

WMO Flood Forecasting Initiative Strategy & Action Plan (SAP) and the Activity Plan review

Commission for Hydrology

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History of the WMO FFI

- 2002 – WMO Secretary General raised a need in Flood Forecasting and Warning Activities;
- 2003 – Preparatory Expert Meeting on Improved Meteorological and Hydrological Forecasting for Flood Situations:
 - WMO Action Programme on Flood Forecasting and Warning (**objective and expected results**);
 - Regional workshops; collaboration with TCs: CHy, CBS, CAS, CCI, JCOMM;
- 2003-2006 – 8 regional workshops on “Improved Meteorological and Hydrological forecasting for Floods” (status of flood forecasting activities, deficiencies);
- 2006 – Synthesis Conference (key challenges for HMHSs , **the SAP**, implementation of the SAP);
- 2007 – Resolution 21 (Cg-XV): “Strategy for the enhancement of cooperation between NMSs and NHSs for improved flood forecasting” (to endorse the SAP);
- 2008 – Resolution 3 (CHy-XIII): “To supplement the SAP on the FFI with a detailed activity plan that will assist Members in establishing flood forecasting systems”;
- 2009 – workshop on the SAP of the WMO FFI (consolidated **Activity Plan** of the SAP);
- 2011 – Resolution 15 (Cg-16): “To establish the WMO FFI Advisory Group (FFI-AG)”
- 2013 – 1st FFI-AG meeting (Work plan of the FFI-AG);

FFI Objective and expected results

FFI Objective

Improve the capacity of meteorological and hydrological services to jointly deliver timely and more accurate products and services required in flood forecasting and warning and in collaborating with disaster managers, active in flood emergency preparedness and response.

Expected results

- a) Improved quantitative and qualitative weather forecasting products are available in such a way that these can be directly used for flood forecasting;
- b) Medium-range weather forecasting and climate prediction tools can be applied to extend warning times and produce pre-warning information;
- c) NMHSs have improved their capacity to cooperate to jointly deliver timely and accurate flood forecasting information;
- d) Integrated weather, climate and hydrological forecasting information are available in a relevant format for use by civil organizations responsible for disaster preparedness and mitigation.

Key challenges for NMHSs

Fig. 1 - Overall Status of National Flood Forecasting and Warning (FF&W) Services
[sample - 86 countries]

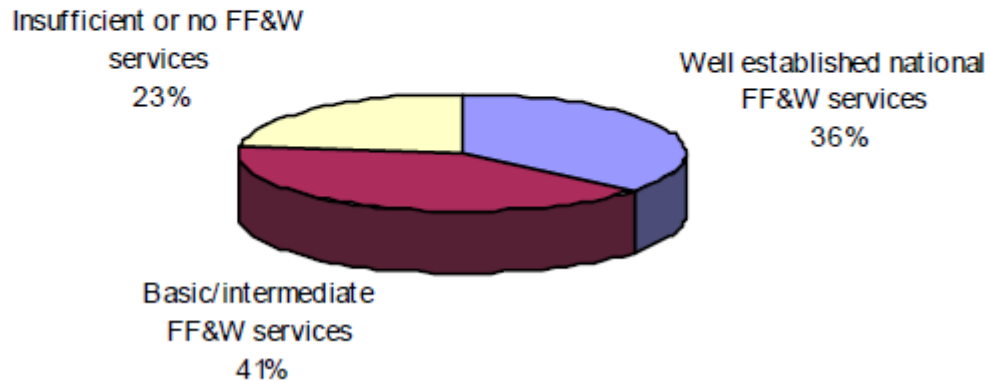
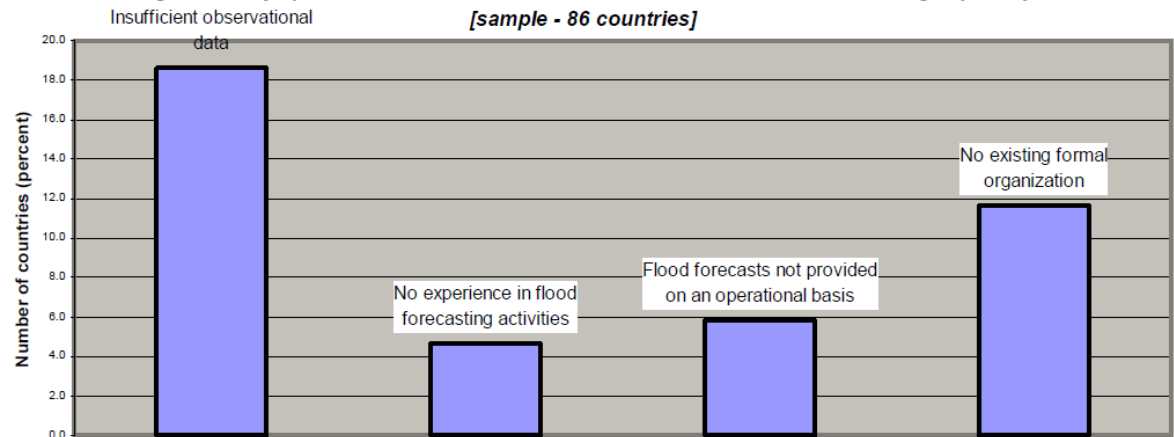


