

# **Water procurement and the environment: A comparative history of South Africa's Nandoni and De Hoop dams 1994-2007<sup>1</sup>**

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*Beeld* newspaper, Media 24  
Gauteng

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## ***Samevatting***

Die konstruksie van damme in Suid-Afrika het in onlangse jare uiteenlopende response tot gevolg gehad in die geledere van die omgewingsbewuste lede van die land se burgerlike samelewing. Twee voorbeelde is die De Hoop- en Nandonidam wat onderskeidelik in Mpumalanga en die Limpopoprovinsie geleë is. Hierdie damme oefen albei 'n bepalende invloed uit op die omgewing in die wêreldbekende Nasionale Krugerwildtuin (NKW). Albei is geleë in die opvanggebied van riviere wat deur die wildtuin vloei.

Hierdie damme het 'n belangrike rol om te speel. Benewens die feit dat hulle, in sommige gevalle, in van die land se mees agtergeblewe streke voorkom, het albei grootliks ten doel om ontwikkeling te stimuleer. Die Suid-Afrikaanse regering het tans 'n beleidsdoelwit om armoede in die land teen 2015 uit te wis. Hierdie beleid word in samewerking met die sakesektor om die doelwitte wat gestel is by wyse van samewerking te verwesentlik. Omgewingsbewustes het egter die ontwikkeling in sommige kontekste veroordeel.

In die artikel word aandag gegee aan 'n manier waarop die burgerlike samelewing, die regering en die sakesektor saamgewerk het om te onderhandel vir die voorsiening van water in streke wat waterarm is. In die besonder word aandag gegee aan die geskiedenis, sedert 1994, van die beplanning, voorbereiding en uitvoer van damkonstruksieprojekte in die Limpopoprovinsie en Mpumalanga.

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<sup>1</sup> This article is based on a paper presented at the 5th International Water History Association (IWHA) conference, "Pasts and Futures of Water", Tampere, Finland, 13-17 June 2007.

## **Introduction**

In the public sphere of governance, storage dams usually form part of the basic water supply infrastructure necessary for communities in southern Africa. These storage facilities are intended to be for the benefit of all. As is the case in all parts of the world, history informs us that in former times large dam projects were seldom planned and executed with any significant consideration being given to the local populations, directly affected by the schemes. In the first place, large dams are frequently built with the major beneficiaries located at a considerable distance from the storage site. It then happened that local communities, if they were allowed to remain resident in the proximity of the dam, seldom enjoyed direct benefits of the storage facility.<sup>2</sup> There have been a number of shifts in engineering management projects in recent years.<sup>3</sup> There is now internationally an acute sense of the need to be considerate – on humane grounds – towards people, who for example, need to be relocated at proposed dam sites.<sup>4</sup>

Since the 1990s there has been a lively debate on the real benefits of large dams.<sup>5</sup> More recently, the focus has shifted. There is now more sensitivity to the need for dams under conditions of development.<sup>6</sup> Dam construction is now subject to principles of sustainable development. Considerations in this sphere also have to contend with concerns that over-development might work to the detriment of the environment. It is not far-fetched. Four<sup>7</sup> of the five largest reservoirs in the world are in Africa.<sup>8</sup> The development syndrome can be taken too far. The biodiversity of a given environment can be compromised by favouring either industry or human settlements as the major beneficiaries. More than often the price, that is paid amounts to an unsustainable state of development. This, in turn, leads to environmental degradation. At the

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2 See for example O Mwangi, "Hydropolitics, ecocide and human security in Lesotho: A case study of the Lesotho Highlands water project," *Journal of Southern African Studies*, 33(1) March 007, pp. 3-17.

3 E van Wyk, BW Wilgen and DJ Roux, "How well has biophysical research served the needs of water resource management? Lessons from the Sabie-Sand catchment," *South African Journal of Science*, 97, October 2001, pp. 349-356.

4 C de Wet, "The experience with dams and resettlement in Africa" (World Commission on Dams: Contributing paper, prepared for Thematic Review 1.3: Displacement, resettlement, rehabilitation, reparation and development), c. 1999.

5 HJ Hoag, "The damming of Africa: the spread of river basin planning in post-war Africa," JWN Tempelhoff, *African water histories: transdisciplinary discourses* (North-West University, Vanderbijlpark, 2005), pp. 171-183.

6 See United Nations Environmental Programme (UNEP), *UNEP dams and development project: interim report covering the period of February 2005-May 2006* (United Nations Environmental Programme, Nairobi, 2006).

7 Lake Victoria at the Owen Falls Dam, Lake Nasser on the Nile, Kariba on the Zambezi River and the Akosombo Lake on the Volta.

8 UN-Water/Africa, *African water development report 2006* (United Nations Economic Commission for Africa, Addis Abeba, 2006), p. 130.

same time, when the natural environment is privileged, the chances are slim of eliminating poverty and improving living standards on one of the poorest continents in the world. This dilemma is seldom solved in practice. The best strategy, to find a middle path, is usually by giving careful attention to planning and the considerate execution of development projects. There is a need for a sensitive balance in the process of interaction between humans and nature where water plays a facilitating role. If need be, constant monitoring should be an integral part of integrated water resource management (IWRM) strategies.

In this article attention is given two dam projects in South Africa – the De Hoop Dam and the Nandoni Dam. In explaining how the plans were conceived and then implemented, the intention is to point out how, over the long term, development could influence the Kruger National Park. It is suggested that the natural environment (in which the conservation of the endemic botanical and zoological heritage is a priority), stands to lose, if it is downstream of a large dam. Therefore, careful consideration needs to be given to planning and consultation with conservation authorities when rivers are used for development purposes.

### **The De Hoop Dam project**

The South African Government considers the De Hoop Dam project in the catchment of the Olifants River in Gauteng and Mpumalanga as one of the flagships for a major development initiative.<sup>9</sup> The Accelerated and Shared Growth-South Africa (ASGISA), strategy was announced by Government in 2006. The objective is to promote growth, actively work towards the eradication of poverty, and limit unemployment by 2014. A major element of the strategy is to eliminate a backlog in the development of infrastructure in the country by creating job opportunities for the country's unemployed people.<sup>10</sup> The De Hoop Dam project is one of the major showpieces of the strategy.

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9 The Presidency of the Republic of South Africa, *Accelerated and shared growth initiative – South Africa* (ASGISA), (Government of the Republic of South Africa, N.p., n.d [c. 2006]), p. 8.

