EXAMINING THE NEED AND NECESSITY OF WATER MANAGEMENT IN GREATER NOIDA CITY

ABSTRACT:

GREATER NOIDA INDUSTRIAL AREA IS LOCATED AT THE INTERSECTION OF THE WESTERN AND EASTERN DEDICATED FREIGHT CORRIDORS AND IS ALSO THE GATEWAY TO THE DELHI-MUMBAI INDUSTRIAL CORRIDOR (DMIC). IT LIES WITHIN THE NATIONAL CAPITAL REGION OF INDIA'S CAPITAL - NEW DELHI AND IS ADJACENT TO NOIDA, ONE OF THE LARGEST INDUSTRIAL TOWNSHIPS IN ASIA. HAVING POPULATION MORE THAN 100000 IN TOTAL AS PER THE CENSUS 2011.

GREATER NOIDA IS DEVELOPING CITY AND MOVING FAST TO BECOME THE DEVELOPED CITY IN THE PROCESS EXPLOITATION OF NATURAL RESOURCES REQUIRED TO DEVELOP THE ECONOMIC DEVELOPMENT OF THE COUNTRY. OVER EXPLOITATION OF SOURCES CREATES THE SCARCITY AND BIG PROBLEMS. AS OVER EXPLOITATION OF GROUND WATER, LOWERING THE WATER TABLE AND EFFECTING THE QUALITY OF GROUND WATER. WITH MORE PEOPLE LIVING IN GREATER NOIDA CITY THAN EVER BEFORE AND MANY NEW CONSTRUCTION WORK IS GOING ON, THE GREATER NOIDA CITY DRAWS MORE WATER FROM GROUND AND ALSO THE ILLEGAL EXTRACTION OF GROUND WATER FOR CONSTRUCTION LEADS TO DECREASE IN WATER TABLE

THE HARDNESS OF WATER IS ONE OF THE ISSUES WHICH ARE TROUBLING RESIDENTS OF SEVERAL SECTORS ACROSS GREATER NOIDA FOR A LONG TIME NOW. THE TDS LEVEL IN WATER IS FOUND MORE THAN 500. HOWEVER, THE NORMAL TDS IN WATER SHOULD BE 500, ACCORDING TO THE HEALTH DEPARTMENT."THE TDS LEVELS IN WATER VARY ACROSS ALL SECTORS IN GREATER NOIDA. THE TDS LEVEL IN SECTOR ALPHA IS 700 AND ABOUT 800 IN SECTOR OMEGA, AS THE TDS LEVELS ARE HIGH, QUANTITY OF UNDESIRABLE MINERALS LIKE CALCIUM AND MAGNESIUM ARE ALSO HIGH. THIS LEADS TO SEVERAL ISSUES LIKE CORROSION OF ELECTRIC APPLIANCES, PIPES AND TAPS.TODAY THE CITY IS FACING THE BIGGEST PROBLEM THAT IS SCARCITY OF WATER DRINKING WATER AS THE LEVEL OF WATER IS CONTINUALLY DECREASING.

Plate-2

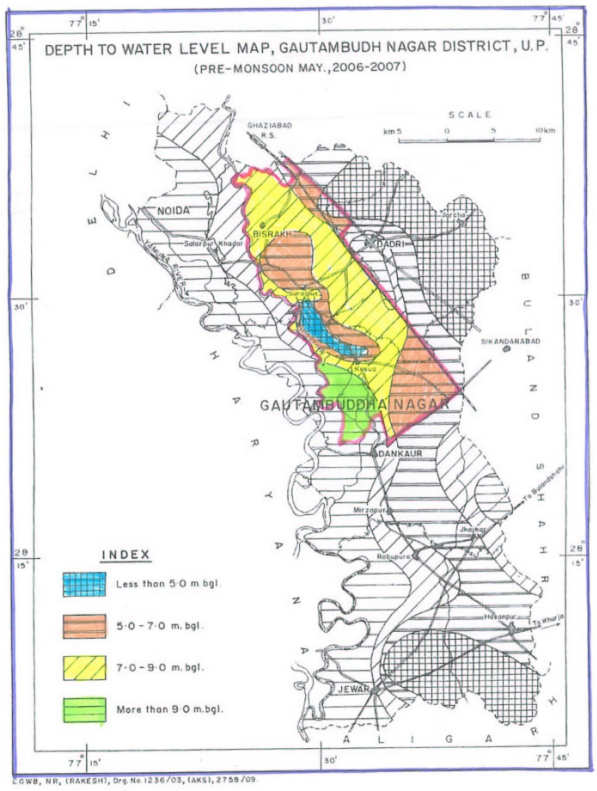

Fig-1 ref: CGWA

WE NEED SOME WELL-PLANNED STRATEGIES LIKE IF WE KNOW THE PLACES WHERE HEAVY RAINFALL OCCURS, THEN WE CAN PUT EXTRA EFFORTS THERE IN ORDER TO SAVE WATER FOR

FUTURE USE. THOUSANDS OF GALLONS OF WATER CAN BE SAVED IF WE KEEP OUR DRAINAGE SYSTEM PROPER. THE GROUNDWATER LEVEL, ACCORDING TO THE CGWA , AREA'S GROUND WATER HAS SURPASSED THE "CRITICAL LEVEL" AND IS NOW "OVEREXPLOITED", WHICH MEANS THE CITY COULD FACE A SERIOUS WATER SHORTAGE IN THE YEARS TO COME UNLESS ITS GROUND WATER IS ADEQUATELY RECHARGED.THE GROUND WATER LEVEL IN THE DISTRICT IS FALLING ALARMINGLY BY A METER EVERY YEAR, SAYS A RECENTLY RELEASED REPORT BY THE MINISTRY OF WATER RESOURCES, A CONSEQUENCE OF THE CITY'S BREAKNECK PACE OF URBANIZATION THAT NOW THREATENS TO DERAIL IT.

TO SAFEGUARD ITS WATER, AUTHORITY HAS PLANNED MANY WAYS TO CONSERVE WATER NATURALLY, STILL THE REGION IS IN A STATE OF "WATER STRESS": IT USES MORE THAN 40 PERCENT OF THE WATER AVAILABLE TO IT.
WITH MORE PEOPLE LIVING IN CITY THAN EVER BEFORE AND MANY NEW CONSTRUCTION WORK IS GOING ON, TODAY, THE GREATER NOIDA CITY DRAWS MORE WATER FROM GROUND. TO SAFEGUARD ITS WATER, AUTHORITY HAS PLANNED MANY WAYS TO CONSERVE WATER NATURALLY, STILL THE REGION IS IN A STATE OF "**WATER STRESS**": IT USES MORE THAN 40 PERCENT OF THE WATER AVAILABLE TO IT.

