steers clear of this pitfall by translating the policy recommendations stated in section 6 as actions, stated in measurable terms, and recommends that best practices to be adopted while prescribing a time frame for various tasks. It is envisaged that these new features of the Goa SWP 2021 will find favour with other policy makers also.

## 2. Goa.—

### 2.1 The State:

Goa, the former Union Territory and the 25th State of the Union of India since 30th May 1987, is a maritime State on the Arabian Sea coast. Bounded on the North by Maharashtra and on the East and South by Karnataka, Goa lies between 15°48' 00" N and 14°53' 54" N Latitude and 74°20' 13" E and 73°40' 33" E Longitude.

### 2.2 The Land:

Located on the west coast of India, Goa is part of the larger Sahyadri eco-system. It has a geographical area of 3702 sq. kms. Broadly,

the State comprises three distinct geographical divisions, namely:

(i) Sahyadri mountain ranges (Western Ghats) to the East of the State, separating the State from the Deccan plateau further East;

(ii) The Central Plains; and

(iii) The Coastal Plains.

The Western Ghats, where all the major rivers draining Goa rise, are thickly wooded. The central plains comprise plateaus at elevations between 30 mts. to 300 mts. above mean sea level. The coastal plains are alluvial lowlands formed by the estuaries at the mouths of the rivers falling into the Arabian Sea.

About 81% of Goa's soils are lateritic and are sandy loam to silt loam in texture; the lands along the sea coast and estuaries constituting about 11% are sandy to sandy loams; and the remaining 8% of the soils are alluvial in nature. Soils in the Khazans and adjoining areas are alluvial, subject to saline water inundation and have high water table.

Khazan lands are unique to Goa and consist of low-lying areas, often below sea level, along the estuaries. It is estimated that about 18,000 Ha. of land in different parts of Goa, is under Khazans. The land is used for cultivation of salt tolerant monsoon paddy crop followed by Rabi vegetables. In limited areas pisciculture is also undertaken.

### 2.3 Climate:

Goa has a warm and humid tropical climate. Except during the months from December to January, which are relatively cooler, average temperature in the year is about 32°C, the mean annual maximum and minimum temperatures being 34°C and 22°C respectively. Approximately 90 % of the total annual rainfall occurs during the South-West monsoons from June to September, and ranges from 2500 mm in the coastal areas to over 5000 mm in the Western Ghats. Relative humidity averages at 76%, rising to as high as 89% in August.

### 2.4 Land Use:

About 34 % of the State's area is covered by forests, out of which about 20% is protected forests. Seven sanctuaries spread over an area of around 755 sq. kms. have been notified, and a one kilometer wide belt around six of these sanctuaries has been declared as an Eco-Sensitive Zone. Forests in Goa are classifiable into the following:

(i) Mangroves of different species along the narrow muddy banks of the rivers forming the estuarine vegetation.

(ii) Strand vegetation along the coastal belts.

(iii) Plateau vegetation confined to the low altitudes; and

(iv) Semi evergreen and evergreen forests in patches in the higher altitudes of the Western Ghats.

Nearly 35% of the State's geographical area is under cultivation, of which a little over a quarter of the land receives irrigation. The main crops grown are:

- Rice
- Cashew Nut
- Coconut
- Vegetables
- Mango and Banana
- Pulses

### 2.5 Economy and Livelihoods:

Goa has a resident population of 14,58,545 as per the 2011 decennial census and the resident population in 2021 is likely to be 16.5 lakhs. Mining, tourism, and fisheries are the mainstays of the Goan economy. Among industries, pharmaceutical industries have gained a firm foothold. Even with its rich

natural endowments of agricultural land and water resources, agriculture has progressively declined as a livelihood occupation. Between 1971 and 2011 the percentage of the State's population engaged in agriculture declined from about 14% to about 4%. Goa depends on neighbouring States to meet its needs of food grains and dairy products.

### 3. Water Resources.—

#### 3.1 River Basins:

Nine independent rivers, four of which are inter-state rivers, drain Goa's territory. In the order of their geographical location from the North to the South of the State, they are: Terekhol, Chapora, Baga, Mandovi, Zuari, Sal, Saleri, Talpona, Galgibag. These are shown in Figure 1. Between the basins of Terekhol and Chapora, there is a significant tract of land that drains directly in to the sea, through two rivers known as Harmal and Mandrem. Table 1 shows important features of the river basins.

