FIJI ISLANDS: *FLOOD MANAGEMENT - REWA RIVER BASIN*

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Abstract. Information is provided about the approach and experience on flood management and mitigation in the Rewa Basin (Fiji). This consists mainly of a combination of structural measures (river dredging, seawalls and floodgates) with non-structural ones (flood forecasting). The description provided of what has been so far accomplished to reduce flood damage reduction problems is accompanied by an assessment of what still needs to be done to address all issues in a holistic manner, so as to reach an IFM. This is complemented with information on existing flood and water management instruments and on plans for legislation to support a comprehensive sustainable development policy. The role of gender and in particular women in flood-related activities is described. The information provided in this case study could well be used to transfer experience to other basins with similar geographical and socio-economic development conditions

1. Location

Fiji comprises over 300 islands, 109 of which are permanently inhabited. The majority of these islands lie between longitudes 176^0 50'E and 178^0 W and latitudes 16^0 S and 20^0 S. The total land area of 18 272 km^2 is dispersed in territorial waters of 141 800 km^2. All major economic activities are based in two main islands, Viti Levu and Vanua Levu, which support the majority of the population of 775,077[2]. The Rewa River is on the island of Viti Levu**.**

Viti Levu has a central mountain range generally dividing the island into the leeward dry western and windward wet eastern area. Rugged mountains with perpendicular cliffs and pointed peaks are common on the plateau. The Rewa River flows from the central high lands to the southeast. It has narrow flood plains running into the well-rounded hills in the middle catchment. Two thirds of the way down-stream the river plain widens; at the lower reach the river meanders and in the delta splits into several tributaries. The catchment area is 2960 km^2 at Nausori Bridge.

The flood plains and delta are prone to floods. They have fertile soils which support agricultural crops and a dense population. The urban population of Nausori Town is 5,744 and an additional 15,873 people live in the peri-urban area[2]. The watershed including the delta has a population of approximately 196,000 people.

2. Nature of floods

Tropical Cyclones are the principal cause of major floods. Rainfall begins while the centre of the cyclones is still some distance out at sea. As it approaches rainfall intensity increases. Rapid runoff from an already saturated catchment results in extensive floods. Other severe weather events with high intensity rainfall also cause floods, but these are of lower magnitude and less frequent.
On average, 15 tropical cyclones affect Fiji each decade and each one causes high intensity rainfall. The magnitudes of floods are dependent on the tropical cyclone system, its distance from land, its intensity, and its movement and speed. Flash floods are infrequent and damaged restricted to smaller sub-catchments. Storm surges exacerbate flood levels on the coastal zone. When the eye of the tropical cyclone passes close to shore or traverses land surges are inevitably generated. Floodwater discharge is restricted and riverbanks are often breached. Seawalls are over-topped with large storm surge.

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[2] Population figures from 1996 census

Between 1983 to 2003 seven major floods affected Fiji with damages and lives lost. Tropical Cyclone Kina flood (January 1993), followed a severe drought induced by the El Nino event of 1992/93, was the most severe in recent history, with damages amounting to some USD 100 million and 23 lives lost. In the Rewa watershed people from the urban, peri-urban and rural areas sustained damage and losses. Across the country more than 120,000 people (approximately 10% of the population) suffered serious losses and had to be supplied with food rations for up to six months to cope with the disaster.

The flood-induced losses have serious social and economic implications. Relief and rehabilitation costs are high. The national GDP and government's development plans and programmes are adversely affected. Resources earmarked for capital development works have to be urgently redirected for relief and rehabilitation.

3. Flood management measures

Dredging of the Rewa riverbed is the major structural flood management measure to increase flood discharge capacity. The low gradient of the bed in the lower reaches of the river system has high sedimentation. The dredged material is used for construction of roads, buildings and raising village sites to provide relief from floods. However, high sediment loads call for costly continual dredging.

Most of the flood plains with established infrastructure and agriculture are subjected to flood damage. Only in Nausori town the levee has been developed into a park. Some, albeit small areas that have suffered frequent floods are dedicated for grazing. Similarly some farmers have restricted flood prone lowlands to grazing or cultivation of flood-tolerant crops.

Plentiful supply of freshwater does not warrant use of floodwaters yet, and no mechanisms are in place for use or storage of floodwaters. The Monasavu hydropower dam is the only storage facility that captures a relatively small amount of floodwater; otherwise all floodwater is discharged to the sea. Flow from small adjacent catchments is drawn into the dam via a tunnel. There is no pressing demand for storing large quantities of water, although in recent years water shortage has been experienced because of the increase in energy demands and high inter-seasonal variation in rainfall.

In many low-lying flood prone areas a number of drainage schemes have been established by the *Drainage Board*, a statutory authority. A network of drains and out-fall structures (floodgates) enable floodwaters to escape and prevent seawater entering, helping prevent water logging and assisting rapid drainage. The *Board* levies a charge to land users[3] to meet the maintenance and operation costs. However, during the dry season the drains get infested with weeds, which are washed into the floodgates thus exacerbating flood problems.