10 Background document to media briefing by Deputy president P Mlambo-ND Ngcuka, A catalyst for accelerated and Shared growth – South Africa (ASGISA) (available at <http://www.info.gov.za/speeches/briefings/asgibackground.pdf>, pp. 4-5 as accessed on January 2007).

It is anticipated that the De Hoop Dam would have a capacity of 347 million m<sup>3</sup>. Construction work on the dam, along with the establishment of an estimated 17 platinum mines would create substantial job opportunities for many of the 90 000 people resident in an impoverished and semi-arid Sekhukhuneland in South Africa's Limpopo Province.

At the time of the inauguration of the construction project, on 19 March 2007, Ms Lindiwe Hendricks, the Minister of the Department of Water Affairs and Forestry (DWAF), also promised that the proposed dam would provide good drinking water for the 800 000 people resident in the vicinity of the Jane Furse settlement and on the Nebo plateau.<sup>11</sup>

However, environmental organisations are less than optimistic about the prospects for the people as beneficiaries of the proposed dam scheme in the Olifants River. Non-governmental organisations (NGOs) are warning that the dam – to be built in the Steelpoort River, which is a tributary of the Olifants – is not sustainable.<sup>12</sup> Moreover, they maintain, it should have a negative impact on what was, in former times described as the 'mighty Olifants'.<sup>13</sup> Since the mid-twentieth century, the water flow in this river has dwindled down to a mere stream. It is now (in 2007) only a few metres wide in some places.

### ***Problems and controversies***

Part of the problem is that the river runs through South Africa's premier nature reserve, the Kruger National Park. In the section of the river, running through the reserve, the water in 2005 stopped flowing for the first time in human memory for 78 days.<sup>14</sup> In March-April 2007, at the time of extraordinary drought conditions, throughout South Africa, the river once again stopped flowing. The general deterioration of the river's water supplies in the Kruger National Park forced the authorities to announce stringent water restrictions at the start of the winter of 2007.<sup>15</sup> The severe water shortages have had

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11 These facts were outlined in a press release, issued by the Department of Water Affairs and Forestry (DWAF) on 5 November, 2006 at the official launch of the construction project on 19 March 2007.

12 This principle has been indirectly conceded. See O van den Berg, T Basson and HS Pieterse, "The Olifants River water resources development project", *Civil Engineering*, 14(6) June, 2006, p. 9.

13 CJ Kleynhans, "Daar was 'n rivier," *Fauna & Flora*, 48, 1992, p. 4.

14 Tempelhoff Collection, Correspondence, L Hopkinson (Legal advisor, SANParks, Pretoria)/M van Schalkwyk (Minister, Department of Environmental Affairs and Tourism, Pretoria), 21 November 2005, p. 6.

15 Tempelhoff Collection, Email, EJ Tempelhoff/R Travers ( See also Ref. 9/2/2/-07, press release: Stringent water restrictions announced in KNP), 18 April 2007.

a negative impact on the biodiversity of the riverine area. Widespread fish deaths have been symptomatic of the decline of the aquatic biodiversity of the Olifants River.

Ever since President Thabo Mbeki first announced the De Hoop project in 2003, it has been embroiled in controversy. In debates on the issue, the president is often quoted for having said that the dam was intended to work for the development of platinum mining and irrigation farming activities.<sup>16</sup> Little reference was made, at the time, to the 'impoverished people' who are now earmarked to benefit from this development of an estimated R4 billion. NGOs point out that only once the development was criticised, was it considered feasible to replace 'irrigation' with 'people'. The Endangered Wildlife Trust (EWT), the National Parks Support Group (NPSGT), the South African Water Caucus (SAWC) and Geosphere of Mozambique have all predicted that the proposed development would cause irreparable environmental damage.

Dr Nick King, director of the EWT has serious reservations about the manner in which the water of the De Hoop dam will reach the people. South Africa's DWAF has budgeted an amount of R3 billion for the dam project. It is the responsibility of local authorities – one of the major weak links in South Africa's current system of governance – to take the water to the people.<sup>17</sup>

Initially staff of the South African National Parks (SANParks), the Government agency responsible for managing the Kruger National Park, seriously criticised the proposed dam scheme. They even threatened to go to court, should the project go ahead.<sup>18</sup> Then they gave in to political pressure and withdrew their opposition.<sup>19</sup> However, scientists, working in the Kruger Park, are still concerned about the likelihood of the river 'strangling' the reserve. In economic terms, it could be very serious for the park.

Mr Jaap Kroon, DWAF's project manager of the De Hoop Dam, has given the assurance that the Government has committed itself to a strategy to preserve the ecological reserve of the water released from the Olifants River into the Kruger Park. The Government, he explained in discussions, was more than aware of the right of nature to water. Moreover, the completed dam - at

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16 Tempelhoff Collection, Speech, President Thabo Mbeki, at the opening of parliament, Cape Town, 14 February 2003.

17 Tempelhoff Collection, Interview, JWN Tempelhoff/N King, November 2006.

18 Tempelhoff Collection, Correspondence, L Hopkinson/M van Schalkwyk, 21 November 2005, p. 10.

19 Tempelhoff Collection, Interview, JWN Tempelhoff / W Mkutshulwa (Spokesperson for SANParks), November 2006.

the time of its completion - would be in a position to store quantities of water, available for release under drought conditions. It would be beneficial for the part of the nature reserve situated in a semi-arid region of the Mpumalanga Province.<sup>20</sup>

A serious concern has been the lack of long term data to determine the quantity of water released in the river at all times of the year. Philip Owen, the South African representative of Geosphere, an NGO operating in Mozambique, warns that if the Olifants River stops running it could be responsible for political tensions between South Africa and its neighbouring state. Mozambique's Massingir Dam has already reached a point in time when the dam is hardly able to fill up completely.<sup>21</sup>

Experts who had studied the documents of appeal submitted by the NGOs, at the request of the Department of Environmental Affairs and Tourism (DEAT), Minister Marthinus van Schalkwyk, have pointed out that the Government did not have proper deliberations with its Mozambican counterpart.<sup>22</sup>

### ***When the past exposes the present***

Dr Cornelius Ruiters, deputy director general of the infrastructure for national water resources, has admitted that the Olifants River system is at present one of the country's most stressed areas.<sup>23</sup> This is an issue that comes a long way. In 1992 Dr Neels Kleynhans, currently at the Institute for Water Quality Studies at DWAF noted:

Met inagneming van al sy probleme is die Olifantsrivierstelsel seker een van die beste voorbeelde, indien nie die beste nie, van 'n opvanggebied wat gebruik, verbruik en amper opgebruik is.

