

Lecture note

# Glossary

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by

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*Lecture notes have been prepared on the following topics:*

*Aggregate water balances for basinwide planning*

*Case study: Kok River Basin*

*Case study: Lower Mekong Basin*

*Environmental management*

*Floods and drought*

*Glossary*

*Good governance strategies (example from Thailand)*

*Internet applications in river basin management*

*Paddy cultivation*

*Poverty alleviation*

*Project design*

*Public administration*

*Ramayana*

*Reporting*

*River basin ethics*

*River basin management*

*Sector planning and integrated planning*

*Socio-economics*

*Strategies for natural resources and environmental management (example from Thailand)*

*Technology management*

*UTM coordinates*

*Water demand management*

*Water resource economics*

*Water user associations*

*Each note is intended as a quick introduction of a subject prepared for professional practitioners who are specialists in other subjects.*

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*Suggestions and comments are most welcome!*

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- Absolute poverty: (1) With means or consumption below a certain fixed value (for example 0,5 USD per person per day, or 2100 calories of food per person per day); or (2) lack of the means required for basic minimum needs
- Accumulation (of mass or heat): Time-wise increase within a certain volume (of water), often to a quasi steady-state level
- Accuracy: The compliance between a true and a measured or a calculated value, expressed in the physical unit of the value, and often expressed as the (estimated) standard deviation. The accuracy of a measured value can often be improved by repeating the measurement several times
- Acid soils (or sulphur acid soils): Soils that have been rendered acid due to formation of sulphuric acid by oxygenation of pyrite (natural iron sulphide, FeS<sub>2</sub>), often due to human interference (lowering of the groundwater table by drainage, or excavation of ponds for aquaculture). Such soils are unsuited for cultivation, effluents leaking from such areas can be poisonous to fish (because acid can dissolve aluminium), and the process can be practically irreversible
- Acknowledgement: A short expression of gratitude and recognition of persons or organizations who have supported the work in some way
- Acronym: A name made of initials - for example ADB, ASEAN, UNDP
- Action plan: An operational description of '*what to do, who will do it, and when*'; sometimes also '*how to do it*', in order to reach a goal. An action plan can also contain a budget, and criteria and indicators for progress monitoring. It can be structured into an hierarchy of components and/or projects and/or outputs and/or activities and/or tasks. See also strategy
- ADCP: Acoustic Doppler current profiler, an instrument that measures the vertical current profile (rather than one single point only). Can be applied at a fixed station or from a vessel
- Administrative reports: Inception report, progress reports/status reports, and other documents describing the management, progress, resource utilization, and various administrative implications and practicalities
- Advection: Mass transport determined by the flow
- Advocacy: Public promotion (of good practices)
- Aerobic: Containing free oxygen (O<sub>2</sub>), with access to free oxygen, or depending on access to free oxygen. Opposite of anaerobic
- Agenda 21 (Agenda for the 21st Century): was passed by the UN Conference on Environment and Development (UNCED) in Rio de Janeiro, 1992 (with participation by 179 countries). It is a global programme for environmental restoration, preservation and social development, facing challenges such as global warming, pollution, biodiversity and the inter-related social problems of poverty, health and population. Article 18.9 of Agenda 21 deals with integrated water resources management: *'Integrated water resources management, including the integration of land- and water-related aspects, should be carried out at the level of the catchment basin or sub-basin. Four principal objectives should be pursued, as follows: (a) To promote a dynamic, interactive, iterative and multisectoral approach to water resources management, including the identification and protection of potential sources of freshwater supply, that integrates technological, socio-economic, environmental and human health considerations; (b) To plan for the sustainable and rational utilisation, protection, conservation and management of water resources based on community needs and priorities within the framework of national economic development policy; (c) To design, implement and evaluate projects and programmes that are both economically efficient and socially appropriate within clearly defined strategies, based on an approach of full public participation, including that of women, youth, indigenous people and local communities in water management policy-making and decision-making; (d) To identify and strengthen or develop, as required, in particular in developing countries, the appropriate institutional, legal and financial mechanisms to ensure that water policy and its implementation are a catalyst for sustainable social progress and economic growth.'*
- Alluvial: Formed by river sediments. An alluvial river flows in a landscape formed by its own sediments
- Anaerobic (water): That contains no free (dissolved) oxygen; anaerobic (organism): That lives in the absence of free oxygen
- Analysis (of field data, for example hydrological data): Processing, involving a sometimes comprehensive transformation and interpretation, in order to arrive at some desired knowledge. In general, data

analysis involves both hidden and explicit assumptions about the relation between primary data and final results. (As one example, a flow rate in a river can be calculated assuming that the current measurements were made simultaneously, even if they took a whole day). Such assumptions can affect both the accuracy and the validity of the results. A suitable quality is supported by an adequate transparency of the analysis

Anthropogenic: Man-made

Aquaculture: Cultivation, aiming at commercial production, of aquatic plants or animals, such as fish, prawns, shellfish, etc.

ATR: Activity-Time-Resources, a framework for project design and implementation

Authority: (1) The right to make and implement a decision; (2) an organisation or institution with a certain power and certain responsibilities

Availability of water(in a river basin): The flow from upstream (if any) plus the (surface and groundwater) resources generated by net rainfall minus priority allocations in the basin or downstream. The availability is largely determined by the rainfall. It changes slowly - from one decade to the next, due to medium-term climate variations, or due to construction of reservoirs or diversions. The availability can be measured, and/or determined by numerical modelling, with an accuracy that is determined by the coverage and quality of the basic hydrological data

Baroclinic and barotropic fields:A barotropic volume of seawater is characterised by parallel surfaces of equal pressure and equal density, respectively, while volumes where these surfaces intersect are called baroclinic. A barotropic field can be motionless (if the surfaces of equal pressure and density are parallel with the geoid). Roughly, baroclinic flow is influenced by density differences, while barotropic flow is not

Basic minimum needs: These can comprise food and water, shelter, primary education, vital health care, and personal integrity

Bathymetry:The shape of the seabed. A bathymetric survey determines the seabed elevations

Bed load: Sand transported immediately above the sea bed or river bed, and in almost continuous contact with it, carried forward by rolling, sliding or hopping. To be distinguished from near-bed transport

Benefits of floods: The value (to agriculture, fisheries, and floodplain habitats and ecosystems) generated by floods. The value is highest on flood plains exposed to regular (seasonal) floods

Benthic: Growing/living on or in the sea bed or river bed. See also pelagic

Beri-beri: A lethal disease caused by lack of thiamine (vitamin B1). The relation between the disease and the diet was established in 1889 in Jakarta by Christiaan Eijkman (who observed chicken eating either brown or white rice) and confirmed in 1907 in Kuala Lumpur by William Fletcher (based on experiments with asylum inmates). Hereby, it was known as a fact that people eating white rice (and white rice only) would inevitably get beri-beri, and that they would recover if they shifted to brown rice - but it was not understood why. Vitamin B1 - the first vitamin to be discovered - was identified in brown rice in 1912 by Casimir Funk

Biodiversity: The number of species (of plant and animals) that actually live in an area (or biotope) where they belong. Agenda 21 (Chapter 17.7) states about coastal biodiversity: '*Coastal States, with the support of international organisations, upon request, should undertake measures to maintain biological diversity and productivity of marine species and habitats under national jurisdiction. Inter alia, these measures might include: surveys of marine biodiversity, inventories of endangered species and critical coastal and marine habitats; establishment and management of protected areas; and support of scientific research and dissemination of its results*'

BOD: Biological oxygen demand, meaning the amount of oxygen required for biological mineralisation of organic (or inorganic) degradable matter in sewage or in a natural water body within a fixed number of days. This indirect unit is widely applied because it is easy to measure in the laboratory for samples that contain a variety of (perhaps unknown) compounds. BOD is harmless in itself, but excessive supplies can cause oxygen depletion. BOD is expressed as a mass (g or kg oxygen), a concentration (mg oxygen per litre), or as a supply rate (oxygen mass per time unit)

Brackish water: A mixture of sea water and freshwater, found at places where inland waters discharge into the sea: River mouths, fjords, estuaries, lagoons, inland seas, etc. The salinity will be higher than nil, but

lower than the ocean salinity of 35 PPT. Stratification is common in brackish areas, and the salinity will often vary highly, both in time and place

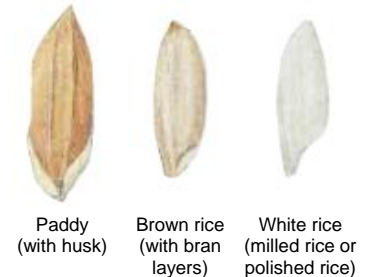
**Bran:** Outer, thin ('pericarp' and 'skin') layers of the grain, removed during the milling process (to process brown rice into white rice). Bran contains carbohydrates (starch), protein, fat, vitamins, minerals, and fibre. Removing the bran reduces the nutritional value of rice

**Bridging institution:** Service institutions that disseminate theoretical knowledge, practical experience and new technology. Often, such institutions serve a specific sector, for example aquaculture, rubber cultivation, food processing, tourism, etc.