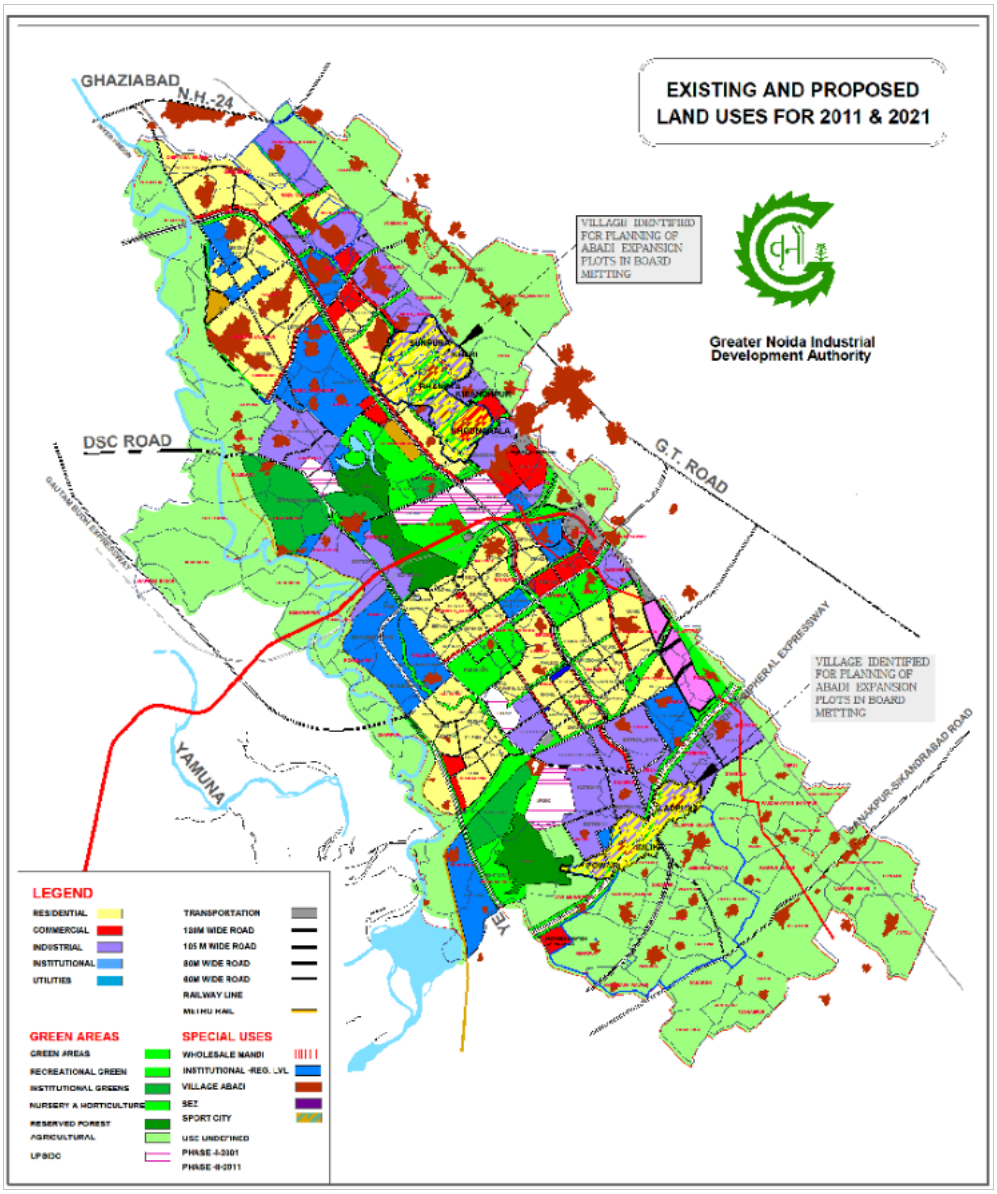

FIG-02, REF: www.greaternoidaauthorityonline.co.in

INTRODUCTION:

WATER SHORTAGE IS ONE OF THE MAJOR PROBLEMS OF THE 21ST CENTURY WHICH INCIDENTALLY IS ALSO THE BEGINNING OF THE NEW MILLENNIUM. HORRIBLE PREDICTIONS ARE

BEING MADE REGARDING THE WATER PROBLEMS BEING FACED BY THE MANKIND DURING THE NEXT 50 YEARS. IF THE LAST 50 YEARS ARE ANY GUIDE, THERE IS NO DOUBLE THAT THE WORLD IS GOING TO FACE A SERIOUS PROBLEM. SINCE WATER IS LIFE WE CANNOT DO WITHOUT IT, WE ALL HAVE TO THINK HOW TO DEAL WITH THIS SITUATION. UNTIL THE SCIENTISTS CAN THINK OF BETTER AND DURABLE SOLUTIONS WE MUST DO WHATEVER IS POSSIBLE AT THE GRASS ROOT LEVEL.

THE IMPACT IS REALIZED SOON AS DEPLETING WATER LEVELS AND QUALITY DETERIORATION DUE TO OVER-EXPLOITATION AND OVER APPLICATION

THE SITUATION IN URBAN AND INDUSTRIAL SECTORS OF THE COUNTRY. ALMOST ALL URBAN AREAS ARE DEPENDING UPON WATER SUPPLY. ABOUT 50% OF INDUSTRIAL REQUIREMENTS OF WATER ARE PRESENTLY BEING FULFILLED BY THE GROUND WATER RESOURCES.

THERE IS NO DOUBT THAT COUNTRY IS FACING WATER CRISES. AS PER TERI REPORT OF 1997 PER CAPITA WATER AVAILABILITY WILL DROP TO 1500 CUBIC METERS IN THE YEAR 2017, WHICH WAS AROUND 6000 CUBIC METERS IN 1947. .

TODAY WE NEED AN INTEGRATED WATERSHED DEVELOPMENT WHERE RIVERS CANAL, LAKES UNDERGROUND RESERVOIR AND AVAILABLE RAIN WATER I A GIVEN AREA SHOULD BE TAPPED TO ADDRESS THE LOCAL POPULATIONS WATER NEED. COMMUNITY IN ITIATIVES TO MANAGE WATER RESOURCES IN A SUSTAINABLE MANNER AT LOCAL LEVEL ARE MOST REQUIRED. IN PRESENT SCENARIO, WHEN SURFACE WATER RESOURCES ARE FULLY COMMITTED AND THERE IS IMMENSE PRESSURE ON UNDERGROUND RESERVOIRS

PIC-01

NEED OF WATER MANAGEMENT IN GREATER NOIDA:

GREATER NOIDA CITY	**TOTAL**	**MALE**	**FEMALE**
CITY POPULATION	**102,054**	55,540	46,514
LITERATES	**75,431**	43,422	32,009
CHILDREN (0-6)	**14,821**	8,152	6,669
AVERAGE LITERACY (%)	**86.47 %**	91.63 %	80.33 %
SEXRATIO	**837**		
CHILD SEXRATIO	**818**		

HINDON RIVER POLLUTION

THE WHOLE AREAS WITNESSES SEVERE GROUND WATER CONTAMINATION MAINLY BECAUSE OF ITS GEOGRAPHICAL LOCATION ON THE BANK OF HIGHLY POLLUTED HINDON RIVER AND ALSO

DUE TO THE LEACHING OF LIQUID AND SOLID WASTE FROM INDUSTRIES IN UPSIDE AREA AND GREATER NOIDA.

EXISTING WATER RESOURCES AND NEEDS OF GREATER NOIDA

POTABLE WATER SUPPLY SYSTEM IN GREATER NOIDA

PRESENTLY BOREWELLS ARE USED FOR WATER SUPPLY IN RURAL & URBAN AREAS.
THE SUPPLY IS DIVIDED INTO 4 ZONES.
IN URBAN AREAS 91 BOREWELLS, 28 UPPER RESERVOIRS AND 06 UNDERGROUND RESERVOIRS (SECTOR-GAMMA, ALPHA, DELTA, SECTOR-37, STADIUM AND BALAK INTER COLLEGE) ARE DOING THE WATER SUPPLY.
WHERE THE UNDERGROUND RESERVOIRS ARE FUNCTIONAL THERE BOREWELLS ARE USED TO FILL UNDERGROUND RESERVOIRS AND THEN FROM UNDERGROUND RESERVOIRS TO UPPER RESERVOIRS ARE FILLED TO SUPPLY THE WATER IN THE AREA.
THE SECTOR WHERE THE UNDERGROUND RESERVOIRS ARE NOT THERE, BOREWELLS FILL THE UPPER RESERVOIRS /OVERHEAD TANKS DIRECTLY.
WITH THE INCREASE IN THE WATER DEMAND THE NEW OVERHEAD TANKS AND BOREWELLS ARE GETTING CONSTRUCTED IN THE URBAN AREAS OF GREATER NOIDA 29 BOREWELL ARE FUNCTIONAL AND 78 BOREWELLS ARE UNDER CONSTRUCTION