[Translation: Given all its problems the Olifants River system is perhaps one of the best examples – if not the best – of a river catchment that has been used, consumed and almost depleted.]<sup>24</sup>

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20 Tempelhoff Collection, Interview, JWN Tempelhoff/J Kroon (DWAF), 11 May 2006.

21 Tempelhoff Collection, Interview, JWN Tempelhoff/P Owen (Geosphere), March 2006.

22 Tempelhoff Collection, Evaluation of the supporting documentation as well as the appeals received against the record of decision. See Ref.12/12/20/553 De Hoopdam, issued by the DWAF for the Olifants River Water Resources Development Project, De Hoopdam: An evaluation document (as compiled by M Seaman, University of the Free State) and C Bruwer (EnviroAfrica, Onrusrivier), September 2006.

23 Tempelhoff Collection, Interview, EJ Tempelhoff/C Ruiters, November 2006 (Breakfast meeting).

24 CJ Kleynhans, "Daar was 'n rivier", *Fauna & Flora*, 48, 1992, p. 5.

At the same time Ruiters asked how it could have happened that that a river system, considered at one time as being one of the jewels of the country to be damaged to the extent that disheartened inhabitants of the region had started harbouring feelings of dejection about it.<sup>25</sup> Kleynhans, along with other scientists, point to the fact that several decades of coal mining activities have destroyed the dynamic ecosystem of the river.<sup>26</sup> It all started at the turn of the twentieth century when the town of Witbank and its rural hinterland on the grass- and wetlands of the Highveld became localities for intensive coal mining activities. Currently Witbank is one of the major burgeoning urban centres of Mpumalanga Province.<sup>27</sup> These activities have had a disastrous effect on the Olifants River.<sup>28</sup>

The farming industry has also been responsible for near-disastrous change in the catchment. There are, at present more than 300 dams, 2400 farm dams and weirs, as well as 9800 boreholes in the river system.<sup>29</sup> Many of these sources have dried up – as is the case of the source that has, for many years, supplied water to the farming town and settlement of Ohrigstad in Mpumalanga. Local residents now have to rely on a borehole that is still operating on the land of a local farmer. The Olifants River system, it is estimated, is currently used about 20 per cent above its capacity.<sup>30</sup>

### *The views of stakeholders*

DWAF maintains that the De Hoop Dam is the only solution to the anticipated future water shortages in the catchment area. If Government refrains from taking any initiatives now, annual water shortages could increase

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25 CJ Kleynhans, "Daar was 'n rivier", *Fauna & Flora*, 48, 1992, pp. 4-8.

26 The whole issue of *Fauna & Flora*, 48, 1992, was dedicated to the Olifants River. Other articles included GR Batchelor, "Die Olifantsrivier," pp. 1-3; J Engelbrecht, pp. 9-14; J Engelbrecht, "Suur reën en suur fonteine," pp. 15-21; GR Bachelor, "Van dam tot dam," pp. 22-29; WH Tarboton, "Van Calais tot Dover," pp. 30 – 32.

27 See S Schirmer, "Mpumalanga's economic heritage: enterprise and exploitation in the 20th century," P Delius (ed.), *Mpumalanga: reclaiming the past, defining the future* (Manuscript of research report for the Mpumalanga Government, Johannesburg 2006), pp. 189, 192-194.

28 See PJ Botes and JF van Staden, "Investigation of trace element mobility in river sediments using ICP-OES," *Water SA*, 31(2), April 2005, pp. 183-191; FG Bell, TFJ Halbich and SET Bullock, "The effect of acid mine drainage from an old mine in the Witbank coalfield, South Africa", *Quarterly Journal of Engineering Geology and Hydrogeology*, 35(3) 2002, pp. 265-278; L Coetzee, HH du Preez and JHJ van Vuren, "Metal concentrations in *Claria Gariepinus* and *Labeo Umbratus* from the Olifants and Klein Olifants River, Mpumalanga, South Africa: Zinc, copper, manganese, lead, chromium, nickel, aluminium and iron", *Water SA*, 28(4), October 2002, pp. 433-448.

29 Tempelhoff Collection, Email, EcoRisk, SA Pty Ltd, "De Hoop Dam in relation to the proposed Richmond dam," pp. 1, 3 December 2006.

30 Tempelhoff Collection, Interview, EJ Tempelhoff/N King (CEO, Endangered Wildlife Trust), February 2006.

to an estimated 120 million m<sup>3</sup> by 2020.<sup>31</sup>

DEAT'S representatives pointed out major weakness of the proposed scheme. It was approved in isolation, without prior investigations to determine if the Olifants River could carry yet another large dam. Furthermore, the potential of pollution from the new platinum mines received insufficient attention. This could directly affect the Kruger National Park.<sup>32</sup>

Simon Tebele, spokesperson for AngloPlatinum, one of the mining companies in the region, is confident that this poses no threat. The mines would be recycling their water.<sup>33</sup>

NGOs remain concerned that the Government have not discounted all the proposed mining activities in its planning for the region. It implies that sustainable development is shifted to the backburner in favour of short-term economic growth. There is, among them, consensus that the Government has been over hasty in accepting the environmental impact assessment study. They claim it is because the mining companies put pressure on the Government.

Government argues that the mining operations, in the eastern parts of the Steelpoort area of the Bushveld have an estimated life expectancy of 100 years. This creates a serious environmental problem because the De Hoop Dam should silt up with deposits within a few decades. It is questionable who the beneficiaries of the dam scheme would be then.

At the time of giving the Government's approval of the project in October 2006, DEAT acknowledged that the issue was complex. Minister Van Schalkwyk explained that the Government had serious reservations about the potentially destructive impact of De Hoop on the environment. Simultaneous with the Government's approval, instructions were given to ensure that a total strategic appraisal be done on the Olifants River system.<sup>34</sup> This clearly was a final attempt at determining the environmental impact of the dam on the whole system.

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31 Department of Water Affairs and Forestry (DWAF), Olifants River, water resources development project (ORWRDP), Discussion information pack (DWAF, Pretoria, 2006), p. 7.