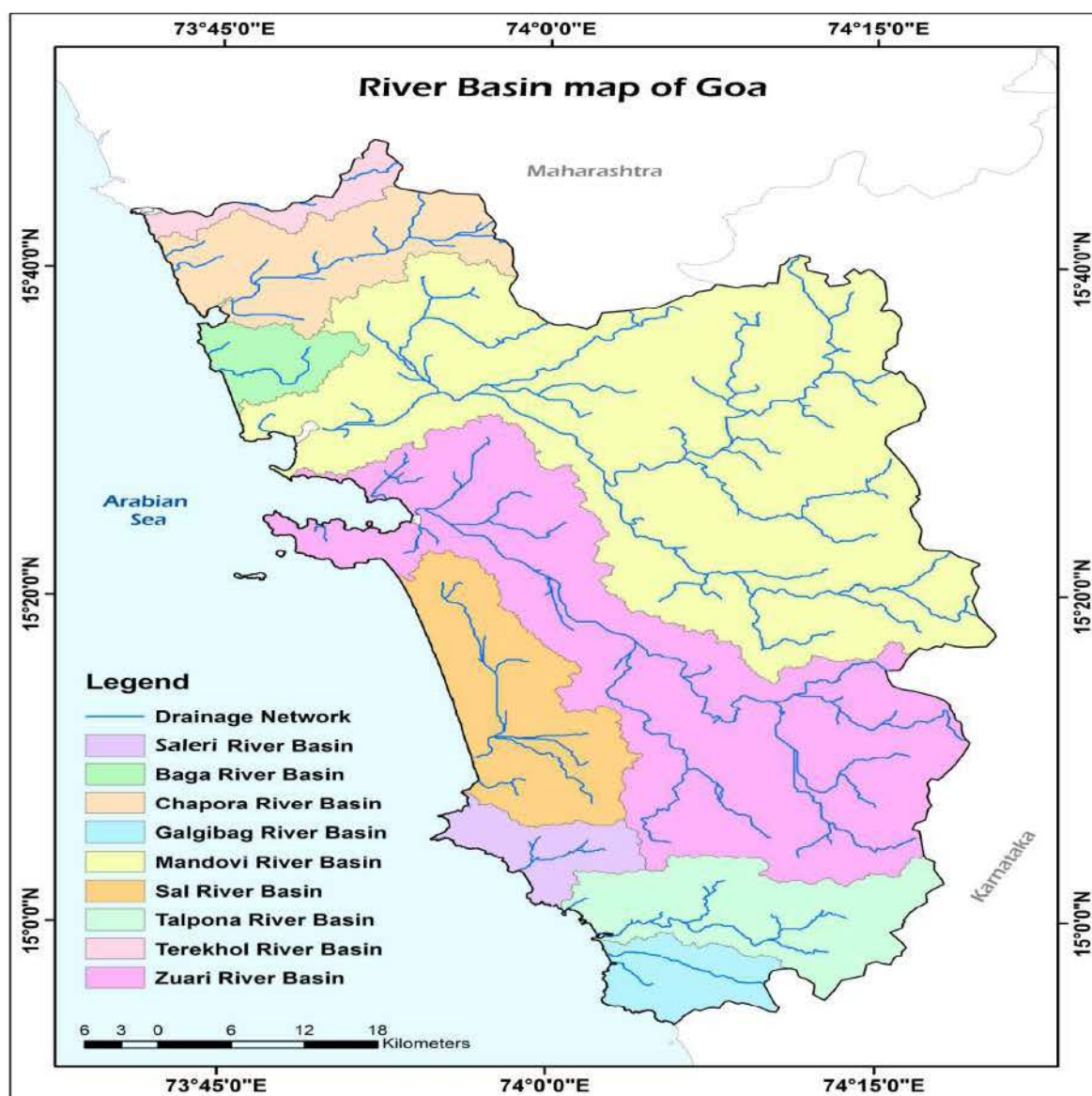


Figure 1

**Table 1: River Basins**

River Basin	Co-Basin States	Origin	Elevation (M)	Outfall	Length of the River (Km.)			Important Tributaries in Goa
					Total	In Goa	Salinity Affected	
1	2	3	4	5	6	7	8	9
Terekhol	Maharashtra	Sindhudurg District, Maharashtra	680	Keri Village, Pernem Taluka	70	27.5	27.5	Torxem, Kadshi, Pernem.
Chapora	Maharashtra, Karnataka	Chandgad Taluka, Maharashtra	800	Vagator Beach Bardez Taluka	97	32	28	Sal, Kalna, Virnoda, Parse.
Baga	—	Assagao, Bardez Taluka	90	Baga, Calangute	10	10	10	—
Mandovi	Karnataka, Maharashtra	Khanapur Taluka, Karnataka	940	Miramar, Panaji	111	76	46	Madei, Surla, Kotrachi, Ragada, Khandepar, Kudne, Valvanta, Bicholim, Assonora, Sinquerim.
Zuari	Karnataka	North Canara District, Karnataka	700	Vasco-da-Gama, Marmagoa Taluka	108	87	61	Ugem, Guleli, Kushawati, Santana.
Sal	—	Verna, Salcete Taluka	105	Betul, Quepem Taluka	40	40	22	Santana, Navelim, Cuncolim
Saleri	—	Barcem and Gokuldem Villages, Quepem Taluka	230	Dhaval Khajjan, Agonda, Canacona	11	11	5	Padi, Agonda, Molorem.
Talpona	—	Ambeghat, Canacona Taluka	690	Talpona, Canacona	41	41	7	Nadke, Bhatpal, Gaondongri, Khalwade.
Galgibag	Karnataka	North Canara District, Karnataka	200	Galgibag, Canacona Taluka	20	14	4	Maxem, Loliem.

### 3.2 Surface Water:

Estimation of the surface water resources of Goa is a complex task because:

- In all the nine rivers basins there are only two river gauging sites maintained by the CWC, and where long-term discharge data is available. Both these sites are in the Mandovi (Mahadayi) basin. The data at both these sites has been analyzed extensively and the conclusion is that the quality of the data is not satisfactory. Thus, effectively there is no reliable and long term discharge data available on any river of Goa.
- A significant length of most rivers is affected by salinity and therefore conventional methods for estimation of basin yield, where a regression equation is developed between the rainfall as independent variable and the runoff as dependent variable, and the equation is then applied to the weighted mean rainfall for the entire basin, can not be used.

Average yield has been tentatively estimated based on 1993 publication by the CWC "Reassessment of the Water Resources Potential of India" and is given in Table 2. However, a more accurate estimation of the yield is one of the priority action points identified in this policy.