Fig. 2 Main symptoms of insufficient or non-existent national Flood Forecasting capability



Key challenges for NMHSs

Basis – country survey (86 countries)

Major issues:

- a) Strengthening of observing and information systems
- b) Promoting data exchange at national and international river basin levels
- c) Improvement of meteorological forecasting practices and products
- d) Improvement of hydrological forecasting practices and products
- e) Strengthening of institutional coordination, cooperation and integration between NMHSs
- f) Strengthening of cooperation and coordination of countries in issues related to flood forecasting and warning
- g) Promoting training and capacity building in NMHSs
- h) Formulating technical documentation and guidelines related to flood forecasting and warning

Complementary issues

- i) Supporting disaster management
- j) Addressing climate variability and change in the light of extreme events
- k) Demonstrating the value of meteorological and hydrological data, information and products (including forecasts)

Strategy for the enhancement of cooperation between NMSs and NHSs for improved flood forecasting

– Resolution 21 (Cg-XV)

The SAP would serve as a guide to TCs and WMO Secretariat in all activities related to improving flood forecasting capabilities worldwide.

- (1) identifies areas of activities (core and complimentary);
- (2) promotes the preparation of national implementation plans;
- (3) suggests the implementation of demonstration projects;
- (4) advocates the establishment of a regional framework under which partnership and development assistance could be provided;
- (5) addresses requirements of well-established EWFFS for their further improvement

SAP Scope and Expected Results

SAP Objective

To produce more accurate, timely and reliable forecasts and warnings of weather, climate, and water and to improve the delivery of weather, climate, water and related services to the public, governments and other users