32 Tempelhoff Collection, "Appeal response on questionnaire, issued by the minister of the DWAF", 26 February 2006.

33 Tempelhoff Collection, Interview, EJ Tempelhoff/S Tebele (AngloPlatinum), February 2006.

34 DEAT, Revised Record of Decision for the Olifants River water Resources Development Project, October 2006.

Meanwhile AngloPlatinum has started with an environmental impact assessment for the construction of the Richmond Dam in the Klein-Dwarsrivier, a branch of the Steelpoort River.<sup>35</sup> The dam was originally planned as an alternative and temporary measure for the mining company's water requirements, in case the De Hoop project was shelved. Currently, despite the approval of the De Hoop project, it seems as if the Richmond project is also continuing. An aggravated King criticised the proposed dam. It was, he said:

the way in which things usually happened on the Olifants River. One dam is approved in a one-eyed manner and shortly afterwards another one is built.

At first DWAF officials refrained from acknowledging that the Richmond Dam was in the pipeline. Later they explained that they had heard of the project.<sup>36</sup> No applications were submitted to the Department for the construction of the dam. NGOs fear that if the Richmond dam is approved it would be a death sentence for the Olifants River.<sup>37</sup>

There have been a number of hold-ups in the construction project. Work was scheduled to start on 1 April 2006. Because of protests by NGOs, work on the reconstruction of the R555 route, through parts of the proposed dam site, could only hopefully start in 2007.<sup>38</sup>

### ***At last. Dam building commence***

The dam is being built in the Steelpoort River between the towns of Roosenekal and Steelpoort. The mining companies will share the water with local residents in the Limpopo Province.<sup>39</sup> As a first phase in the development the wall of the Flag Boshielo Dam (formerly the Arabie Dam) was lifted by 5 metres.<sup>40</sup>

No water of the De Hoop dam will be used for irrigation purposes. As a part of the Government's revised management plan for the Olifants River, water

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35 Tempelhoff Collection, Email, JE Tempelhoff /S Tebele, 26 November 2006.

36 Tempelhoff Collection, Interview, JE Tempelhoff/ J Kroon (DWAF), November 2006.

37 Tempelhoff Collection, Interview, JE Tempelhoff/N King, (EWT), November 2006.

38 Tempelhoff Collection, Interviews, DWAF, April 2007.

39 Tempelhoff Collection, DWAF, Olifants River water resources development project (ORWRDP), Discussion information pack (DWAF, Pretoria, 5 November 2006).

40 DWAF, Olifants River water resources development project (ORWRDP), Discussion information pack (DWAF, Pretoria, 2006); (Fact sheet, February 2006), p. 1.

licenses previously granted to local farmers, will all be subject to revision. Irrigation currently uses some 75 per cent of the river's water. De Hoop's water will go to platinum mines in Mokopane (formerly Potgietersrust).<sup>41</sup>

The Government has set aside an amount of R40 million for the expropriation of 20 farms that will be flooded on the site of the proposed dam. Deliberations are also currently at the order of the day with a number of land claimants in the region, who, in the framework of South Africa's land reform and restitution programme have laid claim to large portions of the region.<sup>42</sup>

The dam will cover a surface area of 1690ha and 295 endemic plant species will be jeopardised in the process. Five of the species, in the Sekhukhuneland region, are on the endangered red data list. Some 50 000 tonnes of plant material will disappear under the water. DWAF officials have offered to relocate plants to the eastern parts of the dam site.<sup>43</sup> Experts do not consider this feasible.

It will take about four years for the dam to fill up. It should be completed by 2010 and is expected to be in use for the anticipated 100 years in which platinum will be mined in the area. The EIA report suggests that the dam should have a positive effect on the local fish life and it would also attract birdlife. A number of gravesites will have to be relocated. A total of 109 archaeological sites, dating back to the Stone Age and Iron Age, will vanish to the bottom of the dam.<sup>44</sup> It is uncertain what criteria would be applied in selecting sites for excavation and relocation. Little information has been disclosed on the nature of the potential research to be conducted in the area.

One advantage of De Hoop is that it is not the largest dam in the Olifants River. The Loskop Dam, situated in the Klein Olifants River, stores 1 million m<sup>3</sup> more.<sup>45</sup> Still, there is a sense of concern that the De Hoop project was been launched with unnecessary haste and insufficient stakeholder participation. The dire consequences of past some dam projects in Africa are evident from some recent case studies.<sup>46</sup>

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41 DWAF, Working Document, 11 May 2006.

42 Tempelhoff Collection, Interview, *Beeld*, November 2006.

43 DWAF, Working Document, Nandoni Dam Project, 11 May 2006.

44 DWAF, Olifants River Water Resources Development Project, EIA, (2006), p. 144.

45 DWAF, Olifants River Water Resources Development Project, Discussion Information Pack, 11 May 2006.

46 H Hoag, "The politics of damming in postcolonial Africa: a re-examination of Ghana's Volta River Project" (Paper, IWHA biennial conference Tampere University, Finland, June 2007); A Daimon, "The Mazwikadei Dam as an axis of lifge: the hydro-politics of dam construction, human survival and economic development in post-independent Zimbabwe" (Paper, IWHA biennial conference Tampere University, Finland, June 2007).

We now turn to another dam project that was completed in 2006. In many respects it can be considered to be a worthy example for the proposed De Hoop project.

### **The Nandoni Dam project: Another type of dam**

Planning for a dam in the Luvuvhu River catchment started in the early 1980s. Construction work was delayed for a considerable period. Only in the 1990s, because of rapid urban growth in the eastern Soutpansberg region did the department of water affairs and forestry (DWAF) commission the construction of the dam.<sup>47</sup>

The major objective with the Nandoni Dam scheme<sup>48</sup> was to secure a bulk storage site for the region and provide a water treatment plant that would provide sufficient water for domestic and other consumers in the eastern parts of the Soutpansberg region. The urban areas of Louis Trichardt and Thohoyandou, as well as the rural communities in the northern parts of the Limpopo Province from Malamulele and Lambani in the east, to Sinthumule/Kutama in the west, are beneficiaries of the water scheme.<sup>49</sup> At the time of its completion, at the start of 2006, it was pointed out that ultimately some 9 million people in the Limpopo Province would ultimately receive water from the scheme when it is completed.<sup>50</sup>

### ***The Nandoni dam***

Situated in the Luvuvhu catchment,<sup>51</sup> covering a surface area of 1380km<sup>2</sup> the Nandoni Dam, is one of the larger dams in the Limpopo Province. Its wall extends over a distance of more than 2km with a maximum height of 47m.

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47 Tempelhoff Collection, Interview, JWN Tempelhoff/ RA Pullen (BKS Pty Ltd), 16 January 2007, pp. 1-2.