### 3.3 Ground Water Resources:

The State of Goa was one of the first States in Union of India to regulate ground-water by enacting "Goa Ground Water Regulation Act, 2002". Under this Act, it is mandatory to register all ground water structures, to obtain

prior permission for sinking of wells and all abstraction of ground-water for commercial use, which are chargeable. Upon enforcement of this Act, there is regulation of the usage of ground water resources and there is generation of revenue to the State.

The Central Ground Water Board (CGWB) has estimated Goa's Annual Extractable groundwater resources as of March 2017 as 160.33 MCuM and the extraction of ground water for all uses as 53.71 MCuM of the balance 106.62 MCuM, the net available ground water for irrigation development has been estimated as 69.93 MCuM. The average stage of groundwater development in North Goa is 30% while that in South Goa is 39%. The overall stage of development for the entire state is 34%. All talukas of the state are declared to fall under 'safe category'. The depth of ground water in the pre-monsoon period i.e. May 2016 varied from 1.7 mbgl. (metres below ground level) to 18.84 mbgl. The corresponding range in the post-monsoon period i.e. November 2016 was from 0.61 mbgl. to 14.49 mbgl. The rise in groundwater levels in the period May to November across the state has been estimated to be in the range of 0 to 2 mts. Compared to the decadal mean the groundwater levels from May 2006 to May 2015, about 46% of the analysed wells showed an average pre-monsoon rising trend of 0 to 2 mts. while about 51% recorded a fall of 0 to 2 mts. The post monsoon trend has registered an average rise of 0 to 2 mts. in about 30% of the observation wells and an average fall of 0 to 2 mts. in about 61% of the observation wells.

**Table 2: Water Resources**

River	Catchment Area Sq. Km.				For Yield Computation	75% Dep. Yield/Sq. Km. as per CWC 1993	75% Dependable Yield MCuM
	Total	In Goa	% of State Geographical area	In Saline Zone			
1	2	3	4	5	6	7	8
Terekhol	435	71	1.92%	71	0	1.748	0
Chapora	926.85	255	6.89%	255	0	1.748	0
Baga	50	50	1.35%	50	0		0

1	2	3	4	5	6	7	8
Mandovi	2032	1580	42.68	509	1071	1.53	1639
Zuari	989	973	28.28%	373	600	1.445	867
Sal	301	301	8.13%	301	0	1.367	0
Saleri	149	149	4.02%	149	0	1.417	0
Talpona	233	233	6.29%	70	163	1.417	231
Galgibag	105	90	2.03%	29	61	1.417	86
Total							2823

Note: 75% Dependable Yield/Sq. Km. has been computed based on the 1993 CWC Publication "Reassessment of Water Resources potential of India".