**Brown rice** is rice that is un-milled or lightly milled, so that the bran remains <sup>1</sup>

**Buffer zone:** An intermediate area with certain restrictions on activities and/or land use, surrounding a natural reserve or an otherwise protected area

**Calibration:** (1) (of an instrument): A series of measurements where the result is known beforehand, for example by comparison with a more accurate instrument under controlled conditions, in order to determine the systematic deviation of the instrument; (2) (of a hydraulic model): A series of simulations aiming at improving the concordance between measurements and calculated results by adjustment of relevant parameters



**Cadmium in rice** is the main contributor to the human intake of cadmium in Asian countries <sup>2</sup>. Cadmium can be supplied to the paddy fields by wastewater, sludge, phosphate fertilizer, and sometimes by mine tailings

**Catchment (or drainage area):** An area (delineated by a watershed or catchment boundary) that drains through a specific river cross-section

**Chena (in Sri Lanka):** Shifting cultivation or slash-and-burn cultivation (clearing of forest, followed by cultivation for 2-3 years, after which the area is abandoned for natural restoration over a period of many years). Under a population density pressure, the cycle can be too short for recovery of the forest, in which case a serious semi-permanent degradation can occur

**CO2 quota (with reference to the 1997 Kyoto Protocol):** The amount of CO2 that can freely be emitted to the atmosphere by a country. Unused allocations can be traded

**Coastal flood:** A flood in a coastal area (for example caused by a cyclone)

**Cohesive sediments:** Fine sediments, or a mixture of fine and coarse sediments, where the particles adhere to each other in a way that influences the surface erosion of the bed. To be distinguished from non-cohesive sediments, where the surface erosion of the bed is not influenced by interaction between particles. A minor portion of fine sediments in a mixture can make the mixture cohesive

**Command area:** The area that can receive water via an irrigation scheme

**Compliance:** The extent to which a rule is observed

**A comprador:** Originally, a national employee of a (Portuguese) colonial trader, who was knowledgeable about both foreign and local language, rules, and ways of doing business, and who could hereby facilitate business relations and transactions. Today: A negative name for a person who is knowledgeable about foreign preferences, whose wealth and/or power builds on this knowledge, and who is indifferent to national interests

**Confucius:** A Chinese scholar and teacher (551-479 BC). He promoted peace, stability, and freedom based on responsibility. He considered six major relations: Parent and child; ruler and subject; husband and wife; teacher and pupil; elder and younger brother; and friend and friend. Human relations and governance should be free of selfishness and should build on mutual respect and universal ethical values that applied to everybody

<sup>1</sup> Figure from Centre de coopération internationale en recherche agronomique pour le développement, CIRAD, <http://www.cirad.fr>

<sup>2</sup> N Schouw and Jens Chr. Tjell (2003)

- Connectivity (in river basin planning):** The physical possibility for aquatic organisms to move from one place to another - for example for fish to migrate from one river branch to another
- Consensus:** General agreement. There is consensus about a decision if no participant opposes it
- Conservative substance:** A substance with no decay nor dissipation through surface or bed
- Consistency (of data):** Compliance between the quality of different data sets, produced by different methods, or at different places, or at different times
- Consistency:** Extent of resemblance over time, or from case to case
- Consistent (terminology or approach or logics):** Uniform; fitting with each other; unchanged over time; unchanged from one chapter to another, or from one report to another
- Contaminant:** A compound that has entered an environment where it does not belong. See also pollutant and xenobiotic compound
- Contingencies:** A budget allocation for unforeseen expenses
- Corruption:** Trading of favours by a person who is in control of an administrative decision
- Cost (of water):** Can be divided into operation and maintenance costs of supply and distribution system, capital costs, opportunity costs, external costs, and environmental costs. (External costs are consequential costs or benefits, or simply opportunity costs in a wider sense). See also valuation of water
- Country:** (1) same as an independent state; *or* (2) an area of land within a state, with or without its own government. (For example, Scotland is a country but not a state. Texas is a state but not a country)
- Critical path diagram:** A flow chart of outputs (or tasks) with arrows from outputs that must be produced first to outputs (tasks) that depend on them. A critical path diagram shows whether a delay is critical to the timely completion of the entire project
- Crop intensity:** The part of an area that is actually cultivated. If the whole area is cultivated in the wet season, and half of it is cultivated in the dry season (due to water shortage), the crop intensity becomes 150 %.
- Crop water requirement:** The amount of water required for cultivation of a crop, as available to the crop in the field where it grows (mm/day, mm/month or mm/crop). The crop requirement equals the evapotranspiration of the crop in question. The crop requirement is served by rainfall, soil moisture variation and irrigation. Irrigation water requirement (in FAO terminology) is the part of the crop requirement that is not supplied by rainfall or by soil moisture variation
- Crustaceans:** Spineless aquatic animals with an outer skeleton, such as crabs and shrimps
- Current velocity:** The rate of movement of the water (in m/s). The velocity is a vector, which is either described by a speed and a direction, or by 2 or 3 orthogonal components. Often, reference is made to depth-averaged current velocity without explicit mention of it
- Cyclone:** A strong depression, characterised by heavy rainfall, high wind speeds, and high storm surge set-up, particularly in shallow coastal areas. In the sub-tropics, extreme cyclones can have wind speeds of 200 km/hour or even more. In most coastal areas, cyclones are systematically monitored and can be forecasted within a period of some days, but their route is difficult to predict
- Data assimilation:** Statistically optimized estimation of the state of a system that is over-specified by a combination of time series of measured state variables and (physical) relations between them. Data assimilation can be done by integration of field measurements and simulations, with the objective of improving the quality of joint estimates of system variables
- Datum:** (1) A well-defined reference level for elevations (such as water-levels and bed levels). A datum does not need to be horizontal. WGS84 (used for GPS positioning) is not horizontal, and neither is a chart datum reflecting Lowest Astronomical Tide or Mean Sea Level; (2) a geodetic coordinate system, such as WGS84
- Decentralization:** To allocate decision-making authority to a local level (for example to an elected commune council). **Deconcentration:** To implement central decision-making authority via local departments (for example a provincial department of a ministry)
- Demand (of water):** The amount of water required for a given purpose, for example litre per person per day, or mm per crop. The demand can be present or future, and it can be actual (i.e. related to an available infrastructure) or potential (assuming full infrastructural development and no raw water shortage).

- Consumptive demand (e.g. for irrigation) relates to water that must be removed from the river, while non-consumptive (or '*in-stream*') demand (e.g. for fisheries or for navigation) relates to water that remains in the river. The serviceable (part of the) demand is limited both by infrastructure and raw water availability. The demand depends on consumer lifestyles; land use; crops and cultivation routines; and infrastructural and industrial development and technology. It can be estimated by various techniques, often with a large uncertainty. Availability and demand of water are largely independent
- Demand management:** Intervention in order to reduce the consumption of water, in order to meet a water shortage, or a shortage of funds for infrastructural development, or to improve the water efficiency. Demand management can comprise improved operation and maintenance of distribution systems (including reduction of seepage losses), green taxes to reduce the demand, awareness campaigns to change consumer habits, introduction of new crops or cultivation routines, etc.
- Demand satisfaction:** The ratio between the water that is available (at the intake from a river or a gate of a reservoir) and the withdrawal demand, at a given time for a given purpose (for example a given crop and a given cultivation routine). The demand satisfaction is 100 percent if there is enough water to serve the demand
- Demonstration projects:** are intended for confirming the site-specific, practical value of new technology (for example new crops or new cultivation routines)
- Density:** (1) (of water): Mass per unit volume. The density of sea water is determined by its temperature and salinity, and, at large depths, its pressure. Freshwater has its density maximum at 4 ° C, while sea water with a salinity above 27 PPT has its density maximum at its freezing point. (2) (of population): Number per unit area
- Deontological ethics (or '*over-riding*' ethics):** A school of ethics that assumes the existence of an absolute (universal) reference for what is good, irrespective of actual consequences. Complementary to teleological ethics
- Deterministic description:** A process description based on the laws of physics, aiming at a true description of effects on the basis of known determinants and theoretical cause-effect relationships, such as a physical law. Opposite of empirical
- Development objective(or overall objective, or development goal):** (1) the purpose of a development effort; (2) a desired future situation, which can be supported by a plan (or programme or project). The plan (or programme or project) cannot in itself assure achievement of the development objective - this is subject to a number of assumptions on related developments that are outside the control of the plan (or programme or project). Some authors recommend that only one development objective be applied from case to case, and that it be specified in time, space and quantity. See also immediate objective
- Deviation(of a survey instrument, a survey procedure, or a calculation method):** The difference between a true and a measured value, or between a desired and an actual value. The deviation is inversely related to accuracy and validity, and can be random (stochastic) or systematic
- Diffraction (of a wave):**Transformation in connection with openings and bends, for example around the head of a breakwater
- Diffusion:** (Please refer to turbulent diffusion)
- Discharge:** Net flow or net sediment transport through a fixed cross-section of a river
- Disclaimer:** A short statement that a document does not necessarily reflect the official opinions of the organisation that has commissioned (and/or paid for) the work
- Discrimination:** The (unjust) deprivation of rights for a specific part of a population
- Discussion Paper:** A provisional document, which mainly serves the purpose of communication in the course of a project. Often, it will present ideas and suggestions, or internal recommendations. A Discussion Paper can be '*upgraded*' to a Working Paper if so desired. A Discussion Paper is normally not reviewed by anyone except the author(s), so it can be circulated without formal review and endorsement
- Dispersion:** Mass transport determined by the transverse current velocity gradient and the concentration gradient (and always in the direction of the concentration gradient)
- Documents:** Can be printed or electronic; can comprise various types of reports, papers, letters, memos, and e-mails, as well as overhead handouts