48 Up to 1995 it was also known as the Mutoti.

49 Anon., "Nandoni dam to help fight drought" at *Zoutnet.co.za*, 18 October 2002 (available at <http://www.zoutnet.co.za/details.asp?StoNum=1367&from=ar%5Fword%2Easp%3Ftype%3D1%26search%3Dnandoni> as accessed on 20 November 2006).

50 South African Consulate General New York, Water Affairs and Forestry (DWAF), "Water for all" (available at <http://www.southafrica-newyork.net/consulate/wateraffairs.htm> as accessed on 16 October 2006).

51 On the whole the Levuvhu River catchment, which forms part of the Limpopo River catchment is in a fairly pristine condition. This might change as a result of the Nandoni Dam. Indigenous endemic fish species in the river system may be threatened in the future as a result of the dam. For a comprehensive overview of the state of affairs in the region, see Water Research Commission (WRC), Report TT165/01, "State of the rivers report: Letaba and Levuvhu River systems" (Water Research Commission, Pretoria, 2001).

The dam has a storage capacity of 164 million m<sup>3</sup>.<sup>52</sup>

When work on the project started in 1998 it was estimated that the dam would cost R373,3 million. A further R238,4 million was budgeted for the Nandoni Water Treatment Works, pipelines and reservoirs. The treatment works will be completed by early 2008.<sup>53</sup>

The dam scheme has contributed substantially to development in Venda.

The Nandoni Dam development project came at an important point in time in the history of dam construction in South Africa. In 1998 the World Commission on Dams was established. The objective of this commission was to determine worldwide what the impact was of large dams and to contemplate the options open for water and energy development.<sup>54</sup> South Africa did have representation on the commission and was from the outset eager to support initiatives aimed at developing guidelines in the field of dam construction and development. Locally a number of projects, aimed at promoting the concept of sustainable usage planning (SUP), were drawn up for existing dams,<sup>55</sup> as well as new dams (the Nandoni and Berg Water Dam) earmarked for construction.<sup>56</sup> This meant that the Nandoni project would typically become a laboratory for devising appropriate strategies in the execution of dam construction projects. In 2000 the World Commission on Dams issued its report. Finally sensible guidelines had been formulated. It would forthwith be up to individual states to consider and apply as they deemed fit, the commission explained.<sup>57</sup> This meant that, shortly after the Nandoni project had been launched, there were guidelines for procedures and it was up to the management groups, in different sectors of the project, to locate a centre of gravity for successful project execution. According to Mr Bob Pullen of the consulting engineering firm BKS (Pty) Ltd, who had been commissioned to do the relocation action plan (RAP) on the project:

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52 Anon., "Nandoni dam to help fight drought" at *Zoutnet.co.za*, 18 October 2002 at <http://www.zoutnet.co.za/details.asp?StoNum=1367&from=ar%5Fword%2Easp%3Ftype%3D1%26search%3Dnandoni> as accessed on 20 November 2006).

53 Tempelhoff Collection, Information, Mr J Mathivha, Venda fieldwork, November 2006.

54 Anon., "World Commission on dams report: what South Africa is doing about it, viewpoint", *The Water Wheel*, 2(4), September-October 2003, p. 24.

55 The Pongolapoort and Vygeboom dams, as well as the Driekoppies Dam.

56 South African Multi-stakeholder initiative on the World Commission on Dams, *Applying the World Commission on dams report in South Africa* (Environmental Monitoring Group and the South African Multi-stakeholder initiative on the World Commission on Dams, Mowbray 2004), p. 45.

57 Anon., "World Commission on dams report: what South Africa is doing about it, viewpoint", *The Water Wheel*, 2(4), September-October 2003, p. 24.

It was a different mindset from what the world commission had been working on. They were looking on what had happened before and the dissatisfaction of the relocated parties. We now looked at it and tried to find a way of making the relocated people not feel grieved.<sup>58</sup>

It was a major operation. Some 2100 subsistence farmers had to be moved. Also households and small businesses of five villages had to be relocated. Local heritage considerations had the effect that some 1000 graves had to be re-interred.<sup>59</sup> External peer reviews described this project a remarkable feat and a task of substantial social environmental complexity.<sup>60</sup>

### *Archaeological surveys*

The Nandoni Dam is in the cultural heartland of the Venda-speaking people of South Africa's Limpopo Province. This unique community, numbering less than a million people, have strong cultural ties with the Shona of Zimbabwe. However, they also have a long history reflecting a unique cultural evolution in the north-eastern parts of South Africa. Their local history goes back to the sixteenth century.<sup>61</sup> Consequently, at the time of preparing the site for the construction of the dam, special care was taken to be sensitive to the history and customs of these people. Archaeological evidence, gathered by researchers, suggested that the region had been inhabited since the Early Iron Age (about 1000-1600 AD). Four from 67 sites of archaeological significance were then selected for research in an area that had been earmarked for the dam.<sup>62</sup> The sites were thoroughly surveyed and catalogued. It provided a summary of general aspects of the history of the early local residents.

The fact that some 1000 gravesites had to be removed meant that a valuable opportunity was granted for anatomical research in the health sciences. It could inform scientists on the health and disease patterns of rural Venda

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58 Tempelhoff Collection, Interview, JWN Tempelhoff/RA Pullen (BKS Pty Ltd, Pretoria), 16 January 2007, p. 5.

59 A PhD study emanated from this sub-project. See EN L'Abbe, "A palaeodemoigraphic, palaeopathologic and morphologic study of the 20th century Venda" (PhD, Health Sciences, University of Pretoria, Pretoria, 2005).

60 M Olivier, "A bag full of projects for consultancy firm", *Martin Craemer's Engineering News*, 5 August 2005 (available at <http://www.engineeringnews.co.za/eng/features/consulteng/?show=70849> as accessed on January 2007).

61 EN L'Abbe, "A palaeodemoigraphic, palaeopathologic and morphologic study of the 20th century Venda", pp. 8-9; TN Huffman and EOM Hanisch, "Settlement hierarchies in the Northern Transvaal: Zimbabwe ruins and Venda history", *African Studies Journal*, 46(1), 1987, pp. 112-114.

62 Nandoni Dam Archive, BKS H2607, Section 10, Land, crop and natural resources (Module 2)4, Van Riet and Louw Landscape Architects, Nandoni Dam zoning plan: inception report, July 2001, p. 24.

people in the period 1910-1999.<sup>63</sup>

The research work clearly was beneficial to archaeology and the health sciences. It also provided a background for the evaluation of contemporary living conditions in the region of the dam site. This dovetailed with another survey undertaken earlier to determine the socio-economic patterns of local human settlement at the start of the 21st century.