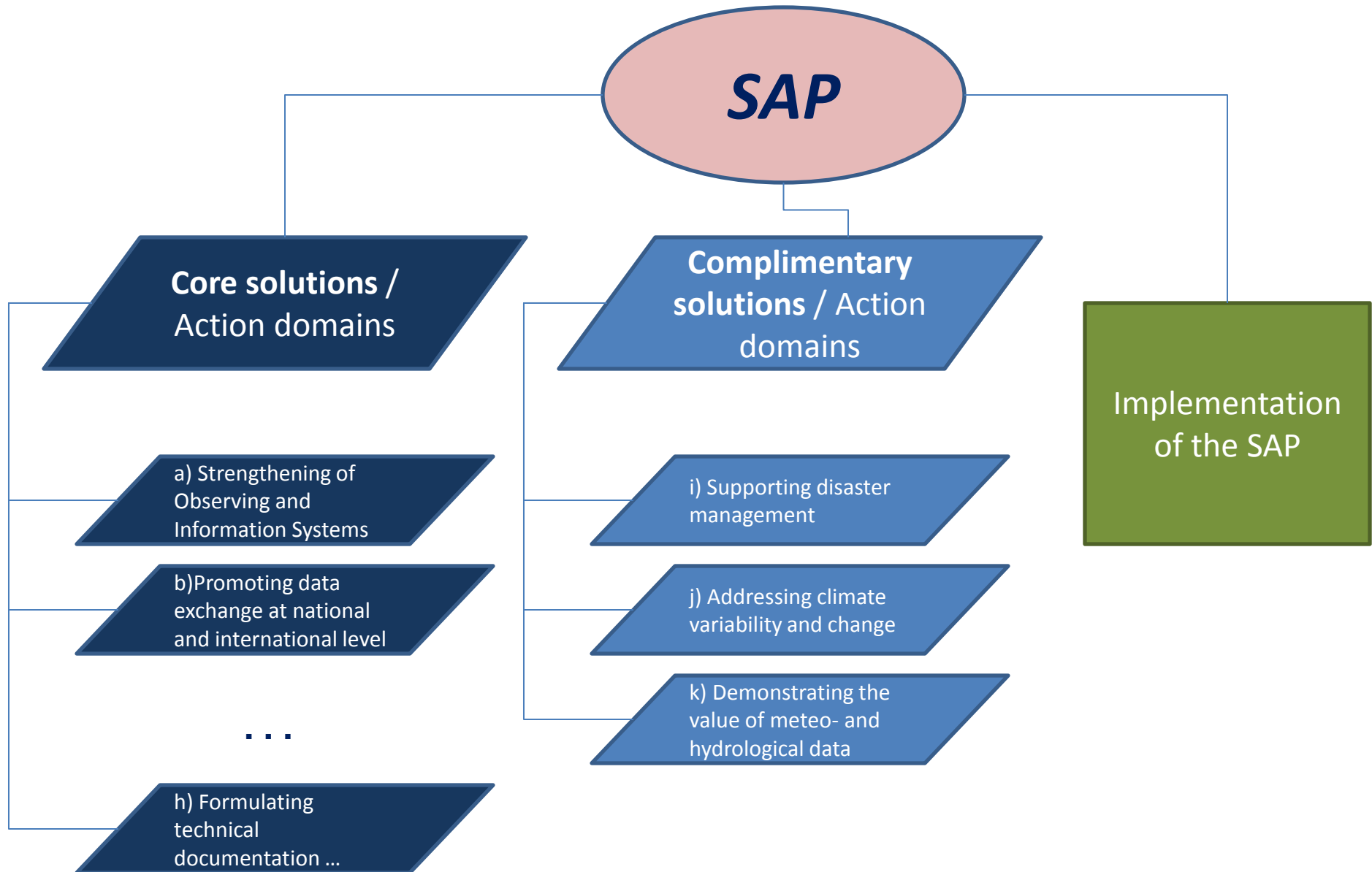
Expected results

- a)** Improved quantitative and qualitative weather forecasting products are available in such a way that these can be directly used for flood forecasting;
- b)** Medium-range weather forecasting and climate prediction tools can be applied to extend warning times and produce pre-warning information;
- c)** NMHSs have improved their capacity to cooperate to jointly deliver timely and accurate flood forecasting information;
- d)** Integrated weather, climate and hydrological forecasting information are available in a relevant format for use by civil organizations responsible for disaster preparedness and mitigation.

The WMO SAP

- Developed on the basis of the outcome of the series of regional workshops/expert meetings (2003-2006), with the view of addressing the identified key challenges for NMHSs;
- Adopted during the Synthesis Conference (2006);
- National implementation of the proposed actions;
- Guide to the WMO Technical Commissions and WMO Secretariat in all activities related to improving flood forecasting capabilities worldwide;
- Promotes the preparation of National Implementation Plans (in accordance with current national and regional flood forecasting capabilities);
- Suggests the implementation of demonstration projects at various level (country-specific, subregional and regional projects).

SAP document structure (WMO, 2006)