137 M L D SEWEGE TREATMENT PLANT

- GREATER NOIDA REGION HAS BEEN DIVIDED INTO 8 REGIONS IN THE SEWERAGE MASTER PLAN .
- 137 MLD STP IS UNDER CONSTRUCTION IN THE KASNA VILLAGE AREA FOR THE PHASE-1.
- 15085 LACS IS THE COST OF STP.
- CONSTRUCTION OF STP IS BASED ON SBR TECHNOLOGY ,THE WATER BOD IS LESS THAN 10 IN THIS TECHNOLOGY.
- PROJECT IS FUNCTIONAL AT PRESENT

5.1.3 GANGA JAL PROJECT

- FOR DISTRIBUTION OF 85 CU SEC GANGA JAL TO DIFFERENT SECTORS OF GREATER NOIDA, 200 MM DIA TO 1400 MM DIA .GRP PIPE APPROXIMATELY 89.0 KM LENGTH LAYING AND CONSTRUCTION 25 UGR ON PMC BASES IS GOING ON BY UPRNN. 78 KM LENGTH PIPE LAYING WORK IS EXECUTED AND COMPLETED BY UPRNN AND UGR'S CONSTRUCTION WORK IS UNDER PROGRESS. 3 UGR AND BALANCE PIPE LAYING WORK HAS SHOPPED BECAUSE OF NON AVAILABILITY OF LAND. TOTAL PAYMENT AGAINST THE WORK DONE BY UPRNN AGAINST THE MOU/AGREEMENT COST 318 CR. 216.46 CR. HAS BEEN PAID . THE PRESENTLY WORK IS UNDER PROGRESS. SOME DISPUTE ON SOME AREA THE WORK IN EFFECTED. 81% WORK HAS COMPLETED.

Sl. No.	Blocks	Annual ground water recharge (in ham)	Net Annual ground water availability (in ham)	Existing gross ground water draft for all uses (in ham)	Net ground water availability for future irrigation development (in ham)	Stage of ground water development (in %)	Category of block
1.	Bisrakh	9528.38	9051.96	6756.76	2079.39	74.64	Safe
2.	Dadri	20355.50	19337.73	5024.83	14155.37	25.98	Safe
3.	Dankaur	17673.36	16789.69	9762.34	6933.23	58.14	Safe
4.	Jewar	15509.17	14733.71	9248.54	5424.44	62.77	Safe
	Total	**63066.42**	**59913.10**	**30792.48**	**28592.44**	**51.40**	

TABLE-01

Chemical Constituents	Range
pH	7.95 - 8.15
Specific Conductance (EC) (µs/cm at 25°C)	419 - 2270
Bicarbonate (mg/l)	152 - 750
Chloride (mg/l)	14 - 347
Nitrate (mg/l)	3.3 – 141
Sulphate (mg/l)	9.6 – 125
Fluoride (mg/l)	0.27 - 1.7
Calcium (mg/l)	8 - 136
Magnesium (mg/l)	4.8 - 50
Total Hardness as $CaCO_3$ (mg/l)	150 - 450
Sodium (mg/l)	35 - 506
Potassium (mg/l)	4.8 - 18
Arsenic (mg/l)	0.0007 – 0.001

TABLE-02

PRE & POST MONSOON WATER LEVEL CITY AREA, GREATER NOIDA														
Sl. No	Name of Place	Depth of peizom (M)	WATER LEVEL (BGL) IN METRE											
			Pre Mon	Post Mon	Pre Mon	Post Mon	Pre Mon	Post Mon	Pre Mon	Post Mon	Pre Mon	Post Mon	Pre Mon	Post Mon
			2006	2006	2007	2007	2008	2008	2009	2009	2010	2010	2011	2011
1	ALPHA	42.6	6.16	6.03	6.69	6.97	7.53	7.43	7.92	8.05	8.73	7.52	7.91	8.16
2	CITY PARK	41.1	5.88	5.85	6.46	6.83	7.69	7.21	8.4	7.75	8.41	7.05	7.95	8.15
3	GAMMA	40.6	5.85	5.6	6.09	5.93	6.77	6.42	7	7.23	7.4	6.69	7.06	7.41
4	D.M. OFFICE	40.65	3.8	3.57	3.91	4.01	4.42	4.37	4.75	4.93	5.45	4.56	4.76	4.81
5	SURAJPUR	39	5.55	5.41	5.81	6.23	6.05	5.86	6.65	6.71	6.75	6.08	6.22	6.16
6	D.P.S.	41.6	4.4	5.36	5.64	5.36	5.58	4.79	5.75	5.66	6.41	4.88	5.01	5.39
7	CHAURUSIA ESTATE	44.05	6.5	5.87	6.28	6.44	6.79	6.23	6.7	6.49	7.23	5.76	6.91	7.04
8	POLICE LINE	40.62	3.15	2.21	2.89	3.24	3.21	2.53	3.46	3.95	4.76	1.73	3.14	2.49
9	SECTOR-36	40.55	14.85	14.68	14.8	15.59	-	-	-	-	-	-	-	-
10	DELTA-3	41.65	6.65	3.31	6.66	6.58	6.58	6.56	6.55	6.49	7.38	5.84	6.44	6.73
11	PIE SYGMA-3	40.2	6.3	4.73	5.13	-	-	-	-	-	6.31	5.13	5.76	5.52
12	PIE-2	43.8	5.65	5.88	6.19	6.17	6.58	5.83	8.05	6.91	7.66	5.87	6.96	-
13	ANOX AIR PRODUCTS	33.45	5.45	5.2	5.68	7.18	7.18	6.59	6.35	6.85	7.35	6.26	6.64	6.67
14	HULDONI TURNING	39.1	6.05	5.62	6.27	6.17	6.24	5.97	-	-	-	5.64	6.21	5.71

15	HONDA SYAL	39.8	5.82	5.47	5.84	5.79	6.15	6.12	7.45	7.44	7.6	6.53	7.14	6.96
16	GREEN NURSARY(H.P. GAS)	36.3	3.85	3.6	4.04	3.93	4.13	4.29	7.05	7.18	6.81	5.51	5.41	6.4
17	KNOWLEDGE PARK-3	39.25	6.08	5.63	6.56	6.57	7.91	7.31	8.81	8.88	9.59	5.88	6.47	6.5
18	I.T.S.DENTAL COLLEGE	38.85	4.5	4.16	4.64	4.76	5.07	4.66	6.47	-	6.06	3.89	4.42	-
19	GULISTANPUR PRY. SCHOOL	33.4	12.35	11.95	12.64	11.91	12.51	12.29	-	-	-	-	-	-
20	MUSICAL PARK	37.3	5.9	5.22	5.58	5.71	6.06	5.63	6.1	6.7	7.38	6.03	5.78	5.64
21	SAFIPUR	39	9.05	8.45	8.93	9.17	9.06	8.72	-	8.85	9.51	7.72	8.31	7.93
22	PARI CHAUK	39	5.92	5.66	6.59	6.72	7.66	6.67	7.95	8.05	9.35	7.64	8.61	8.41
23	N.T.P.C. COLONY	38.75	5.75	5.22	5.62	5.38	5.75	5.21	6.57	-	-	-	-	-
24	TUSIYANA TURNING	39.7	5.85	4.83	5.24	4.98	5.58	5.26	5.76	5.93	6.15	4.79	5.46	5.52
25	HANUMAN MANDIR(BISRUCK)	34	3.85	3.83	3.62	4.56	4.05	3.29	4.05	4.38	5.24	2.26	3.42	2.28
26	A.C.C.	35.65	9.55	8.93	9.54	9.61	10.05	9.54	10.05	10.43	11.07	9.26	9.06	9.51
27	SAKIPUR PRY.SCHOOL	36.1	11.9	10.98	11.62	11	11.68	11.36	11.63	11.93	12.64	10.8	11.08	-
28	DEEP MEMORIYAL SCHOOL	33.9	10	9.19	9.68	9.26	9.85	9.58	10.07	10.25	11.04	8.86	9.94	9.81
29	PIYAJO FACTORY	35.9	3.85	3.38	3.81	3.84	4.1	3.64	4.61	4.72	5.53	3.41	4.31	4.07

TABLE-03

MANAGEMENT APPROACHES AND TOOLS

THERE IS NO ONE-SIZE-FITS-ALL IUWM MODEL; RATHER, EACH CON¬TEXT WILL DEMAND A DIFFERENT MIX OF MANAGEMENT APPROACH¬ES. SO WHAT ARE SOME OF THE OPTIONS FOR SUSTAINABLY MEETING THE WATER NEEDS OF GROWING CITIES AND REDUCING THEIR IMPACT ON THE ENVIRONMENT?