**Double standards:** Unfair application of separate ethical standards for specific persons, groups or countries, so that an act that is regarded as acceptable for one person, group or country is regarded as unacceptable for a different person, group or country

**Driving force:** A circumstance that has a major (positive or negative) influence on pursuance of a set of planning goals. It can be physical, climatic, economic, or political, and can appear as a trend, a cycle, or an event. A driving force cannot be controlled by the participants in the planning process. It can be unpredictable, or not well understood, or even unknown

**Drought:** 'A period with an extraordinary water shortage' (due to the rainfall being less than normal)

**Dublin principles** (from International Conference of Water and the Environment, Dublin 1992): (1) Freshwater is a finite and vulnerable resource, essential to sustain life, development and the environment; (2) water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels; (3) women play a central role in the provision, management and safeguarding of water; (4) water has an economic value in all its competing uses and should be recognised as an economic good

**Ecological demand of water:** The minimum water level or streamflow required for prevention of irreversible ecological degradation. This demand varies over the year and from one place to another. To maintain a healthy environment, the water level and flow must be higher in the wet season than in the dry season, because many aquatic species have annual cycles that reflect the natural availability of water

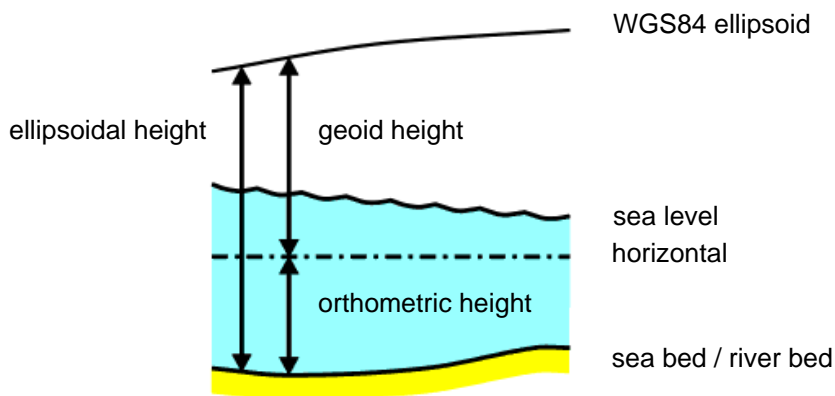
**Effective rainfall:** The part of the direct rainfall that can actually be used by the crop. For rice, the effective rainfall equals the direct rainfall. For other crops, the effective rainfall is the direct rainfall minus surface runoff minus seepage to the underground (below the root zone)

**Efficiency:** The ratio between output (for example food or money) and input (for example land, water, labour, or energy)

**Elevation (or height):** Distance above or below a datum. Wherever an elevation is indicated, the datum should be indicated as well

**Ellipsoid (for geodetic mapping):** An assumed, simplified, but geometrically well-defined shape of the Earth (a flattened sphere given by its major axis and its minor axis, which is the axis of the Earth)

**Ellipsoidal height:** Height relative to an ellipsoid



**Empirical:** Fully based on observation (for example as it is the case for a stage-discharge rating curve). Empirical knowledge cannot be extrapolated (as it is exemplified by the rating curve), and is usually unfit for prediction

**Empowerment:** Control of one's life, including personal integrity, citizenship, livelihood, norms, attitudes, and access to participation in social life and politics

- Endemic: Occurring only in one specific geographical area (for example one country, one river basin, or one island)
- Entrainment: Transport of water and mass from one water layer into an adjacent layer, determined by the turbulence level in the receiving layer and the density difference between the layers
- Environmental (or ecocentric) ethics: A school of ethics dealing with living beings and the environment
- Environmental impact assessment (EIA): A written analysis of the predicted environmental consequences of a proposed development activity, including (i) a description of the proposed project, with a map, and a list of emissions; (ii) a description of avoidable and unavoidable adverse environmental effects (together with practical mitigation measures); (iii) a description of alternatives to the activity which might be less harmful to the environment, together with the reasons why such alternatives were rejected; and (iv) a description of any required irreversible or irretrievable commitment of resources
- Error (of a calculation method): (1) same as deviation, (2) a deviation with an unacceptable magnitude
- Ethic: A standard for what is good and what is bad; ethics: The study of ethic; ethical: Related to ethic or ethics
- Eutrophication: Excessive supply of nutrients, resulting in a high primary production. Eutrophication can have negative ecological effects, such as large fluctuations of dissolved oxygen between night and day, or damage to benthic vegetation due to shading by algae
- Evapotranspiration: The loss of water from the ground to the atmosphere by evaporation and by transpiration (of plants). The rate is determined by the energy supply (by sunlight radiation), the wind speed, and the moisture of the air. Potential evapotranspiration is the capacity of the atmosphere to remove water from the ground, if water is abundantly available. Reference evapotranspiration ( $ET_0$ ) is the evapotranspiration of a well-defined vegetation cover, measured by a standard routine, and used for calculating the evapotranspiration for a given crop during its cultivation cycle (by multiplication with a time-varying crop coefficient) (Nesbitt July 2003)
- Executive power: The power to implement and enforce the laws
- Externalities: Side effects (for example of production or resource utilisation)
- Fair: In accordance with an accepted (but implicit) standard; '*on an equal basis*'
- Fees (or tariffs) can aim at cost recovery; and/or (public) income generation; and/or demand regulation (green taxes). They can be flat or progressive. They can distinguish between different uses of water (domestic, industry, etc), and/or different income groups
- Fine sediments: Clay and silt, with a grain size below 0.063 mm (cf. cohesive sediments)
- Fish yield: In reservoirs: 100 kg/ha/year (large and medium size reservoirs), 250-500 kg/ha/year (small reservoirs); cage culture in canals: 100-150 kg/year/m<sup>2</sup> of cage, or 50-60 tonnes/year/km of (primary) canal; rice paddy production: 100-200 kg/ha/year; flood plain yield 50 kg/ha/year; integrated farming systems: up to 5-15,000 kg/ha/year (based on experience from China)
- Flood exposure: The actual occurrence of a flood at a given location
- Flood preparedness: Due awareness of the flood risk, and knowledge and ability of appropriate response. An appropriate flood preparedness is supported by measures such as awareness campaigns, education, and flood forecasting services, as well as flood proofing measures
- Flood proofing: Preventive (structural and non-structural) measures to reduce the vulnerability to floods
- Flood protection: Measures (such as embankments) to reduce the flood risk
- Flood pulse: The shape of the hydrograph during a seasonal flood
- Flood risk: The general probability that a location or an area will be flooded, expressed as a frequency of occurrence, or sometimes as the relation between inundation depth, duration, and frequency of occurrence. The flood risk can be influenced in many ways by human activities
- Flood volume: The volume of the annual flood flow
- Flood vulnerability: The value lost due to a given flood (depending on the population density, land use, and infrastructure in the area)
- Flood warning: An official message to the public about an imminent, severe flood event

Flood: Expansion of a surface water body due to a water level that is significantly above average

Flood-prone: With a high flood risk

Flow: Volume transport per time unit (for example through a cross-section of a river)

Frequency: Number of cycles (or units or events) per unit time

Gauging: Measuring at a fixed point; a gauge is a measuring device (e.g. for water-level or pressure)

Geodetic survey: Mapping of geodetic coordinates (of bench marks, reference stations, etc.)