Core solution 1 – Strengthening of observing and information systems

- a) Develop and implement for upgrade and strengthening of the meteorological and hydrological.
- b) Plan the establishment of reliable and redundant real or near real-time data transmission systems.
- c) Ensure that the instruments are in compliance with WMO standards.
- d) Recipient countries of externally funded projects need to ensure compatibility and interoperability.
- e) Periodic reviews, assessments and revisions of hydrological networks.
- f) Prepare and implement plans to evaluate the need for meteorological radar networks.
- g) Encourage the development of improved techniques for the estimation of observed rainfall from satellites.
- h) Take steps to periodically assess, adapt and/or adopt new emerging observing technologies.
- i) Put in place mechanisms to improve quality of measurement and accessibility of data.
- j) Promote and provide support to WHYCOS components and other regional and national projects
- k) Take appropriate steps to ensure the continuous maintenance and sustainability of observing networks.
- l) Where necessary, there should be a close collaboration in the design of hydrometeorological networks.
- m) With the assistance of WMO Regional Associations where assess the possibility of donor support.
- n) Countries should strengthen joint networks and national systems of hydrometeorological information.
- o) WMO should assist efforts to improve the status of hydrometeorological forecasting in the Mediterranean countries.

Core Solution 2 – Promoting data exchange at National and International River Basin Levels

- a) Align policies in the area of data exchange - Resolutions 25 (Cg-XIII) and 40 (Cg-XII).
- b) Establish or strengthen cooperation in issues related to real-time and historical data exchange at the national, international and transboundary river basin levels.
- c) Establish or strengthen international agreements on data exchange.
- d) Design and establish adequate data collection and sharing mechanisms.
- e) Develop a standardized approach to ensure data compatibility.
- f) Develop and establish communication systems.
- g) Consider the use of the WMO Information System.
- h) WMO should urge NMHSs to establish and exchange metadata to enable greater insight into data availability and access.
- i) WMO should look for innovative methods of transferring well organized information systems and flood forecasting systems such as SAIH¹³ (or an adaptation thereof) to other Mediterranean countries, for example through pilot projects. [RA-I/VI] DEMO PROJECT.

Core Solution 3– Improvement of Meteorological Forecasting Practices and Products

- a) NMSs should consider the hydrologists' needs in terms of meteorological forecasts.
- b) Develop or continue the development/improvement QPE and QPF technique.
- c) Promote arrangements to deliver NWP products for further use at local level.
- d) Promote the use of MRWF on an operational or semi-operational basis.
- e) Continue improvement of the meteorological.
- f) Provide advice to NHSs, through specialized meteorologists in the field of forecasting.
- g) Provide advice to NMSs and NHSs on aspects of downscaling.
- h) Study and undertake downscaling of global.
- i) Development of calibration techniques for radar and satellite derived data.
- j) Consider the application of tools of an international nature.
- k) WMO should promote and organize efforts including case studies (ice and snow floods).
- l) Develop and make available state-of-the-art NWP products and techniques.
- m) Continue the development of long-range hydrological forecasting.
- n) Develop decision-support systems to assist forecast users.
- o) WMO include in its future plans actions to improve the capacities of NMSs for developing meteorological products for flood forecasting, particularly QPF and probabilistic QPF.
- p) NMSs pertaining to a certain WMO Region to consider developing jointly, as required, the relevant products for hydrological use in through enhancing their capability in QPF, use of available technology such as ensemble products, and NWP to guide QPF forecasts. [RA I, SADC]

Core Solution 3– Improvement of Meteorological Forecasting Practices and Products

q) WMO, with the support of members of Regional Centers, to assist in arranging the distribution, possibly free of charge, to the NMHSs of the countries (as required), of the products generated by the European Centre for Medium- Range Weather Forecasting (ECMWF). In addition, such arrangements are also to be sought with other European Agencies in which members of Regional Centers participate, in particular EUMETSAT. [RAs III/IV]

r) WMO to promote and support the international exchange of research addressing the improvement of intense rainfall forecasts in the Mediterranean basin, through projects such as MEDEX. [RAs I-VI. This action should be extended to all member countries that would require such assistance.]

Core solution 4 – Improvement of Hydrological Forecasting Practices and Products

- a) Prepare detailed national requirements assessment as a basis to jointly develop NMS and NHS tailor-made forecasting products.
- b) Plan and implement improvements in flood forecasting systems.
- c) Take steps to strengthen or upgrade, as required, the application of data management and data assimilation procedures and improved methodologies and models for flood forecasting.
- d) Define and assess the NHSs' needs in terms of meteorological forecasts, with a view to integrate meteorological inputs in flood forecasting.
- e) Develop and adapt hydrological models that suit the user needs as well as the characteristics of the river basin and level of risk.
- f) Exchange software and data/information for hydrological forecasting and prediction.
- g) Provide professional guidance to other NHSs that are developing their flood forecasting abilities and skills in the selection, adaptation, calibration and use of hydrological models to suit operational requirements.
- h) WMO to promote the application, as required, of remote sensing information for flood forecasting.
- i) Undertake, as required, storm surge modelling activities, possibly in collaboration with other countries of regions that are similarly affected.