### ***Socio-economic assessments of living conditions on the river, prior to construction***

Research into the socio-economic condition of the people resident in the area where the Nandoni Dam informed the relocation management team on the prevailing living conditions of residents in the region that were to be relocated before construction work on the dam started. It made the process of relocation much less traumatic for the people who had to be moved. Furthermore, informed decisions could be made on the nature of new settlements.

In their report researchers explained that the villages in the region were densely populated with grid settlement patterns, fenced yards and streets with communal taps. A considerable surface area was used for grazing cattle and smaller section for cultivating agricultural crops such as vegetables and fruit. At a local agricultural college, there was a small irrigation scheme in place.

Land had been overgrazed and denuded, on the northern banks of the river. On the southern banks there were a number of cultivated fields with especially maize. In some parts, there were wooded areas, but mostly the land had been overgrazed.

Until construction started on the site of the dam, the river had been used for many social, economic and cultural purposes. By far the most extensive use of the river was for the purposes of agricultural activity and the irrigation of fruit trees. Local women used the riffles and calm pools of the river to do their laundry and socialise. People washed themselves in the river. In some parts, bus taxis were washed in close proximity to the water. Local children used the river as a swimming place. There were also two commercial brick yards close to the river. Moreover, some local clay types were used for ceremonial purposes.

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<sup>63</sup> EN L'Abbe, "A palaeodemographic, palaeopathologic and morphologic study of the 20th century Venda", p. 13.

The reeds in the river were used for weaving screens, sleeping mats, basket weaving and thatching. The reeds were also used for folding tables and flutes. Local endemic plants were harvested for food (tea, coffee, potherbs, sweets, fresh fruit), moulds for yeast and refreshing drinks, such as beer. Furthermore, the endemic plants were used for medicinal purposes, fuel, construction and fencing, carving, art and fish poison.

The river, it was pointed out, in the early phase of investigation, was important for a number of activities of a religious and health-related nature. Some of the deep and quiet pools had spiritual and religious significance to the local residents. In some parts of the river, initiation ceremonies and religious baptisms were conducted.<sup>64</sup>

This type of information informed planners and managers on the manner in which they had to work if they wanted to execute their respective tasks effectively and with a proper degree of sensitivity to the stakeholders, of civil society, in the region. In short, it required of engineers and their assistants to intertwine civil engineering ‘with the intricacies of rural South Africa’.<sup>65</sup>

### ***The objectives with the implementation of the Relocation Action Plan (RAP)***

The role of the Relocation Action Plan was to perform the function of acting as:

a statement of expectations and intentions at the date of writing and was subjected to ongoing adjustment and refinement as the project proceeded.

Three guiding principles featured prominently in the formulation of the Relocation Action Plan. They were:

- the mitigation of social impacts;
- maintaining a development approach and
- ensuring that empowerment was at the order of the day.

The mitigation of social impacts implied that the researchers were aware that there would be a significant impact in the process of locating the residents

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<sup>64</sup> Nandoni Dam Archive, BKS H2607, Section 10, Land, crop and natural resources (Module 2)4, Van Riet and Louw Landscape Architects, Nandoni Dam zoning plan: inception report, July 2001, pp. 19-20, 22-23, 24.

<sup>65</sup> Nandoni Dam Archive, BKS, Implementation of the Nandoni Dam relocation action plan (RAP), (BKS (Pty) Ltd, Pretoria, 2005), p. 3.

of four villages. If they were not removed, their properties would have been threatened by the rising water, once the dam started filling up.<sup>66</sup> Consequently, it was accepted that, in terms of the integrated environmental management plan there should be a constructive motivation to get the people to move from houses and land they had been resident on for many years. In principle, it was accepted, none of the affected people were to be left worse-off than what they had been before.<sup>67</sup>

In respect of maintaining a development approach the understanding was that the available resources were to be developed within the larger framework that fitted in with the regional development objectives and structure that were necessary to ensure the consequences of mitigation measures were compatible with the spatial framework of development that had been outlined for the region. Finally the RAP was used to empower the community.<sup>68</sup>

### ***Empowerment of local communities***

Later the social environmental complexity of the project, proved to be the most challenging part of the undertaking.<sup>69</sup> For example, on the construction site of the dam there were employment opportunities for 340 workers. Of these workers, 183 came from communities affected by the location that of the new dam.<sup>70</sup>

In many ways local residents benefited. Contracts were issued to small companies and within the framework of partnership activities and constant mutual consultation, an award winning resettlement plan was implemented.<sup>71</sup> In total 465 sturdy modern houses were built for households that had to be relocated.<sup>72</sup> Residents had a choice of designs and local building companies

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66 Tempelhoff Collection, E-mail, E Mashau (BKS)/R Pullen (BKS), 22 May 2006. Attachment: Relocation Action Plan for communities directly affected by the construction of the Nandoni Dam in the Luvuvhu [sic] River, pp. 5, 8-9.

67 Nandoni Dam Archive, BKS H2607, Project Information Vol. 1. RAP, Memorandum, Director General Department of Water Affairs/Minister of Water Affairs and Forestry, Pencil-dated 24 February 2003, p. 3.

68 Nandoni Dam Archive, BKS H2607, E-mail, E Mashau/R Pullen, 22 May 2006, Attachment: Relocation Action Plan for communities directly affected by the construction of the Nandoni Dam in the Luvuvhu [sic] River, pp. 8-9.

69 M Olivier, "A bag full of projects for consultancy firm", *Martin Craemer's Engineering News*, 5 August 2005 (available at <http://www.engineeringnews.co.za/eng/features/consulteng/?show=70849> as accessed on January 2007).

70 Anon., "PPC to supply concrete for new dam", *Construction World*, April/May 2000, p. 28.

71 C Knoll, "2005 IAAsa premium award: Nandoni Dam relocation action plan", *Environmental Management*, 2(1), January/February 2006, pp. 16-19.

72 Anon., "Relocation action plan at Nandoni Dam", *Civil Engineering*, 13(2), February 2005, pp. 14-15.

were contracted to build the houses. The first residents moved into their new homes in 2002.