Geoid model: An empirical routine for conversion between ellipsoidal height and orthometric height (for example from WGS84 to UTM)

Geoid: A surface of equal geopotential, or a level surface, or a horizontal surface. The potential energy does not change when moving (a water particle) on a geoid. Due to irregularities in the gravity field, the geoid can sometimes be rather irregular, for example compared with an ellipsoid

Geostrophic current: A current (solely) determined by gravity, pressure, and Coriolis forces, without acceleration, friction, or tidal movement. A (pure) geostrophic current is parallel to the isobars (with the higher pressure to the right of the current direction on the northern hemisphere). A geostrophic current can be used as a model for ocean circulation, particularly for large-scale mean flow; literally, it does not occur in nature

Global Water Partnership (GWP): An international network (established in 1996) of organisations involved in integrated water resources management: Governments of developing as well as developed countries, UN agencies, multilateral banks, professional associations, research organisations, the private sector and NGOs. The activities of GWP build on the Dublin Principles

Goal: Same as purpose, or objective. (Please refer to development objective or immediate objective). (Sometimes, more strict definitions are used of words like 'goal', 'purpose', and 'objective')

Governance: Formulation and implementation of policies. Governance of natural resources is a public management process for allocation and utilisation, possibly based on legislation, an institutional framework, and policies and practices. 'Good governance' can from case to case reflect characteristics such as predictability, transparency, sustainability, value generated, and social balance. ADB recommends 4 pillars of good governance: Transparency, accountability, predictability, and participation

Government officer (or official, or civil servant): A person employed by the government to assist with the public administration

GPS (Global Positioning System): A satellite-based positioning system. Depending on the applied procedure, GPS can provide highly accurate results. A distinction can be made between stationary GPS (on land, where the accuracy can be improved by averaging), and dynamic GPS (on vessels)

Graft: Exchange of favours between friends or business relations

Greater Mekong Sub-region (GMS): Cambodia, Yunnan Province of China, Myanmar, Laos, Thailand and Vietnam. In terms of area and population, the GMS is much larger than the Mekong River Basin, because it comprises the entire countries (or province in the case of Yunnan), and not only the parts that are located in the Mekong drainage area

Green taxes: Taxes that are levied in order to regulate consumption, production or behaviour that affects pollution or utilisation of scarce resources. They aim at a better concordance between actual, immediate, direct (market) costs and total, long-term social costs (including public health, environmental impact and preservation of important resources). They can serve a fiscal purpose as well, or they can be fiscally neutral, for example if the green taxes are used for subsidies of the same sector. Green taxes can for example be levied on cars, fuel, energy, pesticides, fertilisers, water, sewage discharges, and carbon dioxide emissions

Groundwater recharge: The replenishment of groundwater with surface water

Guideline: A clear explanation of how to do, and a tool for coordination of the work. It can contain detailed step-by-step procedures; and/or check lists; and/or conceptual outlines of aspects to consider and aspects to disregard. The consistency of data and analysis can be supported by the use of guidelines

HDR: Human resources development (training)

- Hindcast simulation (of floods):** Simulation of historical flood events, for the purpose of cause-effect analysis, risk assessment or design basis, often supplemented by simulation of 'synthetical storms' or 'artificial flood events'
- Holistic (view, analysis):** (A view, analysis) of an entire system (emphasizing its internal cause-effect relationships)
- Horizontal:** A plane (or direction) which is perpendicular to the the gravity vector. A horizontal plane can be established by a traditional levelling instrument, or by hydrostatic levelling (by a long tube filled with water), but not (directly) by GPS
- Hot spot:**(1) a location with a particular pollution or environmental degradation, or with a particular risk of pollution or environmental degradation; (2) (definition suggested by the ADB Greater Mekong Sub-region programme): A forest, grassland, wetland, coastal, or marine ecosystem or ecosystem cluster that is relatively intact and functioning well biologically, and is at the same time threatened by existing or planned intervention
- Human Development Index (HDI):** An index for national welfare applied by the UN Development Programme (UNDP) for ranking and trend analyses. It is a simple average of three indicators: (1) Life expectancy (25 - 85 years); (2) literacy (0 - 100 percent) and school attendance (0 - 15 years), weighed at 2:1; and (3) Gross National Product (GNP) adjusted for national price level (called 'purchasing power parity', or PPP) (200 - 40,000 USD/person/year). In 2001, Norway ranked as no. 1 with HDI = 0.944, while Sierra Leone ranked last (as no. 175) with HDI = 0.275. The HDI of the Lower Mekong countries were: Thailand 0.768 (no. 74); Vietnam 0.688 (no. 109); Cambodia 0.556 (no. 130); and Lao PDR 0.525 (no. 135)
- Human rights:** The Universal Declaration of Human Rights was passed by the General Assembly of the United Nations on 10 December 1948. It describes basic universal rights of individuals and families, and related obligations of the state
- Hurricane:** Caribbean name for a cyclone
- Hydrograph:** A time series of water level (or stage) at a fixed location (either measured or calculated by a model)
- Hydrography:**(1) The study of the physics of the ocean (same as physical oceanography); or (2) the study of the shape of the seabed
- Hydrology:**The study of the water cycle
- Immediate objective:** The intended situation that is achieved as the direct result of orderly implementation of a plan (or programme or project). The immediate objective is the result of a number of outputs, which, between them, are necessary and adequate for achieving the immediate objective. Some authors recommend a maximum of 3 immediate objectives, and that these are specified in time, space, quantity, quality and target group. See also development objective
- Impact (of floods):** Same as effects. These can be positive and negative; and can be actual effects (of an actual flood) or potential effects (of a given, hypothetical flood)
- Incremental planning:** Planning in (small) steps, for example when development goals are unclear, uncertain, or in conflict with each other
- Incremental planning:**Planning in (small) steps, used for example when development goals are unclear, uncertain, or in conflict with each other
- Indicator (for achievements under a development project):** A measure of compliance between actual and specified results (or 'outputs'). Some authors suggest that indicators be 'important, plausible, sufficient, independent, verifiable, and precisely defined in terms of the nature, quality, quantity, and timing' (Wiggins and Shields 1995, p. 3, after Coleman 1987). Unfortunately, operational indicators tend to be less relevant, while relevant indicators tend to be less operational. Also, the different actors in a project - such as the intended beneficiaries, a host organisation, an implementing agency, a donor agency, and a consultant - may have different views on relevance and value of the different achievements
- Indigenous (species):** (Species) that belong naturally (in a biotope)
- Infiltration:**Loss of surface water by absorption and seepage into the ground. Infiltration capacity is the ability of the soil to absorb surface water. Deep infiltration is seepage from the root zone to the underlying soil layers, whereby the water becomes lost to the vegetation

- Infrastructure: 'The framework for economic activity'. Anne Lorenzen (1990) makes a distinction between (i) physical infrastructure: Roads, harbours, communication systems, etc.; (ii) economic infrastructure: Capital market, credit institutions, financial regulation, etc.; (iii) social infrastructure: Health sector, education sector, labour market, etc.; and (iv) technological infrastructure: Institutions generating and dispersing technology, scientific education, etc.
- Initial environmental examination (IEE): A written report with an assessment of possible environmental impacts of a proposed development activity, with a view to determining whether such impacts are significant, and whether a more comprehensive EIA is required
- Integrated coastal zone management (ICZM), according to World Bank guidelines from 1996: 'A process of governance that consists of the legal and institutional framework necessary to ensure that development and management plans for coastal zones are integrated with environmental (including social) goals and are made with the participation of those affected. The purpose of ICZM is to maximise the benefits provided by the coastal zone and to minimise the conflicts and harmful effects of activities upon each other, on resources and on the environment'
- Integrated farming: An area-intensive and labour-intensive combination of different parallel productions, like a fish pond, paddy, fruit trees, livestock, cash crops and vegetables. Integrated farming can give yields that highly exceed monoculture yields
- Integrated Water Resources Management (IWRM) (as defined by Global Water Partnership): A process which promotes the co-ordinated development and management of water, land and related resources, in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems
- Interface: The (more or less horizontal) boundary between layers in case of stratification, characterised by a stepwise shift of density and (often also) concentration. Occurs for example in lower reaches of rivers, where saline water penetrates from the sea, or in lagoons and estuaries. The interface can tilt due to external forcing, such as flow friction or wind stress
- Intrinsic value (of water): According to some authors, the total value of water can be split into the value of direct and indirect uses, and an intrinsic value. The latter component represents the value related to the general presence of a water resource, for example as reflected by an increased value of land near a river as compared with the value of similar land far from the river. The intrinsic value can be difficult to assess, not to speak of relating it to a flow rate
- Inundation (same as flooding): Occurrence of a free water surface at a place that is normally dry. Inundation depth is the level difference between the water surface and the ground. An inundation map shows contours of inundation depth
- Irreversible: That cannot be changed back to the original state
- Irrigable area: The area that can actually be irrigated with a specific (present or future) infrastructure (disregarding the finite availability of water)
- Irrigation: Artificial supply of water (other than rainwater) for cultivation, from groundwater, or by diversion of surface water, or by distribution or retention of flood water, or from a storage tank or reservoir. FAO makes a distinction between 5 possible sources of irrigation water: Surface water, renewable groundwater, fossil water, treated wastewater and desalinated water. Please compare with '*water-managed area*'
- Irrigation demand (or withdrawal demand for irrigation): The required gross amount of water needed to be withdrawn (from the river) to cultivate a crop, expressed in mm per crop or m<sup>3</sup>/s. It equals the crop requirement, minus direct rainfall, plus the return flow from the field to the river, plus miscellaneous losses (distribution, conveyance, and infiltration out of the root zone). The irrigation demand can be several times higher than the crop requirement - particularly for paddy cultivation
- Irrigation efficiency: The ratio between the crop water demand and the irrigation demand
- Irrigation: Artificial supply of water (other than rainwater) for cultivation, from groundwater, or by diversion of surface water, or by distribution or retention of flood water, or from a storage tank or reservoir. FAO makes a distinction between 5 possible sources of irrigation water: Surface water, renewable groundwater, fossil water, treated wastewater and desalinated water. Please refer to '*water-managed area*'