#### 3.4 Per capita water availability:

Annual water resource is 2823 MCM of surface water, 160 MCM of ground water, totaling 2983 MCM. The population projection for 2021 is 16.5 lakh. Thus per capita annual water availability is 1807 CuM. Falkenmark is an internationally accepted indicator of water stress, or the lack of it. If the amount of renewable water in a country is less than 1700 CuM per person per year, that country is said to be experiencing water stress. By this yardstick, water availability in Goa seems to be well above "water stress" level. However, for reasons elaborated below, all this estimated water is not available for human consumption.

#### 3.5 Water Quality Assessment:

Surface Water: For the purpose of restoring polluted river stretches to the prescribed standards of water quality, the National Green Tribunal (NGT) has directed state governments to prepare action plans. To decide the overall water quality for restoration of rivers, the National Green Tribunal (NGT) has used the Biological Oxygen Demand (BOD) of the river water as the criterion. Using this criterion, the NGT has identified eleven rivers/tributaries in Goa as being in need of intervention. Among the identified rivers, the NGT has classified the Mandovi river in its middle stretch between Marcel and Volvoi to be within Priority Category IV with a BOD between 6 and 10 mg/l. Five other tributaries of the Mandovi in some of their stretches have been identified as Priority Category V rivers with BODs between 3 and 6 mg/l. Certain stretches of three other rivers namely Chapora, Terekhol and Zuari have been identified as Priority V Category rivers. Sal and Talpona with BOD ranges of 10-20 mg/l and 6-10 mg/l respectively have been identified as rivers of Priority Category III and IV.

Groundwater: About 98% of the ground water samples showed electrical conductivity values within limits. Chloride, Nitrate, Fluorite and Calcium were also found within permissible limits for drinking. Authentic and spatially well distributed data about the micro-biological quality of ground water is not available. Overall, groundwater in an area of 430.33. Sq. Kms. has been found to be of poor quality. The in-storage ground water resource in this poor quality area has been estimated as 68.02 MCuM

#### 4. Present Development and Utilisation.—

##### 4.1 Major, Medium and Minor Schemes:

The State has completed one Major Irrigation Project (Salaulim) and one Medium Irrigation project (Anjunem). The second Major Irrigation Project (Tillari), a joint inter-state undertaking with Maharashtra, is currently under construction. Four minor irrigation tanks, Amthane, Panchawadi, Chapoli, and Gavnem, have also been completed. Under Minor Irrigation, 57 Lift Irrigation Schemes are in operation, besides several bandharas, spring-fed and traditional tanks etc. which are community owned. The combined command area under irrigation from reservoirs and Lift Irrigation schemes is around 31,000 Ha. Definite data on agricultural area

under irrigation from bandharas, spring-fed and traditional tanks is not available.

#### 4.2 Ground Water use and Artificial Recharge:

Groundwater is also being used for irrigation and drinking water supply from open wells and borewells. Dug wells in the state irrigate about 4665 Ha. Annual quantity of ground water extracted for all uses is estimated to be 53.71 MCuM, against a potential of 160.33 MCuM. A unique development in the state has been the construction of 337 open-type Bandharas to retard the escape of ground water to the base flow.

#### 4.3 Storage Created:

Not counting the storage in the traditional tanks, the total surface water impoundage created in the reservoirs and bandharas is estimated at about 634 MCuM. The installed capacity for treated water supply for drinking and industrial uses is estimated at about 54 MCuM annually.

#### 4.4 Waste Water Treatment:

Sewerage network in Goa covers only 16% of the population in only three towns, Panjim, Margaon and Vasco are equipped with STPs. Total sewage generation in the state is estimated to be 165 MLD. Nine STPs are presently operational at Panjim, Margaon and Vasco. Their combined capacity is 78.35 MLD sewage. Five more are under construction with a capacity of 35.5 MLD. These are likely to be completed by December 2021.