WATER RECLAMATION AND REUSE

STORM WATER MANAGEMENT

IN DEVELOPING COUNTRIES, MANY PARTS OF CITIES AND IN PAR¬TICULAR SOME LOW-INCOME BUILT-UP AREAS ARE EXPERIENC¬ING EXTENSIVE FLOODING DURING PERIODS OF INTENSE RAINFALL. THERE ARE OPTIONS FOR URBAN STORMWATER MANAGEMENT THAT CAN REDUCE NEGATIVE IMPACTS AND INCREASE THE AVAILABILITY OF WATER RESOURCES LOCALLY. THESE INCLUDE USING RETENTION PONDS, PERMEABLE AREAS, INFILTRATION TRENCHES AND NATURAL SYSTEMS TO SLOW THE WATER DOWN. LODZ AND BELO HORIZONTE ARE USING SUCH SYSTEMS, AND BIRMINGHAM IS EXPERIMENTING WITH GREEN ROOFS TO ACHIEVE THE SAME EFFECT (SWITCH, 2011). GREEN AREAS THAT TAKE UP WATER CAN BENEFIT CITIES WITH HIGH RISK OF FLOODING AND PROVIDE ECOSYSTEM SERVICES INVOLVING LOWER COSTS COMPARED TO CONVENTIONAL STORMWATER DRAINAGE SYSTEMS (BOLUND AND HUNHAMMAR, 1999). THOSE

CONVEN¬TIONAL SYSTEMS MAY INCLUDE CLEANING UP URBAN RUNOFF AND STORMWATER IN ORDER TO REDUCE POLLUTION AND INCREASE THE AVAILABILITY OF WATER RESOURCES LOCALLY. THE VALUE OF NATU¬RAL AND CONSTRUCTED WETLANDS AND SWAMPS IN URBAN WATER RETENTION AND PURIFICATION IS INCREASINGLY RECOGNIZED.

RAINWATER HARVESTING

FLOW- OR ROOF-WATER HARVESTING CAN BE A MEANS OF INCREAS¬ING LOCAL WATER SUPPLY AND GROUNDWATER RECHARGE WHILST SIMULTANEOUSLY ALLEVIATING FLOODING PROBLEMS IN SOME AREAS. THESE MEASURES MAY BE AN IMMEDIATE SOLUTION TO ACCOM¬PANY LONG-TERM INFRASTRUCTURE IMPROVEMENTS IN WATER SUP¬PLY AND DRAINAGE. ALTHOUGH FLOW- OR ROOF-WATER HARVESTING SYSTEMS HAVE BEEN IMPLEMENTED IN SOME CITIES, THERE HAS BEEN NO COMPREHENSIVE DOCUMENTATION OF DESIGN CRITERIA USED, COSTS AND BENEFITS, IMPACTS AND CONSTRAINTS TO LARGE SCALE ADOPTION. SUCH AN EVALUATION WOULD ALLOW OUT-SCALING SUCH PRACTICES.

'GREEN INFRASTRUCTURE'

INCORPORATING ECOLOGICAL FUNCTIONS INTO LANDSCAPE DESIGN CAN ALSO EXTEND BEYOND STORMWATER MANAGEMENT. THEY IN¬CLUDE NATURAL OR NATURE-MIMICKING SYSTEMS TO TREAT POLLUTED WATER (ASANO, 2005; BROWN, 2009). BY COMBINING FLEXIBLE TREATMENT TECHNOLOGIES WITH FUNCTIONAL LANDSCAPES, THEY ALLOW VARIOUS COST-EFFECTIVE APPROACHES TO RESTORING THE INTEGRITY OF URBAN ECOSYSTEMS (BROWN, 2009).

PAYMENT FOR ECOSYSTEM SERVICES (PES)

PES IS ANOTHER TOOL THAT HAS PROVED USEFUL, PARTICULARLY IN PROTECTING URBAN WATER SUPPLIES FROM UPSTREAM ACTIVITIES. HERE, LAND OWNERS AND USERS ARE GIVEN INCENTIVES (OFTEN MONETARY) TO ENGAGE IN LAND-USE PRACTICES THAT LEAD TO AN ECOLOGICAL SERVICE. WITHIN THE WATER SECTOR, PAYMENT MODELS ARE DESIGNED WITHIN THE CONTEXT OF WATERSHEDS. CONVENTION¬ALLY, DOWNSTREAM COMMUNITIES PAY UPSTREAM WATER USERS TO REFRAIN FROM PRACTICES THAT CAN UNDERMINE THE INTEGRITY OF NATURAL RESOURCES IN GENERAL, AND RIVER FLOWS AND WATER QUALITY IN PARTICULAR. PES IS INTENDED TO COMPENSATE RURAL (OFTEN POOR) WATER-USERS TO MANAGE A COLLECTIVE ECOSYSTEM, EVEN IF THEY ARE NOT THE IMMEDIATE BENEFICIARIES OF SUCH ACTIONS (ISET-NEPAL, 2008). PES, THUS, AMOUNTS TO A TOOL FOR JOINED-UP MANAGEMENT OF NATURAL RESOURCES ACROSS THE URBAN-RURAL CONTINUUM.

EFFICIENT WATER USE

THIS CAN INVOLVE REDUCING LOSSES AND ENCOURAGING MORE EFFICIENT PRACTICES ON THE PART OF WATER USERS. DOMESTIC WATER SUPPLY SYSTEMS OFTEN FACE MAJOR WATER LOSSES, WITH LEAKAGE PERCENTAGES OF OVER 50 PERCENT. EFFICIENCY OF WATER USE SHOULD MINIMIZE WATER LOSSES DURING TREATMENT, TRANS¬PORT, STORAGE AND USE. REDUCING WATER LOSS INVOLVES ASPECTS RELATED TO DESIGN, CONSTRUCTION AND OPERATION AND MAIN¬TENANCE OF SYSTEMS, AS WELL AS USER BEHAVIOUR. SINGAPORE AND PHNOM PENH ACHIEVED SIGNIFICANT REDUCTIONS IN UNAC¬COUNTED-FOR WATER OVER THE LAST DECADE. IN ZARAGOZA, SPAIN, THE MUNICIPALITY INSTITUTED A DEMONSTRATION ON WATER LOSS MANAGEMENT WITH THE INSTALLATION OF WATER SAVING DEVICES AND WITH THE MONITORING OF FLOWS AND PRESSURES THROUGH A SUPERVISORY CONTROL AND DATA ACQUISITION SYSTEM, LINKED TO A GEOGRAPHIC INFORMATION SYSTEM AND SIMULATION MODEL (SWITCH, 2011).