- Isobar:** A curve (at some given level) connecting points with equal pressure. **Isobaric surface:** A surface with equal pressure
- Kyoto Protocol for implementation of the (1992) UN Framework Convention on Climate Change:** An action plan, formulated in Kyoto in December 1997, for international collaboration towards stabilisation of greenhouse gas concentrations in the atmosphere
- Lead time:** The time between a (flood) forecast and the actual event
- Littoral:** Related to the near-shore zone, characterised by breaking waves. Characteristic processes are wave-generated currents, wave-generated transport of sediments and solutes, and complex 3-dimensional circulation
- Livelihood:** A way to earn a living
- Losses of water:** At scheme level, losses take place via evaporation, seepage, percolation, and release of return flows; but at the basin level, the '*lost*' volumes can often be utilized at a different time and place
- Maha (in Sri Lanka):** The north-east monsoon season (October to January), bringing rain to the northern and eastern parts of the country
- Manageable water resources (according to FAO Aquastat):** The part of the water resources which is considered to be available for development under specific economic and environmental conditions. This figure considers factors such as the dependability of the flow, extractable groundwater, minimum flow required for non consumptive use, etc. Also called water development potential
- Mangrove:** A coastal habitat, common in sheltered tropical coastal areas, characterised by salt-tolerant trees and plants growing in or near the (brackish) water
- Mapping:** Measurements covering a certain area. To be distinguished from gauging
- Marco Polo (1254-1324)** introduces Sri Lanka and comments on its coast erosion problems: 'On leaving the island of Andaman and sailing for 1,000 miles a little south of west, the traveller reaches Ceylon, which is undoubtedly the finest island of its size in all the world ... It has a circumference of some 2,400 miles. And I assure you that it used to be bigger than this. For it was once as much as 3,500 miles, as appears in the mariners' charts of this sea. But the wind blows so strongly in these parts that it has submerged a great part of this island under the sea. That is why it is no longer as big as it used to be.' (MARCO POLO: The travels, Penguin Books, 1958)
- Mean Sea Level (MSL):** The long-term average sea level, without influence from waves, tide, or any short-term variations, but influenced by average river discharge and salinity, and average wind, air pressure, and current. Therefore, Mean Sea Level is not horizontal. Please refer to orthometric height
- Mekong River Commission (MRC)** is a permanent regional body formed by Cambodia, Laos, Thailand and Vietnam. Its mandate is laid down in the 'Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin', or the 'Mekong Agreement', which was signed by the member countries in Chiang Rai on April 5, 1995. The Mekong Agreement includes articles on intra-basin and inter-basin use of the Mekong River in the dry and the wet season, and charges the MRC Joint Committee with preparing and proposing rules for water utilisation and inter-basin diversions. The predecessor of MRC, the 'Committee for the Coordination of Investigations of the Lower Mekong Basin', was established by the same countries on 17 September 1957
- Mercator, Gerardus (1512-1594):** Inventor of the Mercator map projection, which projects directions (compass sightings) as straight lines, while the length scale is distorted, and the shortest way between two points is generally projected as a curve. The Mercator projection is used for navigational charts. See also UTM
- Microcredit:** Small loans extended by an institution to poor people, with the objective of improving their livelihood (for example by buying a tool, seeds, or some livestock). In some schemes, repayment is collectively pledged by a user group. Impressive positive experience from the Grameen Bank in Bangladesh (founded by dr. Yunus in 1983) has served as an inspiration to many other countries
- Milestone:** A major, visible achievement with a target date (for example the Inception Report). Most outputs are milestones
- Minister:** A member of the government (who holds certain executive powers)
- Ministry:** A government department, headed by a minister, and performing the tasks assigned to the minister

- Mitigation: Reduction or neutralisation (of some negative consequence). Same as alleviation
- Mixing: Transport by diffusion or dispersion, i.e. transport of mass in the direction of the concentration gradient, and without transport of water
- Model: (i) A simplified description of a part of reality, preferably on a well-defined basis; (ii) a simplified but well-defined description of selected, assumed relations within a part of a system (used for analysis of that system); (iii) a software system for analysis of natural phenomena
- Moisture content (in rice): Paddy is best milled with a moisture content of 14%<sup>3</sup>. Many rice buyers apply an upper limit of 12-12.5 % for milled rice. The official upper limit for Thai Hom Mali rice is 14 %
- Monarchy (or kingdom): A state governed by a monarch - compare with *republic*. In an absolute monarchy, the monarch holds all the powers of the state. In a constitutional monarchy, the monarch shares the power with other bodies. Most monarchs are hereditary
- Monsoon: Regional weather pattern, characteristic to South and Southeast Asia, determining the prevalent seasonal variation of wind direction and rainfall
- Morphology (of a landscape, coast or a river): (1) its shape, (2) the study of states, processes and effects related to the shape
- Mud: Unconsolidated fine sediments
- Nation: A group of people living in an area of land and with some shared identity, for example a common language and/or culture and/or religion. (A nation does not in all cases have its own government). (Examples: Greenland, which is part of Denmark; Kurdistan, which extends across several countries). A nation state is a state with a shared culture
- Natural flow (according to FAO Aquastat): The amount of water which would flow in natural conditions, i.e. without human influence
- Near-bed sediment transport: Sediment transport in the lowest part of the water column, where the suspended sediment concentration is usually highest, but where sediment sampling and flow measurements are for practical reasons particularly difficult
- 'Negative social heritage' (or 'inherited poverty'): The phenomenon that children of poor people have an increased risk of a life in poverty, even if formally offered equal opportunities (such as access to education)
- Nepotism: Giving preference to family members when selecting a candidate for a job
- Net current: A non-orbital current component (for example an ocean current averaged over at least one tidal period, or a wave current averaged over several wave periods)
- Nutrients (in aquatic ecology): Dissolved salts that are essential for primary production in the aquatic environment. A nutrient can control the rate of the primary production, if all other necessities (like other nutrients, light and carbon) are plentiful. Key nutrients are nitrogen and phosphorus. Eutrophication (or 'over-nourishment') is caused by excessive supplies of nutrients by sewage or by agricultural runoff
- Objective (1) (same as goal): Please refer to development objective or immediate objective; (2) (about criteria) (opposite of subjective): Clear, unambiguous, undistorted by arbitrary judgement
- Operational, (1) (about criteria): Measurable, or otherwise objectively verifiable; (2) (about strategies): Clear, objectively implementable
- Opportunity costs: The cost difference between one course of action and another (better) course of action. In a wider sense, the implications of one course of action relative to alternative strategies. In development projects, the opportunity costs can reflect the time lag from when a new technology emerges and until it becomes available to the target group. There is often an opportunity cost related to doing nothing
- Opportunity window: A shift between 'technological regimes', represented by access to a new technology, which can change the balance between for example centralised/decentralised development, or large-scale/small-scale development. The new technologies can for example be within agriculture, food

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 IRRRI website, [http://www.knowledgebank.irri.org/grainQuality\\_loband/module\\_3/02.htm](http://www.knowledgebank.irri.org/grainQuality_loband/module_3/02.htm)

processing, information technology, etc. One example is access to high-yield varieties of rice. The outcome need not be positive in all respects