### 5. Future Requirements.—

Reliable and recent estimates of the requirement of water for different sectors are not readily available. Determining such requirement is one of the key elements of the action plan.

### 6. Policy Recommendations.—

#### 6.1 Water Security:

“Optimum utilization of available water resources” means unconstrained extraction of water from the natural cycle, till all the available water resources are utilized.

Following the principle of “minimum disturbance to nature”, this SWP puts its main objective as ensuring water security, which means providing water of satisfactory quality, and in adequate quantity, for all human requirements.

#### 6.2 Not merely subsistence:

Human requirements are not to be limited to mere subsistence. The people of Goa are proud that the State of Goa ranks No. 1 in the list of India's states in per capita GDP and the water policy has to support in maintaining this position, even improve on it. The state needs resources to sustain its rate of growth and development.

#### 6.3 Achieving Balance between Environmental Concerns and Economic Concerns:

Western Ghats are recognized as a hot-spot of rich bio diversity and the people of Goa attach a very high value to conservation of the environment. At the same time, economic development is also important and water is a key input for the economy.

Over the years, unfortunately, a misconception has developed that the conservation of environment and economic development are competitors and either one can flourish only at the cost of other. The global experience, however, is exactly the opposite. It is seen that the more prosperous a nation, the better they can do for protection of the environment. Some examples are – purchase of water from the farmers for releasing in the river as environmental flow (Murray-Darling basin, Australia); very high level of grey water treatment to make the effluent not only usable but even potable (NEWater, Singapore); reduced use of agro-chemicals, organic farming, replacement of fossil fuel energy by more expensive solar energy (several Western Europe nations). On the other hand there is no global experience of poor nations being able to spend for protection of the environment.

At a micro level, hydraulic infrastructure can have some adverse impacts on the local

environment. But at macro level the environmental objectives and development objectives are not rivals and actually complement each other. It is therefore absolutely essential to determine the trade-off between these two concerns and put an end to the tussle and the disquiet that has become a common feature of water resources development.

#### 6.4 Determination of Requirements:

To determine the trade-off, a first step is to estimate the demands. Master Plans have been prepared for the Mahadayi, Zuari, Galgibag and Talpona basins. These master plans are now more than twenty years old, and will have to be revisited and updated, and demand for water for all human uses, will have to be re-assessed for the entire Goa.

As regards water requirements for the environmental objectives, a scientific assessment of the quantity of water required and also its temporal distribution is yet to be carried out.

Water requirement for human uses and also for environmental needs, shall be carried out on a scientific basis as a high priority task.

#### 6.5 Estimation of Resource:

Hydrologic studies shall be undertaken in all the basins to determine the average yield; 75% dependable yield; and utilizable yield. Groundwater assessment shall be done based on aquifer mapping and estimation of ground water resources being carried out by the CGWB.

#### 6.6 Data:

Data is the fuel that drives the engine of planning. At present there is paucity of data in the state of Goa, whether on the resource side or on the utilization side. While the overall matrix of data is very large, urgent steps shall be taken to improve the collection of following data.

River data: This includes river gauge, discharge, and sediment. New sites shall be established and existing sites shall be

upgraded in number of parameters observed, and also in the technology used.

Utilization data: This includes water use by various sub-sectors (agriculture, domestic, industry), and also wastage of water (non-revenue water) with spatial distribution.

Water Quality Data: All data shall be stored in a suitable digital format.

None of the basins of Goa are international and therefore there is no reason for any secrecy of river data. Independent scholars need water related data for their research. All data shall be made available freely, without any impediment, on internet.

#### 6.7 RTDAS and SCADA:

RTDAS (Real Time Data Acquisition System) and SCADA (Supervisory Control And Data Acquisition) systems have been installed in some places for acquisition of hydro-met data. This shall be extended to all the water bodies across the state. Rigorous hydrological studies shall be carried out based on the RTDAS and other data. Mapping of the data shall be undertaken to prepare a Water Atlas for the State of Goa, based on the data collected and analyzed.

#### 6.8 Water Allocation Priorities:

The experience at national level has been that a rigid priority order for allocation of water is difficult to implement, and the NWP of 2012 did away with such an order of priority. Drinking water requirements shall have priority claim on any available water. Thereafter, allocation of any remaining water shall be determined on the principle of "the greatest good for the greatest numbers".