At the river mouth along the delta sea walls prevent seawater intrusion into farmland. Out fall structures or floodgates prevent seawater entering but discharges floodwaters out to sea. Some 40 floodgates and 85 km of sea wall are in place along the coast.
As a non-structural measure, a flood forecasting system is in place and has operated for the last two decades. Real or near real-time data on water levels and rainfall is collected from a network of six stations by radio telemetry at a central base Office. A computer model makes forecasts of river levels at flood prone locations. Reports received of river levels at certain locations by telephone directed at relevant authorities are made available. Regular update from the *National Meteorological Service* on the location, intensity, movements and direction of tropical cyclones is received in regular bulletins. The *Hydrology Section* of *PWD* makes its own continual assessment of the situation using all available data and information.
Forecasts and early warnings of impending floods are issued to alert the habitants, and have effectively been instrumental in reduced damage and losses. Because of the short lead-time of floods (6 to 8 hours), adequately phrased alerts and when possible warnings are issued while there

[3] Land users are owners or lessees

is daylight for mitigation measures to be effective. Experience has shown that movement out of flood-prone localities to safety at night can be hazardous in itself.

There is heightened co-operation while data and information on the occurrence, magnitude and time of the flood event is sought. There are also discussions amongst authorities on ways to improve mitigation measures, improve timeliness and accuracy of forecasts. Soon after the event the *National Disaster Management Office* brings all interested parties together at a debriefing meeting.

While structural measures like dredging will arrest flood problems, watershed management, particularly reduction of soil erosion and sedimentation, will require attention. Restrictions on use of flood plains, hill slopes and generally improved land use practice will assist in flood mitigation. So far restriction on land use and cropping is only by persuasion and there are no authoritative regulatory provisions to affect such measures. Therefore, a cautious planning and improvement in land and water use, including the imposition of restrictions is necessary for integrated flood management.

In conclusion, the flood management measures in the Rewa as yet do not constitute an integrated system and improvement in catchment management and appropriate land use strategy is still needed.

4. Flood and water management instruments

The *National Disaster Management Act* of 1998 gives authority and provides institutional arrangement for all actions related to disaster management and related activities, and defines the functions and duties of government and relevant agencies. It also stipulates the establishment of a *National Disaster Management Council (NDMC),* that is chaired by the Minister responsible for disaster activities. The NDMC is supported by a *National Disaster Management Office* (NDMO) and three committees: the *Emergency Committee* has the central control during emergency operations, the *Preparedness Committee* is responsible for community awareness activities and the *Mitigation and Prevention Committee* initiates and co-ordinates the implementation of disaster mitigation activities.

Most of the land in the catchment is owned by indigenous land owning units. There is no specific legislation to restrict land use although a proposed *National Land Use Plan* has been prepared by the *Ministry of Agriculture Land Resettlement and Sugar*. The *Land Conservation Board* through an old *Land Conservation and Improvement Act* has powers to place restriction on land use but this has never been applied for flood mitigation.

The *Disaster Management Committee* is triggered into action at the formation stages of tropical cyclones or other severe weather conditions. It also conducts a one-week disaster awareness program before the onset of the cyclone season annually. It plans, promotes and implements disaster preparedness activities using the mass media. Public at large and school children are targeted to propagate messages.

Development of land particularly for housing and residential subdivision requires the approval of the *Town and Country Planning*. They may place restrictions on development and/or require improvements. However, use of land for agriculture in flood prone localities does not have restrictions. The insurance industry plays a regulatory role by increasing or not accepting insurance for properties and developments in flood prone areas.

5. Institutions responsible for flood management

The *Land and Water Resources Management (LWRM)* of the *Agriculture Department* is responsible for river engineering, drainage and irrigation activities. Together with the *Public Works Department* they are responsible for flood control and water shed management. *PWD Hydrology* is responsible for flood forecasting[4]. Flood forecasts are issued and disseminated through the NDMO for specific localities[5]. Meteorological data and information is freely available from the *Fiji Meteorological Service* stations through out the country. The *Fiji Public Works Department* (hydrology section) provides flood forecasts, which are communicated to the NDMO for the public.

Cabinet is the final authority and all relevant institutions are government departments. There is no central authority as such; however, during disaster the *National Disaster Management Office* plays a central coordination role.

The communities of flood prone localities are the beneficiaries of the different flood mitigation measures in place. They participate initially by offering suggestions, identifying historical flood levels and later by observing warning and making appropriate arrangements to overcome flood disaster. Both genders participate.

6. Policy

Fiji's water legislation is fragmented and out dated. A national water policy for Fiji is in the process of being drawn up, with cabinet approval, by an interim national water committee consisting of multi-ministerial and departmental stakeholders. The *National Land Use Plan* has been developed and legislative instruments for monitoring and execution is required. It will place restrictions on rural land use to encourage its prudent use. A sustainable development bill has also been drafted for legislation to support a comprehensive sustainable development policy.

The *National Disaster Management Act* (1998) is in place. The policies it contains have been developed after repeated disastrous events affected Fiji in recent years and after much consultation and reviews, which included participation of experts, government and non-government organisations, private and public sector representatives. Loss of lives, economic losses, social disruption and set back to development caused by the urgent redirection of development funds for relief and rehabilitation has resulted in the development of comprehensive policies on disaster management. Sustainable and economically viable solutions and policies are continually explored.

7. Main lessons learned

- Flood management requires an integrated approach to address all issues in a holistic manner. Issues related to land and water resources use need to be planned and executed in a manner that will reduce or eliminate risks.

- Community co-operation and participation is essential for the success of flood mitigation programmes. The Drainage Boards include members of different communities from different areas as the beneficiaries. With the latter having ownership of the scheme support for changes, improvements and reviews are undertaken with enthusiasm.

- Public awareness and education on the application of IFM is necessary. Full community participation with ownership needs to be supported with strengthened institutional arrangements and resources.

[4]Only the Rewa River has a telemetered flood forecasting system
[5] Individual areas within the river basin