Core solution 4 – Improvement of Hydrological Forecasting Practices and Products

- j) Use the probabilistic forecasts from the ensemble prediction systems.
- k) Continue the development of meteorological ensembles coupled with hydrological models for improving long-range hydrological forecasting.
- l) Expand the forecast products' provision to include long-range hydrological forecasting.
- m) Develop/improve hydrological modeling for extension and interpolation of hydrological data needs in areas where the networks are inadequate.
- n) Develop decision support systems to assist local authorities, civil protection agencies.
- o) Consider and ensure the participation and involvement of local communities in activities related to hydrological forecasting and warning.
- p) Promote steps in filling gaps in historical time series of data.
- q) Promote steps in using data assimilation in hydrologic models.
- r) Promote the collection of real time data for flood forecasting purposes.
- s) Provide guidance for floodplain mapping and for addressing specific issues.
- t) Countries are encouraged, with WMO's support, to participate actively in the EUMETSAT SAF-Hydrology projec
- u) WMO to include in its future plans actions to support development and outreach activities between NHMs on effective methods to incorporate probabilistic products into their hydrological forecasting, when possible.
- v) In the case of design and implementation of technical assistance projects with external funding it should be ensured that the relevant characteristics of the basins are addressed, the actual capabilities of the NHMs are taken into account etc.

Core solution 5 – Strengthening of Institutional Coordination, Cooperation and Integration between NMSs and NHSs

- a) Review the issue of administrative and legal reforms required for improved arrangements for flood forecasting and warning
- b) Develop a checklist of common areas of cooperation between the NMSs and NHSs.
- c) Develop a standardized communications and operation terminology for meteorologists and hydrologists in flood forecasting and flood risk management .
- d) Establish guidance for enabling involvement of all stakeholders in the development and operation of flood forecasting services, especially at the community level.
- e) Expose hydrologists to operational meteorological forecast activities and vice versa.
- f) Establish joint working groups of hydrologists and meteorologists.
- g) Promote and encourage dialogue, cooperation and exchange of expertise between the meteorological and societies.
- h) Develop a policy of closer collaboration between the NMHSs and academia.
- i) Ensure that hydrologists and meteorologists participate equally in relevant meetings..
- j) Encourage NMSs and NHSs to issue joint bulletins.
- k) Continue the organization of fora, under the WMO strengthening of institutional capacity of countries exchange of experience in the field of flood forecasting and warning.

Core Solution 6 – Strengthening of Cooperation between Countries in Issues related to Flood Forecasting

- a) Promote dialogue between NMSs and NHSs.
- b) Foster twinning agreements between NMSs and NHSs with the objective of sharing know-how and technology in improved cooperation.
- c) Set-up focal points between riparian states of an international basin.
- d) Encourage and promote close links between hydrological, meteorological and civil defence groups and services within the countries at the basin level.
- e) Establish agreements for the provision of flood forecasting and warning services.
- f) Promote access to NWP products, observations and forecasts between countries.
- g) Establish networks using a cascade of information from the global level through regional and catchment based groups in the developing countries.
- h) WMO and international river basin organization to also consider support to those countries where international rivers represent only a minor share of the total of their water resources so as to also strengthen their national for flood forecasting and warning activities and allow workshops.
- i) Latin American countries to strengthen their joint.
- j) WMO should also consider possibilities of assisting the Sava River countries (Albania, Bosnia and Herzegovina, Croatia, Serbia, Montenegro a Sava Initiative for improving their forecasting systems.
- k) Countries concerned, with the assistance of WMO, consider the strengthening of the Drought Monitoring Centre (DMC) of SADC countries to address hydrological forecasting