#### 6.9 Basin as a Unit:

The NWP stresses that the basin should be the unit for all water resources planning. However, the river basins of Goa are very small; in many basins a large part of the river is affected by sea-water ingress; so much so that in certain basins the river qualifies more as a creek, an extended arm of the sea, rather than as a river; and in small basins near the

coast it may not be possible to construct water conservation and diversion structures.

To mitigate this issue, systematic studies by delineating the water sheds optimal development of the Water Resources to be initiated for each watershed to ensure its self-sufficiency.

#### 6.10 IWRM:

The NWP also advocates Integrated Water Resources Development and Management (IWRM). Ground Water in Goa is relatively underutilized. The overall water security plan shall be made based on integration of GW and SW.

#### 6.11 Rain Water Harvesting:

Roof-top Rain Water Harvesting (RWH) is already mandatory for certain classes of buildings. This policy shall be reexamined with a view to expand the scope and bring more classes of buildings under mandatory RWH.

Large scale RWH by arresting the runoff can augment fresh water resources, particularly in areas where the main river is affected by salinity ingress. Therefore, large scale RWH shall be promoted in such areas. RWH shall also be promoted as a part of watershed development program in rural areas.

The harvested rainwater may be used directly from a storage, or may be used for deep ground water recharge.

#### 6.12 Arresting Salinity Ingress:

Possibilities of arresting the intrusion of seawater in to the river, by construction of barriers across the river as near its outfall as possible, shall be explored.

#### 6.13 Desalination of seawater:

Possibilities of desalination of sea water for providing drinking water to coastal areas shall be explored.

#### 6.14 Water Quality:

Improvement of water quality will be a key instrument in ensuring water security. Target

will be to achieve 100% interception and treatment of sewage in urban areas, to bring the water quality in rivers to at least CPCB-Class C standards (BOD < 3 mg. per liter). Likewise, treatment of industrial effluent shall be enforced to conform to prescribed standards.

#### 6.15 Recycle and Reuse of waste water:

The State is generating significant quantum of treated sewerage water, which is estimated to be 165 MLD by December 2021. At present the treated sewerage water is mostly simply let out in the river/sea. To judiciously use the treated water, schemes need to be formulated to supply the same for industrial and agricultural consumers, or to discharge it in water stress areas as e-flow to rejuvenate the rivers.

#### 6.16 Installation of STPs:

Installation of STPs shall be promoted for bulk consumers. PPP mode shall be explored for the same.

#### 6.17 Water Charges:

Charges for the water used shall be governed by three underlying principles.

1. Water is a common property of the people and therefore every user should pay for the water s/he uses, even if the user is procuring the water at her/his own cost.

2. The state has to make considerable investment in infrastructure required to extract the water from its natural source, process it, and bring it to the user. And at least part of this expenditure should be recovered from the users.

3. Pricing of water is an instrument to bring economy in its use.

A structured system of water charges on volumetric basis shall be introduced. All water charges, whether surface water or ground water, shall be rationalized and updated periodically.

#### 6.18 Enumeration of Water Bodies:

Save for the few structures owned and maintained by the WRD, the majority of the

water bodies in the state such as spring-fed and other traditional water tanks, irrigation bandharas, bunds, wells etc. are community-owned. These bodies run into considerable numbers and meet a very important proportion of the state's water needs for irrigation and drinking water supply. However, the community and private ownership of the water bodies runs against the principles of IWRM and basin planning. As the first step in bringing in some regulation on the use of water from these bodies, preparation of a geo-tagged inventory of the water bodies will be immediately taken up.

#### 6.19 Public Education:

Peoples' participation plays an important role in protecting the water and environment. It is necessary that the people at large be "water literate". To achieve this, basics of water literacy needs to be included in courses at the high school level, in consultation with the WRD. For the public at large, awareness programmes will be initiated through the mass media like print, electronic, social and on ground level by the way of workshop, seminars, competition, Water Mela at taluka/village level.

#### 6.20 Irrigation Potential Utilization:

The gap between irrigation potential created and utilized shall be reduced, by improving the implementation of the CAD programme. Stress will be laid on adopting the advanced community based advanced micro irrigation systems, to enhance the optimal utility of water and to achieve the Goal of "More Crop per Drop".

#### 6.21 Master Plans:

Master Plans for development and management of water resources shall be prepared for all river basins of the State, and shall be implemented, to secure future water requirement of the State".

#### 6.22 Legislation:

All water-related acts shall be revisited and updated as necessary. New appropriate

legislation shall be enacted where required, viz. for WRA.