ECONOMIC AND FINANCIAL INSTRUMENTS

EFFORTS TO PROMOTE IUWM MUST ADDRESS THE QUESTION OF CAPITAL AVAILABILITY, INCLUDING APPROPRIATE FINANCIAL TOOLS AND COST SHARING. INVESTMENTS BY NATIONAL GOVERNMENTS IN WATER RESOURCES DEVELOPMENT HAVE TRADITIONALLY BEEN OVERSHAD¬OWED BY THOSE FOR TRANSPORT, ENERGY, TELECOMMUNICATIONS AND THE MILITARY. FUNCTIONAL RESPONSIBILITY FOR WATER SERVICES HAS TENDED TO REST ON THE SHOULDERS OF LOCAL GOVERNMENT (SERAGELDIN, 1994; AS CITED IN REES, 2006). HOWEVER, IN THE GLOBAL SOUTH, LOCAL GOVERNMENT REVENUE STREAMS ARE OFTEN INADEQUATE. AS A RESULT, THEY OFTEN LACK THE FINANCIAL MEANS TO MAINTAIN INVESTMENTS IN LINE WITH DEMOGRAPHIC CHANGE AND PHYSICAL DEVELOPMENT. AT THE SAME TIME, THE COST-RE¬COVERY POTENTIAL OF COMMERCIAL SERVICE PROVIDERS IS CON¬STRAINED BY LOW AVERAGE INCOMES AMONG USER GROUPS. WATER PRICING AND APPLICATION OF THE POLLUTER PAYS PRINCIPLE CAN BE IMPORTANT COMPONENTS OF ENCOURAGING MORE EFFICIENT RESOURCE USE AS WELL AS PROVIDING FUNDING FOR IUWM FUNC¬TIONS. OTHER FINANCIAL STRATEGIES, INCLUDING FISCAL TRANSFERS AND CROSS-SUBSIDIES, SHOULD BE DEPLOYED IN ORDER TO TACKLE RESOURCE DEPLETION AND INEQUALITY (UNDP, 2006).

ALSO, SPECIFIC STRATEGIES ARE NEEDED TO FOCUS PUBLIC RE-SOURCES ON LEVERAGING RESOURCES FROM LOCAL AUTHORITIES, CONSUMERS AND THE PRIVATE SECTOR (SEE BOX 3). SUCCESSFUL MICROFINANCE, OUTPUT-BASED AID AND LOAN-FINANCED AP¬PROACHES MAY BE ADOPTED AS CORE STRATEGIES PARTICULARLY IN THE SANITATION SECTOR. CONVENTIONAL PUBLIC SECTOR FINANCING OF WATER AND SANITATION SERVICES FREQUENTLY DOESN'T REACH THE POOR AND VULNERABLE AND SPECIFIC STRATEGIES ARE NEEDED, MANY OF WHICH INVOLVE ALTERNATE FUNDING SOURCES (BAHRI ET AL., 2010).

PIC-02-

PLAN OF ACTION BY THE GREATER NOIDA AUTHORITY

SPATIAL PLANNING WITH WATER

FROM THE AFORE GOING IT SHOULD BE CLEAR THAT EXPANSION CAN BE SUSTAINED ONLY IF IT IS BASED UPON SUSTAINABLE UTILIZATION OF LOCALIZED WATER RESOURCES. SINCE THE AVAILABILITY OF SURFACE WATER IS BECOMING INCREASINGLY DIFFICULT EXPANSION BEYOND THAT LIMIT SUSTAINABLE BY LOCAL RESOURCES SHOULD TAKE PLACE ONLY ONCE WHEN THE ADDITIONAL SURFACE RESOURCES ARE ACTUALLY MADE AVAILABLE.

THEREFORE SPATIAL PLANNING SHOULD BE DONE WITH A VIEW TO EFFICIENT RESOURCE MANAGEMENT OF THE AVAILABLE LOCALIZED VARIETY. PLANNING WITH WATER MEANS INCORPORATING THE UNDERSTANDING OF THE WORKING OF THE HYDROLOGICAL AND HYDRO GEOLOGICAL SYSTEM AND PRINCIPLES IN LAND USE PLANNING AS A BASIS FOR MAKING A SPATIAL PLANNING DECISION. ANY URBAN SETTLEMENT CAN, WITHIN AN AREA OF THREE TO FOUR TIMES THE URBANIZED AREA, IF SUFFICIENT SITES FOR WATER STORAGE TO MEET ITS REQUIREMENTS WITHIN THE CONTEXT OF MODERATE RAINFALL. IT IS IMPORTANT FOR PLANNERS TO UNDERSTAND:

- THE WORKINGS OF THE HYDROLOGICAL CYCLE
- THE INTERCONNECTEDNESS OF TOPOGRAPHY, SURFACE SOIL AND RUNOFF
- THE INTERCONNECTEDNESS OF SURFACE WATER AND GROUND WATER
- RECHARGE AND SOIL CHARACTERISTICS FOR UNDERGROUND FLOWS
- AQUIFERS HYDROLOGEOLOGY
- MECHANICS OF ARTIFICIAL RECHARGE
- MACHINES OF SUSTAINABLE GROUNDWATER WITHDRAWAL

THIS IT WOULD BE ENSURED THAT ANY PLANNED DEVELOPMENT THAT WOULD NOT BE AT THE EXPENSE WATER SYSTEM BUT WOULD ENHANCE THE LOCALIZED AUGMENTATION OF SUPPLY AND IN THE PROCESS ENHANCE AND ENRICH THE LOCAL ECOLOGY.

IN INDIA WHERE THE RAINFALL IS CONCENTRATED IN TIME THE BULK OF RAIN WATER FLOWS AWAY VIA RIVERINE SYSTEM. INDEED SO FAR THERE HAS BEEN AN EXAGGERATED EMPHASIS ON DRAINAGE. THE REALIZATION IS NOW SINKING IN THAT RAINWATER RUNOFF AND FLOOD DISCHARGE CONSTITUTE A MAJOR RESOURCE TO BE CONVERSED. THE USAGE OF MONSOON WATER WHOSE ARRIVAL IS CONCENTRATED MAINLY IN THREE MONTHS NEEDS TO BE DISPERSED

OVER THE YEAR. IT IS ESTIMATED THAT JUST 1% OF THE ANNUAL PRECIPITATION ALL OVER INDIA, IF STORED, IS SUFFICIENT TO TAKE CARE OF ITS DOMESTIC WATER REQUIREMENTS.

GUIDELINES FOR URBAN PLANNING AND DEVELOPMENT

URBAN PLANNING SO FAR HAS BEEN BASED ON ASSUMPTION THAT THE COLOSSAL NEED OF WATER OF THE FAST GROWING POPULATION OF OUR CITIES WOULD BE "SOMEHOW" SERVED BY THE GROUNDWATER. IT HAS NOT HAPPENED THE WATER SUPPLY SCENARIO FOR ALL OUR METROPOLIS IS VERY GRIM AND WE CAN HOPE TO OVERCOME THE PROBLEMS OF WATER SCARCITY ONLY BY TAKING ALL NECESSARY STEP TOWARDS HARVESTING RAINWATER AT THE INDIVIDUAL USE, COMMUNITY AND CITY LEVELS.

NECESSARY ACTS AND BYELAWS NEED TO BE ENACTED BY THE STATES AND LOCAL SELF-GOVERNMENTS TO INCORPORATE RAINWATER HARVESTING AS MANDATORY PART OF BUILDING DESIGN AND CITY DEVELOPMENT.

THE FOLLOWING ARE SOME GUIDELINE POLICY RECOMMENDATIONS AND STRATEGIES TO GET MAXIMUM BENEFITS FROM RAINWATER HARVESTING IN FUTURE.

TECHNO-ECONOMIC ASPECTS.

RAINWATER HARVESTING SHOULD BE ADOPTED AS A NATIONAL PROGRAMME WITH THE OBJECTIVE OF INCREASING GROUND WATER STORAGE, ASPECT THE QUANTUM REQUIRED FOR MAINTAIN THE RIVER ECOLOGY.

THE RAINWATER HARVESTING SCHEMES SHOULD BE BASED ON SCIENTIFIC APPROACH WHEREIN THE TWIN ESSENTIAL ELEMENTS OF SOURCE WATER AVAILABILITY FOR RE-CHARGE AND SUITABLE HYDROLOGICAL SITUATIONS TO CREATE SUB-SURFACE RESERVOIRS ARE GIVEN PRIME IMPORTANCE. MULTIDISCIPLINARY APPROACH INCLUDING HYDROLOGICAL AND GEOPHYSICAL ASPECTS NEED TO BE ADOPTED FOR DESIGNING RAIN WATER HARVESTING SCHEMES.