- Optimal solution (or Pareto-optimal solution): (1) A solution with 'absence of a distributable surplus' (Maurice Allais 1943); (2) a state where nobody can be made better off without someone being made worse off. In planning, it is normal that there is a whole profile of optimal solutions, from low-value-and-low-cost solutions to high-value-and-high-cost solutions. In river basin planning, a solution that is optimal for a sub-basin can be sub-optimal for the entire basin. Please compare with sub-optimal solution
- Orthometric height: Height relative to a horizontal reference level
- Overland flow: The flow of water on the ground from precipitation to streams located at lower elevations. Occurs when the infiltration capacity of an area soil has been exceeded
- Paddy: (1) a field where rice is grown; (2) rice in its husk (also called rough rice)
- Parboiled rice is soaked, cooked and dried before it is milled. As compared with ordinary white rice, the milling efficiency is higher. Parboiled rice has a different taste and texture. and needs a somewhat longer cooking time. Some countries have a traditional preference for parboiled rice
- Pareto-optimal solution (after Vilfredo Pareto, Italian economist, 1848-1927): Please refer to optimal solution
- Parliament: A body in charge of legislation. A parliament can have one or several chambers, with members that are elected or appointed
- Pathogen (organism): (An organism) that causes a disease
- Peak (in a record): An anomaly of short duration, as compared with previous and subsequent levels of an observed or simulated variable
- Pelagic: Living in the free water column. See also benthic
- Perceived poverty: The state of a person considering himself/herself as being poor
- Percolation, seepage: Flow through a porous material. Some authors distinguish between seepage ('horizontal' leakage through a bund) and percolation ('vertical' leakage through the soil layers to the groundwater)
- Perennial: That takes place all year. A perennial river flows all year. Perennial crops grow (and need water) all year
- Period: (Please refer to time scale)
- Photosynthesis: The primary production (by plants, algae and some bacteria) of simple carbohydrates (such as sugar), normally from (inorganic) carbon dioxide, and using energy supplied by the sun
- Phytoplankton: Photosynthetic aquatic microorganisms (algae)
- Pilot projects Projects intended for full scale testing of new, potential solutions to complex problems - while demonstration projects are intended for confirming the site-specific, practical value of new technology (for example new crops or new cultivation routines)
- Pollutant: A compound that is harmful or otherwise undesired in the environment, either absolutely, or at an elevated concentration level. See also contaminant and xenobiotic compound
- Pollution: (1) release to the environment of a substance that can harm it; (2) any direct or indirect alteration of the physical, thermal, chemical, biological, or radioactive properties of any part of the environment by the discharge, emission, or the deposit of wastes so as to affect any beneficial use adversely or to cause a condition which is hazardous to public health, safety or welfare, or to animals, birds, wildlife, aquatic life, or to plants of every description
- Populism: Popular (but sometimes short-sighted and unsustainable) policy-making, intended to please a majority of the people
- Position paper: A technical progress report, normally serving the purpose of communication during the work, often for a specific purpose, and often confined to one subject
- Potential yield (according to FAO Aquastat): Total amount of water resources, be it surface water or groundwater, generated by the hydrological cycle on a yearly basis. It is a physical concept, and is equivalent to the natural resources
- Poverty (or 'income poverty'): 'Lack of means to maintain an acceptable standard of living'

**Power:** The ability of a person, group or institution to effectuate one's preferences in competition with alternative preferences of other persons, groups or institutions. Power can be legal (based on law), or informal, or based on tradition

**Precipitation:** Rainfall and snow reaching the ground

**Predictability:** The extent to which an aspect (such as a response, a decision, a requirement, or a cost item) is known beforehand; opposite of arbitrariness (of a response, a decision, a requirement, or a cost item)

**Priority allocations (of water in a river basin):** Allocations to serve important demands (like human consumption or ecological demand) in the basin or downstream of the basin

**Procedure (for a study):** The combination of applied (software) tools and practices; (for a field survey): The combination of applied instruments and practices

**Procedure:** (1) A description of how to do something (for example how to make a decision); (2) a way to do something (for example make a decision)

**Project:** A set of related activities (often carried out by a team) with a common goal, and often carried out according to a budget and a time schedule. A project can form an element of a structured entity of activities, which are, between them, also called a project

**Province (in SE Asian countries):** A major administrative unit, part of a state, sometimes with partial internal independency. A province is governed by an (appointed or elected) governor and/or by its own elected council

**Puddling (of paddy fields):** Softening (by various operations) of the top soil layer before transplanting, at the same time levelling the soil surface and destroying weeds, while maintaining a low permeability of the sub-soil (to reduce percolation losses)

**Pyrite:** Iron disulphide. Please refer to acid soils

**Quality management:** General management or project management addressing the quality of produced services



**Quality:** The compliance between an actual and a specified or desired property (or set of properties) (for example the actual contents of a report as compared with the specified or desired contents). Within hydraulic modelling, quality characteristics can comprise accuracy, resolution, transparency, validity, relevance, costs, delivery time, and several other aspects

**Ramsar area:** A wetland area designated with reference to the 'Convention on Wetlands of International Importance especially as Waterfowl Habitat', passed in Ramsar (Iran) in 1971

**Rating curve:** A relation between stage and discharge, used for generating time series of discharge from time series of water-level (which is easier to gauge). Based on a series of joint measurements of stage and discharge, or calculations, or both

**Record:** Set of related data, either a time series (for example of water-level), or an array (for example of position, depth, and current velocity), or a time series of arrays

**Recording cycle (or data logging cycle) (of an electronic instrument):** The sampling routine, for example defined by a registration period and -interval ('10 minutes every hour'), and a sampling frequency ('2 readings per second'). The single, basic reading (of for example an echo-sounder) is often filtered by averaging before or after it is stored. If so, a recorded value can originate from a series of single readings, each of which has a better resolution but a poorer accuracy than the recorded value. Therefore, the performance of an electronic instrument is related to the applied recording cycle. Also, the data storage capacity can influence the choice of the recording cycle

**Recording:** Please refer to registration



**Red tape:** Delays or obstruction caused by time-consuming procedures in the government system. (Originally, the red tape was used for assembling document files in the Indian public administration)

**Redundant** (words or paragraphs or even chapters): Unnecessary (for example a duplication, literal or logical, or not required in the context, or not required for the purpose of the document)

**Reference:** A basis for comparison (in planning for example 'present situation', or 'future situation without intervention')

**Reflection** (of a wave): The returning of a wave after hitting a barrier, such as a hard, vertical seawall. Reflection can result in wave height amplification and standing waves. Often (but not always), breakwaters are designed to reduce wave reflection by absorbing the wave energy

**Refraction** (of a wave): The transformation (of speed and direction) of a wave approaching the shore, due to depth differences

**Registration:** (1) Same as measurement and same as recording, is sometimes distinguished from observation (which involves some elements of arbitrary judgement); (2) please refer to recording cycle

**Relative poverty:** (1) With means that are inadequate for a living standard that can reasonably be expected in the social environment; (2) belonging to the lower part of the national income distribution (for example 'with an income of less than half of the median income')

**Renewable resources**(according to FAO Aquastat): Natural resources that, after exploitation, can return to their previous stock levels by natural processes of growth or replenishment. Total resources that are offered by the average annual natural inflow and runoff that feed each hydrosystem (catchment area or aquifer). The total actual renewable water resources is the sum of internal renewable water resources and incoming flow originating outside the country, taking into consideration the quantity of flows reserved to upstream and downstream countries through formal or informal agreements or treaties.; this gives the maximum theoretical amount of water actually available for the country. The total natural renewable water resources is the sum of internal renewable water resources and natural incoming flow originating outside the country

**Republic:** A state governed by a president, who shares the powers of the state with other bodies, elected by (or with a mandate from) the general public - compare with *monarchy*

**Resolution** (of a survey instrument or a simulation): The smallest increment of the true value that can be reproduced by the applied procedure. The variation can be in time, space, or with respect to the measured value (current speed, water-level, etc). The resolution is not related to the accuracy, except as a limiting factor

**Rice species:** Rice (*Oryza*) is one of around 600 members of the grass (*Poacea*) family of plants. Two species (of about 22) are cultivated. *Oryza glaberrima* (African rice) is native to Sub-Saharan Africa, where it was domesticated in the upper Niger River Basin some 2-3,000 years ago. *Oryza sativa*, (Asian rice), domesticated 10-15,000 years ago, is by far the prevalent cultivated species. It has thousands of varieties, covering a broad span of properties. Long-grain rice (*indicas*) and short-grain rice (*japonicas*) are groups of varieties. Well-known varieties are (the aromatic) basmati rice (from India and Pakistan) and (the aromatic) Thai jasmine rice (Thai Hom Mali)

**River basin:** The catchment of a river

**Rule:** A description of what to do or what to decide under specific circumstances

**Saline intrusion:**Inflow of saline sea water into the lowermost parts of a river basin in periods with low river discharge. Can be detrimental to many uses of the freshwater resource (domestic supply, irrigation, etc). Can sometimes be controlled by gates or weirs

**Salinisation:**Gradual accumulation of salt in the topsoils, for example in connection with irrigation

**Salinity** (of sea water): Relative mass of the salt contents, given in PPT (parts per thousand) (kg per 1,000 kg), or in PSU (practical salinity units) (which is very nearly the same as PPT)

**Scenario:** A possible future situation, which is the result of a (hypothetical) combination of events, developments and conditions. For example, a scenario can reflect 'business as usual' (= no intervention); accelerated

technological development; low and high development of irrigation systems; a series of dry years; and/or alternative modes of demand regulation and other intervention in water availability and water demands. For basinwide planning, a distinction (suggested by MRCS/WUP-A, 2003) may be made between a 'planning scenario' of circumstances outside the control of the planning (climate, energy prices, population growth), and a 'development scenario' of such circumstances + the related demand (of water) + interventions to meet this demand. The latter would comprise 'a unique combination of hydrological circumstances, demands, and interventions to try to meet those demands'. Please compare with 'driving forces'

Seasonal flood: The annual flood in a (large) river with a typical seasonal stage variation (for example determined by a monsoon weather system, and/or by the melting of snow during summer)

Secchi depth: The transparency of a water body, registered as the depth at which a painted 'Secchi' disc remains visible

Sector planning: Planning for a specific source of income, like agriculture, fisheries, hydropower, industry, service, tourism, etc.