Comprehensive measures were taken to insure that sufficient infrastructure was available for the new housing in the form of water, sanitation and electricity. In Mutoti Village, which was not moved, residents were provided with electrical power. The local supply of trees for making fire was impounded as part of the dam. Consequently, in an effort to create win-win situation a special project saw the village receiving electricity for the first time.<sup>73</sup>

Comprehensive plans were also put into place to ensure that the subsistence farmers that had to be relocated were not worse-off than at their original places of residence.<sup>74</sup>

### ***Current concerns of local communities***

During fieldwork investigations by researchers of North-West University, towards the end of 2006 and the beginning of 2007, local residents in the Thulamela Local Municipal area appeared to be uncertain about the benefits that would ultimately reap from the Nandoni Dam project. There is a lot of speculation. Some say that the water would be used in distant places and they would not be reaping any benefit. They complain about the water infrastructure that is not yet in place.<sup>75</sup>

Officials were irate. They felt that more needed to be done to ensure that especially households in the area of Thohoyandou were sufficiently provided with the necessary fittings for a sound water supply. It was clear that a good briefing session and comprehensive media coverage (on the radio, in the local newspapers, as well as a road show) could do much to eliminate unnecessary speculation.

There were also rumours that luxury golf estates were planned for the southern banks of the Nandoni Dam area. It was said that people from Johannesburg would come in and purchase holiday homes. In view of the current criticism of golfing estates, as is the case in the Southern Cape's Garden Route region, it

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73 C Knoll, "2005 IAAsa premium award: Nandoni Dam relocation action plan", *Environmental Management*, 2(1), January/February 2006, p. 17.

74 Anon., "Relocation action plan at Nandoni Dam" *Civil Engineering*, 13(2), February 2005, p. 15.

75 Based on fieldwork done by R Wuriga and JWN Tempelhoff (researchers NWU, Vaal Triangle Campus), November 2006.

was felt by the researchers that there should be a comprehensive information campaign to inform local residents on:

- the organisational structure and civil society participation in local water catchment forums and a comprehensive catchment management agency;
- the anticipated tendency of local climate change as a result of a large body of water in the region;
- how comprehensively the dam interacted with upstream<sup>76</sup> and downstream<sup>77</sup> consumers of water;
- what developments were intended in the proximity of the dam;
- strategic measures that needed to be taken to see to it that the remaining natural environment in the vicinity of the dam was not disturbed, but rather conserved;
- the need to maintain a fairly pristine environment in the proximity of the dam to prevent the contamination of the water supply;
- the way in which the dam and its environs could be used responsibly for leisure time activities and
- the need to continue using water responsibly in a water-poor region.

### **Comparisons: Nandoni and De Hoop**

First and foremost, it needs to be pointed out that the historical contemplation of a comparative base in the history of both dam projects is conducted at different points in time, of their respective development.

There are a number of similarities and clear differences:

#### ***Similarities***

- Both dam schemes have an effect on the water supply from rivers to the Kruger National Park.
- Both projects are in rural regions where impoverished communities stand a chance to benefit from the developments.
- The dams form part of the larger Limpopo River catchment.

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<sup>76</sup> Makhado and other settlements.

<sup>77</sup> Specific attention needs to be given to the water allocation from the Levhuvhu catchment to the Kruger National Park. It has serious implications for nature conservation in the Limpopo Province. See F Venter, "Protecting the ecological reserve for all rivers in Kruger National Park" (Conservation Services, SANParks, Pretoria, 21 December 2005), pp. 6-7.

## ***Differences***

- The Luvuvhu catchment is ecologically in a much better condition than the Olifants River catchment.
- In the case of the Nandoni Dam there clearly was comprehensive consultation, in particular with the affected communities. This was not the case with the De Hoop Dam at the outset.
- The Nandoni Dam was from the outset intended for community development purposes. A substantial part of the proposed De Hoop project, is intended for platinum mining.
- In the case of De Hoop, primarily as a result of the extent to which the Olifants River has been put to use by humans, there has been a clear and articulated protest to the proposed development. This has not been the case in the development of the Nandoni Dam. In the Soutpansberg region, the project was popular, from the outset.
- When the Nandoni project was launched the World Commission on Dams was in the process of drawing up its report. The De Hoop development was initiated at a time when, it appears, as if the guidelines that had been outlined in the WCD report had not been used to the same extent as was the case with the Nandoni development. There are thus indications of a lethargic attitude. The impressive benchmark that had been at the order of the day at the start of the new millennium. The elaborate principles, it appears, have now been relegated to the backburner.
- Of particular importance in the case of the Nandoni Dam was the archaeological survey which informed science on a number of anatomical and health issues of local residents, in the course of the twentieth century. In the case of the De Hoop Dam, up to this point in time, there is little information available on the nature of archaeological work to be done on the site of the proposed dam.
- As pointed out above, the socio-economic information gathered by comprehensive research into local conditions at the Nandoni Dam site, informed planners on the most efficient manner in which local developments could be used to the benefit of the local residents. In the case of the De Hoop Dam similar research is still not readily available. The local people, in the early phases of the De Hoop project, only featured as an aside.
- UNEP's Dams and development project had not yet been issued at the time of the Nandoni Dam project reaching fruition in 2005. This document undoubtedly informed opinions around planning in the case of the De Hoop Dam. It possibly accounts for the reason why there have been so many sophisticated and well-articulated issues of protest against the proposed De Hoop dam.
- Internationally the De Hoop Dam has attracted a lot more attention and

criticism. The Massingir Dam in Mozambique relies on the water of the Olifants River. In the case of the Nandoni Dam, the Luvuvhu River forms a small part of the Limpopo River catchment. It appears as if the development of the dam has a primary influence on the Kruger National Park and only indirectly affects users on the other side of the border.