MODEL RAINWATER HARVESTING PROJECTS IN DIFFERENT HYDROLOGICAL SETUPS SHOULD BE IMPLEMENTED ON LARGER SCALE SO THAT THESE COULD ACT AS "DEMONSTRATION PROJECT" REPLICATION IN SIMILAR ENVIRONMENT.

THE AREAS WITH HIGH RATE OF GROUNDWATER DEVELOPMENT, ESPECIALLY "OVER EXPLOITED" BLOCKS METRO AND HIGHLY URBANIZED AREAS SHOULD GET PRIORITY FOR IMPLEMENTING THE RAIN WATER HARVESTING SCHEMES.

ALTHOUGH ON A MACRO SCALE, MAJOR AREAS SUITABLE FOR RAINWATER HARVESTING HAVE BEEN IDENTIFIED, MICRO LEVEL STUDIES IN CRITICAL AREAS OF DRAW DETAILED

PLANS FOR GROUND WATER RESOURCES MANAGEMENT ARE ALSO REQUIRED BEFORE IMPLEMENTATION OF NEW OPERATIONAL PROJECTS.

DEVELOPMENT OF CHEAPER ALTERNATIVE FOR RAINWATER HARVESTING AND CONSERVATION METHODS LIKE LAY SUB-SURFACE DYKES, VARIOUS DESIGNS OF RECHARGE SHAFTS, SURFACE SPREADING METHODS AND ALSO OTHER COMBINATION METHODS IS A MAJOR THRUST AREA FOR SCIENTISTS AND ENGINEERS-PLANNERS.

REGIONAL AQUIFER SYSTEM ANALYSIS SHOULD ALSO BE TAKEN UP ON A LARGER SCALE FOR FURTHER DEVELOPMENT AND MANAGEMENT TO GROUND WATER RESOURCES INCLUDING RAINWATER HARVESTING. CENTRAL GOVERNMENT, STATE GOVERNMENTS, INSTITUTES AND PRIVATE ORGANIZATIONS ARE REQUIRED TO MAKE JOINT EFFORTS TO ACHIEVE IT.

TECH-ECONOMIC EVALUATION OF RAIN WATER HARVESTING SCHEMES SHOULD BE TAKEN UP TO ASSESS THE BENEFITS. A PART OF THE COMPONENT OF THE FINANCIAL ASSISTANCE FROM INSTITUTIONAL FINANCE AGENCIES, INCLUDING NABARD, MUST BE SET FOR RECHARGE SCHEMES AND EXTENDED FOR THE PURPOSE.

A SUITABLE PRICING MECHANISM NEED TO BE ADOPTED FOR WATER SO AS TO RECOVER THE COST OF RAIN WATER HARVESTING AND MANAGEMENT OF WATER RESOURCES. IT SHALL ALSO HELP IN PROMOTING CONSERVATION OF WATER RESOURCES. RAINWATER HARVESTING PROJECTS SHOULD BE TAKEN UP IN COASTAL AREAS TO PREVENT THE SEA WATER INGRESS.

TRADITIONAL RAINWATER HARVESTING TECHNIQUES, WHICH HAVE SEVERELY, ERODED SHOULD BE REVIVED WITH A MIX OF MODERN TECHNIQUES TO PRIVATE SUSTAINABILITY OF WATER RESOURCES.

PLANNING AND MANAGEMENT ASPECTS

CLEAR DELINEATION OF RIGHTS OF INDIVIDUAL, COMMUNITY, STATE AND CENTRE OVER GROUND WATER IN AN AREA NEED TO BE DEFINED BY THE PLANNERS AND LEGAL EXPERTS IF MAXIMUM BENEFITS ARE TO BE REAPED THOUGH RAINWATER HARVESTING. ROLE OF CENTRAL STATE AND LOCAL BODIES IS ALSO TO BE DEFINED CLEARLY IN CONSTRUCTION AND MAINTENANCE OF RAINWATER HARVESTING STRUCTURES.

PEOPLE PARTICIPATION AND SOCIAL ACCEPTANCE IS ESSENTIAL FOR SUCCESS OF RAINWATER HARVESTING PROJECTS. THERE IS NO ALTERNATIVE TO MASS AWARENESS FOR POPULARIZING WATER RESOURCES MANAGEMENT PRACTICES; OTHERWISE ALL SUCH PROGRAMMES MAY NOT BE SUCCESSFUL WITHOUT PEOPLE PARTICIPATION. ALL THE RAIN WATER HARVESTING TECHNIQUES SHOULD REACH TO THE PANCHAYAT/MUNICIPALITY LEVEL SINCE THESE LOCAL BODIES WILL BE MORE EFFECTIVE IN THE MANAGEMENT OF GROUND WATER RESOURCES OF THEIR AREA. THE PARTICIPATORY ASSOCIATION OF SCIENTISTS, ENGINEERS AND BENEFICIARIES WOULD DEFINITELY GO A LONG WAY IN PROPER AND OVERALL DEVELOPMENT AND MANAGEMENT OF GROUND WATER RESOURCES.

ROOFTOP RAINWATER HARVESTING OFFERS A GOOD SCOPE FOR RECHARGING THE GROUND WATER RESERVOIR IN URBAN AREAS. CREATING SUCH FACILITIES WITH THE CONSTRUCTION OF BUILDINGS BE MADE MANDATORY AND INCLUDED IN THE BUILDING BYELAWS IN URBAN AREAS.

IT SHOULD B RESPONSIBILITY OF THE URBAN MUNICIPAL BODIES TO HARVEST THE STORM RUNOFF FROM THE EXISTING DRAINAGE SYSTEM, WHICH CAN BE EFFECTED INVESTING LITTLE AMOUNT OF FUNDS.

FUNDS FOR RAINWATER HARVESTING BEING RELEASED UNDER VARIOUS SCHEMES SUCH AS WATER MANAGEMENT, RURAL DEVELOPMENT ETC. CGWB CAN BE DESIGNATED AS NOIDAL AGENCY FOR TECHNICAL VESTING OF SCHEMES. IT SHALL ENSURE TECHNICAL VIABILITY OF ARTIFICIAL RECHARGE SCHEMES INCLUDING GAINFUL UTILIZATION OF FUNDS.

TILL RECENTLY, RAINWATER HARVESTING HAS BEEN GOVERNMENTS EFFORTS. OFF LATE SOME NGOS AND VOS ARE ALSO COMING FORWARD AND HAVE DONE COMMENDABLE WORD. A MECHANISM SHOULD BE EVOLVED SO THAT CONTINUOUS PROCESS OF INTERACTION AMONG CENTRAL/STATE GOVERNMENT AGENCIES, LOCAL BODIES, NGOS AND VOS WHO IN TURN WILL ENSURE OPTIMUM UTILIZATION OF FUNDS FOR DERIVING MAXIMUM BENEFITS FROM RAIN WATER HARVESTING SCHEMES. THIS MECHANISM WILL ALSO GENERATE ADDITIONAL EMPLOYMENT OPPORTUNITIES FOR LOCAL POPULANCE. CO-ORDINATION BETWEEN VARIOUS VENTRAL AND STATE GOVERNMENT AGENCIES INSTITUTIONS AND COMMUNITY IN FUNDING AND IMPLEMENTING RAINWATER HARVESTING SCHEMES IN THE CORE ISSUE, IF MAXIMUM BENEFITS ARISES ARE TO BE OBTAINED FROM SUCH SCHEMES. PROJECTS/SCHEMES BE EVALUATED AND SUCCESS STORIES BE DISSEMINATED THROUGH MEDIA (T.V., RADIO, INTERNET, NEWSPAPER ETC.) SO THAT THE SAME MAY BE REPLICATED.