Seepage: Slow movement of water in the ground, or from the ground to the surface

Seiche: Long-periodical wave (which can cause disturbance in harbour basins)

Self-interest occurs when citizens, politicians, bureaucrats and states use the authority of government for their own benefit. Citizens use political influence to get access to benefits allocated by government; politicians use government resources to increase their hold on power; public officials trade access to government benefits for personal reward; and states use their power to get access to the property of citizens. The result is an inefficient and inequitable allocation of resources, general impoverishment and reduced freedom (Paul Streeten 1994)

Settling (or sedimentation): The downward transport of suspended substance under the influence of gravity

Simulation period: The period that is described by a simulation

Simulation: A specific reproduction, by numerical modelling, of the time variation of a natural system. Can be divided into hindcast simulation, 'now-cast' (or real-time) simulation, and forecast simulation

Solute: A dissolved substance (that is transported by advection, mixing or entrainment, but not by settling, and which will affect the density of the water)

Spate: An abrupt flood with a short duration, often carrying large amounts of sediment. Spate irrigation (a traditional technology in many semi-arid areas) draws water from spate flows

Spheroid (for geodetic mapping): An assumed, simplified, but geometrically well-defined shape of the Earth

Stage (of a river): Same as water-level

Stage: Same as water level (of a river)

Stakeholder: A person, group or institution that has a particular interest in an activity, project, programme or policy. This includes both intended beneficiaries and intermediaries, winners and losers, and those involved in, or excluded from the decision-making process. A key stakeholder is one who can significantly influence or who is otherwise important to the success of the activity, project, programme or policy

Standard: (1) A reference for what is acceptable; (2) same as normal; (3) same as rule. (4) in ecology, a distinction can be made between an 'indicator standard' and a 'habitat standard'. This is in order to avoid confusion caused by the different meanings of an 'environmental standard'. An indicator standard is an acceptance level (or 'tolerance limit') for an environmental indicator (for example x mg/l of a pollutant). A habitat standard is a desired environmental state (for example a healthy fish breeding ground). The former is operational, while the latter is conceptual. Often, habitat standards are defined by a political process, while indicator standards are defined in guidelines prepared by professional specialists

State (as a management unit): (2) A area of land controlled by a government. Federal states (like The United States, Germany and Malaysia) are formed by a number of individual states, which are partly independent with respect to internal affairs; (2) the governing institutions

State (of a system): The actual appearance of a system, at a given time, or under given conditions

Step (in a record): An abrupt shift in the general level of values. (The time step of the record is something different, namely the applied, fixed time increment)

Strategic: 'Long-term and goal-oriented'

Strategy: A conceptual framework plan for how to reach a goal; or a set of principles that will assist in reaching a goal. See also action plan

Stratification: Occurrence of separate layers with different density. Mass transport between such layers will proceed much more slowly than within each layer. (In deep-water oceanography, stratification is sometime used as a term for a gradual, rather than step-wise, density increase with depth). See also interface

Sub-optimal (or inferior or deficient) solution: (1) A solution with an unallocated surplus; (2) a solution where the value can be increased without increasing the costs, and/or where the costs can be reduced without reducing the value. Please compare with optimal solution

Subsistence economy: An economy serving own household needs only

Survey: A specific data collection programme (of field measurements or interviews)

Sustainability (1) (according to the UN World Commission on Environment and Development, the 'Brundtland Commission', as reported in 'Our Common Future'): Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs; (2) environmental sustainability means avoidance of irreversible conflicts with a desired state of the environment (for example groundwater being suited for drinking); (3) a donor agency considers a project as sustainable if it provides adequate benefits to the target group for a certain period of time (preferably many years) after project completion

Synergy: Mutual stimulation or amplification of two parallel processes, whereby their joint (positive or negative) effect becomes larger than the sum of the effects of each individual process. The existence of synergy effects is a part of the background for integrated planning

Tariffs: Please refer to fees

Technical report: A document that describes one or several outputs (or results) of the work

Teleological ethics (or 'goal-oriented' ethics): A school of ethics that assumes the reference for what is good is related to the aim, consequences and usefulness of the decision. One example is the school of utilitarianism. Complementary to deontological ethics

Thalweg: The deepest part of a river or a flow channel; the line connecting the points of maximum depth of each cross-section

The Third World: A loosely delineated term for those countries that are non-industrialised and/or developing and/or poor and/or non-aligned during the Cold War and/or located in Africa or Asia. The expression refers to the underprivileged Third Estate ('the Commons') of pre-revolution France

Thematic planning: Planning for a specific topic that affects different sectors, like water resources, the environment, education, public health, poverty alleviation, etc.

Tide: Today, the same as astronomical tide. Earlier, the word was used for any type of long ocean waves, irrespective of their origin

Time scale (or period, in statistical terms): A time interval that is characteristic for a specific phenomenon (for example a turbulence pattern or a tidal variation). A description of the phenomenon requires a fair number of measurements within one time scale. By averaging a record over several time scales, the phenomenon will become concealed (aliased, in statistical terms)

Topographic survey: Mapping of land elevations

Transparency (1) (of rules and decisions): The extent to which rules and procedures are publicly known; (2) (of a decision): The extent of public knowledge about who made the decision, by which authority, and on which basis

Transparency (2) (of a procedure): The insight conveyed to the data user about how the data were produced, for example for assessing the validity of the data for a given, possibly unforeseen, purpose. (of public administration): The insight conveyed to applicants, owners, operators, and to the general public about

the basis for a decision. An acceptable transparency is obtained by documentation and can be supported by using standard procedures

Transplanting<sup>4</sup>: Traditional lowland cultivation often comprises sowing the rice in nursery beds, and transplanting the seedlings after a period of 12 days to 6 weeks. Transplanting requires intensive labour within a short period of the cropping calendar. Depending on site-specific conditions, this can give a higher yield (but a longer cultivation period, and hereby a higher risk of drought exposure), as compared with direct seeding (or broadcasting)



Trend (in a record): A gradual change of the general level of values

True value (of a parameter or variable): An ideally correct value, determined without any errors whatsoever, and expressed in a standard unit. A true value can be instantaneous or averaged over a certain period of time, and it can relate to an infinitesimal point or be averaged over a certain length, area or volume

Tsunami: A long wave (or a short series of long waves) generated by a submarine earthquake, with a typical period of 15-20 minutes. A tsunami can propagate over long distances across the ocean and can cause an extreme surge in coastal areas

Turbulent diffusion: Mass transport determined by the turbulence level and the concentration gradient (always in the direction of the concentration gradient, and without any net transport of water)

Typhoon: Chinese name for a cyclone

Utilitarianism: A school of ethics assuming that the right decision is the one that gives maximum value to the largest number of people

UTM (Universal Transverse Mercator) grid: A geodetic grid of the Mercator type, which features a true projection of angles and a slightly distorted projection of distances. The grid divides the Earth into 60 zones, each of which spans 6 longitudinal degrees, and each of which is aligned along a meridian. The scale distortion is small, and the grid coordinates, eastings and northings, are orthogonal. They are given in m or km from a defined point of origin located on Equator (on the northern hemisphere) or 10,000 km south of Equator (for the southern hemisphere) and 500 km west of the central meridian. Hereby, all coordinates become positive. Except on the central meridian, the 'north' and 'east' directions of the UTM grid deviate slightly from geographical north and east, and the shortest distance between two points is only approximately a straight line

Validation (of a numerical model): Same as verification. Comparison between results produced by a calibrated model and measurements (other than the ones used for calibration), for confirmation of the intended accuracy of the results

Validity (of data): The compliance between a pursued and an actual value. Even if both are accurate, the validity can sometimes be low, for example due to time and space variations (such as flow determination based on a single-point current recording)

Valuation (of water): The direct value to users of water can be expressed in terms of crop yield, production output, generated energy, environmental quality, or money, expressed per unit of water, or as a function of quantity. The total value of water is the direct value, plus a net benefit of return flows, benefits from indirect uses, a societal value, and an intrinsic value (reflecting access, ownership, amenity, etc). See also cost of water

Value of natural bioresources (after Pearce and Moran 1994): Can be divided into (1) direct value, related to uses such as timber production, fisheries, etc.; (2) indirect value, representing benefits deriving from ecosystem functions such as flood control, storm protection, soil conservation, etc.; (3) option value of a potential future use of the resource, for example as a genetic material, for pharmaceuticals, etc.; (4) bequest value, representing the benefit accruing to the knowledge that others might benefit from the