Core Solution 7 – Promoting Training and Capacity Building in NMHSs

- a) Identify staff training requirements as regards meteorology and hydrology.
- b) WMO to plan and execute capacity building programmes that include training activities for meteorological and hydrological forecasters.
- c) WMO to review and periodically revise the training programmes aimed at providing NMSs and NHSs staff so as to meet the challenge of emerging technology.
- d) Provide training on different aspects of hydrological forecasting.
- e) Plan and undertake capacity building activities and the development/adaptation/improvement of hydrological forecasting models.
- f) Plan and provide training for the development of user-oriented products.
- g) WMO to assist in the organization of regional training activities as required.
- h) Ensure regular budget allocations for staff training and continuing education.
- i) Encourage WMO to continue to assist training of staff of NMHSs in developing countries and developed countries.
- j) Ensure that following training, participants are provided with the data, information, software, hardware and other tools necessary to implement the training in their own organizations.
- k) Develop a specific educational//training package targeted at flood forecasting related to the occurrence of tropical cyclones.
- l) Use pilot projects to support capacity building and education opportunities in relation to flood forecasting.

Core solution 8 – Formulating Technical Documentation and Guidelines related to Flood Forecasting

- a) Prepare guidelines for the dissemination of flood forecasting products to include probability statistics aimed at enhancing their utility for end-users.
- b) Compile documentation on the effects of flooding to help amongst others demonstrate to decision-makers the benefits of a flood forecasts.
- c) Undertake a compilation of regional experiences in the use of improved techniques for meteorological modeling, including QPE and QPF, for flood forecasting.
- d) Make available documentation on the state of development of ensemble forecasting techniques related to flood forecasting.
- e) Develop guidelines for data quality control and management associated with flood forecasting (including the evaluation of forecast accuracy).
- f) Case studies should be used in guidance material to demonstrate best practice in flood forecasting.

Complimentary solution 1 – Supporting Disaster Managers

- a) Link forecasting services to socio-economic factors including the development of a standardized methodology for damage assessment.
- b) Promote the development of standardized methodologies for impact and damage assessment and information linked to hydrologic forecasting services.
- c) NMHSs should be actively involved in the national disaster response system.
- d) Consider strengthening the role of NHSs in disaster management.
- e) Chose and establish a multi-hazard approach in terms of observation systems, telecommunications and the development and communication of forecasting products, ensuring a close cooperation between NMSs and NHSs.
- f) Re-enforce links with national disaster managers.
- g) Develop common regional warning Internet websites for meteorology/hydrology information for disaster risk management.
- h) Develop risk-qualified hazard maps.
- i) Promote public education and awareness with regard to flood maps and flood management.
- j) Develop decision support systems to assist local authorities, civil protection, etc. in taking the necessary preventive measures.
- k) African countries concerned to study and undertake accordingly a realistic reorganization of the ORSEC (disaster relief organization) plans in place, so as to bridge gaps and rectify weaknesses, through awareness-raising amongst the various stakeholders, capacity-building. [RA-I]