#### 6.23 Research and Development:

R&D is a continuous endeavour. The Goa state does not have any institution dedicated to R&D in water sector. The Union Ministry of Water Resources provides R&D funding to any institution with a good R&D proposal. The institutions in the state, viz. engineering colleges, agricultural universities, and Government institution, and others, shall be encouraged for taking up R&D in water and allied sector. Some topics that need research are:

- Quantitative assessment of the impacts of climate change on rainfall and river flow regime;
- Quantitative assessment of the impacts of climate change on crop water requirement; and cropping seasons;
- Crops tolerant to new climate regime;
- Improving water use efficiency;
- Automated irrigation management;
- Hydrology – estimation of yield from un-gauged catchments;
- Telemetry for hydrologic observations;

#### 6.24 Human Resource Management (HRM):

HRM is an important ingredient for the overall target of achieving water security. HRM has two main components.

- a) Regular recruitment and career planning.
- b) In-service Training.

While retirement is automatic, dictated by the date of birth, recruitment is not automatic. When recruitment does not take place regularly, the line departments suffer from paucity of human resources. Regular recruitment is necessary to achieve a steady-state of human resources within WRD.

Career planning involves regular promotions and cadre reviews and is essential for good morale amongst the personnel. Good

career prospects are also necessary to attract talented engineers to the WRD.

Training is required at all levels. Broadly, the training needs are

- at junior levels in practice of engineering;
- at middle level in designs, and soft-skills
- at senior levels in new technologies and in soft-skills.

The total strength of Goa WRD is not large enough to sustain a dedicated training institution. But training can be imparted within WRD by engineers from WRD; by visiting faculty from CWC, technical institutes and management institutes. The WRD personnel can also be sent for training to National Water Academy and training institutions of large states like Maharashtra.

A perspective plan for the next 15 years shall be drawn up for HRM, which includes recruitment, career planning and training. A scheme shall be prepared to encourage the officers of the WRD to obtain higher qualifications in engineering and management.

#### 7. Miscellaneous.—

While there is no strict definition as to what all topics the “water policy” should address, it is generally agreed that the focus of water policy is on development and management of surface and ground water resources, for providing water that is adequate in quantity and is of satisfactory quality, with due consideration to the principles of sustainable development. There are some topics that are outside this definition, but are related because they have some overlap with development and management of water resources, or because the concerned tasks may be assigned to the WRD. This section deals with such topics that are on the periphery of water policy.

#### 7.1 Hydropower:

The Report on the Electrical Power Survey of the Central Electricity Authority estimates the peak power demand in Goa State for FY

2018-19 as 949 MW and energy requirement as 5572 MU. Goa’s indigenous power generation capacity, all of which is in the thermal sector is about 65 MW. Goa meets its balance power requirements by signing power purchase agreements with the National Thermal Power Corporation (NTPC).

Hydropower is necessary for meeting the peak demand, and for frequency stabilization. To reduce Goa’s dependence on the external sources, it is necessary for Goa to harness its hydroelectric potential to the fullest. The steep river profiles are conducive to power generation. Hydroelectric potential of the Mandovi basin has been well identified. Implementation of hydro-power projects needs to be expedited.

Hydropower generation can be explored in Public Private Partnership (PPP) basis while keeping all other rights on water and infrastructures with the department.

#### 7.2 Inland Waterways:

Goa’s rivers hold immense potential for promoting inland water transportation. A total length of 371 Kms. of the rivers are navigable for small country crafts of which 253 Kms. are navigable for large country crafts and mine ore barges. A very large proportion of mine ore transport in the state is already being transported through inland navigation. Promotion of inland navigation for passenger transportation, in addition to being more energy efficient, has the additional advantage of attracting tourist interest. However, engineering requirements of inland navigation have to be kept in view while planning dams, barrages and bridges. A systematic study of the potential of inland navigation will help in incorporating the engineering requirements of inland navigation, while planning river valley infrastructure.

#### 7.3 Floodplain Management:

Floodplains are land areas adjacent to rivers and streams that are subject to occasional but recurring inundation, when the river is in spate. Floodplains temporarily

store the water and moderate the intensity of floods.

While the population continues to increase with time, the land resources remain the same. As the demand for land increases, the land rates also increase steeply and people are tempted to encroach on the floodplains. This reduces the waterway causing flooding in areas which formerly had no history of flooding; can intensify flood problem; and can also add to the pollution in the water courses.