## **Conclusion**

Towards the end of April 2007, the management of the Kruger National Park announced that as of 23 April water restrictions would be introduced in the whole Kruger National Park. It implied that in all camps the lawns would no longer be watered regularly. Ultimately, it would have an effect on all human operations, in respect of water consumption in the Kruger Park.<sup>78</sup>

When the first reports surfaced, it was clear that there was no consensus between the users, DWAF and SANParks on the issue of using the water of the reserve's rivers. Of crucial importance, it seems, was the issue of the ecological reserve. This principle formed a cornerstone of South Africa's water legislation in the 1990s.<sup>79</sup> On the one hand officials of the Kruger National Park were suggesting that the game reserve was not getting its rightful quota of water. On the other hand, the farming community argued that it was all the responsibility of the serious drought conditions. The Kruger simply had to get along with less water. At the same time officials at the department of water affairs and forestry that it made little sense, pointing a finger at the department. It was not correct to state that the Kruger's water was running dry. River water was merely reaching the reserve via alternative routes.<sup>80</sup>

Environmentalists, such as Dr Nick King of the EWT took a fairly neutralist standpoint and argued that the Kruger Park's management had to be more careful with the manner in which it used water in the camps – it was sometimes used in an irresponsible manner. Perhaps the time had come, he suggested,

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78 Anon., "Stringent water restrictions announced in KNP", *South African National Parks SANParks – official website*, 18 April 2007 (available at <http://www.sanparks.org/parks/kruger/news.php?id=554?PHPSESSID=5q7iledkhgpc6g8vrkbuh01ve1>); E Tempelhoff, "3 Riviere in wildduin 'ontstellend' laag", *Beeld*, 24 April 2007, p. 10 (available at <http://152.111.1.251/argief/berigte/beeld/2007/04/24/B1/10/etkrugerdrg.html> both as accessed on 12 May 2007).

79 CG Palmer, "Application of ecological research to the development of a new South African Water Law", *Journal of the North American Benthological Society*, 18(1), March 1999, pp. 132-142; pp. 135, 138.

80 Y Groenewald, "Why the Kruger rivers ran dry", *Mail & Guardian (online)*, 13 May 2007 (available at [http://www.mg.co.za/articlePage.aspx?articleid=304595&area=/insight/insight\\_\\_national/](http://www.mg.co.za/articlePage.aspx?articleid=304595&area=/insight/insight__national/) as accessed on 29 May 2007).

for the Government to step in and summarily close down the sugar farming operations along the Crocodile River, in the southern extremity of the KNP, where water supplied had become extremely low.<sup>81</sup>

It appears as if the major issue is the need for all stakeholders to sit down and carefully discuss the manner in which water will be distributed in the region – particularly in respect of the requirements of the Kruger National Park. At present a lot of planning is done – but in isolated silos of development. Naturally, the result is then that scant attention is given to the water needs of the Kruger National Park.

The position of the Kruger National Park is vulnerable. When officials of the park wanted to prevent developments in the Olifants River, the Government fingered them.

The KNP is currently unable to comply with its mandate – i.e. that of preserving the biodiversity of the reserve. Kevin Rogers, director of the Centre for Water in the Environment at the University of the Witwatersrand recently pointed out in the media that if the water in the KNP had to stop running it would threaten many animal and plant species. As river pools evaporated, fish would become concentrated and easy prey for other animals. Larger populations of hippopotami in water pools that were shrinking would contaminate the water more severely, thereby threatening a variety of aquatic species.<sup>82</sup>

Finally, it is inevitable that the need for water in the eastern parts of the Limpopo and Mpumalanga province will only increase in future. An even more comprehensive water storage network, than that which is already in place, would have to be planned within the next decade. Now the Nandoni Dam project is in its early phase. There is consensus between the KNP, DWAF and the local stakeholders in terms of how the water should be used. In time to come, there will be a demand for more water. This will require further sensitive negotiations.

In the case of the De Hoop Dam, it seems, there are hairline fractures of distrust between the stakeholders. This is the result of:

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81 E Tempelhoff, “3 riviere in wildduin ‘ontstellend’ laag”, *Beeld*, 24 April 2007, p. 10 (available at <http://152.111.1.251/argief/berigte/beeld/2007/04/24/B1/10/etkrugerdrg.html> as accessed on 2 May 2007).

82 Y Groenewald, “Why the Kruger rivers ran dry”, *Mail & Guardian (online)*, 13 May 2007 (available at [http://www.mg.co.za/articlePage.aspx?articleid=304595&area=/insight/insight\\_national/](http://www.mg.co.za/articlePage.aspx?articleid=304595&area=/insight/insight_national/) as accessed on 29 May 2007).

- Hurried planning on the side of the Government departments of water affairs and forestry, as well as energy and mineral affairs;
- An apparent lack of transparency and
- An unwillingness to stall mining developments for the sake of determining what is in the best interest of the environment (especially South Africa's conservation jewel, the Kruger National Park).

The National Water Act, 36 of 1998, makes the minister of water affairs and forestry ultimately responsible for ensuring that "water is allocated equitably and used beneficially in the public interest, while promoting water valued".<sup>83</sup> However, it seems as if the environment comes second to industrial development. The environment is also marginalised in determining political principles of equity.<sup>84</sup>

On the positive side, the manner in which preliminary preparations were made for the construction of the Nandoni Dam are praiseworthy. The project was introduced over an extended period. There were many deliberations and all stakeholders were part of the planning and execution of the project. More important, the project was executed at a time when the World Commission on Large Dams was busy with its investigation on the phenomenon of large dams in all parts of the world. As part of a new democratic society, South African hydrologists and officials in the responsible Government departments were eager to conform to international benchmarks. It might just be that by the time planning of the De Hoop project started, the stringent guidelines of a noble initiative in sensible dam planning and construction, was no longer uppermost in the minds of the planners.

Falkenmark, an influential authority in the field of hydro-ecology, recently called for eco-hydro-solidarity in integrated water resource management strategies. It implies that good governance requires wise reflection and constructive engagement between resource managers and users.<sup>85</sup> Only once there has been a concerted action in realising the objective of good governance and sound partnership, especially at the user-management level would it be possible to find some lasting solutions to a persistent set of problems.

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83 Under section "Purpose of the Act", *National Water Act*, 36, of 1998 (available at <http://www.elaw.org/resources/text.asp?id=1153> as accessed on 20 May 2007).

84 See KC Prasad, B van Koppen and K Strzepek, "Equity and productivity in the Olifants River basin, South Africa", *Natural Resources Forum*, 30(1), February 2006, pp. 63-75.

85 M Falkenmark, "Good ecosystem governance: balancing ecosystems and social needs", AR Turton, HJ Hattingh, GA Maree, DJ Roux, M Claassen and WF Strydom (eds.), *Governance as a dialogue: Government-society-science in transition* (Springer, Berlin, Heidelberg, 2007), pp. 59-76.

Finally, it is evident that, because both the Nandoni and De Hoop are feeder rivers of the Kruger National Park, the utmost care should be taken in the integrated resource management of the rivers. The nature reserve is a downstream user. It is fragile and sensitive to human interventions. Therefore great care should be taken at all times for managements strategies to constantly be flexible enough to serve the interests of a major nature reserve (the Kruger National Park) and, at the same time, work in the interest of development and the eradication of poverty in the rural parts of South Africa.