COMMUNITY PARTICIPATION

FROM THE EXPERIENCE OF PANI PANCHAYAT WORKING IN PURANDHAR TEHSUIL OF MAHARASTRA, WE CAN LEARN VARIOUS LESSONS, WHICH CAN BE DIRECTLY IMPLEMENTED IN OTHER AREAS WELL AS. THE FOLLOWING RECOMMENDATIONS SHALL BE USEFUL AT THE COMMUNITY LEVEL.

THERE SHOULD BE A COMMITTEE IN EACH WARD, WHICH SHOULD TAKE CARE OF THE WATER MANAGEMENT OF LOCAL AREA AND MAINTAIN THE LOCAL WATER HARVESTING STRUCTURES.

FOR ANY PROPOSAL ONLY GROUP SCHEME SHOULD BE TAKEN, WHICH FOSTERS A COMMUNITY SPIRITS.

WATER SHOULD BE SHARED ON THE BASIS OF THE NUMBER OF FAMILY MEMBERS AND NOT SIZE OF LANDHOLDING. IN THIS WAY WE CAN INCORPORATE THE PRINCIPLE OF EQUITY.

WATER RIGHT SHOULD NOT ACCOMPANY LAND RIGHTS, IF THE LAND IS SOLD, THE WATER RIGHTS REVERT TO THE GROUP.

BENEFICIARIES MUST SHARE, IN CASH, A TOTAL OF 20 PERCENT OF THE CAPITAL COST OF ANY WATER HARVESTING PROJECT IN THE AREA ACCORDING THEIR WATER SHARE, BEFORE THE COMMENCEMENT OF THE PROJECT. PEOPLE'S PARTICIPATION IS THUS ENSURED. THE BALANCE 80 PERCENT SHOULD BE GIVEN BY THE GOVERNMENT AND OTHER AGENCIES AS AN INTEREST FREE LOAN TO BE PAID IN FIVE YEARS. PROJECT BENEFICIARIES SHOULD ADMINISTER, MANAGE AND OPERATE THE SCHEME. THIS RECOGNIZES THE LEADERSHIP CAPABILITY AND SKILLS OF THE COMMUNITY PEOPLE.

USES OTHER THAN RESIDENTIAL SHOULD NOT BE PERMITTED IN THE AREA, WHICH CONSUME MORE WATER.

LANDLESS PEE AND POOR AND SLUM RESIDENT SHOULD ALSO GET A SHARE OF THE WATER SO THAT THEY CAN SHARE THE LABOLUR IN THE PROJECT. THIS HELPS THEM TO GET EMPLOYMENT IN THE AREA ITSELF AND CHEKS UNEMPLOYMENT.

SOME ISSUES FOR DECISION MAKING AND IMPLEMENTATION

COUNTRYWIDE DEMONSTRATION PROJECTS IN SELECTED AREAS TO PROVIDE USEFUL INFORMATION AND IDEAS FOR RAINWATER HARVESTING AND WASTEWATER UTILIZATION. THE

SCOPE OF INCORPORATING WATER HARVESTING IN A MICRO-WATERSHED BASIS AND EQUITABLE USE OF THIS WATER IN A WAY THAT IT INCREASES PRODUCTION AND EMPLOYMENT PER UNIT OF WATER AS A BASIS OF REGIONAL PLANNING.
THE NEED FOR CORRECTING THE CURRENT USE OF SURFACE WATER BY FORMING A GRID OF SMALL WATERSHED OF INDIVIDUAL WARDS AND OF MAJOR AND MINOR INDUSTRIAL, INSTITUTIONAL AND OTHER WATER USES.
THE POTENTIAL OF REPLACING LANDUSE PLANNING WITH A COMBINED LANDUSE WATER USE PLANNING FOR DEVELOPMENTS.

THE NEED FOR ADOPTING PARTICIPATORY PLANNING IN CITY PLANNING PROCESS TO INVOLVE THE COMMUNITY AT HOUSEHOLD LEVEL WITH REGARD PLANG FOR BASIC NEEDS AND SERVICES, LIKE WATER SUPPLY AND SOLID WASTE MANAGEMENT.

POLICY DIMENSION: GETTING CITY – DWELLERS TO DO IT

A POLICY FOR PROMOTING URBAN WATER HARVESTING SHOULD INCLUDE A MIX OF INCENTIVES AND PENNALTIES

THE EXPERIENCE OF CHENNAI THAT TO PROMOTE WIDESPREAD, ADOPTION OF RAIN WATER HARVESTING IN URBAN AREAS, A NUMBER OF MEASURES NEED TO BE UNDERTAKEN.
1. A SINGLE WATER AUTHORITY OR LOCAL BODY, AS THE CASE MAY BE, SHOULD BE VESTED WITH THE CONTROL AND REGULATION OF ALL WATER BODIES, INCLUDING RIVERS
CANALS, WATER WAYS AND GROUND WATER IN URBAN AREAS.
2. TOWN PLANNING REQUIREMENTS MUST PROVIDE A CHECKLIST OF ESSENTIALS IN WHICH THE PROVISION OF RAIN WATER HARVESTING/CHARGE OF GROUNDWATER SYSTEM IS A PREREQUISITE FOR SANCTION OF ALL NEW COLONIES/LAYOUT.
3. TOWN PLANNERS/LOCAL AUTHORITIES/MUNICIPAL BODIES MUST IMMEDIATELY PROVIDE FOR SURFACE WATER PERCOLATION ALONG ROADS/PAVEMENTS AND OTHER OPEN SPACES.
4. ALL BUILDING PLANS MUST PROVIDE FOR RAINWATER HARVESTING STRUCTURES BEFORE APPLICATIONS ARE ACCEPTED.
5. PROVISION OF RAINWATER HARVESTING SYSTEMS IN PLANS SHOULD BE FOLLOWED UP BY ENFORCEMENT, FOR EXAMPLE, AT THE TIME OF GRANT OF WATER/SEWER CONNECTIONS/ ASSESSMENT OF PROPERTY TAX.
6. NO BUILDING/LAYOUT SHOULD BE PERMITTED TO ALLOW RAINWATER TO FLOW INTO SEWAGE DRAINS OR SEPTIC TANK SYSTEMS.
7. BUILDERS/PLANNERS SHOULD BE GIVEN CLEAR TECHNICAL GUIDELINES ON CAUTIONS TO BE OBSERVED IN PROVIDING RAIN WATER HARVESTING SYSTEMS IN A WAY THAT THERE IS NO CONTAMINATION WITH SEPTIC TANKS. SUITABLE PUNISHMENTS SUCH AS FINES/DISCONNECTION OF WATER SUPPLY SHOULD BE PROVIDED FOR VIOLATION OF SUCH STIPULATIONS.
8.THE LOCAL WATER AUTHORITY OR AGENCY IN CHARGE OF WATER SUPPLY SHOULD BE HELD RESPONSIBLE FOR MAINTENANCE OF RIVERWAYS, CANALS/LAKES/TEMPLE TANKS/ STORMWATER DRAINS AND ALL OTHER WATERBODIES WITH THE SPECIFIC OBJECTIVE OF ENSURING THAT ALL THESE WATER CARRIERS AND BODIES ARE USED AS WATER STORAGES THROUGH RAINWATER HARVESTING SYSTEMS.
9. MASTER PLANS FOR RAINWATER COLLECTION AND USE FOR ALL URBAN CENTERS OR GROUPS OF URBAN ENTRES SHOULD BE MADE A PREREQUISITE FOR MEETING THE ELIGIBILITY REQUIREMENT OF FUNDING AGENCIES, INCLUDING HOUSING AND URBAN DEVELOPMENT CORPORATION (HUDCO), STATE/CENTRAL GOVERNMENT/ WORLD BANK/EUROPEAN COMMISSION/ASIAN DEVELOPMENT BANK AND OTHER BILATERAL AND MULTILATERAL AID FOR URBAN IMPROVEMENT AND URBAN DEVELOPMENT.