Complimentary solution 2 – Addressing Climate Variability and Change

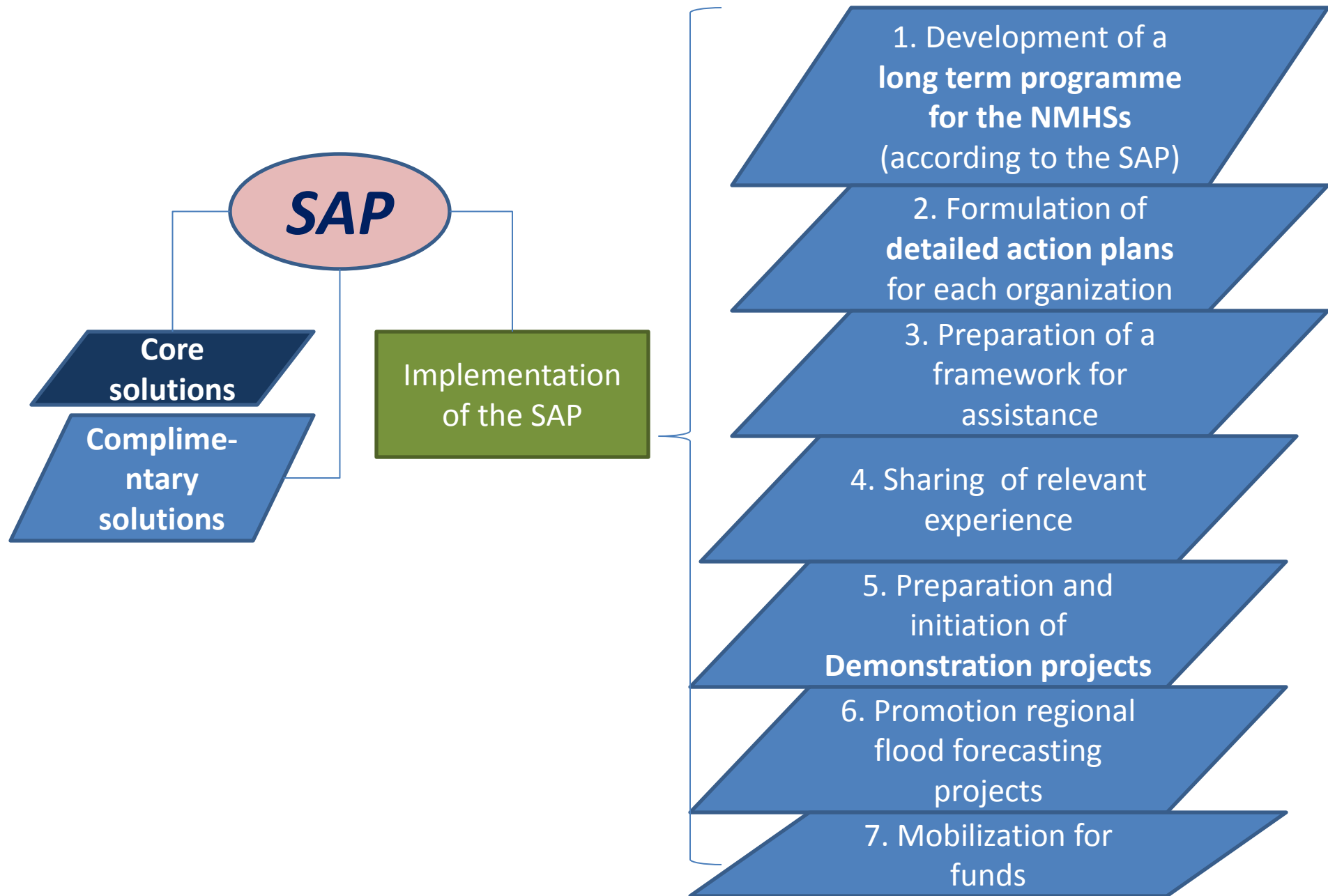
- a) Initiate or continue studies on basin, national and regional levels examining the hydrological effect of climate variability and change on flood frequency and magnitude so as to be able to adapt the flood forecasting and warning systems as required.
- b) Review new developments in climate indices/signals (e.g. ENSO) for use in hydrological studies and water management.
- c) Plan and undertake studies to examine the effects of La Nica and ENSO events on the respective affected regions as a whole and its individual countries.
- d) Undertake studies on the use of climate prediction for assessing changes in the availability of fresh-water resources.

Complimentary solution 3 –

Demonstrating the value of meteorological and hydrological data, information and products

- a) Develop and implement a programme to raise general awareness of the social and economic importance of flood forecasting of NMHS in order to ensure the required financial, technical and staffing support for these services.
- b) Compile documentation on the effects of flooding to help demonstrate to decision-makers the benefits of a flood forecasting system.
- c) Governments should, where required, increase support to the NMHSs to enable them to provide appropriate and timely flood forecasting to their nations and fulfil their national, regional and international obligations.
- d) NMHSs should take advantage of the World Meteorological Day and the World Water Day celebrations to promote and disseminate information on the role and value of NMHSs.

Steps proposed for implementation of the SAP



Activity Plan of the SAP

2008 – Resolution 3 (CHy-XIII): “**To supplement the SAP on the FFI with a detailed activity plan that will assist Members in establishing flood forecasting systems**”;

Development of implementation plans (detailed activity plan) took in account different level of priority, capacity, implementation means and constrains for every WMO region.