<sup>4</sup>

Photo: YANMAR Agricultural Equipment Co., Ltd. (2003), <http://www.yanmar.co.jp>

- conserved resource in the future; and (5) existence value, which is the value of the continued existence of a resource, irrespective of whether or not it will ever be used
- Value of natural bioresources (after Pearce and Moran 1994): Can be divided into (1) direct value, related to uses such as timber production, fisheries, etc.; (2) indirect value, representing benefits deriving from ecosystem functions such as flood control, storm protection, soil conservation, etc.; (3) option value of a potential future use of the resource, for example as a genetic material, for pharmaceuticals, etc.; (4) bequest value, representing the benefit accruing to the knowledge that others might benefit from the conserved resource in the future; and (5) existence value, which is the value of the continued existence of a resource, irrespective of whether or not it will ever be used
- Variable (in nature): A changing property that can be measured
- Vector-borne disease: A disease transmitted by an organism (for example malaria)
- Virtual water: Water represented by a traded commodity (for example rice). (1 kg of milled rice may represent 3-6 m<sup>3</sup> of water). (If so, for example, Thailand would export some 30 km<sup>3</sup> of virtual water per year, represented by the country's rice export)<sup>5</sup>. The opinion is offered that this line of thinking is not entirely fruitful - the comparative value of the traded commodity may be quite different from the comparative value of the 'virtual water'
- Viscosity coefficient: The proportionality coefficient between the velocity gradient and the shear stress. To be distinguished from the eddy viscosity coefficient, which is the exchange coefficient for momentum
- Wadi (adopted from Arabic): A river that is dry in most of the time, with occasional and abrupt flows, possibly originating from a mountainous catchment
- Water development potential: Please refer to manageable water resources
- Water logging: Formation of a stagnant water volume in the root zone, impeding or preventing cultivation, caused by lack of drainage. Can for example occur in connection with impoundment for flood protection, road construction, and/or due to lack of maintenance of drainage systems
- Water pricing: A tool for management of water allocation between areas, sectors and individual users, assuming that an 'optimal' allocation (or just a sustainable allocation) can be determined on the basis of a water price that reflects the full costs (and hereby the full value) of water (for example, in economic theory, by charging the full costs and relying on free market mechanisms for allocation). Such a strategy can improve water efficiencies and reduce waste of water. It will often give preference to industrial allocations rather than irrigation. See valuation and cost of water
- Water use: The part of the consumptive demand that is actually served at a given time. Many uses generate a return flow, (for example sewage, or irrigation tailwater). The return flow can occur at a different time or place than the withdrawal (for example a storage reservoir retaining water for release in a different part of the year). The use of water can be increased by infrastructural development and reduced by demand management
- Water-managed area (according to FAO): An area on which water, other than direct rainfall, is used for the purpose of agricultural production. The term irrigation refers to that part of the water managed areas that are equipped to provide water to the crops: (i) Areas equipped for full and partial control irrigation; (ii) spate irrigation areas; and (iii) equipped wetland or inland valley bottoms
- Watershed: (1) A line in the landscape (e.g. a ridge) that delineates a catchment. The surface runoff on each side of the watershed will proceed towards different locations. (2) In American English, a watershed is the same as a catchment or a drainage basin. Watershed management: Management of land use within a watershed
- Wave current (or wave-generated current): Current related to the wave motion, and oscillating with the period of the wave. Near a coast, the wave current can contain a pronounced net component that can carry pollutants or sediments
- Wave: An orbital movement of water particles, caused by the wind, the tide, or other external forcing. Internal waves (in a stratified water body) are related to interface oscillations, rather than surface oscillations

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<sup>5</sup> The total export of virtual water from Thailand has been estimated at 47 km<sup>3</sup>/year (1995-99) (Hoekstra and Hung 2002)

- Wetland:** An area that is covered by water in at least a part of the year. A wetland can represent a special ecological habitat, sometimes with a high biodiversity, and can serve as a fish breeding ground. The Ramsar convention defines wetlands quite broadly as 'areas of marsh, fen, peat-land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including marine areas with a depth less than 6 m at low tide'
- WGS84 (World Geodetic System 1984):** An ellipsoidal (and hereby geometrically well-defined) geodetic coordinate system applied for GPS positioning
- White rice (or milled rice or polished rice):** The inner rice grain, consisting mainly of starch. Milling increases the storage time and reduces the cooking time, but removes the protein, fibre, vitamins and minerals
- Win-win solution:** A solution (or strategy) where all stakeholders gain an advantage, and no stakeholders suffer a disadvantage (Examples: Reforestation of barren lands; recycling of waste)
- Withdrawal demand:** Same as irrigation demand
- Working Paper:** An internal and, sometimes, provisional document, which mainly serves the purpose of communication during the work. It can present summary descriptions of 'facts', or open ideas and suggestions, or recommendations. It is often confined to one subject
- Xenobiotic compound:** A (harmful or harmless) compound that is foreign to a biotope in which it occurs. See also contaminant and pollutant
- Yala (in Sri Lanka):** The southwest monsoon season (May to August), bringing rain to the southern, western and central parts of the country
- Yield (of rice):** Production (in t/ha/crop or t/ha/year). In the Lower Mekong Basin, the annual yield is 1.9 t/ha/year (Cambodia 2000), 2.0 t/ha/year (NE Thailand 2001), 2.9 t/ha/year (Laos 1999) and 4.1 t/ha/year (Viet Nam, Mekong Delta 1999). Yields are higher in the dry season than in the wet season (where the solar radiation from the clear sky is higher, even if the day length is shorter) <sup>6</sup>
- Yield gap:** The (often significant) difference between an actual and a potential yield. A distinction can be made between (1) the gap between the potential theoretical yield and the experiment station yield; (2) the gap between the experiment station yield and the potential farm yield; and (3) the gap between the potential and the actual farm yield. Narrowing yield gaps not only increases rice yield and production, but also improves the efficiency of land and labour use, reduces production costs and increases sustainability <sup>7</sup>

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<sup>6</sup> H. Nesbitt (May 2003)

<sup>7</sup> FAO (2004c)

### **Appendix 1: Water resources data terminology used by FAO**

(from the FAO Aquastat website: [http://www.fao.org/ag/agl/aglw/aquastat/water\\_res/indexglos.htm](http://www.fao.org/ag/agl/aglw/aquastat/water_res/indexglos.htm))

- Average precipitation (mm/year and km<sup>3</sup>/year): Double average over space and time of rainfall on the country in a year.
- Average evapotranspiration (mm/year and km<sup>3</sup>/year): Represents the actual rate of water uptake by the plant which is determined by the level of available water in the soil.
- Dependency ratio (%): That part of the total renewable water resources originating outside the country.
- (External) groundwater inflow (km<sup>3</sup>/year): Average quantity of groundwater annually entering the country (usually restricted to large aquifers shared by several arid countries).
- (External) groundwater outflow into neighbouring country (km<sup>3</sup>/year): Average quantity of groundwater annually leaving the country to other countries (usually restricted to large aquifers shared by several arid countries).
- (External) renewable water resources (km<sup>3</sup>/year): Part of the country's renewable water resources shared with neighbouring countries.
- (External) surface water / outflow not submitted to agreements or treaties (km<sup>3</sup>/year): Average quantity of water leaving the country (including to the sea) and not submitted to treaties.
- (External) surface water / flow of bordering rivers (not submitted to agreements or treaties) (km<sup>3</sup>/year): Average quantity of water annually reaching the country through bordering rivers.
- (External) surface water / outflow to be reserved through agreements or treaties (km<sup>3</sup>/year): Average quantity of water to be reserved by treaty for a downstream country.
- (External) surface water / inflow secured through agreements or treaties (km<sup>3</sup>/year): Average quantity of water entering the country which is secured through treaties.
- (External) surface water / inflow not submitted to agreements or treaties (km<sup>3</sup>/year): Average quantity of water annually entering the country through trans- boundary flow (rivers, canals, pipes). This figure concerns only the flows which are not submitted to a formal agreements or treaties.
- Internal renewable natural water resources (IRWR) (km<sup>3</sup>/year): Average annual flow of rivers and recharge of groundwater generated from endogenous precipitation.
- Manageable water resources (km<sup>3</sup>/year): Part of the water resources which is considered to be available for development under specific economic and environmental conditions. This figure considers factors such as the dependability of the flow, extractable groundwater, minimum flow required for non consumptive use, etc. Also called water development potential.
- Natural flow (km<sup>3</sup>/year): The amount of water which would flow in natural conditions, i.e. Without human influence.
- Overlap between surface and groundwater km<sup>3</sup>/year): That part of the water resources which is common to both surface water and groundwater.
- Potential yield (km<sup>3</sup>/year): Total amount of water resources, be it surface water or groundwater, generated by the hydrological cycle on a yearly basis. It is a physical concept, and is equivalent to the natural resources.
- Renewable resources: Total resources that are offered by the average annual natural inflow and runoff that feed each hydrosystem (catchment area or aquifer). Natural resources that, after exploitation, can return to their previous stock levels by natural processes of growth or replenishment.
- Total actual renewable water resources (km<sup>3</sup>/year): The sum of internal renewable water resources and incoming flow originating outside the country, taking into consideration the quantity of flows reserved to upstream and downstream countries through formal or informal agreements or treaties. This gives the maximum theoretical amount of water actually available for the country.
- Total natural renewable water resources (km<sup>3</sup>/year): The sum of internal renewable water resources and natural incoming flow originating outside the country.
- Total natural outflow (km<sup>3</sup>/year): annual natural outflow of surface and ground waters from a country into the sea or a neighbouring country. In the Aquastat calculation sheet, only the outflow into the neighbouring countries are accounted (natural in general; actual if there are reservation for downstream countries).