Clearing such encroachments is not easy but the state should endeavour to clear such encroachments and restore the waterways to their original widths and health. Surviving flood plains need preservation, while the shrunken and lost plains need to be redeemed through proper management. Flood plains in the State along the important rivers and streams will be surveyed and demarcated. A proper flood plain main management plan will be adopted, which will also include adoption of appropriate legislation.

#### 7.4 Khazan Land Management:

Khazans are a complex and intricate eco-system, involving water management, sustainable agriculture, pisciculture, etc. There is therefore a need to adopt a holistic Khazan management. There is scope for improvement in the specifications for bund construction, construction methodology, materials used, etc. A comprehensive plan for management of the Khazans is necessary.

#### 7.5 Mining:

Mining is an important economic activity in the state. However, open cast mining does adversely impact the water courses and also the aquifer.

- Mining adds large volumes of sediment to the rivers, thereby changing the river geometry,
- Sediment collecting in the reservoirs reduces the useful life of the reservoirs,
- Sediment in rivers reduces the draft available for vessels,

- Mining disrupts aquifer geometry and affects ground water balance,
- Mining also causes pollution in the natural water bodies,

During periods of water scarcity, stored water from the mining pits can be pumped out to augment supplies.

#### 7.6 Anti-sea erosion works:

Goa's small size is offset by its status as an important maritime state. Its sea coast measures 105 Kms in linear length and accommodates important naval installations and harbours. Beaches along the coast are the favourite with the tourists worldwide. The coast also supports fishing as an important occupation. Besides, there are large human settlements in its vicinity, including hotels and other recreation facilities.

Several stretches of the coast have suffered erosion, some of which are extensive and serious. A comprehensive shore management plan should be adopted along with appropriate anti-sea erosion measures that are both effective and environmentally acceptable.

#### 7.7 Pisciculture:

The large number of water bodies and reservoirs in the state hold immense potential for promoting fresh water pisciculture. Measures will be initiated in conjunction with the Directorate of Fisheries to promote fish breeding and fish harvesting in ponds and reservoirs.

#### 8. Action Plan and Review.—

For a policy to be effective, it is necessary that at least the key policy statements are translated in to an action plan that is SMART, Specific, Measurable, Achievable, Realistic, and Time bound. Following are identified as some of the actions with measurable targets.

- Determination of Requirements — for agriculture use; for domestic use; for industrial use.
- Determination of environmental flow.
- Determination of surface water availability.

- Determination of groundwater availability and distribution.
- Preparation of a plan for upgrading hydrologic observations network, and implementing it in phases as per the said plan.
- Preparation of plan for collection of water utilization data, and putting the plan in to action.
- Modernizing the data management center.
- Undertaking studies for inter-basin water transfer.
- Review of policy for mandatory Roof-top Rain Water harvesting in urban areas.
- Undertaking studies for large scale RWH in rural areas; and implementing it in phases as per the said plan.
- Undertaking studies for arresting the intrusion of seawater in to the river, and ground water.
- Undertaking studies for desalination of sea water.
- Preparation of draft legislation for setting up a WRA.
- Setting up the WRA.
- Reducing the gap between irrigation potential created and utilized.
- Mahadayi Basin Projects — Preparation of DPR; Obtaining various approvals; Construction.
- Preparation of Training policy; sending personnel for training as per the said policy.
- Improvement of water quality of the rivers as per CPC and Goa pollution control norms.
- Upgrade water quality testing laboratory, in order to create historical data on water quality.
- To carry out analysis for biological and chemical parameters of the surface and ground water.
- To map the pollutants in the rivers, ground-water and water bodies.

This list is comprehensive but not exhaustive, and more actions can be added to it when the need arises.

Specifying a time frame for various actions is, however, outside the domain of policy document, for this depends on the man power available, and budget available. Within one year from adoption of this SWP by the state of Goa, the WRD shall firm up the above action points with a time frame.

The performance of the action plan shall be reviewed every 3 years. The Policy itself shall be reviewed after 10 years, or earlier if the Government so deems fit.

[www.goaprintingpress.gov.in](http://www.goaprintingpress.gov.in)

Printed and Published by the Director, Printing & Stationery,  
Government Printing Press,  
Mahatma Gandhi Road, Panaji-Goa 403 001.

**PRICE – Rs. 32.00**

PRINTED AT THE GOVERNMENT PRINTING PRESS, PANAJI-GOA—168/150—9/2021.