For every single action of every Solution/Action domain of the SAP activity plan was developed (2008):

Action	Priority I - III	WMO RA I - VI	Capacity level I-III	Implementation means	Constraints
Action (a)					
Activity I: ...	I	III and VI	A and II	Investments to implement the network	Financial recourses could ne limited for investments

Activity 1.b - According to the proposed criteria, review the SAP and subsequently the Activity Plan. Assess the validity of the concept, objective, and the SAP; and advise on adjustments, where necessary.

SAP review proposal 1

Deficiency	Proposed action
<p>WMO FFI goal and expected results are not strict – it is quite spread around collaboration between MHSs and NHSs, and is not really focused on particular measurable result. Leads to broad list of proposed actions, that cover almost all issues of operational hydrology.</p>	<p>Adjust the goal of the FFI – make it more strict, efficient and measurable. The goal could be for example "National Meteorological and Hydrological Services develop and implement effective flood forecasting and early warning systems".</p>

SAP review proposal 2

Deficiency	Proposed action
<p>FFI, and thus FFI SAP is not limited in terms of lead time – all ranges are included in consideration. However flood forecasting typically is doable at short to medium time ranges (depending on NWP skill, river basin size etc). In the result SAP covers flash floods, riverine floods, long-range predictions, climate risk assessment...</p>	<p>Limit FFI with medium range perspective (up to 10 days) - the period where it is possible to actually issue flood forecast (not flood risk estimation). The proposal leads to limitation of the SAP and AP in the same manner.</p> <p><i>Resolution 21 (Cg-XV)</i> – all types of floods and all possible lead-terms</p>

SAP review proposal 3

Deficiency	Proposed action
<p>The SAP coverage is very broad and covers all possible water-related activities. There are too many SAP Action Domains and these contain too many actions, resulting in a SAP that is hardly achievable.</p>	<p>The SAP should be adjusted and many different actions should be removed from the SAP. The number of the Action Domains should be reduced by combining existing ones. For example, the Action Domains could be reduced to four: data, meteorology, hydrological modeling, and final products.</p>

SAP review proposal 4

Deficiency	Proposed action
<p>Implementation strategy of the SAP appears to only be successfully accomplished through Demonstration Projects (out from 7 items) such as CIFDP, SWFDP, and flood forecasting-related projects, such as GFFGS.</p>	<p>Adjust SAP implementation strategy.</p> <p>Leave Demonstration Projects (check their parameters according to the SAP actions and recommendations).</p>

SAP review proposal 5

Deficiency	Proposed action
<p>The SAP approach and its documentation are too lengthy and complex, resulting in its not being transparent nor it's being broadly adopted.</p> <p><i>e.g.:</i> SAP – Solutions – Action Domains – Action – Activity Plan – Activities – ...</p>	<p>New, simpler documentation for all aspects of the SAP including concepts and terminology should be developed.</p>

Activity Plan review proposal

Deficiency	Proposed action
<p>It is not obvious that Country Members, WMO Secretariat, FFI Demonstration Project developers use the Activity Plan in their operations. The Activity Plan makes it even more difficult to track the SAP actions implementation. There is no person (or body) who controls the Activity Plan progress.</p>	<p>Create new FFI implementation strategy instead of the Activity Plan, possibly with accounting for some of proposed activities and information of the Activity Plan.</p>

Overall questions

- 1. FFI goal adjustment** (more strict and flood forecasting systems oriented);
- 2. New survey of NMHSs capacities, deficiencies, ...**
- 3. Retool the SAP:**
 - limit with short- to-medium term forecasts;
 - limit areas;
 - adjust terminology;
 - update (done based on 2003-2006 survey).

Overall questions

4. Adjust SAP implementation strategy:

- concentrate on Demonstration Projects and flood related projects (e.g. GFFGS);
- make sure they cover recommendations of the SAP;
- motivate further implementation.

5. Target audience of the SAP (WMO Secretariat, TCs)?

Overall questions

- 6. Target audience of the SAP (TCs, WMO Secretariat)?**
- 7. Roadmap (checklist, to do list) for NMHSs development/upgrading flood forecasting systems (possibly based on the Activity Plan)**
- 8. Retool Activity Plan (according to the SAP adjustments).**