10. MISUSE OF WATER WAYS THROUGH DISCHARGE OF SEWAGE SHOULD BE RIGOROUSLY FOLLOWED UP WITH THE PROVISION OF INTERCEPTOR SEWERS/CANALS ALONG WATERWAYS. THIS IS AN EXPENSIVE PROPOSITION AND CAN BE TAKEN UP IN A PHASED MANNER.
11. THE USE OF WATERWAYS AS WATER STORAGES IN URBAN AREAS, PARTICULARLY WHERE THERE ARE NO OTHER REPAIRIAN OF AGRICULTURAL INTERESTS, SHOULD BE ENCOURAGED AS A SOURCE LF:

a) ADDITIONAL AVAILABILITY OF WATER
b) RECHARGE OF GROUND WATER ALONG THE WATERWAYS, AND,
c) PREVENTION OF ENCROACHMENTS OF DRY RIVERS/LAKEBEDS DURING THE NON-MONSOON SEASONS.

12. A LARGE NUMBER OF LOCAL AUTHORITIES ARE BOTH WATER-STARVED AND CASH-STARVED.

A CENTRAL RAINWATER HARVESTING FUND CAN BE SET UP BY THE UNION WATER RESOURCES MINISTRY OFFERING FUNDS ON LOAN-CUM-GRANT BASIS FOR THE PROMOTION OF RAINWATER HARVESTING BY URBAN COMMUNITIES, EITHER THROUGH PUBLIC, PRIVATE OR JOINT VENTURES OF BOTH AGENCIES.

13. COMMUNITY-BASED SYSTEMS BY RESIDENTS GROUPS/TEMPLE AUTHORITIES/NON GOVERNMENTAL ORGANIZATION (NGOS) AND SERVICE ORGANIZATIONS SHOULD BE ENCOURAGED WITH GRANTS/SOLT LOANS INVOLVING THE LOCAL WATER AUTHORITY AND OTHER AGENCIES.

14. RAINWATER HARVESTING SYSTEMS MUST BE PROMOTED AS A MEANS OF BOTH PROVISIONS OF WATER AND PREVENTION OF FLOODING OF LOW-LYING URBAN AREAS.

15. ONE OF THE MOST EFFECTIVE MEANS OF ENCOURAGING HOUSEHOLD AND COMMUNITY PARTICIPATION IS THROUGH FINANCIAL INSTRUMENTS SUCH AS WATER TERIFFS AND PROPERTY TAX ASSESSMENTS.

A SPECIAL REBATE ON PROPERTY TAX FOR SETTING UP RAIN WATER HARVESTING SYSTEMS, PARTICULARLY IN OLD BUILDINGS, CAN BE ANNOUNCED BY LOCAL URBAN BODIES. A WATER TARIFF STRUCTURE THAT ALLOWS A PROGRESSIVE RATE OF INCENTIVES FOR EFFECTIVE USE OF RAIN WATER HARVESTING SYSTEMS AND TREATED WASTE WATER FOR DOMESTIC USE SHOULD BE CONSIDERED.

16. AN APPROPRIATE CENTRAL AUTHORITY SHOULD BE NOMINATED AS THE NODAL AGENCY FOR THE DISSEMINATION OF CORRECT TECHNICAL AND ENGINEERING ADVICE ON STRUCTURES AND SYSTEMS TO BE USED, PARTICULARLY IN URBAN CENTRES, WHERE AVAILABILITY OF NON-PAVED SPACES IN RESIDENTIAL AREAS IS BECOMING A RARITY. BEST PRACTICES OF CITIES AND DETAILS OF INDIVIDUAL TECHNICAL EXPERTS WITHIN AND OUTSIDE THE COUNTRY SHOULD BE COLLECTED, COLLATED AND TRANSMITTED TO URBAN WATER AND PLANNING/DEVELOPMENT AGENCIES. THE LACK OF A CENTRAL STOREHOUSE OF WELL RESEARCHED/ DOCUMENTED KNOW-HOW HAS BEEN A SERIOUS STUMBLING FOR INTERESTED NGOS, GOVERNMENT AGENCIES AND INDIVIDUALS.

17. A MASSIVE, WELL-DESIGNED MEDIA CAMPAIGN SHOULD BE TAKEN UP AT THE NATIONAL LEVEL. A RECOGNIZABLE AND IDENTIFIABLE MASSAGE ON RAINWATER HARVESTING SCHEMES AND INCENTIVES FOR THE SCHEMES REQUIRE CAREFUL AND IMMEDIATE ATTENTION.

18. RAINWATER HARVESTING SYSTEMS AND WATER CONSERVATION MAY BE INTRODUCED AS PART OF THE CURRICULUM IN SCHOOLS AND TAKEN UP AS PROJECTS UNDER YOUTH ACTIVITIES PROMOTED BY THE NATIONAL CADET CORP (NCC).

19. IN URBAN AREAS, INDUSTRIES AND BUSINESS HOUSES MUST BE ENCOURAGED BOTH BY THE INCENTIVES, TOWN PLANNING REQUIREMENTS AND POPULATION CONTROL REQUIREMENTS TO PROVIDE FOR:

a) RAINWATER HARVESTING IN THEIR PROMISES, AND
b) PROMOTING AND MAINTAINING AT LEAST ONE COMMUNITY RAINWATER HARVESTING STRUCTURE IN AN URBAN AREA.

20. THE CENTRAL GOVERNMENT SHOULD PROCLAIM RAINWATER HARVESTING SYSTEMS AND CONSERVATION OF WATER AS A MATTER OF NATIONAL IMPORTANCE THROUGH SIGNIFICANT AND APPROPRIATE INTERVENTIONS IN NATIONAL PROGRAMMERS SUCH AS THE TECHNOLOGY MISSION ON DRINKING WATER. THE POLICY STATEMENT SHOULD BE ALL ENCOMPASSING AND NOT BE CONFINED TO RURAL/URBAN AREAS OR HAVE ANY OTHER RESTRICTIONS.

21. ANNUAL STATE AND NATIONAL AWARD SHOULD BE ANNOUNCED ON RECOGNITION OF OUTSTANDING WORK. THE AWARD SHOULD BE MONETARILY ATTRACTIVE WITH THE STIPULATION THAT IT MAY BE USED FOR WATER/SANITATION PROJECTS.

A COMPREHENSIVE APPROACH IS THEREFORE NECESSARY. THE ABOVE POLICY INITIATIVES CAN BE FURTHER STRENGTHENED THROUGH LEGISLATION, LEGALLY COMPELLING

OWNERS TO BUILD RAINWATER HARVESTING STRUCTURES IN ALL BUILDINGS. IN ADDITIONS, THERE IS ALSO THE NEED TO LEGALLY REGULATE GROUNDWATER USE. NO AMOUNT OF RAINWATER HARVESTING WILL BE OF HELP IN SITUATION WHERE THERE IS NO CONTROL ON THE AMOUNT OF GROUNDWATER EXTRACTED.

CONCLUSIONS

TO SUM UP IT MAY BE SAID THAT THE LAST FEW DECADES OF THE 20^{TH} CENTURY HAVE FOCUSED OUR ATTENTION TO THE PROBLEMS OF WATER SHORTAGE WHICH WE ARE LIKELY TO FACE IN THE NEXT FEW DECADES. LUCKILY THE SCIENCE AND TECHNOLOGY HAS MADE IT POSSIBLE FOR THE HUMAN BEING TO FIND SOLUTIONS TO THE PROBLEMS PROVIDED THE PEOPLE TAKE ADVANTAGE OF IT. IT MUST BE OUR ENDEAVOUR TO PROTECT OUR FLORA AND CONSERVE

WATER TO MEET OUR NEEDS. WITH THE TECHNOLOGIES AVAILABLE AND LEGAL POLICIES IT SHOULD NOT BE DIFFERENT TO SUSTAIN OUR LIFE BY INCORPORATING ALL THE TECHNOLOGIES TO HARVEST RAINWATER.

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